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Final Complex Transformation Supplemental Programmatic Environmental Impact Statement

Volume I
Chapters 1 - 4

COMPLEXtransformation

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ABSTRACT: The National Nuclear Security Administration (NNSA), an agency within the Department of Energy, has the responsibility to maintain the safety, security, and reliability of the United States' nuclear weapons stockpile. This Complex Transformation Supplemental Programmatic Environmental Impact Statement (SPEIS) analyzes the potential environmental impacts of reasonable alternatives to continue transformation of the nuclear weapons complex to be smaller, and more responsive, efficient, and secure in order to meet national security requirements. The current Complex consists of sites located in seven states (California, Missouri, Nevada, New Mexico, South Carolina, Tennessee, and Texas). This SPEIS evaluates alternatives that would restructure special nuclear materials manufacturing and research and development facilities; consolidate special nuclear materials throughout the Complex; consolidate, relocate, or eliminate duplicative facilities and programs and improve operating efficiencies; and identify one or more sites for conducting NNSA flight test operations.

COOPERATING AGENCIES: The Department of the Air Force and the U.S. Army Garrison White Sands are cooperating agencies in the preparation of this Complex Transformation SPEIS.

PUBLIC COMMENTS: The Draft Complex Transformation SPEIS was issued for public review and comment on January 11, 2008. Comments on the Draft SPEIS were requested during a period of 90 days following publication of the U.S. Environmental Protection Agency's (EPA's) Notice of Availability in the *Federal Register*. Twenty public hearings to solicit comments on the Draft SPEIS were held during the public comment period. Prior to the end of this comment period, NNSA extended the public comment period by 20 additional days, until April 30, 2008. All comments received during the comment period were considered during preparation of the Final SPEIS. Late comments were also considered, to the extent practicable.

The Final SPEIS contains revisions and new information based in part on comments received on the Draft SPEIS. Vertical change bars in the margins indicate the locations of these revisions and new information. Volume 3 contains the comments received during the public comment period on the Draft SPEIS and NNSA's responses to the comments. NNSA will use the analysis presented in this Final SPEIS, as well as other information, in preparing the Record(s) of Decision (RODs) regarding Complex Transformation. NNSA will issue one or more RODs no sooner than 30 days after the EPA publishes a Notice of Availability of this Final SPEIS in the *Federal Register*. This document and related information are available on the Internet at www.ComplexTransformationSPEIS.com.

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National Nuclear Security Administration
U.S. Department of Energy

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ACRONYMS AND ABBREVIATIONS

A/D	Assembly/Disassembly
A/D/HE	Assembly/Disassembly/High Explosives
AC and MC	Analytical Chemistry and Materials Characterization
ACE	Altamont Commuter Express
ACHP	Advisory Council on Historic Preservation
ACRR	Annular Core Research Reactor
AEC	Atomic Energy Commission
AFB	Air Force Base
AF&F	Arming, Fuzing, and Firing
ALARA	as low as reasonably achievable
ALCM	Air-Launch Cruise Missile
ALOHA	Aerial Location of Hazardous Atmospheres
AQCR	Air Quality Control Region
ARF	airborne release fraction
ASER	annual site environmental report
ATEC	U.S. Army Test Evaluation Command
BA	Biological Assessment
BAAQMD	Bay Area Air Quality Management District
BACMs	Best Available Control Measures
BEA	Bureau of Economic Analysis
BEEF	Big Explosives Experimental Facility
BEIR	Biological Effects of Ionizing Radiation
Bison-m	Biota Information System of New Mexico
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BMAP	Biological Monitoring and Abatement Program
BMPs	Best Management Practices
BNM	Bandelier National Monument
CA	Composite Analysis
CAA	*Clean Air Act*
CAIRS	Computerized Accident/Incident Reporting System
CAMU	corrective action management unit
CASSC	California Species of Special Concern
CAUs	Corrective Action Units
CD-0	critical decision on mission need
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFF	Contained Firing Facility
CFR	Code of Federal Regulations
CGTO	Consolidated Group of Tribes and Organizations
CHS	Center for Homeland Security
CIF	Consolidated Incineration Facility
CMR	Chemistry and Metallurgy Research

CMRR	Chemistry and Metallurgy Research Building Replacement Project
CNC	Consolidated Nuclear Center
CNPC	Consolidated Nuclear Production Center
CNPS	California Native Plant Society
Complex	nuclear weapons complex
Complex Transformation SPEIS	Complex Transformation Supplemental Programmatic Environmental Impact Statement
COPCs	contaminants of potential concern
CPC	Consolidated Plutonium Center
CRT	Cargo Restraint Transporter
CSAs	Canned Subassemblies
CUC	Consolidated Uranium Center
CWA	*Clean Water Act*
CWL	chemical waste landfill
CY	calendar year
D&D	Decontamination and Decommissioning
DA	design agency
DAF	Device Assembly Facility
DARHT	Dual Axis Radiographic Hydrodynamic Test
dB	decibel
dBA	A-weighted decibels
DAF	Device Assembly Facility
DCE	Distributed Centers of Excellence
DCGs	Derived Concentration Guidelines
DHHS	U.S. Department of Health and Human Services
DHS	U.S. Department of Homeland Security
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOT	U.S. Department of Transportation
DP	Defense Programs
DPE	data processing equipment
DR	damage ratio
DTC	Developmental Test Command
DTRA	Defense Threat Reduction Agency
DTSC	Department of Toxic Substances Control
DU	Depleted Uranium
DWPF	Defense Waste Processing Facility
DWTF	Decontamination and Waste Treatment Facility
DX	Dynamic Experimentation
EA	Environmental Assessment
ECF	Entry Control Facility
EDE	effective dose equivalent
EE	Energy Efficiency and Renewable Energy
EFPC	East Fork Poplar Creek
EH	Office of Environment, Safety and Health

EIS	Environmental Impact Statement
EM	Environmental Management
EMAC	Ecological Monitoring and Compliance Program
EOA	expanded operations alternative
EODU	Explosive Ordinance Disposal Unit
EOL	End-of-Life
EOS	Equation of state
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ERPG	Emergency Response Planning Guideline
ESL	Effects Screening Level
ETB	Engineering Test Bay
ETF	Environmental Test Facility
ETTP	East Tennessee Technology Park
EU	enriched uranium
EWTF	Explosives Waste Treatment Facility
FBI	Federal Bureau of Investigation
FE	facilities engineering
FGZ	fine-grain zone
FLAME	Fire Laboratory for Accreditation of Models and Experiments
FM	Farm-to-Market Road
FMD	Fissile Materials Disposition
FONSI	Finding of No Significant Impact
FPPA	*Farmland Protection Policy Act*
FTE	Full Time Employee
FWHM	Full Width at Half Maximum
FXR	Flash X-Ray
GCD	Greater Confinement Disposal
GIF	Gamma Irradiation Facility
GPD	gallons per day
GPS	Global Positioning System
GSA	General Services Area
GTS	Gas Transfer System
GWPP	groundwater protection program
HAN	hydroxylamine nitrate
HANDSS-55	"handling and segregation system for 55-gallon drums"
HANMF	H-Area New Manufacturing Facility
HAPs	Hazardous Air Pollutant
HE	High Explosives
HEAF	High Explosives Application Facility
HEPA	high-efficiency particulate air
HETB	Hardened Engineering Test Building
HEU	Highly Enriched Uranium
HEUMF	Highly Enriched Uranium Materials Facility
HEWTF	High Explosives Wastewater Treatment Facility
HI	Hazard Index

HLW	high level radioactive waste
HPS	Hantavirus Pulmonary Syndrome
HQ	Hazard Quotient
HR	Human Resources
HSC	Hazardous Materials Spill Center
HTM	High-Tech Mobile
HVAC	heating, ventilating, and air conditioning
HWDU	Hazardous waste disposal units
HWMF	hazardous waste management facility
HWSU	Hazardous Waste Storage Unit
HWTPF	Hazardous Waste Treatment and Processing Facility
HYDEC	hydride/dehydride casting
I	Interstate Highway
ICD-9-CM	International Classification of Disease, 9th Revision, Clinical Modification
ICRP	International Commission on Radiological Protection
IFF	Identification, Friend or Foe
IH	Industrial Hygiene
INEEL	Idaho National Engineering and Environmental Laboratory
INRAD	intrinsic radiation
IOM	Institution of Medicine
IPT	Integrated Project Team
ISCORS	Interagency Steering Committee on Radiation Standards
ISCST	Industrial Source Complex Short Term
ISD	Independent School District
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
ITRD	Innovative Treatment Remediation Demonstration
IWQPs	Inland Water Quality Parameters
JTA	Joint Test Assemblies
KAFB	Kirtland Air Force Base
KCP	Kansas City Plant
KCRIMS	Kansas City Responsive Infrastructure Manufacturing and Sourcing
KTF	Kauai Test Facility
LAC	Los Alamos County
LANL	Los Alamos National Laboratory
LANL SWEIS	Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LB/TS	Large Blast Thermal Simulator
LCF	latent cancer fatality
LDRGIF	Low Dose Rate Gamma Irradiation Facility
LLNL	Lawrence Livermore National Laboratory
LLW	low level waste
LOS	Level of Service

LPF	leak path factor
M&O	Management and Operations
MACCS	MELCOR Accident Consequence Code System
MACCS2	MELCOR Accident Consequence Code System Version 2
MACs	maximum allowable concentrations
MAR	material at risk
MBTA	*Migratory Bird Treaty Act*
MC&A	Material Control and Accountability
MCL	maximum contaminant level
MDC	maximum detectable concentration
MDL	maximum detection limit
MEI	maximally exposed individual
MEK	methyl ethyl ketone
MLLW	mixed low level waste
MOX	Mixed Oxide
MPF	Modern Pit Facility
MPF EIS	Modern Pit Facility Environmental Impact Statement
mrem	millirem
MRTFB	Major Range and Test Facility Base
MSGP	Multi-Sector General Permit
MVAs	motor vehicle accidents
MVM	million vehicle miles
MWDU	Mixed Waste Disposal Unit
NAAQS	National Ambient Air Quality Standards
NAFB	Nellis Air Force Base
NC	numerically controlled
NCRP	National Council on Radiation Protection Measurements
NDA	nondestructive assay
NDEP	Nevada Division of Environmental Protection
NE	Office of Nuclear Energy
NECI	Northeast Center Impact Area
NEP	Nuclear Explosive Package
NEPA	*National Environmental Policy Act*
NESHAP	National Emission Standards for Hazardous Air Pollutants
NEST	Nuclear Emergency Search Team
NGPF	Neutron Generator Production
NHP	National Hydrotesting Program
NHPA	*National Historic Preservation Act*
NMAAQS	New Mexico Ambient Air Quality Standards
NMAQCR	New Mexico Air Quality Control Regulations
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
NN	Nonproliferation and National Security
NNSA	National Nuclear Security Administration
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent

NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPR	Nuclear Posture Review
NPS	National Park Service
NPT	Nuclear Nonproliferation Treaty
NPTEC	Nonproliferation Test and Evaluation Complex
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSO	Nevada Site Office
NSTec	National Security Technologies
NTS	Nevada Test Site
NTTR	Nevada Test and Training Range
NWS	National Weather Service
NWSM	Nuclear Weapons Stockpile Memorandum
NWSP	Nuclear Weapons Stockpile Plan
OB/OD	Open Burn/Open Detonation
OEPG	Office of Environmental Policy and Guidance
ORNL	Oak Ridge National Laboratory
ORPS	Occurrence Reporting and Processing System
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
OST	Office of Secure Transportation
OUs	operable units
PA	Performance Assessment
PAAA	*Price-Anderson Amendments Act*
Pantex	Pantex Plant
PCBs	polychlorinated biphenyls
pCi/L	picocuries per liter
PDCF	Pit Disassembly and Conversion Facility
PF-4	Plutonium Facility, Building 4
PHERMEX	Pulsed High Energy Radiation Machine Emitting X-Rays
PHETS	Permanent High Explosive Test Site
PIDAS	Perimeter Intrusion Detection and Assessment System
PIXY	Pulse Intense X-Ray
PMDA	Plutonium Management and Disposition Agreement
POLs	petroleum, oils, lubricants
PPE	personal protective equipment
ppy	pits per year
PQL	practical quantitation limit
PSD	Prevention of Significant Deterioration
PSRs	Potential release sites
Pu	Plutonium
PUREX	Plutonium-Uranium Extraction Process
QASPR	Qualification Alternatives to Sandia Pulsed Reactor
R&D	Research and Development
RANT	Radioassay and Nondestructive Testing

RCRA	*Resource Conservation and Recovery Act*
rem	roentgen equivalent man
REOP	Real Estate Operating Permit
RF	respirable fraction
RFI	RCRA facility investigation
RIMSII	Regional Input-Output Modeling System
RLWTF	Radioactive Liquid Waste Treatment Facility
RMWMF	Radioactive and Mixed Waste Management Facilities
ROD	Record of Decision
ROGs/POCs	reactive organic gases/precursor organic compounds
ROI	Region of Influence
RRF	respirable release fraction
RRW	Reliable Replacement Warhead
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
S.C.	South Carolina State Highway
SAAQS	State Ambient Air Quality Standards
SASN	Silver acetylide-silver nitrate
SCDHEC	South Carolina Department of Health and Environmental Control
SEAB	Secretary of Energy Advisory Board
SEIS	Supplemental Environmental Impact Statement
SFNF	Santa Fe National Forest
SGT	Safeguards Transporters
SHIST	Seismic Hardrock in Site Test
SHPO	State Historic Preservation Office
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
SMR	standardized mortality rate
SNF	Spent nuclear fuel
SNL	Sandia National Laboratories
SNL/NM	Sandia National Laboratories/New Mexico
SNL/CA	Sandia National Laboratories/California
SNM	Special nuclear material
SPEIS	Supplemental Programmatic Environmental Impact Statement
SRARP	Savannah River Archaeological Research Program
SREL	Savannah River Ecology Laboratory
SRS	Savannah River Site
SS&C	sand, slag and crucible
SSM	Stockpile Stewardship and Management
SSM PEIS	Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management
SSO	Sandia Site Office
SSP	Stockpile Stewardship Program
SST	Safe Secure Trailers
STP	Site Treatment Plan
STS	Stock-to-Target Sequence
SVOC	Semi-volatile organic compound

SWEIS	Site-Wide Environmental Impact Statement
SWSC	Sanitary Wastewater Systems Consolidation
SWTF	Solid Waste Transfer Facility
T&E	Threatened and Endangered
TA	Technical Area
TA-55	Technical Area 55
TBF	Terminal Ballistics Facility
TBP	tributyl phosphate
TCEQ	Texas Commission on Environmental Quality
TCP	Traditional Cultural Property
TECC	Transportation and Emergency Control Center
TEDE	Total Effective Dose Equivalent
TEF	Tritium Extraction Facility
TLD	Thermoluminescent dosimeter
TNRCC	Texas Natural Resource Conservation Commission
TPCB	Transurance Pad Cover Building
TPDES	Texas Pollutant Discharge Elimination System
TRAGIS	Transportation Routing Analysis Geographic Information System
Trinity NHL	Trinity Site National Historic Landmark
TRU	transuranic
TRUPACT-II	Transuranic Package Transporter
TSCA	Toxic Substance Control Act
TSD	Transportation Safequards Division
TSP	total suspended particulates
TSPI	Time Space Positioning Information
TTR	Tonopah Test Range
TVA	Tennessee Valley Authority
UC	University of California
UPF	Uranium Processing Facility
US	United States
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USC	United States Code
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
USPHS	United States Public Health Service
UXO	unexploded ordnance
VOC	volatile organic compound
VPP	Voluntary Protection Program
WAC	Waste Acceptance Criteria
WCRRF	Waste Compaction, Reduction, and Repackaging Facility
WEF	Waste Examination Facility
WETF	Weapons Engineering Tritium Facility
WFO	Work for Others
WIPP	Waste Isolation Pilot Plant

WSMR	White Sands Missile Range
WSRC	Washington Savannah River Company
WTG	Weapons Test Group
WVDP	West Valley Demonstration Project
WWTF	Wastewater Treatment Facility
XTF	Cross-wind Fire Facility
Y-12	Y-12 National Security Complex

CHEMICALS AND UNITS OF MEASURE

Bq	Becquerel
C	Celsius
Ci	curie
cm	centimeters
CFC	chlorofluorocarbons
CO	carbon monoxide
dB	decibel
dBA	decibel A-weighted
DCE	1, 2-dichloroethylene
DNA	deoxyribonucleic acid
F	Fahrenheit
ft	feet
ft^2	square feet
ft^3	cubic feet
ft^3/s	cubic feet per second
g	grams
gal	gallons
ha	hectares
hr	hour
in	inches
kg	kilograms
km	kilometers
km^2	square kilometers
kV	kilovolts
kVA	kilovolt-ampere
kW	kilowatts
kWh	kilowatt hours
L	liters
lb	pounds
m	meters
m^2	square meters
m^3	cubic meters
m/s	meters per second
mg	milligram (one-thousandth of a gram)
mg/L	milligrams per liter
MGD	million gallons per day

MGY	million gallons per year
mi	miles
mi^2	square miles
mph	miles per hour
mrem	millirem (one-thousandth of a rem)
MVA	megavolt-ampere
MW	megawatt
MWe	megawatt electric
MWh	megawatt hour
NO_2	nitrogen dioxide
NOX	nitrogen oxides
O_3	ozone
Pb	lead
PCB	polychlorinated biphenyl
pCi	picocurie (one-trillionth of a curie)
pCi/L	picocuries per liter
PM_{10}	particulate matter (less than 10 microns in diameter)
ppb	parts per billion
ppm	parts per million
ppbv	parts per billion by volume
rem	roentgen equivalent man
s	seconds
SO_2	sulfur dioxide
T	short ton
t	metric tons
TCA	1, 1, 1-trichloroethane
TCE	trichloroethylene
yd^3	cubic yards
yr	year
μCi	microcurie (one-millionth of a curie)
μCi/g	microcuries per gram
μg	microgram (one-millionth of a gram)
μg/kg	micrograms per kilogram
μg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter

CONVERSION CHART

To Convert Into Metric			To Convert Into English		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inch	2.54	centimeter	centimeter	0.3937	inch
feet	30.48	centimeter	centimeter	0.0328	feet
feet	0.3048	meter	meter	3.281	feet
yard	0.9144	meter	meter	1.0936	yard
mile	1.60934	kilometer	kilometer	0.62414	mile
Area					
square inch	6.4516	square centimeter	square centimeter	0.155	square inch
square feet	0.092903	square meter	square meter	10.7639	square feet
square yard	0.8361	square meter	square meter	1.196	square yard
acre	0.40469	hectare	hectare	2.471	acre
square mile	2.58999	square kilometer	square kilometer	0.3861	square mile
Volume					
fluid ounce	29.574	milliliter	milliliter	0.0338	fluid ounce
gallon	3.7854	liter	liter	0.26417	gallon
cubic feet	0.028317	cubic meter	cubic meter	35.315	cubic feet
cubic yard	0.76455	cubic meter	cubic meter	1.308	cubic yard
Weight					
ounce	28.3495	gram	gram	0.03527	ounce
pound	0.45360	kilogram	kilogram	2.2046	pound
short ton	0.90718	metric ton	metric ton	1.1023	short ton
Force					
dyne	0.00001	newton	newton	100,000	dyne
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

METRIC PREFIXES

Prefix	Symbol	Multiplication Factor		
exa-	E	1 000 000 000 000 000 000	=	10^{18}
peta-	P	1 000 000 000 000 000	=	10^{15}
tera-	T	1 000 000 000 000	=	10^{12}
giga-	G	1 000 000 000	=	10^{9}
mega-	M	1 000 000	=	10^{6}
kilo-	k	1 000	=	10^{3}
hecto-	h	l00	=	10^{2}
deka-	da	l0	=	10^{1}
deci-	d	0.1	=	10^{-1}
centi-	c	0.01	=	10^{-2}
milli-	m	0.001	=	10^{-3}
micro-	µ	0.000 001	=	10^{-6}
nano-	n	0.000 000 001	=	10^{-9}
pico-	p	0.000 000 000 001	=	10^{-12}
femto-	f	0.000 000 000 000 001	=	10^{-15}
atto-	a	0.000 000 000 000 000 001	=	10^{-18}

Chapter 1
INTRODUCTION

Chapter 1
INTRODUCTION

Chapter 1 presents an overview of this Complex Transformation Supplemental Programmatic Environmental Impact Statement *(SPEIS). The chapter briefly explains the national security policies and planning factors affecting the identification of reasonable alternatives for analysis in this SPEIS. Chapter 1 summarizes the National Nuclear Security Administration's approach to compliance with the National Environmental Policy Act (NEPA), and summarizes NEPA documents related to this SPEIS. The chapter also summarizes major comments received during the comment period and major changes to the SPEIS. The chapter concludes with a discussion of the organization of this SPEIS.*

1.0 INTRODUCTION

This *Complex Transformation Supplemental Programmatic Environmental Impact Statement*[1] (SPEIS) analyzes the potential environmental impacts of alternatives for transforming the nuclear weapons complex (Complex) into a smaller, more efficient enterprise that can respond to changing national security challenges. A more responsive enterprise would help ensure the long-term safety, security, and reliability of the nuclear weapons stockpile while reducing the possibility that the United States (U.S.) would need to resume nuclear testing. These changes would build upon decisions made in the 1990s following the end of the Cold War and the cessation of U.S. nuclear weapons testing.

National Nuclear Security Administration

Established by Congress in 2000, the National Nuclear Security Administration (NNSA) is a separately organized agency within the U.S. Department of Energy (DOE).

NNSA's primary mission is to provide the U.S. with safe, secure, and reliable nuclear weapons and to maintain core competencies in nuclear weapons. The NNSA needs a nuclear weapons enterprise with facilities capable of supporting this highly technical mission.

NNSA also has complementary missions in nuclear nonproliferation programs, excess fissile materials disposition, and provision of naval nuclear propulsion systems.

National security policies require the U.S. Department of Energy (DOE), through the National Nuclear Security Administration (NNSA), to maintain the U.S. nuclear weapons stockpile,[2] as well as core competencies in nuclear weapons.[3] Since completion in 1996 of the *Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (SSM PEIS, DOE 1996d) and associated Record of Decision (ROD), DOE has implemented these policies through the Stockpile Stewardship Program (SSP).[4] The SSP emphasizes development and application of greatly improved scientific and technical capabilities to assess the safety, security, and reliability of existing nuclear warheads without the use of nuclear testing. Throughout the 1990s, DOE also took steps to consolidate the Complex from 12 sites to its

[1] In the Notice of Intent (NOI) to prepare this EIS (71 FR 61731), NNSA's proposed action was referred to as "Complex 2030." NNSA now believes that the term "Complex Transformation" better reflects the proposed changes and alternatives evaluated and has renamed this document the "Complex Transformation SPEIS."

[2] The nuclear weapons stockpile consists of nuclear weapons that are both deployed to the military services ("operationally deployed") and "reserve weapons" that could be used to augment the operationally deployed weapons or to provide replacements for warheads that experience safety or reliability problems.

[3] Core competencies in nuclear weapons include research, design, development, and testing (including the ability to conduct nuclear testing); reliability assessment; certification; manufacturing; and surveillance capabilities.

[4] In 1996, the program was named the "Stockpile Stewardship and Management Program." It is now called the Stockpile Stewardship Program. There has been no change in the content or purpose of the program.

current configuration of three national laboratories (plus an associated flight test range), four industrial plants, and a nuclear test site as shown in Figure 1-1.

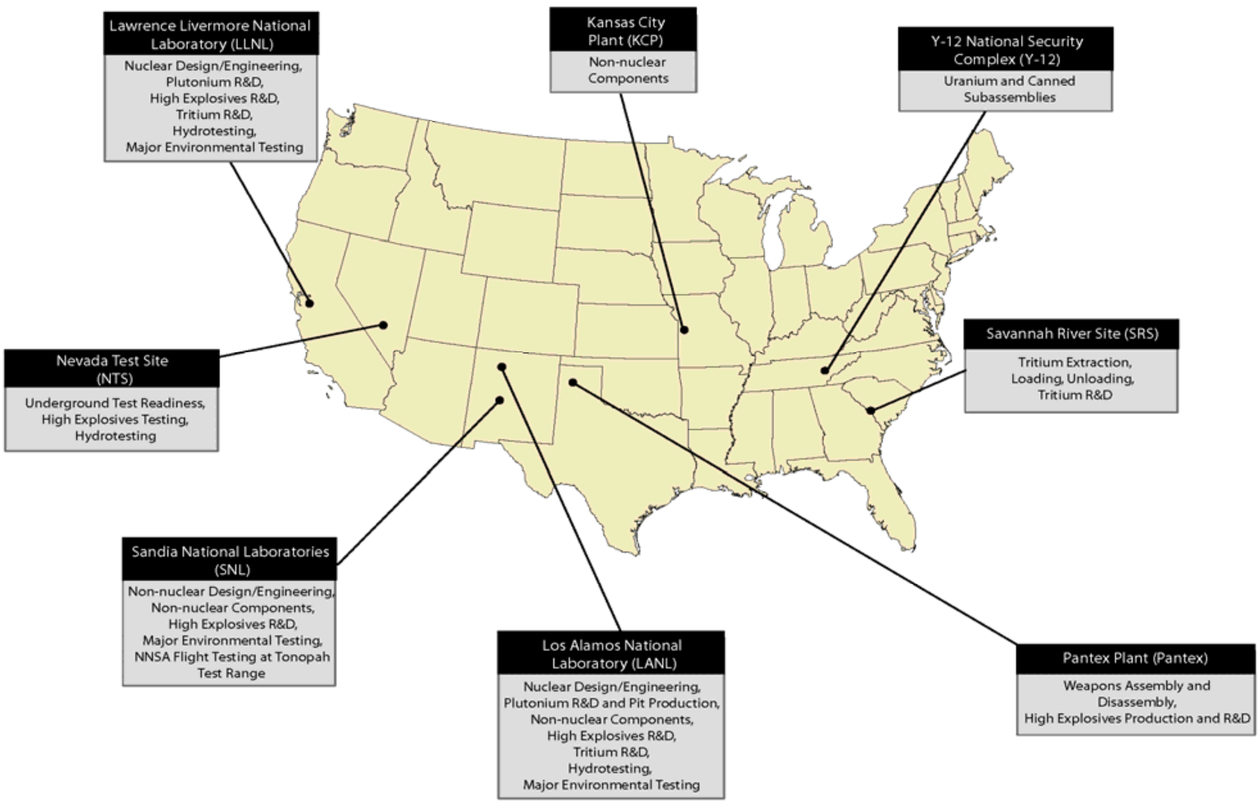

Figure 1-1—Nuclear Weapons Complex Sites and Current Major Responsibilities

NNSA now proposes to continue the transformation of the Complex by further consolidating operations, which could result in the relocation of activities among sites. These changes, particularly alternatives that involve the construction or modification of major nuclear facilities, could have environmental impacts. These changes could also produce significant benefits, including improved safety, security, and environmental systems, reduced operating costs, and greater responsiveness to future changes in national security policy.

The alternatives analyzed in this SPEIS are divided into two categories: programmatic and project-specific. Programmatic alternatives involve the restructuring of facilities that use or store significant (i.e., Category I/II[5]) quantities of special nuclear material (SNM). These facilities produce plutonium components (commonly called pits), produce highly enriched uranium (HEU)

[5] Special nuclear material is categorized into Security Categories I, II, III, and IV based on the type, attractiveness level, and quantity of material. Categories I and II, which require the highest level of security, are the focus of the proposed actions in this SPEIS.

components, and assemble and disassemble nuclear weapons (including related high explosive [HE] component fabrication).

This SPEIS analyzes the potential environmental impacts of locating these facilities at up to three of five NNSA sites: Los Alamos National Laboratory (LANL) in Los Alamos, New Mexico; Nevada Test Site (NTS) north of Las Vegas, Nevada; Pantex Plant (Pantex) in Amarillo, Texas; Savannah River Site (SRS) in Aiken, South Carolina; and Y-12 National Security Complex (Y-12) in Oak Ridge, Tennessee. The programmatic alternatives include different configurations of facilities (consolidated or distributed) and different capacities (ranging from 200 units per year with multiple shifts to about 10 units per year). A minimum set of fundamental capabilities is required under all alternatives to meet national security requirements. In each of these programmatic action alternatives, NNSA also proposes to consolidate the storage of SNM currently at Pantex.

Based on this SPEIS and other information, NNSA expects to decide where facilities for plutonium, HEU, and assembly/disassembly (A/D) activities would be located, whether to construct new or renovate existing facilities for these functions, and whether to further consolidate SNM storage. The programmatic alternatives are described in more detail in Chapter 3, sections 3.3 though 3.6. Any programmatic decisions resulting from this SPEIS may require further project-specific *National Environmental Policy Act* (NEPA) review before implementation.

This SPEIS also analyzes project-specific alternatives to restructure research and development (R&D) and testing facilities. NNSA intends this SPEIS to provide sufficient analysis of potential environmental impacts to enable implementation of decisions related to these project-specific alternatives without further NEPA review. The decisions NNSA expects to make include:

- Whether to eliminate or consolidate duplicative facilities for tritium and high explosives R&D, major hydrodynamic testing, environmental testing, and certain weapons support functions; where these facilities and operations would be located; and where construction activities might be required for future operations; and
- Where to conduct NNSA flight test operations for gravity weapons.

The project-specific alternatives are described in Chapter 3 in Sections 3.8 through 3.13.

The potential environmental impacts of each alternative are summarized in Section S.3.16 and discussed in detail in Chapter 5. NNSA has identified its preferred programmatic and project-specific alternatives in this Final SPEIS. These are described in Section S.3.17.

1.1 COMPLEX TRANSFORMATION

In 1996, DOE prepared the SSM PEIS, which evaluated alternatives for maintaining the safety and reliability of the U.S. nuclear weapons stockpile and preserving U.S. competencies in nuclear weapons in the post-Cold War era. The SSM PEIS ROD (61 FR 68014) documented important decisions related to fulfilling these requirements without under-ground nuclear testing. Since that ROD, NNSA has been implementing those decisions.

The SSM PEIS analyzed the potential impacts of alternatives for managing the nuclear arsenal for about 10 years based on the weapons stockpile proposed by the *Strategic Arms Reduction Treaty* (START)-II and the need for enhanced experimental facilities to replace nuclear testing. Thus, the decisions resulting from the SSM PEIS were focused on: 1) Constructing enhanced experimental facilities at NNSA national laboratories; and 2) Downsizing or consolidating the production infrastructure in view of a projected smaller stockpile. Today, NNSA has to take a longer view for the reasons highlighted below. The national security policies and treaties mentioned below are explained further in Chapter 2.

1.1.1 Maintaining Nuclear Deterrence

In the 1996 SSM PEIS, no new production facilities were proposed. The enduring types of weapons in the stockpile were at the mid-point of their anticipated design life of 20–25 years, and the life extension program plans for the enduring weapons were not yet fully developed. The weapons in the stockpile are now more than a decade older than when the SSM PEIS was prepared. Because the U.S. will maintain a nuclear deterrent in the form of a safe, secure, and reliable stockpile with the smallest number of weapons possible, NNSA needs to preserve its core competencies in nuclear weapons and invest in some replacement nuclear facilities for research and production. Because these major nuclear facilities are more than 50 years old, the ability to keep them safe, secure, and performing within realistic economic constraints is declining.

The 2001 Nuclear Posture Review[6] concluded that a nuclear deterrent relying on a balance of capabilities and a smaller deployed weapons stockpile would provide a credible deterrent in a future of uncertain and evolving threats. The Nuclear Posture Review was the foundation for the *Moscow Treaty*, which was ratified by the U.S. and Russia in 2003. Implementation of the *Moscow Treaty* is cutting the U.S. nuclear weapons stockpile to about one-half the size in the *Strategic Arms Reduction Treaty II*, which was ratified by the U.S. in 1996 and Russia in 2000. To achieve the new balance between a responsive infrastructure and deployed stockpile size, one of the main purposes of the proposed actions in this SPEIS is to make the Complex more responsive. As discussed in Chapter 2, responsiveness means the ability to successfully execute requirements of the national security mission on schedule and react to new developments. A transformed Complex with demonstrated capabilities would ensure that the Nation's nuclear deterrent would remain credible and could support additional reductions in the stockpile if directed by the President and the Congress. A transformed Complex is also expected to be safer, more secure, and less costly to maintain.

1.1.2 Security for Nuclear Weapons and Special Nuclear Materials

There is a classified national security policy directed at enhancing the security of U.S. nuclear weapons and associated SNM. This policy was issued after September 11, 2001, and its requirements reflect a reassessment of the terrorist threat. Today, seven of the eight major NNSA sites store SNM. Consolidation of these materials at fewer sites, and fewer locations at those sites, would enhance security at a reduced cost.

[6] The Nuclear Posture Review establishes the broad outline for future U.S. nuclear strategy, force levels, and infrastructure. The Nuclear Posture Review is a classified report prepared by the Department of Defense.

1.1.3 Proposed Approach to Transformation of the Complex

In 2006, NNSA developed a planning scenario for the future of the Complex (NNSA 2006). This was a continuation of NNSA's effort to establish a Complex that is more responsive to changing national security requirements, as determined by the President and Congress, and that is operated as efficiently as possible. Accordingly, NNSA developed the planning scenario after evaluating how significant economic and security benefits could be realized if the Complex were reduced in size, capacity, number of sites with Category I/II SNM (and locations of Category I/II SNM within sites), and redundant activities at facilities eliminated—in other words, whether and how the Complex could be made more secure and efficient.

NNSA's proposed approach to continuing transformation of the Complex builds on existing programs and management structures so that much of the transformation could be accomplished within currently projected funding levels. The cost and potential environmental impacts of the alternatives in this SPEIS are primarily associated with the construction of new nuclear facilities. Thus, a wide range of alternative configurations for these nuclear facilities is being evaluated. NNSA has completed detailed economic studies of the alternatives (TechSource 2007a, 2007b, 2007c, 2007d, 2008a, 2008b, 2008c, 2008d, 2008e, 2008f, 2008g).

1.2 THE NUCLEAR WEAPONS COMPLEX TODAY

As shown on Figure 1-1, the current Complex consists of eight sites located in seven States. The Complex enables NNSA to design, develop, manufacture, maintain, and repair nuclear weapons; certify their safety, security, and reliability; conduct surveillance on weapons in the stockpile; store Category I/II SNM; and dismantle and disposition retired weapons. Major sites within the Complex and their current primary responsibilities are described below.

Y–12 National Security Complex (Oak Ridge, Tennessee). Y-12 manufactures uranium components for nuclear weapons, cases, and other nuclear weapons components; evaluates and tests these components; maintains Category I/II quantities of highly enriched uranium; conducts component dismantlement, storage, and disposition of their nuclear materials; and supplies highly enriched uranium for use in naval reactors.

Savannah River Site (Aiken, South Carolina). SRS extracts tritium and performs loading, unloading, surveillance of tritium reservoirs, and conducts tritium R&D.[7] SRS does not maintain Category I/II quantities of SNM associated with NNSA weapons activities, but does maintain Category I/II quantities of SNM associated with other DOE activities.

Pantex Plant (Amarillo, Texas). Pantex dismantles retired weapons; fabricates HE components, and performs HE R&D; assembles HE, nuclear, and non-nuclear components into nuclear weapons; repairs and modifies weapons; performs nonintrusive pit modification;[8] and evaluates

[7] Tritium is an isotope of hydrogen produced in nuclear reactors and used in nuclear weapons. Because of its short half-life, tritium must be replenished routinely. The Watts Bar Nuclear Power Plant (Spring City, Tennessee) is a commercial nuclear power plant owned and operated by the Tennessee Valley Authority (TVA) which produces tritium that is extracted from target rods at SRS. As a commercial power station, the Watts Bar Plant is not considered part of the Complex.
[8] A pit is the central core of a nuclear weapon, usually made of plutonium or enriched uranium. Nonintrusive pit modification is modification to the external surfaces and features of a pit.

and performs surveillance of weapons. Pantex maintains Category I/II quantities of SNM for the weapons program and stores SNM in the form of surplus plutonium pits pending transfer to SRS for disposition.

Kansas City Plant[9] (KCP) (Kansas City, Missouri). KCP manufactures and procures non-nuclear weapons components and evaluates and tests these weapons components. KCP has no SNM.

Los Alamos National Laboratory (Los Alamos, New Mexico). LANL conducts research, design, and development of nuclear weapons; designs and tests advanced technology concepts; provides safety, security, and reliability assessments and certification of stockpile weapons; maintains production capabilities for limited quantities of plutonium components (i.e., pits) for delivery to the stockpile; manufactures nuclear weapon detonators for the stockpile; conducts plutonium and tritium R&D, hydrotesting, HE R&D, and environmental testing; and maintains Category I/II quantities of SNM.

Lawrence Livermore National Laboratory (Livermore, California). LLNL conducts research, design, and development of nuclear weapons; designs and tests advanced technology concepts; provides safety, security, and reliability assessments and certification of stockpile weapons; conducts plutonium and tritium R&D, hydrotesting, HE R&D, and environmental testing; and maintains Category I/II quantities of SNM.

Sandia National Laboratories (SNL) (Albuquerque, New Mexico; Livermore, California; and other locations). SNL conducts systems engineering of nuclear weapons; conducts research, design, and development of non-nuclear components; manufactures non-nuclear weapons components including neutron generators for the stockpile; provides safety, security, and reliability assessments of stockpile weapons; and conducts HE R&D and environmental testing. The principal laboratory is located in Albuquerque, New Mexico (SNL/NM); a division of the laboratory (SNL/CA) is located in Livermore, California. SNL also operates TTR near Tonopah, Nevada, for flight testing of gravity weapons including R&D and testing of nuclear weapons components and delivery systems. In 2008, SNL/NM completed removal of its Category I/II SNM. It no longer stores or uses Category I/II SNM on a permanent basis, although it may use Category I/II SNM for limited activities in the future. No Category I/II quantities of SNM are permanently maintained at TTR, although some test operations have involved SNM.

Nevada Test Site (NTS) (65 miles northwest of Las Vegas, Nevada). NTS maintains the capability to conduct underground nuclear testing; conducts high hazard experiments involving nuclear material and high explosives; provides the capability to disposition a damaged nuclear weapon or improvised nuclear device; conducts non-nuclear experiments; conducts hydrodynamic testing and HE testing; conducts research and training on nuclear safeguards, criticality safety, and emergency response; and maintains Category I/II quantities of SNM.

[9] The General Services Administration (GSA), as the lead agency and NNSA, as a cooperating agency, prepared an Environmental Assessment and Finding of No Significant Impact regarding the potential environmental impacts of moving the facilities and infrastructure for the non-nuclear production activities conducted at the KCP to a number of locations (GSA 2008). This SPEIS does not assess alternatives for the activities conducted at the KCP (Section 1.5.2.1).

1.2.1 Nuclear Weapons

A general understanding of nuclear weapons, including the components that make up a weapon and the physical processes involved, helps one understand the alternatives evaluated in the Complex Transformation SPEIS. Figure 1-2 presents a simplified diagram of a modern nuclear weapon. An actual nuclear weapon produced in the U.S. is much more complicated, consisting of many thousands of parts. The nuclear weapon primary is composed of a central core called a pit, which is usually made of plutonium-239, enriched uranium (EU), or both.

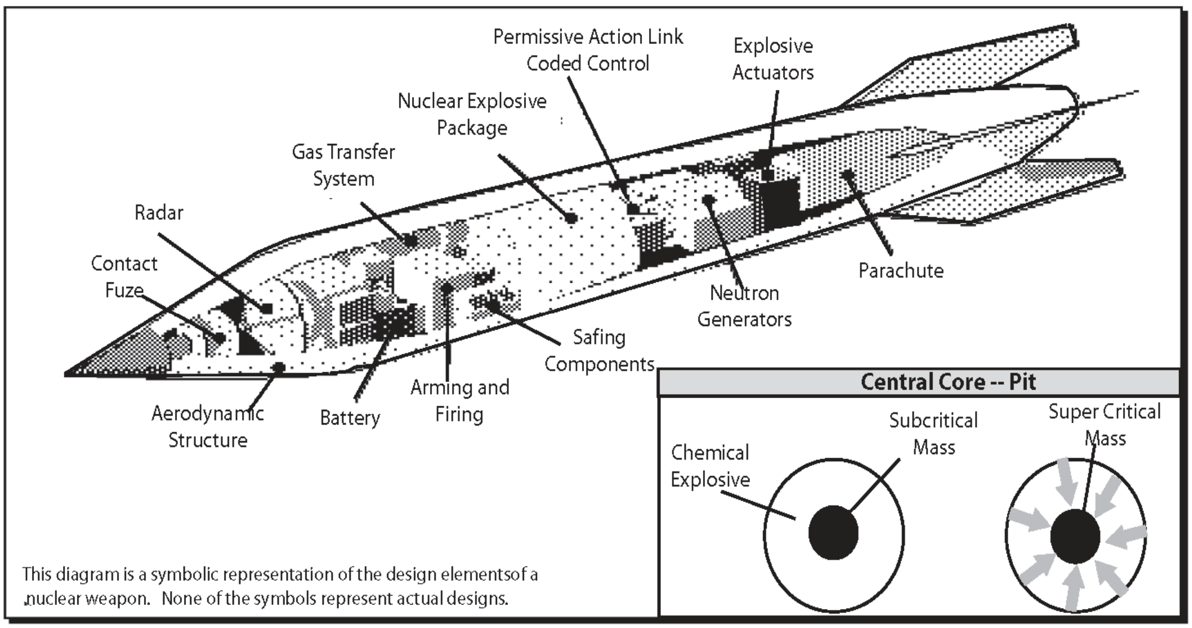

Figure 1-2—Simplified Modern Nuclear Weapon

The pit is surrounded by a layer of HE, which, when detonated, compresses the pit to a supercritical mass, initiating a nuclear reaction. This reaction is generally thought of as the nuclear fission "trigger," which activates the secondary assembly component (containing tritium) to produce a thermonuclear fusion reaction. The remaining non-nuclear components consist of everything from arming and firing systems to batteries and parachutes. As identified in Section 1.2, the production and assembly of many of these components are accomplished at NNSA facilities. A/D of nuclear weapons is done only at Pantex at the present time.

1.3 INTRODUCTION OF THE ALTERNATIVES

NNSA announced its intent to prepare this SPEIS in the *Federal Register* on October 19, 2006 (71 FR 61731). As explained in Section 1.6, input from the scoping process and comments submitted on the Draft SPEIS assisted NNSA in defining the alternatives that are analyzed in this SPEIS. As explained in Chapter 2, these alternatives are grouped into two categories: (1) Restructure SNM Facilities; and (2) Restructure R&D and testing facilities.

1.3.1 Restructure SNM Facilities

The following functional capabilities are considered in this proposed action:

- Plutonium operations, including pit manufacturing, Category I/II SNM storage, and related R&D;
- EU operations, including canned subassembly (CSA) manufacturing, A/D, Category I/II SNM storage, and related R&D; and
- Weapons A/D and HE production.

To consolidate SNM facilities, which would be a long-term process carried out over a decade or more, the SPEIS alternatives address broad issues such as where to locate those facilities and whether to construct new or renovate existing facilities for these functions. As such, this SPEIS analysis is "programmatic" for the proposed action to restructure SNM facilities, meaning that tiered, project-specific NEPA documents could be needed to inform decisions on these facilities if existing site-wide EISs or other NEPA documents were insufficient. The alternatives are fully described in Chapter 3.

1.3.2 Restructure R&D and Testing Facilities

NNSA also proposes to restructure R&D and testing facilities to eliminate duplicative or unnecessary redundancies. R&D and testing capabilities and capacities being evaluated in this SPEIS:

- High explosives R&D;
- Tritium R&D;
- Flight test operations;
- Major hydrodynamic testing; and
- Major environmental testing.

"Downsize-in-place" and "consolidate to fewer locations" are the main alternatives for all functions except flight testing. Flight testing alternatives are to upgrade TTR, move the mission to the NTS, or move the mission to the Department of Defense (DoD) White Sands Missile Range (WSMR). The alternatives are fully described in Chapter 3.

1.3.3 No Action Alternative

As required by NEPA, NNSA evaluated a No Action Alternative that represents continuation of the status quo. The No Action Alternative provides a baseline from which changes resulting from the alternatives can be compared. The No Action Alternative includes the continued implementation of decisions made pursuant to the SSM PEIS, the Tritium Supply and Recycling PEIS, and other project-specific and site-specific EISs and Environmental Assessments (EAs). Section 1.5.2 discusses the pertinent major NEPA documents and their relationship to this Complex Transformation SPEIS.

1.4 RELEVANT HISTORY—EVOLUTION OF THE COMPLEX AFTER THE COLD WAR

A safe and reliable U.S. nuclear weapons stockpile has been a cornerstone of national security policy for more than 60 years. Since the inception of nuclear weapons, the U.S. has maintained a safe and reliable nuclear deterrent force, even as military requirements have changed and technological developments have evolved. Under the *Atomic Energy Act* of 1954 (42 USC. 2011 *et seq*.), DOE is responsible for providing nuclear weapons to support U.S. national security strategy. The *National Nuclear Security Administration Act* (Public Law 106–65, Title XXXII) assigned this responsibility to NNSA within DOE.

In January 1991, DOE completed a Nuclear Weapons Complex Reconfiguration (Complex-21) Study which identified significant cost savings that could be achieved by reducing the size of the Complex. DOE then initiated a PEIS (which became known as the Reconfiguration PEIS) examining alternatives for reconfiguring the Complex. However, in December 1991, DOE decided to separate proposals for transforming non-nuclear production from the Reconfiguration PEIS because proposals and decisions regarding transformation of non-nuclear production would neither significantly affect, nor be affected by, proposals and decisions regarding transformation of nuclear production. Thus, proposals for transforming the non-nuclear production could proceed independently from, and more quickly than, proposals and decisions regarding the nuclear portion of the Complex.

On January 27, 1992, DOE issued a NOI (57 FR 3046) to prepare an EA for the consolidation of non-nuclear production activities within the Complex (DOE 1993). On September 14, 1993, DOE published a Finding of No Significant Impact (FONSI) regarding its proposal to consolidate non-nuclear component production (58 FR 48043). This proposal included termination of non-nuclear production missions at the Mound Plant in Ohio, the Pinellas Plant in Florida, and the Rocky Flats Plant in Colorado. The electrical and mechanical component manufacturing functions were consolidated at the KCP. Detonator production, neutron generator tritium target loading, and beryllium technology were consolidated at LANL; neutron generator and related component production were relocated to SNL/NM in New Mexico.

In October 1993, President Clinton issued PDD–15, which directed DOE to establish the SSP. PDD–15 significantly redirected the nuclear weapons program. Throughout the Cold War, the DoD and the DOE nuclear weapons laboratories had based much of their confidence in the reliability of nuclear weapons on performance data from atmospheric and underground nuclear tests. However, since 1992, the U.S. has been observing a moratorium on nuclear testing.

To ensure weapons reliability during the moratorium on testing, DOE invested in new scientific tools to assess the complicated phenomena involved in the detonation of nuclear weapons. DOE also began to develop sophisticated tools and computer-based simulation techniques to assess various aging phenomena as nuclear weapons were expected to serve well beyond their originally anticipated lifetimes. These actions enhanced the experimental, computational and simulation capabilities at the laboratories. DOE deferred spending on the production complex because there were no new weapons production requirements and because of uncertainty about the future stockpile requirements.

In October 1994, DOE concluded that the alternatives described in the Reconfiguration PEIS no longer fit current circumstances or supported any realistic proposal for reconfiguration of the Complex. That conclusion was based on several factors, including: comments offered at the September-October 1993 Reconfiguration PEIS scoping meetings; the anticipation that no production of new nuclear weapons types would be required for the foreseeable future; budget constraints; and DOE's decision to prepare a separate PEIS on Storage and Disposition of Weapons-Usable Fissile Materials (DOE 1996e).

Consequently, DOE separated the Reconfiguration PEIS into two new PEISs: 1) a Tritium Supply and Recycling PEIS (DOE 1995); and 2) the 1996 SSM PEIS (DOE 1996d). The PEIS for Tritium Supply and Recycling was issued on October 27, 1995 (60 FR 55021). In a ROD on May 14, 1999 (64 FR 26369), DOE announced its decision to produce the tritium needed to maintain the nuclear weapons stockpile at a commercial light-water reactor owned and operated by the TVA and to extract tritium at a new DOE-owned tritium extraction facility at SRS. With regard to the SSM PEIS, DOE issued an NOI on June 6, 1995 (60 FR 31291), a final SSM PEIS on November 19, 1996 (61 FR 58871), and an ROD on December 26, 1996 (61 FR 68014). The following decisions announced in the SSM PEIS ROD have been implemented:

- The National Ignition Facility is under construction at LLNL;
- The Contained Firing Facility was constructed and is operational at LLNL;
- The Atlas Facility was constructed at LANL and subsequently relocated to NTS;
- A small pit fabrication capability and capacity was established at LANL;
- Non-nuclear fabrication activities were downsized at existing KCP facilities;
- Reductions in production capacity for secondary assemblies and cases at Y-12, non-nuclear components at KCP, and HE and weapon A/D at Pantex are continuing;
- Strategic reserves of EU are in storage at Y-12;
- Strategic reserves of plutonium (in the form of plutonium pits) are in storage at Pantex; and
- Plutonium-242 oxide was transferred from SRS to LANL for storage.

Complex Changes

The weapons complex of the 1980's looked much different than it does today. Back then, there were 14 sites producing thousands of nuclear weapons and components annually, and underground nuclear tests were conducted at the NTS to verify the safety and reliability of the weapons in the stockpile. Today, the Complex has shrunk to approximately 50% of the facility square footage, and significantly less production capacity. Today, the safety and reliability of the stockpile are based on surveillance of stockpile weapons, experiments, computation and simulation, rather than underground nuclear testing.

In accordance with the decisions announced in the RODs for the 1996 SSM PEIS, the Non-nuclear Consolidation EA, and the Tritium Supply and Recycling PEIS, DOE began transforming the Complex. Today, the size of the Complex is approximately 50 percent smaller than its peak during the Cold War. It now comprises more than 35 million square feet of facilities at the sites shown on Figure 1-1. DOE has also prepared other NEPA documents that analyze alternatives for the continued transformation of the Complex. Section 1.5.2 discusses these NEPA documents and their relationship to this SPEIS.

1.5 NEPA STRATEGY FOR THIS SUPPLEMENTAL PEIS

NEPA ensures that environmental information is available to public officials and citizens before decisions are made and actions are taken. With the continuing evolution of nuclear weapon requirements, NNSA believes it necessary to consider further transformation of the Complex to improve its efficiency and responsiveness in meeting national security requirements and enhancing the security of special nuclear materials. The 1996 SSM PEIS was the last programmatic review of the SSP. In this SPEIS, NNSA evaluates alternatives to transform the Complex so that it can be more responsive to changing national security requirements and to enhance the security of SNM. This SPEIS has been prepared in accordance with Section 102(2)(C) of NEPA (42 USC 4321 *et seq*.), and regulations promulgated by the CEQ (40 CFR Parts 1500–1508) and DOE's regulations implementing NEPA (10 CFR Part 1021), and follows DOE's NEPA guidance.

1.5.1 Decisions Regarding the Complex Transformation

This SPEIS assesses reasonable alternatives for transforming the Complex to a more efficient, responsive, and secure one. If NNSA decides to proceed with major transformation actions, such as the construction of new nuclear facilities, NNSA would prepare project-specific NEPA analyses, as needed; these documents would rely, in part, on analyses in this Complex Transformation SPEIS. Project-specific NEPA documents would use more detailed design information than is available for this SPEIS to evaluate reasonable site-specific alternatives as well as the No Action Alternative.

Based on this SPEIS, NNSA expects to decide whether to:

- Consolidate SNM at fewer sites or fewer locations within sites;
- Construct new or renovate existing SNM facilities and where any new facilities would be located;
- Eliminate or consolidate duplicative facilities for tritium R&D, HE R&D, major hydrotest, environmental test facilities, and certain weapon support functions, and where these facilities would be located and where construction activities might be required; and
- Where to conduct NNSA flight test operations.

1.5.2 Relevant NEPA Documents

As mentioned in Section 1.5.1, DOE has prepared and is preparing other EISs that would continue the ongoing transformation of the Complex. These documents, and their relationship to the Complex Transformation SPEIS, are discussed in the following sections.

1.5.2.1 *Completed NEPA Analyses*

1993—*Non-nuclear Consolidation Environmental Assessment*, DOE/EA-0792. The Non-Nuclear Consolidation EA analyzed the proposed consolidation of the facilities within the Complex that manufactured non-nuclear components for nuclear weapons. On September 14, 1993, DOE issued a FONSI which resulted a decision to remove defense activities from the Mound Plant in Miamisburg, Ohio; from the Pinellas Plant in Pinellas, Florida; and to end non-nuclear activities at the Rocky Flats Plant in Golden, Colorado (58 FR 36658, July 8, 2993). These activities were relocated to existing facilities at KCP in Kansas City, Missouri, and LANL and SNL in New Mexico. This decision also resulted in the transfer of the tritium handling activities performed at the Mound Plant to SRS. As described below, NNSA and the General Services Administration completed an EA in 2008 and issued a FONSI regarding the proposed relocation of non-nuclear production activities to a new location in the Kansas City area.

1995—*Tritium Supply and Recycling PEIS,* DOE/EIS-0161. The Tritium Supply and Recycling PEIS evaluated alternatives for the siting, construction, and operation of tritium supply and recycling facilities, including the use of a commercial light water reactor (CLWR) for the production of tritium. In the ROD, DOE decided to pursue a dual-track approach to pursue tritium production in a CLWR and an accelerator (60 FR 63878, December 12, 1995). The accelerator option was later discontinued. The ROD also called for the construction of a new Tritium Extraction Facility at SRS. With respect to this Complex Transformation SPEIS, the decisions based on the Tritium Supply and Recycling PEIS apply equally to all alternatives and are not being reconsidered. That is, tritium would continue to be produced and extracted pursuant to the decisions made as a result of the Tritium Supply and Recycling PEIS and tiered project-specific NEPA documents.

1996—*Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management,* DOE/EIS-0236 (SSM PEIS) (DOE 1996c). The SSM PEIS evaluated alternatives for maintaining the safety and reliability of the Nation's nuclear stockpile and preserving U.S. competencies in nuclear weapons in the post-Cold War era. The SSM PEIS ROD (61 FR 68014, December 26, 1996) announced important decisions related to fulfilling these requirements without underground nuclear testing. Since that ROD, NNSA has been implementing these decisions as described in Section 1.4. As such, the SSM PEIS ROD, as modified to account for decisions based on subsequent site-wide and project-specific NEPA documents, is the foundation for the No Action Alternative in this Complex Transformation SPEIS. DOE has previously prepared three Supplemental PEISs related to the SSM PEIS. These three documents involved the National Ignition Facility (NIF), and the now-cancelled Modern Pit Facility.

1996—*Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada,* DOE/EIS-0243 (NTS SWEIS). The NTS SWEIS evaluated four alternatives for the continued operation of NTS: 1) No Action Alternative; 2) Discontinuation of Operations; 3) Expanded Use; and 4) Alternate Use of Withdrawn Lands. Included in the NTS SWEIS was an evaluation of reasonable alternatives for NNSA flight testing at TTR. On December 13, 1996, DOE published a ROD (61 FR 65551) selecting the Expanded Use Alternative. Under that decision, NNSA is continuing the multi-program use of the NTS. The continuing nuclear weapons activities included subcritical experiments (i.e., explosively driven experiments with special nuclear material in which there is no self-sustaining nuclear reaction), readiness to conduct and the conduct of nuclear testing if ordered by the President, and other elements of the SSP. In July 2002, DOE issued a Supplemental Analysis (SA) which concluded that there is no need to supplement the NTS SWEIS. For purposes of this Complex Transformation SPEIS, the analyses and decisions in the NTS SWEIS, ROD, and SA represent the No Action Alternative. That is, if NNSA decides not to proceed with any changes affecting NTS based on this SPEIS, then NNSA would conduct operations at NTS within the framework of the NTS SWEIS, ROD, and SA.

1997—*Final Environmental Impact Statement for the Continued Operation of Pantex and Associated Storage of Nuclear Weapons Components*, DOE/EIS-0225 (Pantex SWEIS). The Pantex SWEIS evaluated alternatives for the continued operation of Pantex. The SWEIS examined environmental impacts resulting from a reasonable range of activity levels by assessing the operations on 2,000, 1,000, and 500 weapons per year. DOE issued a ROD providing for: continuing nuclear weapon operations involving A/D of nuclear weapons (up to 2,000 weapons per year); HE component fabrication; implementing facility projects, including upgrades and construction consistent with conducting these operations; and continuing to provide interim storage at Pantex for up to 20,000 pits (62 FR 3880, January 27, 1997). In April 2002, DOE completed an SA which concluded that there was no need to supplement the Pantex SWEIS. For purposes of this Complex Transformation SPEIS, the analyses and decisions in the Pantex SWEIS, ROD, and SA represent the No Action Alternative at Pantex. That is, if NNSA decides to not proceed with any changes affecting Pantex, then NNSA would conduct operations at Pantex within the framework of the Pantex SWEIS, ROD, and SA.

1999—*Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor*, DOE/EIS-0288 (CLWR EIS). The CLWR EIS evaluated alternatives for producing tritium in CLWRs. In the ROD (64 FR 26369, May 14, 1999), DOE selected the TVA's Watts Bar Unit 1, Sequoyah Unit 1, and Sequoyah Unit 2 reactors for use in irradiating target rods to produce tritium. With respect to this Complex Transformation SPEIS, the decisions based on the CLWR EIS apply equally to all alternatives and are not being reconsidered. That is, tritium will continue to be produced in the TVA reactors. See Section 5.19 for a summary of the environmental impacts of producing tritium in TVA reactors.

1999—*Final Environmental Impact Statement for Construction and Operation of a Tritium Extraction Facility at the Savannah River Site*, DOE/EIS-0271 (TEF EIS). In the Tritium Extraction Facility (TEF) EIS, DOE evaluated alternative designs and locations at the SRS for the construction and operation of a TEF. The TEF extracts tritium from irradiated tritium-producing burner absorber rods (TPBARS) received at SRS from a TVA reactor. With respect to the Complex Transformation SPEIS, the decisions based on the TEF EIS (64 FR 26369, May 14, 1999) apply equally to all alternatives. The TEF became operational in 2006, and DOE will continue to operate the TEF at SRS.

1999—*Site-wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, DOE/EIS-0238 (1999 LANL SWEIS). The 1999 LANL SWEIS evaluated the environmental impacts of ongoing and proposed activities at LANL, including site-specific alternatives for implementing production of up to 50 pits per year (ppy) using a single shift (80 ppy with multiple shifts), consistent with the SSM PEIS ROD. DOE decided to expand the scope and level of LANL operations across several science and technology areas. DOE increased pit production capability to 20 ppy, but deferred any decision to expand pit manufacturing beyond that level (64 FR 50797, September 20, 1999). For purposes of this Complex Transformation SPEIS, the decisions in the 1999 LANL SWEIS ROD represent the No

Action Alternative. That is, if NNSA decides not to proceed with any changes affecting LANL based on this SPEIS, then NNSA would conduct operations at LANL within the framework of the 1999 LANL SWEIS and ROD. As explained below, NNSA recently completed a new Final LANL SWEIS.

1999—*Site-wide Environmental Impact Statement for the Operation of Sandia National Laboratories/New Mexico,* DOE/EIS-0281 (SNL/NM SWEIS). The SNL/NM SWEIS evaluated alternatives for the continued operation of SNL/NM. The ROD provided for expanding SNL/NM operations to the highest reasonable levels that could be supported by current facilities and their potential expansion as well as construction of new facilities for future actions specifically identified in the SWEIS (64 FR 69996, December 15, 1999). In August 2006, DOE/NNSA/Sandia Site Office (SSO) completed an SA (DOE 2006a) which concluded that the environmental impacts of current and projected SNL/NM operations were within the envelope of consequences established in the 1999 SNL/NM SWEIS. For purposes of this Complex Transformation SPEIS, the analyses and decisions in the SNL/NM SWEIS, ROD, and SA represent the No Action Alternative. That is, if NNSA decides not to proceed with any changes affecting SNL/NM based on this SPEIS, then NNSA would conduct operations at SNL/NM within the framework of the SNL/NM SWEIS, ROD, and SA.

2001—*Site-wide Environmental Impact Statement for the Y-12 National Security Complex*, DOE/EIS-0309 (2001 Y-12 SWEIS). The 2001 Y-12 SWEIS evaluated alternatives for the continued operation of Y-12. The ROD provided for the continued operations at Y-12 at the planning basis operations level to meet NNSA mission requirements and other DOE program activities together with construction and operation of two new facilities: an HEU Materials Facility and the Special Materials Complex (SMC) (67 FR 11296, March 13, 2002). The SMC was subsequently cancelled. For purposes of this Complex Transformation SPEIS, the decisions in the 2001 Y-12 SWEIS ROD represent the No Action Alternative at Y-12. That is, if NNSA decides not to proceed with any changes affecting Y-12 based on this SPEIS, then NNSA would conduct operations at Y-12 within the framework of the 2001 Y-12 SWEIS and ROD. As explained in Section 1.5.2.2, NNSA is currently preparing a new Y-12 SWEIS.

2002—*Environmental Impact Statement for the Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory*, DOE/EIS-319 (TA-18 EIS). The TA-18 EIS evaluated alternatives for the relocation of TA-18 capabilities and materials at LANL. The ROD provided for the relocation of Category I/II missions and related materials to the Device Assembly Facility (DAF) at NTS (67 FR 79906, December 31, 2002). The TA-18 missions that were relocated to the DAF are now part of the existing operations at NTS.

2003—*Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EIS-0350 (CMRR EIS). The Chemistry and Metallurgy Research Replacement (CMRR) Building EIS evaluated alternatives for replacing the existing CMR Building at LANL The ROD announced a decision to construct a new CMRR facility at TA-55 as a single, above-ground, Hazard Category 2 building (69 FR 6967, February 12, 2004) with a separate administrative office and support functions building. The first phase of the CMRR project is the Radiological Laboratory Utility Building, also known as the Rad Lab. NNSA has begun construction of the

Rad Lab. NNSA has determined that the Rad Lab is needed at LANL regardless of the decisions NNSA makes based on this SPEIS, and continued construction of the Rad Lab is part of the SPEIS's No Action Alternative. NNSA will decide whether to construct the CMRR's nuclear facility based on this SPEIS. If Los Alamos is chosen as the site for pit production, the nuclear facility could be incorporated into a site-adapted complex of facilities. Should another site be selected for pit production, the nuclear facility could still be constructed at LANL as a bridging strategy to provide an interim capability pending the availability of the new pit production facility. In either case, the preliminary design of the nuclear facility would be applicable to any future pit production facility at any site analyzed in this SPEIS.

2005—*Site-wide EIS for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic EIS,* DOE/EIS-0348 and DOE/EIS-0236-S3 (LLNL SWEIS). The LLNL SWEIS evaluated alternatives for the continued operation of LLNL and the use of SNM in the NIF. The ROD provided for continued management and operation of LLNL, an increase in administrative and material-at-risk limits for plutonium and tritium, and the use of plutonium, other fissile materials, fissionable materials, and lithium hydride in experiments conducted at the NIF (70 FR 71491, November 29, 2005). For purposes of this Complex Transformation SPEIS, the analyses and decisions in the LLNL SWEIS and ROD represent the No Action Alternative. That is, if NNSA decides not to proceed with any changes affecting LLNL based on this SPEIS, then NNSA would conduct operations at LLNL within the framework of the LLNL SWEIS and ROD.

2007—*Programmatic Environmental Impact Statement for Defense Threat Reduction Agency* [DTRA] *Activities on White Sands Missile Range, NM* (WSMR PEIS). In March 2007, DTRA, an agency of the DoD, completed the WSMR PEIS to evaluate the potential environmental impacts associated with testing activities on WSMR over a 10-year period. Issues that are addressed in the WSMR PEIS include:

- Continued operation and maintenance of various test structures used as targets for weapon system evaluations;
- Construction of new test structures, enlargement of existing test beds, and possible development of new test beds;
- Testing, operations, and maintenance activities;
- Use of chemical and biological simulants; and
- Planned improvements to DTRA's facilities.

The DTRA issued a ROD for the WSMR PEIS on May 27, 2007 (72 FR 29306). Based on that ROD, DTRA intends to increase its testing activities at the WSMR. NNSA is considering an alternative to move NNSA flight testing to the WSMR and has incorporated information from the WSMR PEIS into this SPEIS, as appropriate. (Also see discussion of related, ongoing WSMR EIS in Section 1.5.2.2)

2007—*Supplement Analysis, Storage of Surplus Plutonium Materials at the Savannah River Site,* DOE/EIS-0229-SA4. In 1996, DOE finalized the Storage and Disposition of Weapons-Usable Fissile Materials PEIS (DOE 1996e), which analyzed the potential environmental consequences of alternatives for long-term storage, including storage pending disposition and disposition of weapons-usable fissile materials from the dismantlement of U.S. nuclear weapons. For plutonium storage, DOE decided to consolidate part of its weapons-usable plutonium storage by upgrading and expanding existing and planned facilities at Pantex (plutonium pits) and SRS (non-pit plutonium). In 2007, DOE prepared this SA (DOE 2007b) to evaluate the need for additional NEPA review regarding a proposal to consolidate storage at SRS of surplus, non-pit weapons-usable plutonium from the Hanford site (Hanford), LANL, and LLNL. The SA shows that the potential environmental impacts associated with the consolidation of this plutonium at SRS would not be a significant change from the potential environmental impacts associated with the alternatives analyzed in previous NEPA reviews. The conclusions in the SA led to an amended ROD for the Storage and Disposition of Weapons-Usable Fissile Materials PEIS, which DOE issued in September 2007, stating that DOE does not need to conduct additional NEPA review prior to transferring surplus non-pit weapons-usable plutonium materials from Hanford, LLNL, and LANL to SRS for consolidated storage (72 FR 51807). Subsequently, NNSA has begun moving surplus non-pit, weapons-usable plutonium to SRS. These consolidation activities are part of the No Action Alternative for this SPEIS.

2008—*Site-wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico,* DOE/EIS-0380 (2008 LANL SWEIS). NNSA announced the availability of the Final LANL SWEIS on May 16, 2008 (73 FR 28453). The 2008 LANL SWEIS analyzes alternatives regarding pit production at LANL, including construction and operation of the nuclear facility portion of the CMRR facility. NNSA's preferred alternative in the 2008 LANL SWEIS is the Expanded Operations Alternative, which assumes more efficient use of floor space in the existing Plutonium Facility that would result in 50 certified pits each year by producing up to 80 pits annually.

This SPEIS analyzes three alternatives that would involve the nuclear facility portion of CMRR and the Plutonium Facility: the Upgrade Alternative, the 50/80 Alternative, and the Capability-Based Alternative. These alternatives would involve additional process efficiencies and, for the Upgrade Alternative and the 50/80 Alternative, require physical expansion of existing facilities or construction of additional facilities to provide for the manufacture of more pits than are evaluated in the LANL SWEIS.

NNSA will not make any decisions related to pit production at LANL prior to the completion of this SPEIS. In the interim, pit production at LANL will continue within the existing capacity of 20 ppy, as announced in the ROD for the 1999 LANL SWEIS (64 FR 50797, September 20, 1999). NNSA issued a ROD for the continued operation of LANL on September 26, 2008. NNSA announced in the ROD its decision to continue the no action alternative with the addition of some elements of the expanded operations alternative that NNSA concluded needed to be implemented to support the safe and successful execution of the laboratory's mission. None of these decisions affect the alternatives considered in this SPEIS.

2008—KCP—*Environmental Assessment for the Modernization of Facilities and Infrastructure for the Non-Nuclear Production Activities Conducted at the Kansas City Plant,* DOE/EA-1592 (KCP EA). GSA, as the lead agency, and NNSA, as a cooperating agency, issued a Final Environmental Assessment (GSA 2008) and FONSI on April 21, 2008 (73 FR 23244) on their proposal to procure the construction of a new facility to house NNSA's operations concerning non-nuclear components. The selected alternative is for GSA to lease a new facility from a private developer on NNSA's behalf, and for NNSA to relocate its operations from the existing KCP at the Bannister Federal Complex in Kansas City to the new facility. The relocation would involve moving approximately two-thirds of the existing capital and process equipment to the new facility. The proposed facility would be at least 50 percent smaller than the existing facility and would be designed to allow for rapid reconfiguration to meet changing requirements. The new facility would reduce annual operating costs and improve responsiveness, facility utilization, and reliability in supplying non-nuclear components. In addition to these operating improvements, the new facility would reduce the environmental footprint of KCP operations, including improved energy efficiency, lower emissions, and less waste generation.

The selected alternative would continue the consolidation and reduction of the manufacture and maintenance of non-nuclear components that DOE began after completion of the Non-nuclear Consolidation EA in 1993 and continued after the SSM PEIS in 1996.

Because the non-nuclear operations at KCP are essential and do not duplicate work at other sites, no proposal to combine or eliminate these operations was formulated. Thus, NNSA is not proposing to relocate these activities to another geographic area. Nonetheless, NNSA did evaluate three alternatives that involved moving these operations to another geographic area. One alternative evaluated moving KCP's operations to SNL/NM, one alternative evaluated moving those operations to LLNL, and a third alternative evaluated moving those operations to LANL. In addition to the analysis in the EA, a recent analysis of transferring KCP operations to a site other than one within the immediate Kansas City area concluded that "no prospects for economic benefits are apparent" (SAIC 2008). This is primarily because of the longer move, the restart period that would be required, and the costly transfer or reconstitution of the skilled workforce in a new region, which would forfeit a potential savings of approximately $100 million per year. In addition, relocation outside of the Kansas City area would require extending operation of the current facility in order to build the inventory that would be needed for a long transition; this could result in additional loss of key personnel, require additional training, and result in other unnecessary management challenges. Moreover, because of the nature of KCP operations, constructing and operating a new facility in a different location from Kansas City is unlikely to offer any significant benefits. Because no significant environmental impacts were identified in the KCP EA, NNSA and GSA issued a FONSI and are moving forward with this project in order to achieve significant benefits, including cost savings, continuity of operations, and preservation of technical competence independent of other proposals for transformation of the Complex. Consequently, these non-nuclear operations would remain in the Kansas City area. This decision will neither affect nor be affected by the decisions regarding the alternatives evaluated in this SPEIS.

1.5.2.2 *Ongoing NEPA Analyses*

Y-12—*Site-wide Environmental Impact Statement for the Y-12 National Security Complex*, DOE/EIS-0309 (Draft Y-12 SWEIS). NNSA expects to issue a Draft Y-12 SWEIS after completion of this SPEIS that will evaluate alternatives for the continued operation of Y-12. In the Y-12 SWEIS, NNSA is expected to assess a Uranium Processing Facility (UPF), which would consolidate existing EU operations into a new modern facility. The NOI for the Y-12 SWEIS was published in November 2005 (70 FR 71270). As explained in Chapter 3 of this

SPEIS, the UPF is also included within the scope of this SPEIS. NNSA will not make any decisions regarding whether or not to construct a UPF prior to the completion of this SPEIS.

NTS and WSMR—*Environmental Assessment for the Geological Characterization at White Sands Missile Range, White Sands, New Mexico, and Nevada Test Site, Las Vegas, Nevada.* This EA evaluates the environmental impacts of conducting tests to characterize the geology at WSMR and NTS. Characterization activities would include drilling approximately 100 test holes to a 100-foot depth to characterize the geology at each proposed testing location. NNSA needs to understand the geology at both WSMR and NTS to determine which of these locations could best characterize bomb structural performance in flight test operations for future NNSA management decisions. Once the data from characterization activities are available, the data would be incorporated into this SPEIS. This EA is expected to be completed in 2008.

WSMR—*Environmental Impact Statement for Development and Implementation of Range-Wide Mission and Major Capabilities at White Sands Missile Range (WSMR), New Mexico*. On June 19, 2008, DoD issued an NOI to prepare an EIS for expanded activities at WSMR (73 FR 34920). The NOI states that the EIS will "evaluate and disclose the impacts of two alternatives as well as a no action alternative." The Notice further states that "[t]he proposed action would result in a flexible, capabilities-based airspace and land use plan able to accommodate rapidly evolving customer needs, support current and future mission activities, and support a full range of test and training efforts from individual components up through major joint and multinational programs."

NTS—*Supplement Analysis to the NTS SWEIS.* NNSA is preparing an SA to the NTS SWEIS to determine whether there is a need to supplement this environmental impact statement. DOE issued a Notice of Draft Supplement Analysis on April 17, 2008, for comment. Comments on this SA are being reviewed as part of the deliberation process in determining the appropriate path forward. As a result, NNSA may decide to finalize the SA or proceed with further NEPA analysis.

Pantex—*Supplement Analysis to the Pantex SWEIS.* NNSA is preparing an SA to the Pantex SWEIS to determine whether there is a need to supplement this environmental impact statement. This SA is expected to be completed in 2008. As of July 8, 2008, neither a draft nor a final SA has been issued.

SRS—*Supplemental Environmental Impact Statement for Surplus Plutonium Disposition* (hereafter, SPD Supplemental EIS). On March 28, 2007, DOE published a Notice of Intent in the *Federal Register* (72 FR 14543) to prepare the SPD Supplemental EIS to evaluate the potential environmental impacts of dispositioning 13 metric tons of surplus non-pit plutonium. The alternatives included construction and operation of a new Immobilization Facility in the K-Area Complex, processing in H-Canyon/HB-Line and the Defense Waste Processing Facility, and fabricating mixed-oxide (MOX) fuel in the MOX Fuel Fabrication Facility currently under construction in F-Area. The public scoping period extended from March 28, 2007 through May 29, 2007. Scoping meetings were conducted on April 17, 2007, in Aiken, South Carolina and on April 19, 2007, in Columbia, South Carolina. In September 2007, an additional 9 metric tons of plutonium contained in nuclear weapon pits were declared surplus to defense needs. Although the disposition method for the additional 9 metric tons of pits is consistent with DOE's previous decision to fabricate MOX fuel from surplus pit plutonium, this additional material represents potential additional impacts that have not been evaluated under NEPA. Further, time has passed since the completion of NEPA analyses for the facilities needed to effect disposition through the MOX approach, and changes have been made to the design of those facilities. Therefore, DOE and NNSA decided in December 2007, to expand the scope of the SPD Supplemental EIS to include analysis of the additional 9 metric tons of surplus plutonium and to update the NEPA analyses for the MOX alternatives. This SPD Supplemental EIS analyzes three alternatives: Disposition Including Immobilization; Disposition Using MOX and H-Canyon; and as required by NEPA, No Action. DOE has identified the Disposition Using MOX and H-Canyon Alternative as its Preferred Alternative.

Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste (LLW). DOE is responsible for the disposal of GTCC LLW, pursuant to the Low-Level Radioactive Waste Policy Amendments Act of 1985. DOE announced its intent in the *Federal Register* on July 23, 2007 (72 FR 40135), to prepare an EIS for the disposal of GTCC LLW. In addition, DOE proposed to include DOE LLW and transuranic waste having characteristics similar to GTCC LLW and which may not have an identified path to disposal in the scope of the EIS. DOE proposes to evaluate alternatives for this waste, including disposal in a geologic repository, in intermediate depth boreholes, and in enhanced near surface facilities. Candidate locations for these disposal facilities include the Idaho National Laboratory (INL) in Idaho; LANL and Waste Isolation Pilot Plant (WIPP) in New Mexico; NTS and the proposed Yucca Mountain repository in Nevada; SRS in South Carolina; the Oak Ridge Reservation (ORR) in Tennessee; the Hanford Site (Hanford) in Washington; and generic commercial facilities. Disposal impacts will be evaluated in the Draft EIS for the Disposal of GTCC LLW. With respect to the Complex Transformation SPEIS, the GTCC LLW disposal project could affect LANL, NTS, SRS, or Y-12 (which is part of ORR) should DOE select any of these sites for disposal of GTCC LLW and similar DOE waste.

1.6 Public Participation

The process of preparing an environmental impact statement provides opportunities for public involvement (see Figure 1.6-1). These opportunities occur during the scoping process and the public comment period. The scoping process is required by 40 CFR 1501.7 while

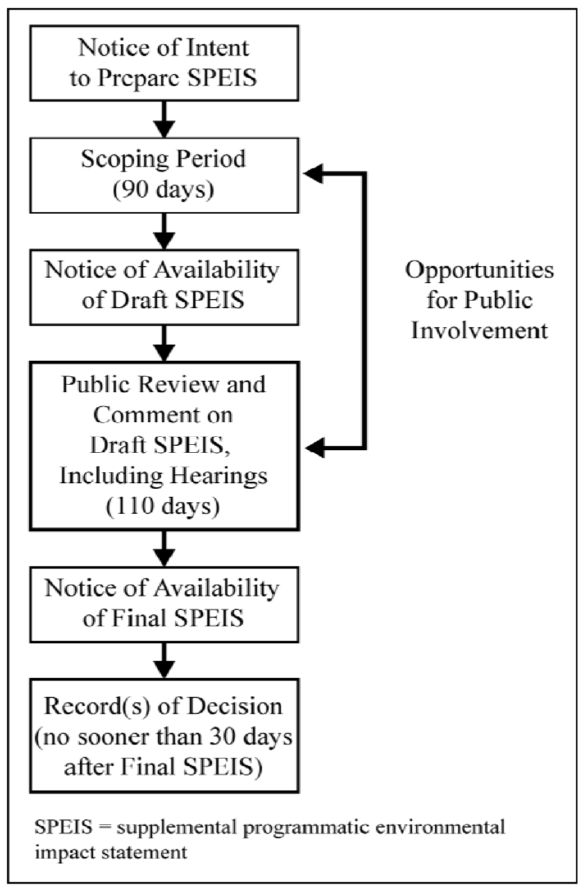

Figure 1.6-1—Public Involvement Process

the public comment period is required by 40 CFR 1503.1. Section 1.6.1 summarizes the scoping process, major comments received from the public during scoping, and changes made by NNSA in response to those comments. Section 1.6.2 summarizes the public comment period process, the major comments raised by the public at that time, and NNSA's responses to these comments.

1.6.1 Scoping Process

The Council on Environmental Quality (CEQ) NEPA regulations require "an early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). This is known as the public scoping process. The purpose of this process is to: (1) inform the public about the proposed action and the alternatives being considered; and (2) identify and clarify issues by soliciting public comments.

NNSA published an NOI) in the *Federal Register* on October 19, 2006 (71 FR 61731) and held public scoping meetings in November and December 2006 near all sites that might be affected and in Washington, D.C. In addition to the meetings, the public was encouraged to provide comments via mail, e-mail, and fax. All comments received during the 90-day scoping period, as well as late comments, were reviewed by NNSA in preparing the Draft Complex Transformation SPEIS.

More than 33,000 comment documents were received from individuals, interested groups, tribes, and Federal, State, and local officials during the public scoping period. A majority of the documents received were copies of 20 different form letters or e-mail campaigns. Twenty different form letters or e-mails were submitted. A summary of the major scoping comments is provided below and in more detail in Appendix D.

1.6.1.1 *Summary of Major Scoping Comments*

The majority of the comments received during scoping were related to nuclear weapon policies. Many commentors expressed opposition to the nuclear weapons program, stating that the United States is violating the Nuclear Non-Proliferation Treaty (NPT). Many of the comments stated that NNSA should assess an additional alternative—disarmament in compliance with the NPT—and not design or build new nuclear weapons. Commentors expressed opposition to any new nuclear facilities. There was specific opposition to expansion of pit production at LANL, as well as the proposed consolidated plutonium center (CPC). Commentors stated that the LANL SWEIS should be issued after the Complex Transformation SPEIS. Many commentors stated that a reliable replacement warhead (RRW) was not needed and should not be pursued. Some commentors stated that NNSA should develop a fair and objective statement for the purpose and need that takes into account the broader missions of NNSA, including prevention of proliferation, implementation of the NPT, and development of strategies to ensure the peaceful denuclearization of the world. Some commentors asked why NNSA was not assessing a Consolidated Nuclear Production Center (CNPC) (one site for plutonium, enriched uranium, and weapons assembly/disassembly) as a reasonable alternative for transforming the Complex. Commentors also stated that pits will last up to 100 years and potentially longer; therefore, there is no need for new pit production capacity. Some commentors asked why KCP's activities were not being considered in this SPEIS and stated that NNSA was not representing the full cost of Complex Transformation by excluding alternatives involving activities currently performed there. Commentors requested an analysis of the risks and impacts of terrorist attacks on NNSA facilities. Support for the continuation of the NNSA flight test mission at TTR was received from the Tonopah community.

As a result of the scoping process, NNSA made the following significant changes to the scope of the SPEIS as originally described in the 2006 NOI:

- A Consolidated Centers of Excellence (CCE) Alternative was added as a reasonable alternative (Section 3.5). NNSA would consolidate plutonium, uranium, and weapon A/D functions into a CNPC at one site or into Consolidated Nuclear Centers (CNCs) at two sites.

- A discussion was added of effects on the Complex of an even smaller nuclear weapons stockpile than the current level envisioned under the *Moscow Treaty* (Section 3.6.3).

- A discussion was added of an RRW's possible impact on the nuclear weapons stockpile and decisions about Complex Transformation. An analysis was added to determine what, if any, changes to the Complex would be required if an RRW were to be developed (Chapter 2).

- A more detailed analysis of the potential impacts of NNSA flight testing was added in order to inform the public and NNSA of the potential socioeconomic impacts on the Tonopah community from the alternatives (Section 5.15.4.2).

- An analysis of a smaller pit production capacity (50–80 ppy) was added (Section 3.4.1.2).

- A more detailed explanation of why the KCP's operations are not included in this SPEIS was added (Section 1.5.2.1).

Each of these changes was included in the Draft SPEIS issued for public review.

1.6.2 Public Comments on the Draft SPEIS

Once a draft environmental impact statement is completed, regulations require that it be issued to obtain comments from any interested entity or individual (40 CFR 1503.1). On January 11, 2008, NNSA announced a 90-day public comment period— twice the legal requirement — for the Draft Complex Transformation SPEIS beginning on January 11, 2008, and scheduled to end on April 10, 2008 (73 FR 2023). In response to public requests, on April 11, 2008, NNSA announced in the *Federal Register* that it was extending the comment period until April 30, 2008 (73 FR 19829). All comments received were considered.

During the comment period, NNSA held 20 public hearings in the following locations: North Augusta, SC (two hearings), Oak Ridge, TN (two hearings), Amarillo, TX (two hearings), Tonopah, NV (one hearing), Las Vegas, NV (two hearings), Socorro, NM (one hearing), Albuquerque, NM (two hearings), Los Alamos, NM (two hearings), Santa Fe, NM (one hearing), Tracy, CA (one hearing), Livermore, CA (two hearings), Washington, D.C. (one hearing), and Española, NM (one hearing). Figure 1.6-2 shows the locations and dates of the hearings. In addition, NNSA encouraged the public to provide comments via mail, facsimile, or electronically via e-mail or the project Web site (www.ComplexTransformationSPEIS.com).

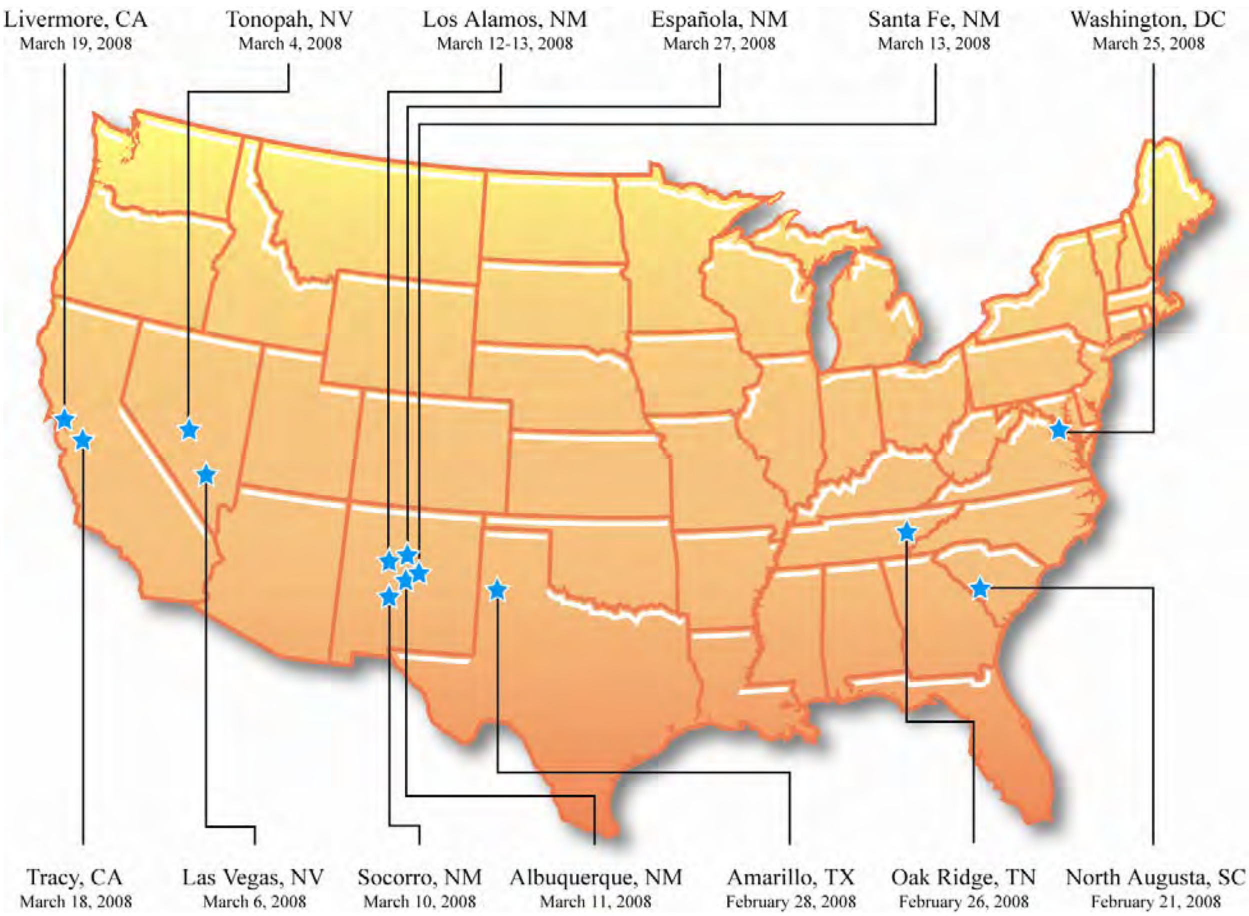

Figure 1.6-2—Public Hearing Locations and Dates

1.6.2.1 *Major Comments Received During the Public Comment Period on the Draft Complex Transformation SPEIS*

NNSA received approximately 100,000 comment documents (including approximately 98,000 comment documents as part of 38 e-mail, letter, and postcard campaigns) from individuals, interested groups, tribal governments, and Federal, State, and local agencies during the comment period. Approximately 1,000 comment documents were received via e-mail, and approximately 625 commentors spoke at the public hearings. The majority of the comments focused on policy issues related to the appropriateness or the need for nuclear weapons:

- Many commentors oppose nuclear weapons and transformation of the nuclear weapons Complex. They state that:

  - The United States is not in compliance with Article VI of the Nonproliferation Treaty;
  - Nuclear weapons lead to nuclear weapons proliferation;
  - Nuclear weapons are immoral;
  - Nuclear weapon activities put NNSA sites and surrounding communities at risk of accidents and terrorist activities;
  - Nuclear weapons take money away from the clean-up of sites already contaminated;
  - More nuclear weapon activities will produce contamination at NNSA sites; and
  - Nuclear weapon activities result in adverse health and safety impacts in communities surrounding NNSA sites.

- Many commentors stated that the 2001 Nuclear Posture Review does not reflect the changed threat environment since September 11, 2001, and should not be used by NNSA in establishing or defining programmatic requirements. Commentors stated that Complex Transformation should not proceed before a new Nuclear Posture Review is completed in 2009 by the incoming Administration, as required by the Congress. NNSA's "transformation" proposal should be withdrawn until then.

- Many commentors believe that there are better ways in which taxpayer money could be spent, such as: feeding the poor, providing better housing, improving energy efficiency, and cleaning up contaminated sites.

- Many commentors stated that there was no need to build any nuclear weapons and NNSA failed to consider an alternative that would provide a nuclear weapons complex that would not manufacture them. Many commentors stated that NNSA should operate only those facilities needed for the safe, secure, and efficient dismantlement of nuclear weapons and the disposition of their parts. Many commentors stated that NNSA should include a No Production Alternative under which NNSA would pursue dismantlement and refrain from further weapons design and production.

- Many commentors questioned the need for new pit production.

- Many commentors oppose an Reliable Replacement Warhead (RRW) Program. Many commentors believe an RRW Program was just an excuse to develop new design nuclear weapons.

- Many commentors stated that the activities at the Kansas City Plant (KCP) should be included in the SPEIS. Commentors stated that KCP is an integral part of the nuclear weapons complex and therefore alternatives for its modernization should be considered in the SPEIS rather than in a separate environmental assessment. By excluding alternatives for activities currently performed at KCP, commentors stated that NNSA was not accurately representing the impacts of the entire nuclear weapons complex.

- Several Native American groups (the Santa Clara Pueblo, Pueblo de San Ildefonso, and the Western Shoshone National Council) submitted comments on the Draft SPEIS. Some of the major comments from these groups focused on the need for government-to-government consultations prior to the issuance of a ROD, and a more detailed analysis of environmental impacts on tribal lands that cannot be avoided. In addition, the Santa Clara Pueblo commented that the new administration will be required to perform a new Nuclear Posture Review. The Santa Clara Pueblo also stated that the version of the CAP-88 computer model used to estimate human health impacts was dated, that the newest version should be used, and that even this model does not assess exposure pathways unique to tribal members. Other tribal comments stated that the Draft SPEIS ignored past contamination issues, that there is no waste disposal path for transuranic waste, and that impacts to specific tribal lands were not analyzed, especially with respect to rivers and other water resources. The Western Shoshone commented that their treaty claims had not been considered.

1.6.2.2 *Major Changes from the Draft Complex Transformation SPEIS*

In order to: (1) respond to comments received on the Draft Complex Transformation SPEIS; (2) include data not available when the Draft SPEIS was prepared; and (3) correct errors and omissions, NNSA made changes to the Draft SPEIS. The Summary and Volumes I and II of this Final Complex Transformation SPEIS contain changes, which are indicated by a vertical sidebar in the margin. A summary of the more significant changes is provided below.

- In response to numerous comments requesting a No Production Alternative, NNSA added a No Net Production/Capability-Based Alternative to Section 3.6 of the Final SPEIS. Chapter 5 of the SPEIS includes an analysis of the potential impacts of this alternative. Under this alternative, NNSA would maintain capabilities to continue surveillance of the weapons stockpile, produce limited life components, and continue dismantlement, but would not add new types or increased numbers of weapons to the total stockpile.

- Several commentors stated that the cumulative impacts of nuclear-related weapons activities at three sites within a few hundred miles of each other in New Mexico need to be considered, especially since the 50-mile radius analysis of impacts of LANL and SNL/NM overlap. In response to these comments, NNSA added a new section (Section 6.4) to provide more information on the potential cumulative impacts of nuclear activities in New Mexico. This analysis considers nuclear activities at LANL, SNL/NM, the WIPP near Carlsbad, and the National Enrichment Facility in Lea County.

- One commentor noted that NNSA used an outdated version of CAP-88, an atmospheric transport model designed by the Environmental Protection Agency (EPA), to estimate dose and risk from radionuclide air emissions as part of compliance with the *Clean Air Act*. The Draft SPEIS used EPA's 1992 version of the CAP-88 model (Version 1.0). According to EPA, users "may use any of the three versions of CAP-88 for enforcement purposes. To allow for updates and refinement of the software, Subpart H of 40 CFR Part 61 does not specify any version. However, because Version 3 incorporates the latest science and is more versatile than the older versions, it is recommended" (EPA 2008). In response to this comment, NNSA revised the dose calculations using the CAP-88, Version 3, software. As shown in Chapter 5, all doses from normal operations are expected to remain below regulatory standards.

- NNSA received many comments on the project-specific flight test alternatives. Many commentors stated that an earlier NNSA study indicated that a high-tech mobile option at Tonopah was at least $20 million less expensive than a high-tech mobile option at WSMR. Other commentors stated that NNSA's own business case report states that TTR is the most favorable alternative. Numerous commentors stated that closure of TTR would result in economic disaster for the community of Tonopah as well as surrounding communities, which rely on the social and health amenities of Tonopah. In response to these comments, NNSA added additional socioeconomic information to Section 5.15.4.2.2, and updated the "Campaign Mode Operation of TTR" alternative. For this alternative, NNSA added several options that would maintain the flight test operations at TTR, but with reduced full-time employment that would be supplemented with staff from SNL/NM and upgraded equipment. Details about this alternative may be found in Section 3.10.3 of the Final SPEIS.

- NNSA received many comments stating that the water usage and quality data for LANL and SRS were outdated and unrepresentative. In response, NNSA revised the water usage and water quality sections at LANL and SRS (sections 4.1.5 and 4.8.5, respectively).

- Several commentors indicated that the presentation of the preferred alternative was confusing and did not provide sufficient specific discussion of the environmental impacts of the alternative compared to others. In response to these comments, NNSA also added Section 5.20, which provides more information on the impacts of the preferred alternative.

- Some commentors stated that tritium production activities should be included in the SPEIS in order to represent the impacts of the entire nuclear weapons complex. Commentors also stated that the Watts Bar reactors are part of the nuclear weapons complex. In response to these comments, NNSA added a summary of the environmental impacts of producing tritium in TVA reactors (Section 5.19).

- Some commentors stated that radiation exposure can also cause nonfatal cancers and genetic disorders, yet the Draft SPEIS only estimates potential fatal cancers. This SPEIS presents estimates of latent cancer fatalities (LCFs) because they are the principal metric for comparing the potential human health effects from low-dose radiation exposure. In response to these comments, NNSA added a discussion in Appendix C regarding nonfatal cancers and genetic effects.

- Several commentors stated that the cumulative impacts of activities at LLNL Site 300 must be analyzed in the Complex Transformation SPEIS. NNSA had filed (now since withdrawn) an application for an air permit with the San Joaquin Valley Air Pollution Control District for increased activities over current levels. Commentors stated that the environmental impacts of these activities, whether conducted by the DoD or the

Department of Homeland Security, should be analyzed in the Complex Transformation SPEIS. Even though NNSA recently withdrew this permit application, NNSA added additional discussion of these potential cumulative impacts at LLNL Site 300 (Section 6.5).

- NNSA added an option of constructing a smaller underground storage facility in Zone 12 at Pantex (Section 3.7.3). NNSA would rely on continued storage of surplus pits in existing facilities in Zone 4 at Pantex until they are transferred to SRS for disposition.

- In the Draft SPEIS, a 9,000 square feet addition to the CMRR was evaluated as a means to support consolidation of plutonium operations to LANL from LLNL, provide increased analytical chemistry support for increased pit production capacity, and ensure sufficient nuclear space as a contingency. Subsequent to that assessment, NNSA decided that the 9,000 additional square feet would be unnecessary for the consolidation of plutonium activities. Therefore, an addition of 9,000 square feet to the CMRR is no longer being pursued.

- The preferred alternatives are the same as the preferred alternatives identified in the Draft SPEIS, with the following exceptions:

  - For plutonium manufacturing and R&D, the Draft SPEIS identified a production capacity of up to 80 pits per year. In the Final SPEIS, NNSA has stated that until completion of a new Nuclear Posture Review in 2009 or later, the net production at Los Alamos would be limited to a maximum of 20 pits per year.

  - For consolidation of Category I/II SNM, the Draft SPEIS stated that NNSA would phase-out Category I/II operations at LLNL Superblock by the end of 2012. Because that action is included in the No Action Alternative and would be carried out regardless of any decisions in the SPEIS, the Final SPEIS clarifies that NNSA's preferred alternative is to continue with the No Action Alternative.

  - For NNSA flight test operations, the Draft SPEIS stated that NNSA would cease operation of TTR in 2009 and conduct flight testing at a DoD facility. The Final SPEIS identifies the preferred alternative as Campaign Mode Operation of TTR (Option 3—Campaign under Reduced Footprint Permit).

  - For HE R&D, the Draft SPEIS stated that LLNL would be the HE R&D center for formulation, processing, and testing (less than 10 kg) HE at the High Explosives Application Facility (HEAF). In the Final SPEIS, NNSA has stated that formulation and processing of HE would be conducted either at a new HEAF Annex to be built adjacent to HEAF, or at existing Site 300 facilities.

  - For hydrodynamic testing, the preferred alternative identified in the Draft SPEIS was to close the Contained Firing Facility (CFF) at LLNL in approximately 2015, which would enable transfer or closure of Site 300. In the Final SPEIS, NNSA has stated that hydrotesting at CFF would be consolidated to a smaller footprint by 2015. The Final SPEIS no longer states that this would enable transfer or closure of Site 300.

- For the SNL/CA weapons support functions, the Draft SPEIS did not identify a preferred alternative. For these functions, NNSA has identified the No Action Alternative as preferred.

1.7 ORGANIZATION OF THIS COMPLEX TRANSFORMATION SUPPLEMENTAL PEIS

The SPEIS consists of six volumes. It includes a stand-alone Summary; Volumes I and II, which contain the main analyses and technical appendices that support the analyses, along with additional project information; and Volume III, which is referred to as the Comment Response Document (CRD).

Volumes I and II contain the following information:

Chapter 1—Introduction. Presents an overview of the SPEIS, summarizes the relevant history and changes to national security policy, introduces the alternatives, identifies the decisions NNSA expects to make, explains the relationship of this SPEIS to other relevant NEPA documents, and includes an overview of the public involvement process.

Chapter 2—Purpose and Need for NNSA Action. Discusses relevant factors such as the stockpile history, weapon aging, and the need for weapon repairs. It also discusses the framework of national security policies and treaties that NNSA used to identify the proposed actions and reasonable alternatives.

Chapter 3—Alternatives. Provides a detailed description of the alternatives, including a discussion of alternatives that were considered and eliminated from detailed analysis. This chapter also includes a summary comparison of the potential environmental impacts of the alternatives and identifies NNSA's preferred alternatives.

Chapter 4—Affected Environment. Presents information regarding the environments that might be affected by the alternatives. The following sites are included: LANL, LLNL, NTS, Pantex, SNL/NM, SRS, TTR, Y-12, and the WSMR.

Chapter 5—Environmental Impacts. Presents the potential environmental impacts from the alternatives.

Chapter 6—Cumulative Impacts. Presents the impacts of the alternatives when added to the impacts of other past, present, and reasonably foreseeable future projects.

Chapters 7-15—Include the following information: unavoidable adverse impacts (Chapter 8); the relationship between short-term and long-term uses (Chapter 9); irreversible and irretrievable resource commitments (Chapter 9); environmental, safety, and health regulations that would apply to the alternatives (Chapter 10); an index (Chapter 11); a list of references (Chapter 12); a glossary (Chapter 13); a list of preparers (Chapter 14); and a list of agencies, organizations, and persons to whom copies of this SPEIS were sent (Chapter 15).

Appendices—Include technical information supporting the environmental analyses. These appendices contain the following information: additional details of the alternatives; human health and accident analyses; additional details regarding environmental studies of special concern; environmental impact methodology; project studies and notices; scoping comments; and contractor disclosure. There is also a Classified Appendix, which analyzes the potential consequences of intentional malevolent acts (e.g., sabotage, terrorism).

Volume III (parts 1 and 2)—Contain the comments that were submitted on the Draft SPEIS and NNSA's responses, presented in three chapters:

- Chapter 1 of the CRD describes the public comment process and contains tables with: the list of attendees at the public hearings; an index of commentors who submitted comments; and the comment document and response locators to assist readers using the CRD.

- Chapter 2 of the CRD contains scanned copies of comment documents received during the public comment period and a summary of the oral comments from the public hearings.

- Chapter 3 contains summaries of all comments organized by topic and NNSA's responses to them.

Chapter 2
PURPOSE AND NEED

Chapter 2
PURPOSE AND NEED

Chapter 2 discusses the underlying purpose and need addressed by the proposed action and alternatives in this Complex Transformation Supplemental Programmatic Environmental Impact Statement *(SPEIS). It addresses relevant national security policy considerations and issues associated with maintaining the safety, security, and reliability of the nuclear weapons stockpile. The Chapter concludes with a discussion of the potential for a Reliable Replacement Warhead (RRW), nonproliferation issues and the possibility of future reductions in the size of the stockpile.*

2.0 PURPOSE AND NEED FOR AGENCY ACTION

The security policies of the United States (U.S.) require the maintenance of a safe, secure, and reliable nuclear weapons stockpile, and the maintenance of core competencies to design, manufacture, and maintain nuclear weapons. The Stockpile Stewardship Program (SSP)[1] is the National Nuclear Security Administration's (NNSA's) program that fulfills these requirements. Broad in scope and technically complex, work for the SSP is performed at three national laboratories, four industrial plants, and a nuclear test site. The SSP guides NNSA in changing the nuclear weapons complex (Complex) so that it continues to meet the national security requirements established by the President and the Congress. The purpose and need underlying the alternatives analyzed in this *Complex Transformation Supplemental Programmatic Environmental Impact Statement* (SPEIS) result from changes in national security policy since the Record of Decision (ROD) on the 1996 Stockpile Stewardship and Management Programmatic Environmental Impact Statement (SSM PEIS), as well as the effects of aging facilities, aging weapons, and evolving security requirements. The purposes of NNSA's proposed actions are:

- Maintaining core competencies in nuclear weapons;
- Maintaining a safe and reliable nuclear weapons stockpile;
- Creating a responsive nuclear weapons infrastructure that is cost-effective and has adequate capacity to meet reasonably foreseeable national security requirements;
- Consolidating Category I/II special nuclear material (SNM) at fewer sites and locations within sites to reduce risk and safeguard costs; and
- Expanding the scientific and technical capabilities of NNSA's workforce.

The fundamental principle underlying NNSA's evaluation of alternatives is that the complex and the SSP must continue to meet existing and reasonably foreseeable national security requirements. This is NNSA's obligation and responsibility under the *Atomic Energy Act* and the *National Nuclear Security Administration Act*. This SPEIS does not analyze alternatives to the United States' national security policy. Rather, it examines the environmental effects of proposed actions and reasonable alternatives for execution of the program based on the existing policy and foreseeable changes in this policy.

[1] In 1996, the program was named the Stockpile Stewardship and Management Program. It is now called the Stockpile Stewardship Program. There has been no significant change in the objectives of the program.

The alternatives analyzed in this SPEIS are based on the need for a more responsive Complex infrastructure that has:

- All necessary technical and industrial capabilities to maintain a nuclear stockpile;
- Adequate production capacity for a smaller stockpile, including pit production;
- A smaller size for more cost-effective operations; and
- Enhanced security, particularly for activities involving special nuclear materials.

A more responsive Complex would also have the capabilities needed to produce a Reliable Replacement Warhead (RRW) if the President and the Congress decide that NNSA should develop one. An RRW would be pursued only if it were able to enhance the safety, security, and reliability of the stockpile without nuclear testing.[2] Transformation of the Complex's infrastructure is required regardless of whether NNSA is directed to develop an RRW. NNSA must have the infrastructure to maintain nuclear weapons whether they are legacy weapons, RRWs, or a combination of both. NNSA must proceed with Complex Transformation regardless of whether it is directed to develop an RRW. The relationship of RRWs to the proposed actions and alternatives in this SPEIS are discussed in this chapter using the best available information.

The possibility that NNSA might be directed to develop an RRW does not affect the alternatives analyzed or their potential impacts in the near-term (next 10-15 years). Pit production and other production activities would be allocated between legacy weapons and RRWs. Production capacity would not be increased if NNSA is directed to develop an RRW because capacity requirements are more dependent on stockpile size rather than whether the stockpile consists of legacy weapons or RRWs or a combination of both. Development of an RRW could reduce the hazardous materials and operations needed to maintain the stockpile, but it would not require changes to the proposed facilities that are analyzed as part of the alternatives evaluated in this SPEIS. If an RRW were developed and produced, its production would be in lieu of refurbishment and component production activities for legacy weapons.

2.1 NATIONAL SECURITY POLICY CONSIDERATIONS

There are four principal types of national security documents and three treaties relevant to the SSP. They are:

- Presidential Decision Directives through 1996 and Public Law (103-160);
- Presidential Directives after 1996 and Public Law (109-163);
- Annual Nuclear Weapons Stockpile Plans;
- Nuclear Posture Reviews (1994 and 2001);
- *Treaty on the Nonproliferation of Nuclear Weapons* (NPT) (1968);
- Proposed *Comprehensive Test Ban Treaty* (CTBT) (1995); and
- *Strategic Offensive Reductions Treaty* (2003)—referred to as the *Moscow Treaty*.

[2] Current U.S. policy is to refrain from nuclear testing while maintaining an ability to resume testing. The NTS maintains the nation's ability to conduct tests if directed by the President. The environmental impacts associated with past and potential nuclear tests are analyzed in the NTS Site-Wide Environmental Impact Statement (DOE 1996b).

These policy documents and treaties form the foundation of the SSP. They determine today's national security requirements that NNSA must meet. The alternatives analyzed in this SPEIS include alternatives that could meet today's national security requirements and other alternatives that could not meet today's requirements but could meet the requirements for a reduced stockpile. Earlier policies and treaties formed the foundation for the Stockpile Stewardship and Management Program (SSM), as well as the alternatives analyzed in the 1996 SSM PEIS. Figure 2-1 illustrates the relationship of the new national security policies to the purpose of NNSA's proposed action, the need for action, and the alternatives evaluated in this SPEIS.

2.1.1 Presidential Directives Through 1996 and Public Law 103-160

The following is a summary of the important features of Presidential Directives in effect through 1996 and the *National Defense Authorization Act* for Fiscal Year 1994, Public Law 103-160; they formed the foundation of the SSP and established the purpose and need for the alternatives analyzed in 1996.

- The continued maintenance of a safe and reliable nuclear weapons stockpile will remain a cornerstone of the U.S. nuclear deterrent for the foreseeable future.
- The core intellectual and technical competencies of the United States in nuclear weapons must be maintained. This includes competencies in research, design, development, and testing (including the ability to conduct nuclear testing); reliability assessment; certification; manufacturing; and surveillance capabilities.
- The United States should develop new ways to maintain a high level of confidence in the safety, reliability, and performance of its nuclear weapons stockpile without nuclear testing. The strategy for this objective is structured around the use of past nuclear test data in combination with enhanced computational modeling, experimental facilities, and simulators to further comprehensive understanding of the behavior of nuclear weapons and the effects of radiation on military systems.
- The continued vitality of all three NNSA national security laboratories is essential to address the challenges of maintaining a safe and reliable nuclear weapons stockpile without nuclear testing.

2.1.2 Nuclear Posture Reviews (NPR)

Beginning in 1991, several presidential policy decisions, some unilateral and some in conjunction with international treaties, led the Department of Defense (DoD) to conduct a comprehensive NPR. President Clinton approved this review in 1994. The 1994 NPR defined and integrated past and present U.S. policies for nuclear deterrence, arms control, and nonproliferation objectives. At the time of the 1994 NPR, it was anticipated that the *START II Treaty* would enter into force in 2004. Based on this anticipation, the 1996 SSM PEIS analyzed the potential impacts of reasonable alternatives that might be implemented over a 10-year period.

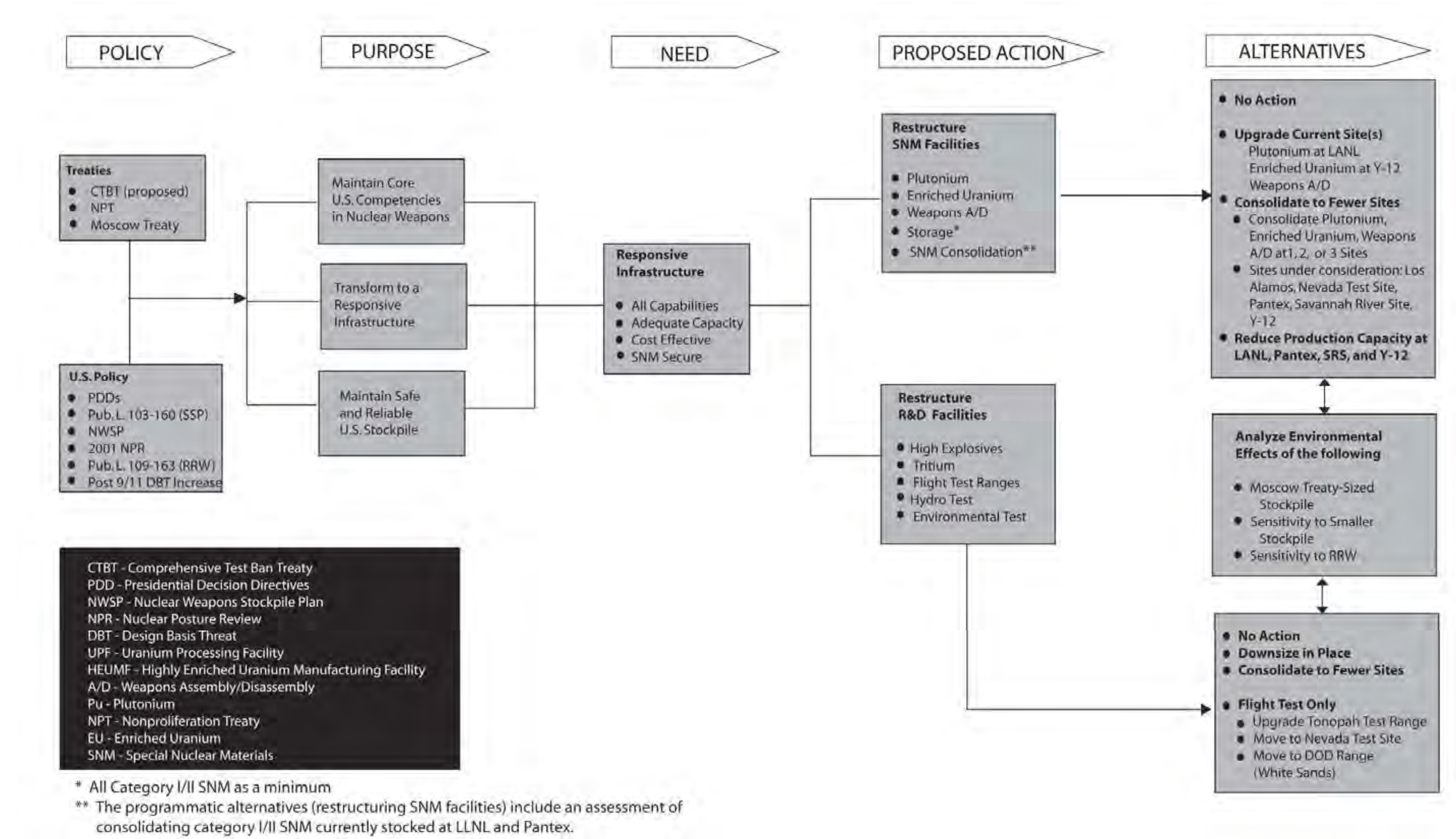

Figure 2-1—Policy Perspective of the Stockpile Stewardship Program and Complex Transformation

In 2001, another NPR was conducted; it concluded that a strategic posture that relies solely on offensive nuclear forces is inappropriate for deterring potential adversaries. A classified summary of the 2001 NPR was submitted to Congress in February 2002. A “new triad” was defined, consisting of nuclear and non-nuclear strike capabilities, defenses, and a responsive nuclear weapons infrastructure supported by enhanced intelligence and adaptive planning capabilities. A more responsive infrastructure would support the element of the new Triad that relies on a responsive infrastructure (See Figure 2-2). Prior to the 2001 NPR, the term “triad” generally referred to strategic land, sea, and air nuclear forces. The 2001 NPR was the foundation for the *Moscow Treaty* with Russia in 2002 (ratified in 2003). The relevance of this treaty to this SPEIS is discussed in the section on the *Moscow Treaty* (Section 2.1.5).

The *National Defense Authorization Act* for fiscal year (FY) 2008 (Public Law 110-181) established a requirement for DoD to prepare a new Nuclear Posture Review. It must be submitted to the Congress in December 2009. This statute also created the Congressional Commission on the Strategic Posture of the United States to “examine and make recommendations with respect to the long-term strategic posture of the United States.” Congress created the commission, also known as the Strategic Posture Review Commission (SPRC), to examine the nation’s strategic posture and the appropriate role of nuclear weapons. The review will include an assessment of the role of nonproliferation programs and missile defenses in our strategic policies. Its recommendations are due to Congress and the President by December 1, 2008.

2.1.3 Proposed Comprehensive Test Ban Treaty

The U.S. Senate has not ratified the CTBT; however, the U.S. has been observing a moratorium on nuclear testing that was imposed by President Bush in 1992. Assessment and certification of the safety and reliability of the stockpile without nuclear testing remains a significant technical challenge for the SSP as weapons in the stockpile age beyond the range of historical data.

It has been more than 15 years since the last U.S. nuclear test and about 17 years since the last new nuclear weapon entered the stockpile. While no issues have yet developed in maintaining legacy weapons that would require a return to nuclear testing in the reasonably foreseeable future, there is increasing concern that the current legacy weapon “life extension” approach to maintaining a safe and reliable stockpile will not ultimately, over the longer term, allow a continued moratorium on testing as weapons become older.

2.1.4 Treaty on the Nonproliferation of Nuclear Weapons

The NPT entered into force, with the United States as a party, in 1970. Article VI of the NPT obligates the parties "to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control." However, the NPT does not establish a time frame for achieving these goals, and the President and the Congress have not yet set a schedule for them. Actions by the United States including its moratorium on nuclear testing accompanied by significant reductions in its strategic forces, nuclear weapons, and production infrastructure, constitute significant progress toward these goals. However, unless and until there are significant changes in national security policy, NNSA must design, produce, and maintain the nuclear weapons stockpile pursuant to requirements established by the President and Congress. In conjunction with the 2001 NPR, President George W. Bush set an objective of "achieving a credible nuclear deterrent with the lowest possible number of nuclear warheads consistent with our national security needs." To that end, in 2004 and again in 2007, President Bush directed unilateral reductions to the stockpile that will make it less than one-half its size in 2001, and the smallest since the Eisenhower Administration. In recognition of this objective and the reductions in the U.S. stockpile since the end of the Cold War, this SPEIS qualitatively evaluates alternatives that would be appropriate if the stockpile were reduced below the level set by the *Moscow Treaty*. Accordingly, this SPEIS analyzes alternatives that satisfy requirements of the existing national security policy framework as well as two options for a Capability-Based Alternative, including a new alternative that would provide for no net additions to the stockpile (Section 3.6.2) that, while not capable of meeting current requirements, could meet requirements if the stockpile were reduced below the level called for by the *Moscow Treaty*.

2.1.5 Moscow Treaty

This treaty does not limit the total number of nuclear weapons possessed by each party—it limits the number of strategic nuclear warheads that are operationally deployed. The provisions of the *START I Treaty*, which is scheduled to expire in 2009, are still being implemented. The *START II Treaty*, while ratified, never entered into force. Both parties ratified the *Moscow Treaty* in 2003, and it further reduced the number of deployed strategic nuclear warheads below the proposed START II levels.

For comparative purposes, 6,000 attributed nuclear warheads were allowed under START I, 3,500 attributed nuclear warheads would have been allowed under START II, and a range of 1,700–2,200 operationally deployed strategic nuclear warheads is allowed under the *Moscow Treaty*. The United States expects to reduce the stockpile to this range by the end of 2012.

2.1.6 Nuclear Weapons Stockpile Plans (NWSPs)

NWSPs are normally issued each year by the President and define the actual stockpile size and composition in the near-term (usually for a six-year period). A joint DoD/Department of Energy (DOE) requirements and planning document is also developed annually that provides projections for a decade or longer. Under the *Atomic Energy Act*, the President, through the NWSP establishes the requirements for nuclear weapons that NNSA must meet. The NWSP is a classified document and contains details about the stockpile size and composition that are not part of treaties or unclassified Government sources. However, the following unclassified information describes the latest NWSP and its effects on planning assumptions for weapon production capabilities.

Stockpile composition refers to the number of different weapon types scheduled to remain in the stockpile; currently there are seven types. This number has not changed significantly after the Cold War from START I to the *Moscow Treaty*. These weapons types contain the same general components and subsystems. The components and subsystems differ in technical and manufacturing detail, but these details have little effect on the basic technical and industrial "capabilities" required by NNSA to maintain them.

Stockpile size refers to the total number of weapons expected to remain in the stockpile for the foreseeable future of the seven major types. The total number includes both the treaty-accountable, operationally deployed warheads and additional warheads retained for a number of reasons, such as support of routine maintenance cycles, repairs, and attrition due to destructive testing. Beyond these requirements, a decision to dismantle any excess weapons in inventory (i.e., weapons not considered part of the stockpile) is considered carefully. An excess weapon can become a valuable asset if exchanged for deployed weapons of the same type in the event a problem is discovered that affects only part of the inventory of that type—for example, one bad manufacturing lot out of 10 lots. Also, some of the weapon types were produced over a number of years. If an aging problem is discovered, perhaps a younger weapon could be exchanged for one that may be older. This could allow more time to investigate and find a solution to the problem. Excess weapons also provide some insurance against the need to return to nuclear testing to identify or fix a problem.

Weapon reliability is assessed annually based in part on laboratory and surveillance tests on a relatively small number of each weapon type. There can be no "end-to-end" functional test of a complete nuclear weapon in its "stockpile-to-target" environments. In lieu of this, laboratory and flight surveillance tests are conducted at the component and subsystem levels, and the data are combined and analyzed to produce a reliability estimate for the weapon. While this methodology is adequate for estimating the current reliability of a weapon, it does not provide high-confidence predictions of the future behavior of an aging weapon. Because of these uncertainties, NNSA needs to plan some excess productive capacity beyond known requirements so that it can respond to unknown policy and technical issues that may arise over the next decades.

2.1.7 Presidential Directives After 1996 and Public Law 109-163

Beginning in 2001, the United States began to develop additional national security policies for the SSP. The 2001 NPR provided for a smaller U.S. nuclear weapons stockpile, but also a more robust and responsive infrastructure as part of the deterrence strategy. Starting in 2005 with Section 3111 of the *National Defense Authorization Act* for FY 2006 (Public Law 109-163), Congress established the Reliable Replacement Warhead program with the following objectives:

1. Increase the reliability, safety, and security of the United States nuclear weapons stockpile.
2. Further reduce the likelihood of the resumption of underground nuclear weapons testing.
3. Remain consistent with basic design parameters by including, to the maximum extent feasible and consistent with the objective specified in paragraph (2), components that are well understood or are certifiable without the need to resume underground nuclear weapons testing.
4. Ensure that the nuclear weapons infrastructure can respond to unforeseen problems, to include the ability to produce replacement warheads that are safer to manufacture, more cost-effective to produce, and less costly to maintain than existing warheads.

5. Achieve reductions in the future size of the nuclear weapons stockpile based on increased reliability of the reliable replacement warheads.
6. Use the design, certification, and production expertise resident in the Complex to develop reliable replacement components to fulfill current mission requirements of the existing stockpile.
7. Serve as a complement to, and potentially a more cost-effective and reliable long-term replacement for, the current Stockpile Life Extension programs.

Section 3111 mandates the study of a different technical approach to the production and maintenance of the safety, security and reliability of the nuclear weapons stockpile without nuclear testing.

2.2 SAFETY, SECURITY, AND RELIABILITY OF THE U.S. STOCKPILE

This section focuses on the technical effects of national security policies in shaping the purpose, need, proposed actions, and alternatives of the SSP and this SPEIS.

2.2.1 Stockpile History

1945–1990. Following World War II, the U.S maintained a nuclear deterrent force as safe and reliable as the evolution of military requirements and technology development would permit. The size of the stockpile peaked in the 1960s. In the 1970s, it was significantly reduced due to the easing of tensions with the former Soviet Union. In the late 1970s and through most of the 1980s, tensions significantly increased, and the U.S. nuclear deterrent force was modernized in response. However, the size of the U.S. stockpile remained stable during the 1980s with the production of new-design weapons replacing dismantled weapons on a nearly one-for-one basis.

1990–2000. The beginning of the 1990s brought the collapse of the Warsaw Pact and the Soviet Union and the end of the Cold War. Changes in U.S. policy in the early 1990s led to dramatic reductions in the size and diversity of the nuclear weapons stockpile. Many thousands of weapons were dismantled, and there were significant reductions in the size and capabilities of the U.S. nuclear weapons production infrastructure.

2000–Present. The beginning of the new century brought a new strategy for nuclear deterrence. The 2001 NPR established the framework of the new strategy, in which a responsive infrastructure replaced a large stockpile as a hedge against future threats. Operationally deployed strategic warheads will be reduced to between 1,700 and 2,200 warheads by 2012 under this framework.

2.2.2 Historical Data and the Smaller, Aging Stockpile

Before the early 1990s, the stockpile's reliability was maintained by a robust testing program, production of new types of weapons, and a continuous cycle of modernization and replacement to meet evolving safety, security, and military requirements. During this period, these practices resulted in the rapid turnover of the stockpile, keeping the average age of weapons at approximately 12 years, or about half their typical design-life goal of 20–25 years. The last generation of weapons produced, now referred to as the legacy stockpile, was built in the 1970s and 1980s, with more than half the weapons produced before 1985.

A nuclear weapon has several thousand parts grouped into a dozen or more hermetically sealed subsystems, each of which contains some combination of organic, inorganic, radiological and hazardous materials. Each of these major subsystems can age or otherwise deteriorate independent of the others even though they are subjected to the same environment. The 1996 SSM PEIS included a lengthy discussion on historical stockpile data. It explained the role that nuclear testing played in finding and correcting defects in the stockpile. It also summarized the results of more than 35 years of data from stockpile surveillance and environmental testing, and NNSA's requirements for making modifications to assure the continued safety and reliability of the stockpile in the absence of testing.

The overall conclusion was that DOE would need to make "certified repairs and replacements" within the stockpile due to aging. This has, in fact, been the case. NNSA has completed or is conducting refurbishments (which includes major life extension program (LEP), modifications, or alterations) of weapon types currently scheduled to remain in the stockpile to correct defects. Some but not all of the defects were due to aging. Some but not all of the refurbishments have been accomplished as part of an LEP. An LEP is a systematic approach that consists of a coordinated effort by the design laboratories and production facilities to: 1) determine which components will need refurbishing to extend each weapon's life; 2) design and produce the necessary refurbished components; 3) install the components in the weapons; and 4) certify that the changes do not adversely affect the safety and reliability of the weapon. There have been, during this same period, a number of retrofits of the seven types of weapons performed outside the nuclear explosive package that were not part of the LEP.

Now, more than 10 years later, the weapons themselves, and many of their individual components and subcomponents, are beginning to enter an age where there may be far less relevant data available to base performance and reliability predictions. NNSA is responding by adjusting surveillance and environmental testing requirements and developing new computer codes and simulation tools to extend its predictive capabilities. This is no small task, and collecting the types and amounts of data required to make credible assessments and predictions can take a considerable amount of time. It should not be assumed that the infrastructure of NNSA's aging facilities will be able to support the operating environment required for some of the tools and processes for these evolving test programs. Nor should it be assumed that these facilities will support the weapons modifications that may be needed in the future. Similarly, it is becoming increasingly difficult to predict whether it will always be possible for these programs to detect and correct whatever problems may develop as the stockpile ages with the same level of confidence as we have in the past.

At the end of FY 2006, the nuclear physics laboratories (Los Alamos National Laboratory [LANL] and Lawrence Livermore National Laboratory [LLNL]) completed the first assessment of the effects of the aging of plutonium on the lifetimes of pits. This study was reviewed by the JASON Defense Advisory Panel (JASON). The unclassified version of the JASON report, which substantially agreed with the NNSA laboratory results, has received significant attention. This study is an example of NNSA's successful stockpile stewardship work. The study concluded that pit lifetime could approach 100 years, however, that conclusion cannot be extrapolated to a general prediction of the remaining life of legacy stockpile weapons. While this study revealed important information, it is the first such estimate for pits and only addressed the known and measurable aging mechanisms for the plutonium components in the pits. There are thousands of components in modern nuclear weapons, many of which are subject to aging, and, as pointed out by the JASON review, additional work is needed to better understand the effects of aging on plutonium and the other materials in primaries. The importance of this study on the planning assumptions for the SSP is that it is unlikely that legacy pits will need to be replaced in the near future. There cannot be an absolute certainty in this regard since some aspects of the performance of modern nuclear weapons cannot be investigated directly without nuclear testing. There is always the potential for the emergence of unanticipated issues affecting pit lifetime. Therefore, NNSA will continue to investigate the aging of plutonium and other materials of concern in nuclear weapons, while monitoring the aging of weapons through stockpile surveillance.

2.3 PURPOSE AND NEED FOR NNSA ACTION

In order to support the national security policies developed after 1996, NNSA needs to continue the transformation of its nuclear weapons complex. The complex must:

- Maintain core competencies in nuclear weapons;
- Maintain a safe and reliable nuclear weapons stockpile;
- Create a responsive nuclear weapons infrastructure that is cost-effective, has adequate capacity to meet reasonably foreseeable national security requirements;
- Consolidate Category I/II special nuclear materials (SNM) at fewer sites and locations within sites to reduce the risk and safeguards costs; and
- Expand the scientific and technical capabilities of NNSA's workforce.

NNSA must transform the complex to support a stockpile level established by the *Moscow Treaty* regardless of whether an RRW proceeds or life-extension of legacy weapons remains the approach to sustaining the stockpile. Likewise, the potential environmental impacts of the infrastructure and its operation to support a smaller stockpile than established by the *Moscow Treaty* are evaluated to the extent practical.

2.3.1 Responsiveness of the Nuclear Weapons Complex Infrastructure

The current production infrastructure is not sufficiently responsive or cost-effective. Responsiveness means the ability to successfully meet national security requirements on schedule and react to new developments. Lack of responsiveness has been evidenced by difficulties in executing weapon production schedules in support of maintenance, retrofit, and LEPs and by lack of a sufficient pit production capability.

A reliable and responsive infrastructure is a cornerstone of the new triad discussed in the 2001 NPR (Figure 2-2) and in section 3111 of the *National Defense Authorization Act* for FY 2006 (Public Law 109-163). The purpose of a reliable and responsive infrastructure is to deter adversaries from trying to seek advantage—an attempt to seek advantage would be detected and negated by a quick response. A more responsive infrastructure is expected to permit further reductions in the weapons stockpile (i.e. permit deeper reductions in the total weapons stockpile that supports the deployed stockpile).

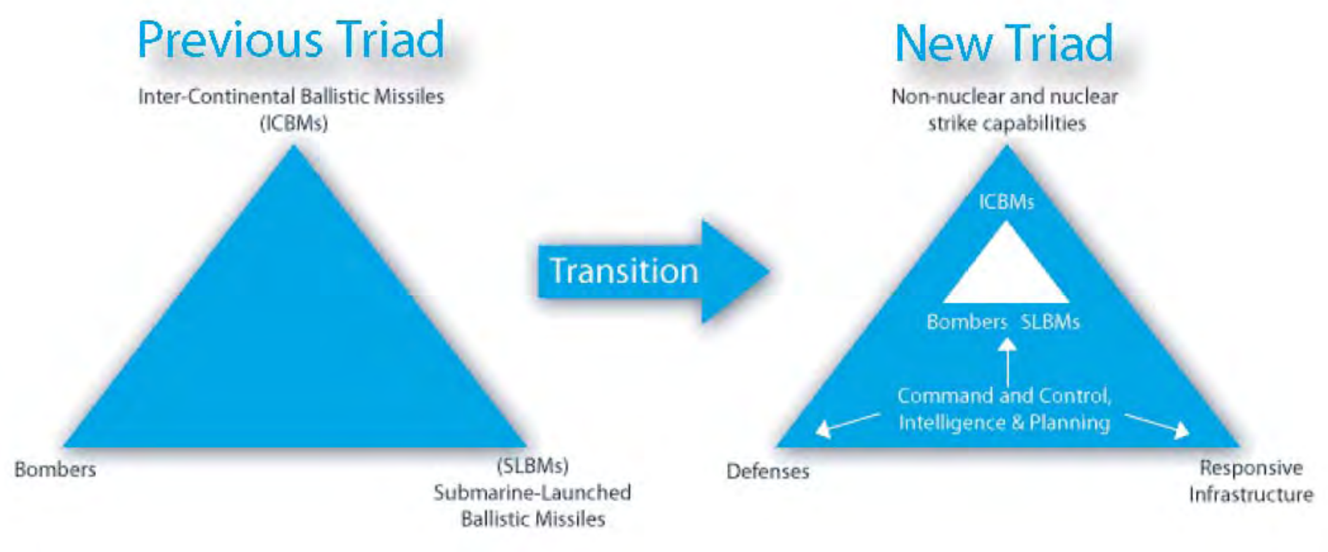

Figure 2-2—Transition to the New Triad

2.3.2 Laboratory Technical and Industrial-Base Capabilities

The underlying purpose and need for the technical and industrial capabilities supporting the SSP remain unchanged from those described in the 1996 SSM PEIS. National security policies still require the core competencies and capabilities of NNSA and its national laboratories, production plants, and test sites (See footnote 4, Chapter 1 for a description of the required basic capabilities). They are basic needs that must be maintained for the foreseeable future in order for NNSA to meet its national security obligations.

2.3.3 Adequate Production Capacity for a Smaller Stockpile

The Complex must retain a reasonable capability to produce required weapons and components. Production capacity, therefore, is established based on NNSA's judgment as to what might be reasonably required. There is presently no validated model that can predict with absolute certainty when major components or subsystems may develop a condition that would require their repair or replacement. Only a few component types are known to have a specific limited life, such as those that are determined by the half-life of the tritium they contain. Technical judgments on the relevance of available data and the implications of other factors for potential production needs must be used to arrive at the planning assumptions for future production. A capacity to produce components does not mean that those quantities of components will actually be produced. National security requirements and the authorization and appropriation of funds by the Congress will determine actual production.

A responsive production infrastructure needs to fix problems in a timely way, and therefore it is appropriate to introduce some conservatism into the planning assumptions. A number of other factors also call for conservatism in consolidating and reducing or "rightsizing" the Complex and its facilities. One such factor is the potential for common failure modes among weapon types that use similar components or materials. Certain types of problems could affect several types of weapons at the same time. Another factor for conservatism is the difficulty in determining the level of responsiveness needed to have the confidence to reduce the total stockpile size to the minimum required to support deployed weapons.

2.3.3.1 *Production Capacity Planning Assumptions*

For the nuclear production alternatives, this SPEIS analyzes a manufacturing capacity operated in single shift for five days per week that produces 10–125 weapons per year. The case of producing up to approximately 200 weapons per year assumes operations in multiple shifts and extended workweeks

Due to the significant investment that may be required for new or modified plutonium and uranium component facilities, more discussion follows on the technical details that could affect decisions in this regard. The pit and the secondary assembly component (canned subassemblies [CSA]) are the two main weapon components that use both plutonium and uranium.

2.3.3.2 *Technical Considerations for Pit Production Capacity Planning*

A particular need addressed by the alternatives in this SPEIS is the requirement for adequate production capacity for plutonium pits. The Record of Decision (ROD) for the 1996 SSM PEIS stated: "DOE's decision is to reestablish the pit fabrication capability at a small capacity at Los Alamos National Laboratory (LANL)…. Should a larger pit fabrication capacity be required in the future, appropriate environmental and siting analysis would be performed at that time."

The SSM PEIS analyzed alternatives with an interim production capacity case of 50 ppy with a single shift and 80 ppy with multiple shifts at LANL. While this SPEIS analyzes a bounding pit production capacity (200 ppy in multiple shifts and extended workweeks), lower rates may provide adequate capacity. One of the reasons for a larger pit production capability is that pit reuse, discussed in the SSM PEIS, while still potentially viable for selective weapon applications, has numerous limitations as discussed below, and no weapon has entered the stockpile with an intrusively modified pit. The following description of pit reuse is taken from the SSM PEIS Summary (page S-20):

> Intrusive pit modification reuse requires handling and processing of the plutonium internal to the pit. Non-intrusive pit modification reuse involves the external features of the pit and does not require an extensive plutonium infrastructure; the risk of contamination and generation of radioactive waste is very low for non-intrusive modification activities.

Because the pit reuse option is available for all alternatives and could be seen as a substitute for new pit production capacity, more discussion is provided here on the limitations of pit reuse in weapon design and its effect on programmatic alternatives regarding pit production.

- Pit reuse can limit NNSA's ability to improve the performance margin of the primary, which contributes to longer-term reliability. Lower primary performance margins reduce confidence in performance because the weapon is more sensitive to changes that may cause it to fail, such as undesirable changes due to aging or other environmental factors.
- Pit reuse can limit NNSA's ability to upgrade the intrinsic safety and security features of a weapon. This is especially true for the nuclear package in a DoD reentry vehicle (RV) that sits atop a strategic land- or submarine-based ballistic missile. DoD has no plans to modify existing RV aeroshells or significantly change the mass properties (weight, center of gravity, etc.) limitations placed on the nuclear package, since modifying the DoD missile delivery system is very expensive. For example, as to nuclear packages containing Conventional High Explosive (CHE), pit reuse may not allow use of Insensitive High Explosive (IHE) to improve detonation safety in accidents or incorporation of enhanced fire safety features. In addition, certain types of enhanced surety features would be technically precluded if CHE is retained. The greatest gains in weapon safety and security could come from improving features in the primary (pit and high explosive [HE] subassembly).
- Evaluation of the technical tradeoffs (reliability, safety, security, etc.) and pit reuse in a specific weapon application is not a simple matter. Pit reuse may make sense for certain weapon applications but not others.
- Reuse in the form of nonintrusive pit modification can range from no external modification of the old pit to the addition of significant new external features. Concepts with new external features were studied and prototyped, and a few nuclear tests were conducted just prior to the moratorium on nuclear testing.
- Reuse in the form of intrusive pit modification has not been tested, and NNSA cannot predict how such reuse might affect production capacity requirements for a pit facility. Conservatively, intrusive pit modification reuse is assumed to require the same basic capabilities as new pit production and require operations not suitable for current weapon A/D facilities.
- Current surveillance data on pits in enduring stockpile weapons indicate that they are holding up well with age. However, should their hermetic seal be broken (due to latent manufacturing defects, corrosion, or long term environmental stresses such as temperature and vibration), their reliability could be compromised in a short time.

Consequently, judgments about new pit production capabilities and capacities are complex and warrant careful consideration.

2.3.3.3 *Technical Considerations for Secondary Assembly Component (i.e., Canned Subassembly) Production Capacity Planning*

Both pits and CSAs have complex internal radioactive and chemical characteristics. Requirements for CSA production may not be equal to those for pit production due to the difference in their expected lifetimes. For these reasons, CSA production may remain in the same range as the pit production planning assumption (single shift: 125 per year; multiple shifts: 200 per year). Further, there is a very large CSA dismantlement backlog from previously dismantled weapons that needs to be worked off. Higher CSA production capacity, if not used for new production or rebuild, could be used to work off this dismantlement backlog.

2.3.4 A Smaller Infrastructure Footprint for More Cost-Effective Operations

In 2005, a Secretary of Energy Advisory Board (SEAB) task force recommended that NNSA consider a smaller, modernized infrastructure footprint to improve responsiveness, cost effectiveness, and security for high-risk special nuclear materials (SNM) (SEAB 2005).

2.3.5 Enhanced Security for Special Nuclear Materials

The attacks of September 11, 2001, altered security requirements in the NNSA Complex. As a result, security costs have increased significantly. Most of the effects on NNSA infrastructure are a result of changes to the Design Basis Threat (DBT). The DBT is a profile of the type, composition, and capabilities of a potential adversary. The DBT is used to design safeguards systems to protect against acts of sabotage and to prevent theft of SNM. The details of the DBT, which DOE uses to establish and evaluate its security systems, are classified. However, the effect of changes in the DBT is one of the underlying needs that led NNSA to examine alternatives for consolidating Category I/II SNM at fewer sites and locations within sites so as to improve security and reduce costs.

2.4 PROPOSED ACTIONS

NNSA's proposed action is to restructure the nuclear weapons complex to make it smaller and more responsive, efficient and secure, while meeting national security requirements. Two basic types of proposed actions result from the needs identified for a more responsive Complex:

- Restructure SNM facilities (Programmatic Alternatives); and
- Restructure R&D and testing facilities (Project-Specific Alternatives).

The basic proposed actions appear simple: the alternatives for accomplishing them are complex. It is important to note that “Restructure SNM facilities” includes evaluation of alternatives having a higher pit production capacity than currently exists at LANL. The details of the alternatives are provided in Chapter 3.

2.4.1 Restructure SNM Facilities

The following activities are included in this proposed action:

- Plutonium operations, including pit manufacturing, Category I/II SNM storage, and related R&D;
- Enriched uranium (EU) operations, including CSA manufacturing and A/D; Category I/II SNM storage; and related R&D; and
- Weapons A/D and HE production.

To restructure SNM facilities, which would be a long-term process carried out over a decade or more, the SPEIS alternatives examine broad issues such as where to locate those facilities and whether to construct new facilities or renovate existing ones for these activities. As such, this SPEIS analysis is "programmatic" for the proposed action to restructure SNM facilities, meaning that tiered, project-specific *National Environmental Policy Act* (NEPA) documents could be needed before construction commences to inform decisions on these facilities, if existing site-wide EISs or other NEPA documents were not sufficient.

An understanding of some of the existing conditions at NNSA sites is useful in providing perspective on the complexity of the alternatives.

- The liability and cost of aging infrastructure is an escalating problem throughout the NNSA Complex. In the past, preventive facility maintenance has been deferred for higher priorities. The current DOE budgeting process allocates 5 to 8 percent less for infrastructure and repair than the industrial average (LANL 2008). Over time, this practice has resulted in a backlog of repairs that threatens to overtake NNSA's ability to effectively address these problems. Because the cost of operations and maintenance for aging facilities (many over 40 – 50 years old) is significant and growing, leaving this problem unaddressed would impact NNSA's ability to carry out it's stockpile stewardship mission. Additionally, there are operational safety issues at some facilities that use Category I/II SNM that call into question their viability for use beyond the next five to ten years. One is the Chemistry and Metallurgy Research (CMR) facility at LANL, and another is the CSA production facility, Building 9212, at Y-12. The NNSA Administrator told the House Armed Services Subcommittee on July 17, 2008, "We cannot continue to do 21st Century national security business with a 50-year-old Cold War infrastructure. Take the 50-year-old Chemistry and Metallurgy Research (CMR) Facility at Los Alamos, for example. The DNSFB has clearly stated that the CMR has significant safety issues which cannot be addressed in the existing structure. Similar issues exist at Y-12 with regards to Building 9212 which currently houses many of our legacy uranium processing operations" (D'Agostino 2008). The need to address these issues is an important factor in the development of NNSA's proposed actions regarding plutonium and uranium.

- Another example of the urgent need to upgrade/replace essential facilities is the Radioactive Liquid Waste Treatment Facility at LANL. That facility is currently required to provide a reliable means for treating radioactive liquid wastes in compliance with DOE and other applicable regulatory requirements. Portions of the current facility do not meet, nor are they capable of meeting current seismic or wind-loading standards and cannot be relied upon beyond the next five to ten years The ability to manage radioactive liquid waste is necessary for the continued performance of Stockpile Stewardship Program work at LANL. The current facility is over 40 years old and cannot be easily or economically retrofitted to meet modern standards or to accommodate present day office electronics, communications equipment, or heating and cooling systems. NNSA needs to provide for the ability to assure that these wastes can be safely, reliably, and effectively treated for the next 50 years with normal maintenance (LANL 2008).

- There are tens of metric tons of plutonium and hundreds of metric tons of enriched uranium at various sites under the control of three programs within NNSA—Defense Programs (DP), Fissile Materials Disposition (FMD) and Naval Reactors (NR). This SPEIS analyzes alternatives for the SSP and the SNM managed by DP; however, the plans for management and ultimate disposition of SNM under the jurisdiction of multiple NNSA programs are also evaluated, as part of the cumulative impact analysis.

Of the eight NNSA sites involved in the SSP mission, six currently have Category I/II SNM. The Kansas City Plant (KCP) does not have Category I/II SNM, and in 2008, SNL/NM completed removal of its Category I/II SNM. Of the eight sites involved in the SSP mission, three are national laboratories, four are manufacturing facilities, and one is a test facility. Two of the national laboratories, LLNL and LANL, will have Category I/II SNM after 2008. LANL has extensive plutonium facilities, including the capability to manufacture plutonium weapons components. LLNL has Category I/II material but does not have extensive plutonium facilities as does LANL, nor does it have the capability to manufacture plutonium weapons components. If Category I/II SNM is retained at a single NNSA national laboratory site, it would be at LANL because of the nature and size of its current plutonium facilities; neither SNL/NM nor LLNL are considered reasonable alternatives for plutonium missions over the long term. This SPEIS evaluates the five remaining sites as alternatives for the proposed action of restructuring SNM facilities—Los Alamos, Nevada Test Site (NTS), Pantex, Savannah River Site (SRS), and Y-12.

The current NNSA mission at SRS involves tritium processing and not SNM, but there is considerable former weapon plutonium under the jurisdiction of NNSA's Office of Fissile Materials Disposition at the site. Much of it came from the Rocky Flats Plant after it was closed in 1992, and NNSA has more plutonium that could be sent there in the form of pits from weapon dismantlements at Pantex. The current two-step disposition path for NNSA's pits and some other surplus plutonium is to build two new facilities at SRS. The Pit Disassembly and Conversion Facility (PDCF) would disassemble pits and convert them into plutonium-oxide. It is expected to be completed in 2019. A mixed-oxide (MOX) fuel facility to fabricate MOX fuel for use in commercial nuclear power plants from the plutonium oxide is expected to be completed in 2014 and the facility is expected to be fully operational in 2016. These plans are considered in the evaluation of SRS as the site for future plutonium operations.

The general approach in this SPEIS is to evaluate the three functional capabilities—plutonium operations, uranium operations, and weapons A/D in "building block" fashion so that the blocks can be arranged in many combinations among the five alternative sites. Both new facilities and upgrades of existing facilities are considered, and the building block approach would allow phasing of construction. For example, to create a Consolidated Nuclear Production Center (CNPC), NNSA would build separate facilities in a campus arrangement: a Consolidated Plutonium Center (CPC) (pit production facility); a Consolidated Uranium Center (CUC) (production facility for secondaries and cases); and an Assembly/Disassembly/High Explosives (A/D/HE) Center. All these facilities would probably be within the same high-security perimeter.

Different production rates to support a stockpile, including pit production, are evaluated for the proposed action. In addition, the environmental impacts of smaller stockpiles are evaluated.

2.4.2 Restructure R&D and Testing Facilities

The 1996 SSM PEIS did not propose any actions restructuring the laboratories technical base other than adding new facilities for enhanced experimental capability. That PEIS concluded "The continued vitality of all three NNSA national security laboratories will be essential in addressing the challenges of maintaining a safe and reliable nuclear weapons stockpile without nuclear testing."

In pursuit of a more responsive and cost-effective Complex, a restructuring of the R&D facilities within the laboratory and production complex is being considered. For the proposed action to restructure R&D and testing facilities, the alternatives focus on shorter-term issues to consolidate, relocate, or eliminate duplicative facilities and programs and improve operating efficiencies. The following functional R&D and testing capabilities are evaluated as part of this proposed action:

- High explosives R&D;
- Tritium R&D;
- Flight test operations;
- Major hydrodynamic testing;
- Major environmental testing; and
- Certain weapon support functions.

The detailed technical description of these functional capabilities is provided in Chapter 3.0.

In general, with the exception of flight test operations, the alternatives for these functions are:

- No Action;
- Downsize-in-Place; and
- Consolidate at Fewer Sites.

For flight testing, alternatives to the SNL-operated Tonopah Test Range (TTR) are evaluated. Today, TTR is operated mainly to conduct a small number of surveillance flight tests of air-delivered gravity bombs. With only two gravity bomb types remaining in the stockpile, it may be possible to cease testing at TTR and use NTS or negotiate with DoD to use the White Sands Missile Range (WSMR) for flight testing.

The sites being considered for each of these functions are:

- High explosives R&D—LLNL, LANL, SNL/NM, Pantex, NTS;
- Tritium R&D—LLNL, LANL, SRS;
- Flight test operations—TTR, NTS, DoD (WSMR);
- Major hydrodynamic test facilities—LLNL, LANL, NTS;
- Major environmental test facilities—LLNL, LANL, SNL/NM, NTS, and Pantex; and
- Certain weapons support functions—SNL/CA, SNL/NM.

The 1996 SSM PEIS evaluated a proposed action of "enhanced experimental capability" that focused on facilities for high energy density physics (HEDP), such as the National Ignition Facility (NIF) and Atlas, and hydrodynamic test facilities, such as the Contained Firing Facility (CFF). In this SPEIS, only consolidation of existing major hydrodynamic test facilities is being considered. No further consolidations or new HEDP facilities are proposed.

The three national security laboratories, LANL, LLNL, and SNL, are multi-function, multidisciplinary laboratories that perform R&D work for other NNSA programs, as well as for other programs within DOE, DoD, and other government agencies. NNSA expects that the nuclear weapon program at the laboratories will change over time and that other missions arising from 21st century challenges, such as energy security, will become increasingly important. The R&D restructuring alternatives under consideration would retain the unique science, technology, and engineering capabilities at the laboratories for the broader NNSA missions relating to national security. As a result, NNSA does not currently consider it reasonable to propose closure of any of the NNSA laboratories (see also Section 3.1.2). However, such consolidation could be proposed in the future, depending upon changes in national security requirements.

2.5 RELIABLE REPLACEMENT WARHEAD

Even though an RRW is only in the design feasibility study phase, due to high congressional and public interest, this section explains RRW's possible impact on the nuclear weapons stockpile.

2.5.1 RRW Status

The current status of the RRW program is that a feasibility study has been completed, a design competition has been concluded, and the Nuclear Weapons Council has selected a design concept. If authorized and funded by the Congress, the design concept would undergo further study and refinement over the coming years, and DoD and NNSA would prepare cost estimates. The RRW would not have a different military requirement than the warhead it would replace. A detailed cost study on an RRW design is in progress. When completed, it should provide the basis for quantifying the cost and efficiency benefits of an RRW approach.

2.5.2 RRW and the Proposed Actions and Alternatives

Consideration of an RRW would assist NNSA in making informed decisions on the capabilities that might be required in select facilities if a decision is made to proceed with an RRW. However, an RRW would not affect the SNM consolidation efforts or the action alternatives related to restructuring SNM facilities, nor the action alternatives related to restructuring R&D and testing facilities nor Complex transformation in general.

- **Restructure SNM facilities.** To restructure SNM facilities, which would be a long-term process carried out over a decade or more, the SPEIS alternatives examine broad issues such as where to locate those facilities and whether to construct new facilities or renovate existing ones for these activities. The Complex must retain a reasonable capability to produce required weapons and components in a safe, secure, and cost effective manner. The Complex must transform whether or not there is an RRW. The impact of an RRW on required capacity and capability are discussed below. The proposed action is also based on the current site configuration that houses a very large inventory of SNM that needs to be consolidated in more modern facilities independent of whether an RRW is developed.

- **Restructure R&D and testing facilities.** Tritium R&D, high explosives R&D, hydrodynamic, environmental, and flight test facilities are needed to support the safety, security and reliability of the existing stockpile as well as potential RRW warheads. The R&D and flight test facilities retained will be those necessary to support either a future legacy stockpile or an RRW based stockpile.

The potential effects of an RRW on other aspects of the transformation of the Complex, including pit production capacity, are discussed in the sections that follow.

2.5.3 RRW and Nuclear Testing

It is important to note what was said in the 1996 SSM PEIS Summary on the issue of new weapon design and testing (page S-46) and consider what has changed since that time.

> *New Weapon Design…* Commentors have suggested that the proposal for enhanced experimental capabilities is directed more at the capability to design new weapons in the absence of nuclear testing than at maintaining the safety and reliability of the existing stockpile and that stewardship alternatives could be different if the facilities were directed only at maintaining the existing stockpile. This PEIS explains why these capabilities are needed to maintain the safety and reliability of a smaller, aging stockpile in the absence of nuclear testing (section S.2). The existing U.S. stockpile of nuclear weapons is highly engineered and technically sophisticated in its design for safety, reliability, and performance. The stewardship capabilities required to make technical judgments about the existing stockpile are likewise technically sophisticated; therefore, it would be unreasonable to say that these stewardship capabilities could not be applied to the design of new weapons, albeit with less confidence than if new weapons could be nuclear tested.
>
> However, the development of new weapon designs requires integrated nuclear testing such as occurs in nuclear explosive tests. Short of nuclear testing, no single stockpile stewardship activity, nor any combination of activities, could confirm that a new-design weapon would work. In fact, a key effect of a "zero-yield" CTBT would be to prevent the confident development of new-design weapons. National security policy requires DOE to maintain the capability to design and develop new weapons, and it will be a national security policy decision to use or not use that capability. Choosing not to use enhanced experimental capability for new weapons designs would not change the technical issues for the existing stockpile and, therefore, the stewardship alternatives would not change.

In 1996, the prevailing technical judgment of DoD and DOE was that the Unites States should not design and field a new weapon without nuclear testing at least equal in sophistication to the testing of weapons already in the stockpile. Their judgment was that the technical risk was too high and the confidence too low with the experimental, computational and simulation tools available at the time. Today, more than a decade later, DoD and DOE believe that, because of the age of the legacy stockpile, the new experimental, computational, and simulation tools available, and new security threats, the United States could design a new weapon without testing. With either a legacy weapon or an RRW, NNSA does not currently see a need to resume nuclear testing to certify the safety, security, and reliability of the United States nuclear deterrent.

2.5.4 RRW and the Stockpile

Legacy stockpile weapons were designed to optimize the "yield-to-weight" ratio—that is, the maximum explosive force for the weight and volume of the nuclear warhead designed for a particular DoD delivery system. This resulted in highly sophisticated, finely tuned designs that optimized yield-to-weight while trying to meet all other competing requirements for safety, security, reliability, survivability (ability of the weapon to remain fully functional in hostile environments), etc. The RRW design concept allows more weight and volume to be used, which would enable larger margins of safety, security, and reliability to be designed into the warhead. Higher design margins imply higher confidence in meeting the requirements under unanticipated and undesirable conditions over a longer term. For example:

- **Warhead safety and security.** The use of insensitive high explosives (IHE) in a warhead requires more weight and volume than conventional high explosives (CHE) to perform the same function reliably, but it significantly reduces the probability of detonation in accidents, such as a fire. Thus, the use of IHE can provide a higher safety margin for the warhead, but, because a larger weight and volume of explosive are required, it occupies a higher fraction of the total weight and volume available for the nuclear package in a DoD delivery system.

- **Warhead reliability.** The reliability requirement for legacy stockpile warheads is quite high. However, an RRW would have designed-in higher performance margins. This results in increased confidence that the warhead would remain very reliable over a longer period of time because it would be less sensitive to internal changes that might cause it to fail due to aging or environmental effects. The ability to improve the performance margins of legacy weapons is limited by the constraints on the original designs developed many years ago.

2.5.5 RRW and Complex Transformation

One of the objectives of the RRW program was to simplify component and subassembly fabrication and warhead A/D processes. In general, simplifying designs to ones with fewer, less complex parts would reduce production operations in the Complex. Coordination and cooperation between the design laboratories and production plants to achieve this objective were encouraged by NNSA in the design competition for an RRW. Some of the benefits accrue simply by fostering a closer working relationship between the laboratories and plants. However, the main benefit would be achieved by the fact that more weight and volume is available, which provides greater flexibility in the manufacture, A/D, and maintenance of weapons. Some specific examples of improvements that emerged in the design competition are:

- Engineering of structural features that would permit safer and more efficient warhead A/D operations;
- Avoiding the use of non-nuclear materials in the design where stockpile surveillance data indicated potential life-limiting concerns;
- Eliminating toxic and hazardous materials if technically acceptable substitutes were available; and
- Substituting lower cost commercially available materials and components for higher cost specialty manufactured materials and components when feasible.

Some promising examples of efficiency improvements in manufacturing processes include pits and the cases surrounding the nuclear package. For example, a new pit manufacturing process is estimated to reduce the manufacturing time for a weapon by about 33 percent.

2.5.6 RRW and the Evaluation of Pit Production Capacity

The current rate of pit production at LANL is about 10 ppy. NNSA decided that LANL could provide up to 20 ppy in the 1999 LANL SWEIS ROD. The 1996 SSM PEIS evaluated rates of 50–80 ppy at LANL and SRS; and this SPEIS evaluates rates up to 200 ppy at five candidate sites. Sections 2.3.3 and 2.4.1 provide more detail on pit production rates and facility siting alternatives. Regardless of location, a new pit facility could take approximately 10 years from the time funding is authorized by Congress to the time of full operations. An RRW would not affect the productive capacity for pits – whatever capacity NNSA decides to create would be allocated between legacy weapons and RRWs if NNSA is directed to pursue RRWs.

2.5.7 RRW and the Use of Radioactive and Hazardous Materials

The environmental impacts of the alternatives in this SPEIS are based on the manufacturing materials and processes needed to support legacy stockpile weapons with LEPs. An RRW is only in the feasibility study stage. However, the RRW design objectives focus on reducing the use of radioactive and hazardous materials when compared to legacy weapons. Because the environmental impacts in this SPEIS are based on legacy weapons, these impacts should be larger than and bound the potential impacts of an RRW if it were to go into production.

For example, the current RRW design would eliminate the use of a toxic metal by substituting a non-toxic metal. If material substitution is not feasible, another way to reduce environmental impacts is to change manufacturing processes so that less radioactive or hazardous waste is created. For example, an RRW pit design could reduce the amount of plutonium scrap by as much as 90 percent compared to the manufacture of the pits used in legacy weapons.

2.5.8 Summary

A decision to pursue an RRW would have no significant effect on the proposed actions in this SPEIS, alternatives, production capacities, or assessment of their environmental impacts. An RRW would enable NNSA to change how operations are conducted within the facilities analyzed in this SPEIS. While an RRW would enable more cost-efficient and less hazardous operations, it would not eliminate the need for SNM operations or substantially reduce near-term production needs. Because the environmental impacts are based on the maintenance of the legacy weapons that are currently in the stockpile, a conservative estimate of the environmental impacts is provided by this SPEIS. Both pit and CSA production capacities will be required for the foreseeable future with or without an RRW.

2.6 PROGRAMMATIC IMPACTS OF SMALLER STOCKPILES

As discussed earlier in this chapter, the United States has steadily reduced its nuclear weapons stockpile since the end of the Cold War. This nation will reduce its stockpile to between 1,700–2,200 operationally deployed strategic warheads by 2012 in accordance with the *Moscow Treaty*. There are more than the 1,700–2,200 treaty-accountable warheads in the current stockpile, and, based on the NWSP, this will remain true in 2012. Section 2.1.6 explains the reasons for extra weapons in support of an operationally deployed stockpile, and it also explains the indirect relationship of stockpile size to planning assumptions for the industrial capacities that may be needed to repair or replace weapons. This section discusses the sensitivity of the proposed actions and alternatives in this SPEIS to the possibility of a stockpile smaller than the one set by the *Moscow Treaty*.

2.6.1 Defining a Smaller Stockpile

In regard to smaller stockpiles, the 1996 SSM PEIS examined a smaller stockpile of about 1,000 weapons. This stockpile level required retaining a capacity to produce about 50 weapons per year. Prior discussions in this chapter explain the technical reasons why this is a judgment and not a mathematical calculation. This was defined as the low case for the production analyses. This is still a reasonable assumption for a production capacity; only it appears somewhat more likely than it did more than a decade ago. In this SPEIS, the 50 weapons per year rate is referred to as "Capability-Based Capacity" (The No Net Production/Capability-Based Alternative would provide production rates as low as 10 sets of components or possibly assembly of 10 weapons per year).

2.6.2 Capability-Based Capacity

A factory-style layout of the process equipment needed to produce just one stockpile quality component is inherently capable of producing many more components per year if operated throughout the year. The production and maintenance of nuclear components within a weapon are the main determinants for infrastructure size and environmental impacts. A reasonable judgment of the inherent capacity of a production line for nuclear components exceeds 50 per year. A modern factory-style layout could result in a minimum inherent capacity in the range of 125 components per year. At these levels, a further decrease in the annual production rate, based on a reduction in stockpile size, would not significantly change the amount of process equipment, factory floor space, or qualified personnel needed. It would, however, affect the environmental impacts of actual operations.

2.6.3 Potential Effects on the Proposed Actions and Alternatives

For the reasons explained in this Chapter, the proposed actions and alternatives in this SPEIS have been scoped to meet a projected smaller stockpile size and annual production rates that are lower (e.g., the No Net Production/Capability-Based Alternative, which includes up to 10 ppy) than already evaluated (i.e. the No Action Alternative, which includes 20 ppy).

- **Restructure SNM facilities.** A smaller stockpile would not reduce the need to restructure SNM facilities or to consolidate SNM. In addition, the alternatives for SNM restructuring already evaluate a maximum consolidation alternative to a single production site.

- **Restructure R&D and testing facilities.** In general, a smaller stockpile would not eliminate the need for the basic R&D facilities evaluated in the alternatives in that all legacy weapon types use the same basic materials (tritium, etc.), and require the same type of R&D and test capabilities.

Chapter 3
ALTERNATIVES

Chapter 3
ALTERNATIVES

Chapter 3 describes the alternatives evaluated in this Complex Transformation Supplemental Programmatic Environmental Impact Statement *(SPEIS). Chapter 3 begins with an overview of the alternatives and a description of the process the National Nuclear Security Administration (NNSA) used to develop the reasonable alternatives for this SPEIS. The majority of Chapter 3 describes the programmatic and project-specific alternatives. Chapter 3 also discusses alternatives that were considered and subsequently eliminated from detailed evaluation. The chapter concludes with a summary comparison of the environmental impacts associated with the alternatives and identifies NNSA's preferred alternative. A more detailed description of the alternatives is contained in Appendix A.*

3.0 OVERVIEW

This *Complex Transformation Supplemental Programmatic Environmental Impact Statement* (SPEIS) evaluates alternatives for transforming NNSA's nuclear weapons complex into one which is smaller, more efficient, and that can respond to changing national security challenges. A more responsive Complex would help ensure the long-term safety, security, and reliability of the nuclear weapons stockpile while reducing the possibility that the United States would need to resume nuclear testing.

3.1 DEVELOPMENT OF REASONABLE ALTERNATIVES

NNSA has been considering how to continue the transformation of the Complex since the Nuclear Posture Review was transmitted to Congress in early 2002. The Stockpile Stewardship Conference in 2003 (DoD 2003), the Department of Defense Strategic Capabilities Assessment in 2004 (DoD 2004), the recommendations of the Secretary of Energy Advisory Board Task Force on the Nuclear Weapons Complex Infrastructure in 2005 (SEAB 2005), and the Defense Science Board Task Force on Nuclear Capabilities in 2006 (DoD 2006) were considered by NNSA in this regard. In 2006, NNSA developed a planning scenario for the future of the Complex (NNSA 2006). As a result of these studies, NNSA developed a range of reasonable alternatives that could reduce in size, capacity, number of sites with Category I/II SNM (and locations of Category I/II SNM within sites), and eliminate redundant activities.

Planning for Complex Transformation includes evaluation of alternatives for approximately the next decade or so, as well as decisions NNSA has already made based on the evaluations in the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (SSM PEIS), Tritium Supply and Recycling PEIS, and other *National Environmental Policy Act* (NEPA) documents (see Section 1.5). NNSA developed the proposed actions and alternatives (described in Sections 3.3 through 3.13) that are analyzed in this SPEIS based on its consideration of developments in nuclear and national security and on comments received during scoping. In addition to the environmental analyses of the impacts of these alternatives, NNSA has completed detailed economic studies of the alternatives (TechSource 2007a, 2007b, 2007c, 2007d, 2008a, 2008b, 2008c, 2008d, 2008e, 2008f, 2008g), which are available to the public.

3.1.1 Restructure SNM Facilities

The following functional capabilities are evaluated in this SPEIS:

- Plutonium operations, including pit manufacturing; Category I/II SNM storage; and related R&D;
- Enriched uranium operations, including canned subassembly manufacturing, assembly, and disassembly; Category I/II SNM storage; and related R&D; and
- Weapons assembly and disassembly (A/D) and high explosives (HE) production.

To consolidate SNM facilities, which would be a long-term process carried out over a decade or more, the SPEIS alternatives address broad issues such as where to locate those facilities and whether to construct new or renovate existing facilities for these functions. As such, this SPEIS analysis is "programmatic" for the proposed action to restructure SNM facilities, meaning that tiered, project-specific NEPA documents could be needed to inform decisions on these facilities if existing site-wide EISs or other NEPA documents were insufficient.

As shown on Figure 3.1-1, these "programmatic alternatives" are:

- **No Action Alternative.** NNSA evaluated a No Action Alternative, which represents continuation of the status quo including implementation of past decisions. Under the No Action Alternative, NNSA would not make additional major changes to the SNM missions now assigned to its sites.

- **Programmatic Alternative 1: Distributed Centers of Excellence (DCE).** As described in Section 3.5, the DCE Alternative would locate the three major SNM functional capabilities (plutonium, uranium, and weapon assembly/disassembly) involving Category I/II quantities of SNM at two or three separate sites. This alternative would create a consolidated plutonium center (CPC) for R&D, storage, processing, and manufacture of plutonium parts (pits). Production rates of 125 pits per year for single shift operations and 200 pits per year for multiple shifts and extended work weeks are assessed for a CPC.[1] A CPC could consist of new facilities, or modifications to existing facilities at one of the following sites: Los Alamos,[2] NTS, Pantex, SRS, and Y-12. This SPEIS also evaluates an alternative that would upgrade facilities at Los Alamos to produce up to 80 pits per year. Highly-enriched uranium storage and uranium operations would continue at Y-12. As part of this alternative, a new Uranium Processing Facility (UPF) and an upgrade to existing facilities at Y-12 are both analyzed. The weapons Assembly/Disassembly/High Explosives (A/D/HE) mission would remain at Pantex.

- **Programmatic Alternative 2: Consolidated Centers of Excellence (CCE).** As described in Section 3.5, NNSA would consolidate the three major SNM functions (plutonium, uranium, and weapon assembly/disassembly) involving Category I/II quantities of SNM at one or two sites under this alternative. Two options are assessed: (1)

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[1] See Section 3.15 for a discussion of a new CPC with a smaller capacity.

[2] In general, when referring to the Los Alamos National Laboratory, this SPEIS refers to this site as "LANL." The term "Los Alamos" is used to describe this site as an alternative location for a CPC or Consolidated Nuclear Production Center (CNPC).

the single site option (referred to as the consolidated nuclear production center [CNPC] option); and (2) the two-site option (referred to as the consolidated nuclear centers [CNC] option). The CCE alternative assesses three major facilities: (1) a CPC; (2) a consolidated uranium center (CUC), which would be similar to the UPF but would also include HEU storage and non-nuclear support functions; and (3) an A/D/HE Center, which would assemble and disassemble nuclear weapons and fabricate high explosives. Under the CNPC option, a new CNPC could be established at Los Alamos, NTS, Pantex, SRS, or Y-12. The SPEIS analyzes the impacts of each of these facilities separately and in combination. If Pantex or Y-12 were not selected for this option, weapons operations at Pantex, Y-12, or both would cease. Under the CNC option, the plutonium and uranium component manufacturing missions could be separate from the A/D/HE mission. The A/D/HE functions could remain at Pantex or be transferred to the NTS, while the plutonium and uranium missions could be located at sites different than the A/D/HE function. The CCE Alternative assumes production rates of 125 weapons per year for single shift operations and 200 weapons per year for multiple shifts and extended work weeks.[3]

- **Programmatic Alternative 3: Capability-Based Alternative.** As described in Section 3.6, under this alternative NNSA would maintain a basic capability for manufacturing components for all stockpile weapons, as well as laboratory and experimental capabilities to support stockpile decisions, but would reduce production facilities in-place to the extent that would allow NNSA to produce a nominal level of replacement components (approximately 50 components per year). Under this alternative, pit production capacity at LANL would not be expanded beyond the capability to produce 50 pits per year. Production capacities at Pantex, Y–12, and the SRS would be reduced to similar levels.[4] Within this alternative, NNSA also added a No Net Production/Capability-Based Alternative, in which NNSA would maintain capabilities to continue surveillance of the weapons stockpile, produce limited life components, and continue dismantlement. This alternative involves a minimum production (production of 10 sets of components or assembly of 10 weapons per year).

[3] See Section 3.15 for a discussion of a new CNPC with a smaller capacity.
[4] A capability-based capacity is defined as the capacity inherent in facilities and equipment required to manufacture up to 50 pits per year. In the Notice of Intent for this SPEIS, this capacity was referred to as a "nominal capacity."

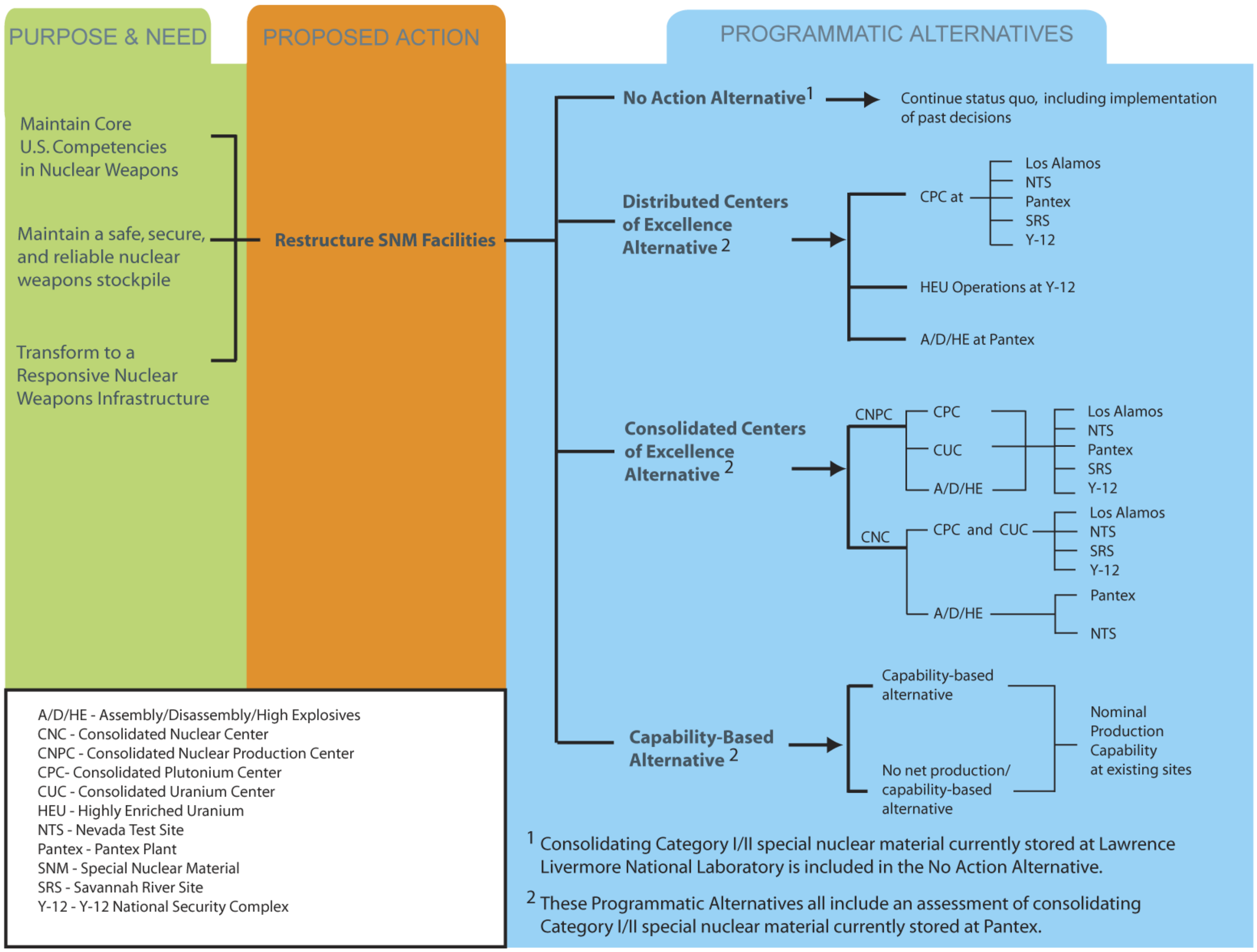


Figure 3.1-1—Programmatic Alternatives

The DCE Alternative, CCE Alternative, and the Capability-Based Alternative all include proposals to reduce the amount of SNM currently stored at LLNL[5] and Pantex. Those proposals are described in Section 3.7.

3.1.2 Restructure R&D and Testing Facilities

In pursuit of a more responsive and cost-effective Complex, NNSA is considering a restructuring of the R&D and testing facilities within the Complex. For this proposed action, the alternatives focus on near-term actions to consolidate, relocate, or eliminate facilities and programs and improve operating efficiencies. The following functional R&D capabilities and capacities are being evaluated:

- High Explosives R&D
- Tritium R&D
- Flight Test Operations
- Major Hydrodynamic Testing
- Major Environmental Testing

> **Project-Specific Analysis**
>
> A project-specific analysis is a detailed analysis of the environmental impacts of a pro-posed action and the reasonable alternatives. The project-specific analysis is sufficiently detailed to allow implementation of the selected alternative after NNSA makes a decision, without any additional NEPA analysis.

The analysis of alternatives for these capabilities is "project specific," meaning that no further NEPA review would likely be needed to implement decisions consistent with the alternatives analyzed in this SPEIS. Restructuring of these facilities is expected to be pursued regardless of which programmatic alternative is selected for SNM facilities. NNSA developed the project-specific alternatives, shown on Figure 3.1-2, to achieve significant benefits in making the Complex more secure and efficient. In addition to these project-specific alternatives for restructuring R&D and testing, this SPEIS also addresses alternatives related to non-nuclear component design and engineering work at SNL/CA.

In order to develop these alternatives, NNSA created Integrated Project Teams (IPTs). The charter of the IPTs was to identify actions that could be taken to achieve downsizing, consolidate activities, eliminate duplicative and excess facilities, or otherwise make an activity more efficient and cost effective. The membership of each IPT consisted of experts in relevant operations around the Complex.

The IPTs evaluated the functional capabilities identified above. These alternatives were identified as those that offered the greatest potential to significantly improve the security or efficiency of the Complex to allow NNSA to better accomplish its mission. The IPTs developed

[5] The LLNL SWEIS (DOE 2005a) assesses the environmental impacts of transporting SNM to and from LLNL and other NNSA sites, SRS, and WIPP. That analysis includes consideration of transportation activities involving greater quantities of SNM and more shipments than are proposed in this SPEIS. As such, the transportation activities associated with consolidating SNM from LLNL are included in the existing No Action Alternative and can proceed without additional NEPA analysis. For completeness, however, this SPEIS includes the environmental impacts associated with such actions.

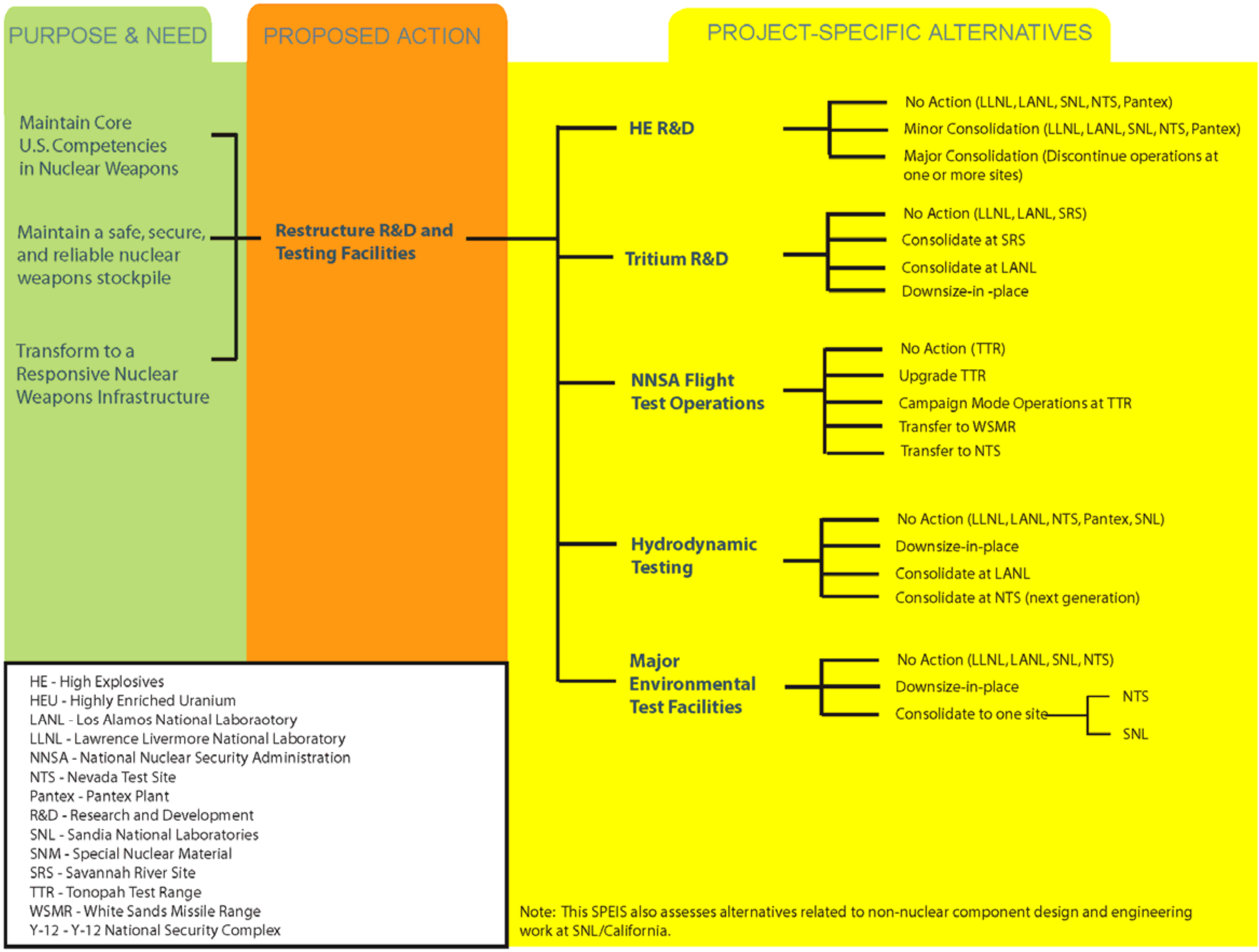


Figure 3.1-2—Alternatives to Restructure R&D and Testing Facilities

an assessment of the requirements for each mission area, conceptualized ways to meet those requirements while making the Complex more secure and efficient. The IPTs developed the proposals and the alternatives that would restructure R&D and testing facilities. Those alternatives are described in Sections 3.8 through 3.13.

3.2 OVERVIEW OF POTENTIALLY AFFECTED SITES AND EXISTING MISSIONS

3.2.1 Los Alamos National Laboratory

LANL was established as a nuclear weapons design laboratory in 1943. Its facilities are located on approximately 25,600 acres about 25 miles northwest of Santa Fe, New Mexico. LANL is a multidisciplinary research facility engaged in a variety of programs for NNSA, DOE, other government agencies, and the private sector. Its primary missions are the Stockpile Stewardship Program, emergency response to nuclear incidents, arms control, nuclear nonproliferation, and environmental clean-up. LANL conducts research and development in the basic sciences, mathematics, and computing applicable to its NNSA missions and to a broad range of other activities including: non-nuclear defense; nuclear and non-nuclear energy; material science; atmospheric, space, and earth sciences; bioscience and biotechnology; and the environment. Table 3.2.1-1 lists LANL's current missions.

With regard to nuclear weapons, LANL is responsible for the design of the nuclear explosive package in certain U.S. weapons (LLNL has this responsibility for the other weapons).[6] LANL performs research, design, development, testing, surveillance, and assessment activities, and maintains certification capabilities in support of the SSP. In addition, LANL produces a small number of plutonium pits pursuant to a programmatic decision based on the SSM PEIS (61 FR 68014) and a site-specific decision based on the 1999 LANL SWEIS (64 FR 50797) to establish an interim production capability of up to 20 pits per year. LANL also conducts surveillance of pits and manufactures some non-nuclear components (e.g., detonators). NNSA completed a revised LANL SWEIS in 2008, but will not make any decisions related to pit production at LANL prior to the completion of this SPEIS.

NNSA issued a ROD for the continued operation of LANL on September 23, 2008. NNSA announced in the ROD its decision to continue the no action alternative with the addition of some elements of the expanded operations alternative that NNSA concluded needed to be implemented to support the safe and successful execution of the laboratory's mission. None of these decisions affect the alternatives considered in this SPEIS.[7]

[6] The general responsibilities assigned to LLNL and LANL for nuclear explosive packages are complementary. LANL and LLNL compete for assignment of responsibility for design and development of the nuclear explosive package for a nuclear weapons system. In the early design definition phase, both laboratories perform systems studies, preliminary development work, and initial design definition. NNSA, in consultation with the DoD and the cognizant military service, then selects either LANL or LLNL to work with SNL to design and develop the new weapon system. LANL or LLNL designs and develops the nuclear physics package and associated support hardware; SNL designs and develops the arming, fuzing, and firing system; other warhead electronics; and external cases and mounts. SNL also performs systems integration to develop the complete system. There are nuclear explosive packages in the current legacy stockpile that have been designed and developed by both LANL and LLNL.

[7] See ROD for the continued operation of the LANL for decisions from the expanded operations alternative (see 73 FR 55833).

Table 3.2.1-1—Current Major Missions–LANL

Mission	Description	Sponsor
Nuclear Weapons	Stockpile stewardship; nuclear design and engineering; pit production and surveillance; limited non-nuclear component production; HE R&D; hydrodynamic testing; tritium R&D	NNSA's Office of Defense Programs
Arms Control and Nonproliferation	Intelligence analysis; technology R&D; treaty verification; fissile material control; nonproliferation analysis	NNSA's Office of Defense Nuclear Nonproliferation
Energy Research, Science and Technology	Neutron science; scientific computing; fusion energy; health and environmental research; high energy and nuclear physics; basic energy sciences; modeling and simulation	DOE's Office of Science; DOE's Office of Nuclear Energy (NE)
Energy Technology	Solar Cells; Fuel Cells; Shale Oil Detection;	DOE's Office of Energy Efficiency and Renewable Energy (EE)
Environmental	Environmental restoration; waste analysis, management, and treatment	DOE's Office of Environmental Management (EM) and NNSA[8]
Work for Others	Conventional weapons; computing, modeling, and simulation	DoD, Department of Homeland Security (DHS), and various other agencies
Bioscience and technology	Biothreat reduction through Biodetection and Bioforensics R&D	Health and Human Services; Center for Disease Control

3.2.2 Lawrence Livermore National Laboratory

LLNL was established as a nuclear weapons design laboratory in 1952. LLNL's main site is located on approximately 821 acres in Livermore, California. LLNL also operates a 7,000 acre "Experimental Test Site" known as Site 300, which is located approximately 12 miles east of the main laboratory. Site 300 is used primarily for high explosives testing, hydrodynamic testing, and other experimentation, such as particle beam research.

LLNL is a multidisciplinary research facility engaged in a variety of programs for DOE, NNSA, other government agencies, and the private sector. Its primary mission is the SSP; emergency response to nuclear incidents, arms control, and nuclear nonproliferation activities. LLNL conducts research and development activities in the basic sciences, mathematics, and computing, applicable to its NNSA mission areas, and to a broad range of other programs including: non-nuclear defense; nuclear and non-nuclear energy; high-energy density physics; atmospheric, space, and earth sciences; bioscience and biotechnology; and the environment. Table 3.2.2-1 lists the current missions at LLNL. With respect to nuclear weapons, LLNL is responsible for the design of the nuclear explosive package in certain weapons (LANL has this responsibility for the other weapons). LLNL maintains research, design, development, testing, surveillance, assessment, and certification capabilities in support of Stockpile Stewardship.

Table 3.2.2-1—Current Major Missions–LLNL

Mission	Description	Sponsor
Nuclear Weapons	Stockpile stewardship; nuclear design and engineering; HE R&D; hydrodynamic testing; tritium R&D; stockpile surveillance	NNSA's Office of Defense Programs
Arms Control and Nonproliferation	Intelligence analysis; treaty verification; counter proliferation analysis; fissile material control	NNSA's Office of Defense Nuclear Nonproliferation

8 NNSA has responsibility for managing newly generated wastes.

Table 3.2.2-1—Current Major Missions–LLNL (continued)

Mission	Description	Sponsor
Energy, Research, Science and Technology	Scientific computing; fusion energy; health and environmental research; high energy and nuclear physics; basic energy sciences; nuclear safety	DOE's Office of Science; NE
Environmental	Environmental restoration; waste management and treatment	EM and NNSA
Work for Others	Conventional weapons; computing, modeling, and simulation; astrophysics and space science; microelectronics and optoelectronics	DoD and various other agencies
Radioactive Waste	Repository Studies	DOE's Office of Civilian and Radioactive Waste Management (RW)
Bioscience and Biotechnology	Biothreat reduction through microbiological and genome studies	NNSA; EPA; Health and Human Services; Center for Disease Control

3.2.3 Nevada Test Site

NTS occupies approximately 880,000 acres in the southeastern part of Nye County in southern Nevada. It is located about 65 miles northwest of Las Vegas. It is a remote, secure facility with restricted airspace that maintains the capability for conducting underground testing of nuclear weapons and evaluating the effects of nuclear weapons on military communications systems, electronics, satellites, sensors, and other materials. The first nuclear test at NTS was conducted in 1951. Since the signing of the *Threshold Test Ban Treaty* in 1974, it has been the only U.S. site used for nuclear weapons testing. The last nuclear test was conducted in 1992. Approximately one-third of the land (located in the eastern and northwestern portions of the site) has been used for nuclear weapons testing; one-third (located in the western portion of the site) is reserved for future missions, and one-third is reserved for R&D, nuclear device assembly, diagnostic canister assembly, and radioactive waste management. In addition, DOE has submitted an application to the Nuclear Regulatory Commission for authorization to construct and operate a repository for spent nuclear fuel and high-level radioactive waste at Yucca Mountain, an area on the southwestern boundary of the site.

A primary NNSA mission at NTS is the nuclear weapons SSP, and includes maintaining the readiness and capability to conduct underground nuclear weapons tests within 24-36 months if so directed by the President. Other aspects of stockpile stewardship at NTS include conventional HE tests, dynamic experiments, and hydrodynamic testing. The Search Augmentation Team maintains the readiness to respond to any type of nuclear emergency, including search and recovery for lost or stolen weapons, and conducts training exercises related to nuclear weapons and radiation dispersal threats. The Device Assembly Facility houses criticality machines and stores SNM in support of a range of NNSA missions. The current missions and functions of NTS are shown in Table 3.2.3-1.

Table 3.2.3-1—Current Major Missions–Nevada Test Site

Mission	Description	Sponsor
Nuclear Weapons Program	Stockpile stewardship activities, including maintenance of readiness to conduct underground nuclear tests, if directed	NNSA's Office of Defense Programs
Waste Management	Safe and permanent disposal of waste through disposal on NTS or to offsite commercial waste treatment or disposal facilities	EM, RW, and NNSA[9]
Environmental Restoration	Identification, reduction, and cleanup of contaminated areas	EM
Nondefense Research and Development	Original research efforts by DOE, other Federal agencies, and universities	DOE's Office of Science; EM and others
Work for Others	Provides for the use of NTS areas and facilities by other groups and agencies for activities such as military training exercises	DoD and various other agencies

3.2.4 Tonopah Test Range

The Tonopah Test Range (TTR), managed and operated by SNL, is a 179,200-acre site located at the very northern end of the Nevada Test and Training Range, about 32 miles southeast of Tonopah, Nevada. TTR is used for NNSA flight testing of gravity-delivered nuclear weapons (bombs). The actual flight tests are conducted with one or more denuclearized warheads, called joint test assemblies, which are dropped from DoD aircraft or simply flown over the test range. The primary purpose of evaluation activities is the timely detection and correction of problems in the hardware interfaces for gravity weapons, and to ensure that components conform to design and reliability requirements throughout their life. DoD also currently uses TTR for exercises and as an emergency divert base for aircraft.

3.2.5 Pantex Plant

Pantex is located approximately 17 miles northeast of Amarillo, Texas, on 15,977 acres. Its missions are research and development on chemical high explosives for nuclear weapons; fabrication of high-explosive components essential to nuclear weapon function; assembly, disassembly, maintenance, and surveillance of nuclear weapons in the stockpile; dismantlement of nuclear weapons retired from the stockpile; and interim storage of plutonium components from dismantled weapons. Weapons activities involve the handling (but not processing) of uranium, plutonium, and tritium components, as well as a variety of non-radioactive hazardous or toxic chemicals. The current Pantex missions and functions are listed in Table 3.2.5-1.

Pantex's mission is to assemble, disassemble, and modify weapons as set forth in the ROD for the *Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components* issued on January 27, 1997 (62 FR 3880). Although the specifics of nuclear weapons operations at Pantex are classified, approximately one-half of the current and future Pantex workload involves dismantling nuclear weapons. Under all alternatives, dismantlement operations would continue and there are no proposals in this SPEIS to increase activity levels

[9] NNSA has responsibility for managing newly generated wastes.

beyond those previously evaluated.[10] The current Pantex missions and functions are listed in Table 3.2.5-1.

Table 3.2.5-1—Current Major Missions–Pantex

Mission	Description	Sponsor
Weapons Assembly and Maintenance	Initial production, repairs, modifications and safety/technology updates of nuclear weapons	NNSA
Weapons Disassembly and Dismantlement	Disassembly and disposal of nuclear weapons and their materials in a manner to protect worker, public, and environmental safety.	NNSA
Evaluation of Weapons	Surveillance testing and evaluation of active system weapons to maintain reliability of the nation's stockpile.	NNSA
High Explosive Fabrication and Research and Development	Develop, fabricate, and research high explosives that surround the nuclear components of weapons.	NNSA
Interim Plutonium Pit Storage	Provide environmentally controlled, safe, and secure interim storage for plutonium pits.	NNSA
Waste Management	Provide waste management and decontamination and decommissioning activities	EM and NNSA[11]

3.2.6 Sandia National Laboratories

SNL was established as a non-nuclear design and engineering laboratory separate from LANL in 1949. The principal laboratory is located in Albuquerque, New Mexico (SNL/NM); a division of the laboratory (SNL/CA) is located in Livermore, California, near LLNL. Sandia Corporation (the contractor that operates SNL under contract with NNSA) also operates the TTR in Nevada.

SNL is engaged in a variety of programs for NNSA, DOE, other government agencies, and the private sector. Its primary missions for NNSA are implementation of the SSP and related systems engineering and non-nuclear component design and engineering, and system qualification testing in Stockpile-to-Target Sequence environments. Other missions involve arms control and nonproliferation activities. In addition, SNL conducts R&D activities in advanced manufacturing, electronics, information, pulsed power, energy, environment, transportation, and biomedical technologies.

SNL is responsible for cradle-to-grave oversight and qualification testing of the non-nuclear components in nuclear weapons as well as system integrator to assure the safety and reliability of the entire weapons system using computational methodologies combined with data from its test facilities. SNL maintains research, design, development, testing, surveillance, assessment, and certification capabilities in support of the SSP. In addition, SNL performs some non-nuclear manufacturing functions, including the fabrication of neutron generators and production of limited quantities of microelectronic parts. Table 3.2.6-1 lists current missions at SNL.

[10] In the Notice of Intent for this SPEIS, NNSA stated that the proposed action would accelerate nuclear weapons dismantlement activities; these activities are already occurring. For example, during fiscal year 2007, NNSA increased its rate of dismantling nuclear weapons by 146 percent over the previous year's rate (NNSA 2007a). This rate was well below the maximum number of weapon dismantlements analyzed in the Pantex SWEIS (DOE 1996c).

[11] NNSA has responsibility for managing newly generated wastes.

Table 3.2.6-1—Current Major Missions–SNL

Mission	Description	Sponsor
Defense Programs and Nuclear Weapons	Stockpile stewardship; non-nuclear design and engineering; system qualification for weapons systems; R&D; modeling and simulation; maintenance of national security readiness; limited non-nuclear component production	NNSA's Office of Defense Programs
Arms Control and Nonproliferation	Intelligence support; treaty verification; nonproliferation technology; reduce threat of nuclear accidents	NNSA's Office of Defense Nuclear Nonproliferation
Energy, Research, Science and Technology	Energy infrastructure enhancements, including electric, geothermal, solar, wind and photovoltaic; coal, gas and petroleum; fusion; basic energy sciences	EE; DOE's Office of Fossil Energy (FE); and DOE's Office of Science
Environmental	Environmental restoration; waste management; hazardous material transport systems engineering	EM and NNSA[12]
Work for Others	Conventional weapons; computing, modeling, and simulation; satellites; arming, fusing, and firing systems; probabilistic risk assessment; transport packaging	DoD and various other agencies

3.2.7 White Sands Missile Range[13]

The White Sands Missile Range (WSMR), located in south-central New Mexico, is the largest installation in the DoD. WSMR is a Major Range and Test Facility Base under the Department of the Army Test and Evaluation Command, Developmental Test Command, providing test and evaluation services to the Army, Air Force, Navy, other government agencies, and industry. The range covers more than 3,000 square miles of land and 10,026 square miles of contiguous restricted airspace fully managed, scheduled, and controlled by the WSMR. Holloman Air Force Base is located adjacent to the range's east boundary, and has capabilities for aircraft support and staging. WSMR has a full suite of flight test instrumentation including radar, telemetry, and optical equipment that would allow for complete coverage of a NNSA gravity weapons flight test. WSMR has extensive experience conducting flight tests with requirements and flight test scenarios similar to the NNSA flight test program.

3.2.8 Savannah River Site

SRS is located in south-central South Carolina and occupies approximately 198,420 acres in Aiken, Barnwell, and Allendale counties. The site was established in 1950 and is approximately 15 miles southeast of Augusta, Georgia, and 12 miles south of Aiken, South Carolina. The major nuclear facilities at SRS have included fuel and target fabrication facilities, nuclear material production reactors, chemical separation plants used for recovery of plutonium and uranium isotopes, a uranium fuel processing area, and the Savannah River National Laboratory, which provides technical expertise. The initial mission at SRS was production of heavy water and

[12] NNSA has responsibility for managing newly generated wastes.
[13] WSMR is not currently part of the NNSA nuclear weapons complex. However, NNSA is considering WSMR as a location for flight testing.

strategic radioactive isotopes (plutonium-239 and tritium) in support of national defense. Today, the main weapons mission at SRS is tritium supply management and R&D.

Tritium, an important component of nuclear weapons, decays and must be replaced periodically to meet weapons specifications. Tritium recycling facilities empty tritium from weapons reservoirs, purify it to eliminate the helium decay product, and fill replacement reservoirs with specification tritium for nuclear stockpile weapons. Filled reservoirs are delivered to Pantex for weapons assembly and to the DoD as replacements for weapons reservoirs. The Tritium Extraction Facility takes rods, which have been irradiated in a commercial light water reactor, and extracts tritium for use in the nation's nuclear weapons. As an NNSA-managed activity separate from weapons activities, a mixed oxide fuel fabrication facility is under construction and NNSA plans to build a pit disassembly and conversion facility at SRS to disposition surplus plutonium. The current missions at SRS are shown in Table 3.2.8-1.

Table 3.2.8-1—Current Major Missions–Savannah River Site

Mission	Description	Sponsor
Tritium Supply Management and R&D Support	Operate H-Area tritium facilities and Tritium Extraction Facility; conduct tritium R&D; evaluate reservoir components returned from the stockpile	NNSA
Research and Development	Savannah River National Laboratory; technical support for NNSA, EM, and NE	NNSA; EM; and NE
Waste Management	Operate waste processing facilities	EM and NNSA[14]
Environmental Monitoring and Restoration	Operate remediation facilities	EM
Energy Technology	R&D of hydrogen (production, separation, and storage) as an energy source	EE
Stabilize Targets, Spent Nuclear Fuels, and Other Nuclear Materials	Operate F- and H- Canyons	EM
SNM Disposition	Build and operate facilities for SNM disposition	NE and NNSA's Office of Defense Nuclear Nonproliferation

3.2.9 Y-12

Y-12 is one of three primary installations on the DOE Oak Ridge Reservation (ORR), which covers a total of approximately 35,000 acres in Oak Ridge, Tennessee. The other installations are the Oak Ridge National Laboratory (ORNL) and the East Tennessee Technology Park (formerly the Oak Ridge K-25 Site). Construction of Y-12 started in 1943 as part of the World War II Manhattan Project. Y-12 consists of approximately 800 acres. The early missions of the site included the separation of uranium-235 from natural uranium by the electromagnetic separation and the manufacture of weapons components from uranium and lithium. Today, as one of the NNSA major production facilities, Y-12 is the primary site for enriched uranium processing and storage,

> **Secondaries and Cases**
>
> Secondaries are components of nuclear weapons that contain elements needed to initiate the fusion reaction in a thermonuclear explosion. Cases confine the nuclear package.

[14] NNSA has responsibility for managing newly generated wastes from NNSA activities.

and one of the primary manufacturing facilities for maintaining the U.S. nuclear weapons stockpile. Y-12 is the only source of secondaries, cases, and certain other weapons components within the Complex. Y-12 also dismantles weapons components, safely and securely stores and manages SNM, supplies SNM to naval and research reactors, and dispositions surplus materials. The current missions and functions are listed in Table 3.2.9-1.

Table 3.2.9-1—Current Major Missions–Y-12

Mission	Description	Sponsor
Weapons Components	Fabricate uranium and lithium components and parts for nuclear weapons and test hardware	NNSA
Stockpile Surveillance	Evaluate components and subsystems returned from the stockpile	NNSA
Uranium and Lithium Storage	Store enriched uranium, depleted uranium, and lithium materials and parts	NNSA
Dismantlement	Dismantle nuclear weapon secondaries returned from the stockpile	NNSA
Environmental Restoration and Waste Management	Waste management and decontamination activities	ER; EH; NE; EM; and NNSA[15]
Work for Others	Provide specialized medical emergency, security technology, and protection strategy expertise to other federal agencies	DoD and various other agencies
Arms control and Nonproliferation	Conduct security technology R&D; technical support for material disposition; global threat reduction; fissile material control; nonproliferation analysis	NNSA's Office of Defense Nuclear Nonproliferation
Naval Reactors	Supply HEU for use as fuel in naval reactors	NNSA

[15] NNSA has responsibility for managing newly generated wastes.

PROGRAMMATIC ALTERNATIVES

3.3 PROGRAMMATIC NO ACTION ALTERNATIVE

Under the programmatic No Action Alternative, NNSA would continue operations to support national security requirements using the existing Complex. As shown on Figure 1.1-1, the current complex consists of multiple sites located in seven states (alternatives for the activities conducted at KCP, which manufactures and procures non-nuclear weapons components, are evaluated separately from this SPEIS). The Complex enables NNSA to design and manufacture nuclear weapons; conduct surveillance on weapons in the stockpile; and dismantle retired weapons. Under the No Action Alternative, NNSA sites would continue to perform the weapons functions identified in Section 3.2. A summary of the functions, and the sites where these functions are performed, follows.

Weapon design and certification. Nuclear weapons are designed at three NNSA national laboratories; these laboratories also certify the weapons safety and reliability. LLNL and LANL design and engineer the nuclear physics package for nuclear weapons. SNL designs and engineers non-nuclear components and is responsible for systems engineering and qualification of nuclear weapons. The laboratories provide the science and technology foundation for the SSP and rely on facilities across the Complex to support essential plutonium, uranium, non-nuclear materials, tritium, and high explosives research and development, as well as, hydrodynamic, environmental, and flight testing. NNSA would not close any of the three laboratories under this alternative (Section 3.14), but could consolidate some research and development and testing facilities to achieve a more integrated, interdependent, and cost-effective Complex.

Plutonium operations and pit manufacture. Pits are the central nuclear core of the primary of a nuclear weapon, and typically contain Pu-239 or HEU. Subsequent to the 1996 SSM PEIS ROD, an interim pit manufacturing capability was established at LANL. In the 1999 LANL SWEIS ROD, DOE decided that LANL would produce up to 20 pits per year. In May 2008, NNSA issued the Final LANL SWEIS that evaluates an alternative to produce up to 80 pits per year in order to obtain 50 certified pits per year. LANL manufactures pits in the Plutonium Facility Complex, which consists of six primary buildings located in Technical Area-55 (TA-55). This activity is supported by numerous laboratories, storage facilities, administrative offices and waste management facilities, located elsewhere at LANL. Both LANL and LLNL currently perform R&D on Category I/II quantities of plutonium.

Uranium operations and secondary and case fabrication. The energy released by the primary explosion activates the secondary assembly. Secondary assemblies may contain HEU, lithium deuteride, and other materials. Implosion of the secondary assembly creates the thermonuclear explosion. Heavy metal cases surround the secondary assemblies. Uranium operations and secondary and case fabrication are generally performed at Y-12, where most highly enriched uranium materials reserved for weapons are retained. NNSA has constructed a new Highly-Enriched Uranium Materials Facility (HEUMF) at Y-12 to consolidate highly-enriched uranium storage. LANL, LLNL, and NTS currently retain smaller Category I/II quantities of highly enriched uranium for R&D. This activity requires high security facilities as well as support, laboratory, waste management, and administrative facilities.

Weapons assembly/disassembly and high explosives production. Weapons assembly and disassembly refers to the assembly, dismantlement, and reassembly of complete nuclear weapons. This activity is primarily conducted at Pantex, which is the principal facility in the Complex that handles complete nuclear weapons. Facilities include heavily fortified work areas, storage facilities, administrative buildings and support laboratories. Waste management facilities are also required. Pantex also produces and machines the high explosives that surround the nuclear components of nuclear weapons. In the ROD for the EIS for the *Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components* (62 FR 3880, January 27, 1997), Pantex is authorized to assemble, disassemble, and modify weapons. Although the specifics of nuclear weapons operations at Pantex are classified, approximately one-half of its current and future workload is associated with dismantling nuclear weapons.

Category I/II SNM storage. Quantities of SNM are categorized into security Categories I, II, III, and IV based on the type, attractiveness level, and quantity of material. Category I/II SNM are the most attractive materials and require the most extensive and expensive security protection. These facilities consist of heavily fortified storage or processing buildings surrounded by security fences with highly trained, heavily armed security personnel. Category I/II SNM storage facilities are currently located at LANL, LLNL, Pantex, SRS, Y-12, and NTS. In 2008, SNL/NM removed its Category I/II SNM, and no longer stores or uses Category I/II SNM quantities on a permanent basis. The potential transfer of LLNL's Category I/II SNM has previously been assessed in the LLNL SWEIS (DOE 2005a) and is included in the No Action Alternative.

Tritium production and R&D. Tritium is a short-lived radioactive isotope of hydrogen used to increase yield in nuclear weapons. The production of tritium is carried out in a Tennessee Valley Authority reactor (see Section 5.19). Tritium extraction, purification, and reservoir loading (which are collectively referred to as the "tritium supply management" missions) are carried out at SRS in the Tritium Extraction Facility, which became operational in late 2006, and the H-Area New Manufacturing Facility, which became operational in 1994. Tritium research and development is performed at SRS and LANL (in the Weapons Engineering Tritium Facility). Very limited tritium operations are performed at LLNL in the Tritium Facility within Superblock, to support preparation of tritium targets for the National Ignition Facility, and at SNL/NM in the Neutron Generator Production Facility for neutron generator production. Tritium operations require supporting laboratory facilities and administrative office buildings.

High explosives R&D. High explosives are used in the primary assembly of nuclear weapons. The development of safer, more stable, and more energetic forms of this material are referred to as high explosives research and development. The research and development work includes confined and unconfined detonation of experimental quantities of high explosives. High explosives research and development are conducted at LANL, LLNL, SNL/NM, Pantex, and NTS. This activity entails development laboratories, radiography facilities, environmental test facilities, administrative buildings and test fire facilities. Waste management facilities are also required.

Flight test operations. Flight test operations assess how weapon systems function in realistic delivery conditions. Denuclearized test weapons[16] are assembled at Pantex. These denuclearized weapons are then subjected to realistic aircraft flight and release conditions. This program is conducted at the TTR for gravity weapons (bombs). Facilities include a drop zone, target facilities, observation and test equipment, and administrative buildings. Flight testing for ballistic and cruise missiles is conducted at existing DoD test ranges.

Hydrodynamic test facilities. Hydrodynamic testing refers to experiments that use high explosives to study the physics of weapons and to assess their performance and safety. These activities are principally conducted at LLNL and LANL, with smaller supporting activities at NTS, SNL/NM and Pantex. High energy radiographic facilities support the hydrodynamic testing capabilities with dynamic radiography. This activity also entails laboratory and administrative office space.

Major environmental test facilities. Environmental test facilities are used to assess the safety, reliability and performance of the nation's nuclear weapons systems through subjecting weapons to differing environmental conditions (shock, vibration, high temperatures, etc.). These facilities test complete (denuclearized) weapons or major weapons subsystems. Major environmental test facilities are located at SNL/NM, LLNL, LANL, and NTS. These facilities are supported by storage, support laboratory, and administrative office buildings. Small environmental test laboratories and capabilities also exist at Pantex and SRS. These smaller test laboratories support component R&D and production, and are an integral part of the production/certification process.

3.3.1 Limitations of the Existing Complex

The existing Complex is aging, too big, and maintains redundant capabilities that were required for the Cold War stockpile. Many of the facilities are being operated beyond their anticipated life. In fact, parts of the Complex were built during the Manhattan Project of the 1940s. It is expensive to maintain these facilities. Reliance on aging facilities increases operating costs and in some instances subjects workers to unnecessary risks. The history of facility construction within the Complex is shown in Figure 3.3.1-1.

The chart shows that there were two periods of significant construction in the 1950s and the 1980s. Construction during these periods was primarily the result of expanding the production capacity as the nuclear weapons stockpile grew rapidly during the Cold War. There are several thousand buildings in the Complex today, covering more than 35 million square feet of floor space, that support weapons activities. Maintaining this much space requires the expenditure of extensive resources for maintenance, safety, and security. As shown on Figure 3.3.1-2, the Complex has undergone significant footprint reductions (approximately 50 percent) since the Cold War ended in 1991. NNSA is continuing to consolidate operations and reduce floor space and ongoing efforts in this regard would continue under the No Action Alternative.

[16] Denuclearized test weapons are designed to simulate the nuclear weapon in its operational configuration as much as possible, but do not contain the physics package with special nuclear materials. During flight tests, these test weapons are expected to operate as if they were an actual nuclear weapon, except for the lack of a nuclear detonation.

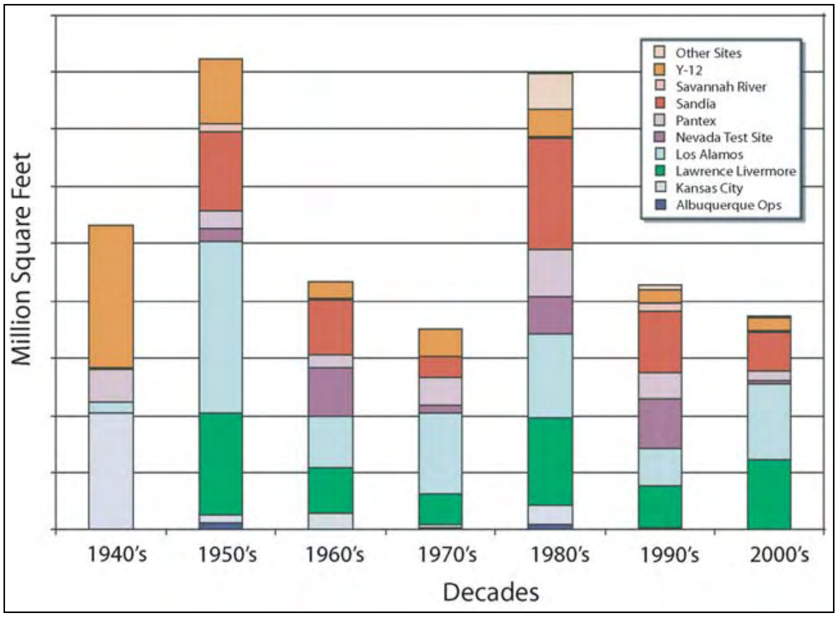


Figure 3.3.1-1—Facility Construction History within the Current Complex

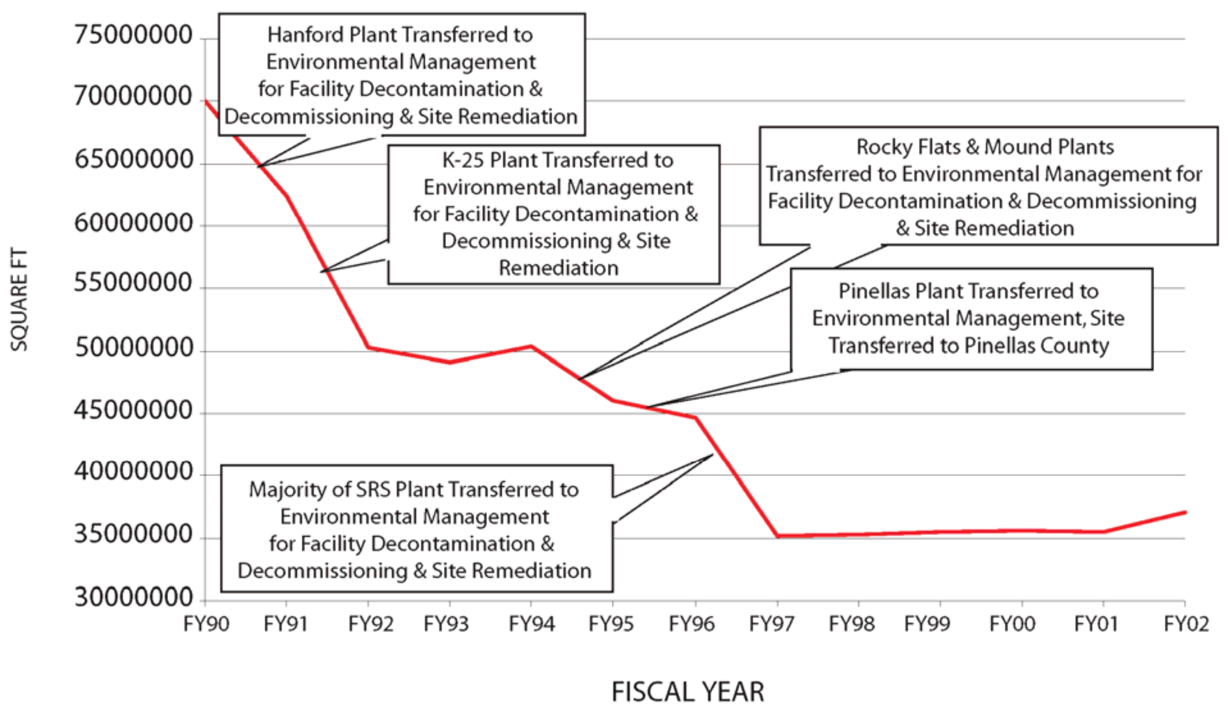


Figure 3.3.1-2—Footprint Reductions in the Complex Due to Mission Changes

While the functions required to sustain the U.S. nuclear deterrent are understood, the actual facilities that will be needed in the future will depend on a number of factors. NNSA anticipates the footprint of the current Complex could be reduced by 20-30 percent in the future. This would result in a footprint of less than 26 million square feet. Figure 3.3.1-3 presents possible reductions in the footprint of the Complex due to mission changes. As can be seen from the figure, nuclear facilities, office space, laboratory space, and indirect support would be significantly reduced. In 2006, approximately 27,000 management and operating contractor personnel were employed at major NNSA sites to support weapons activities. NNSA is continuing to consolidate operations and reduce floor space, on a site-by-site basis, and these efforts would continue under the No Action Alternative.

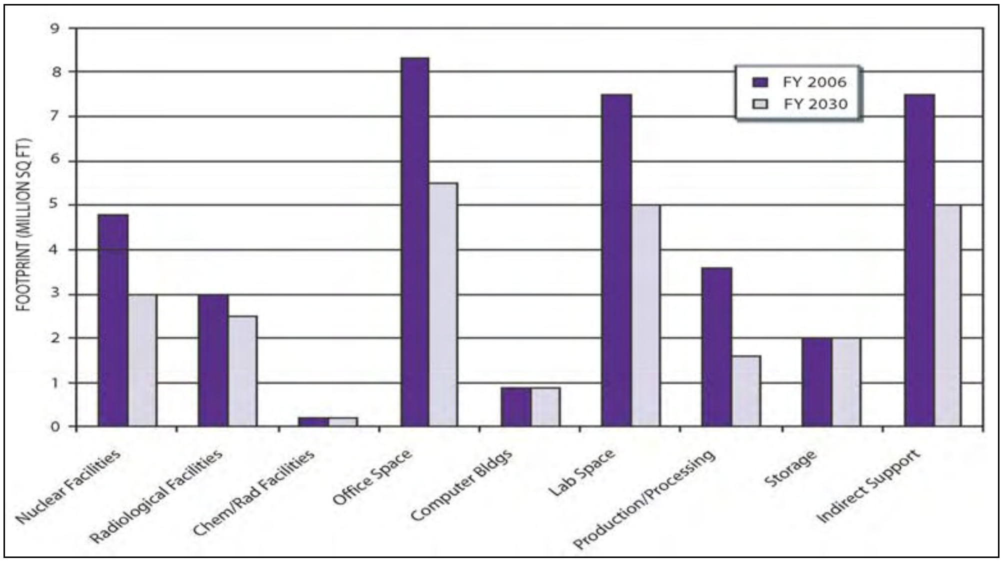


Figure 3.3.1-3—Possible Footprint Reductions in the Complex Due to Mission Changes

Another requirement of a geographically dispersed Complex and military bases is the need for a safe and reliable transportation system to move weapons components and other items. This function is provided by the Department's Office of Secure Transportation (OST) which transports nuclear weapons, components and special nuclear materials, and conducts other missions supporting national security. Since 1974, OST has operated a system for the safe and secure transportation of all government-owned, DOE controlled special nuclear materials in "strategic" or "significant" quantities. Shipments are transported in specially designed equipment, monitored closely with highly sophisticated satellite telemetry, and escorted by armed Federal Agents (Nuclear Material Couriers). Section 5.10.1 describes the existing transportation system (No Action Alternative) for the Complex.

3.4 PROGRAMMATIC ALTERNATIVE 1: DISTRIBUTED CENTERS OF EXCELLENCE

Under this alternative, NNSA would transform the Complex by consolidating major functions required to support the nuclear weapons stockpile at distributed centers of excellence (DCE). This alternative would locate the three major SNM functions (plutonium, uranium, and weapon assembly/disassembly) involving Category I/II quantities of SNM at two or three separate sites. This alternative would create a consolidated plutonium center (CPC) for the R&D, storage, processing, and manufacture of plutonium parts (pits) for the nuclear weapons stockpile. Production rates of 125 pits per year for single shift operations and 200 pits per year for multiple shifts and extended work weeks are assessed.[17] A CPC could either be a completely new configuration of buildings at Los Alamos, NTS, Pantex, SRS, or Y–12, or an upgrade of existing and planned facilities at Los Alamos (two alternatives, referred to as the “50/80” and “Upgrade”) or planned facilities at SRS. Highly Enriched Uranium (HEU) storage and uranium operations would continue at Y-12. As part of this alternative, a new Uranium Processing Facility (UPF) and an upgrade to existing facilities at Y-12 are analyzed. The weapons Assembly/Disassembly/High Explosives (A/D/HE) mission would remain at Pantex.

3.4.1 Consolidated Plutonium Center

The inception of the Cold War in the early 1950s led to the large-scale production of nuclear weapons. During this time, many facilities were constructed across the country to build nuclear weapons. One of these was the Rocky Flats Plant in Colorado. It commenced production of plutonium components for nuclear weapons, including pits, in 1952. From 1952 until 1989, the principal mission of Rocky Flats was the processing of plutonium and the fabrication of pits that went into the nuclear weapons stockpile.

In 1969 there was a major fire in one of the buildings at Rocky Flats and its cleanup took approximately two years. To prevent similar fires, the Department made many changes to both the equipment and processes used in the manufacture of pits. During the mid 1970s and the 1980s a series of events occurred that altered operations in the Complex: the enactment of major environmental legislation (including the *Resource Conservation and Recovery Act* [RCRA] and the *Comprehensive Environmental Response, Compensation and Liability Act* [CERCLA]); issuance of a Department of Energy Report (DOE 1988) recommending the phase-out of plutonium operations at Rocky Flats due to encroaching population as well as emerging information about the environmental contamination at the site.

In 1989, agents from the Federal Bureau of Investigation (FBI) and U.S. Environmental Protection Agency (EPA) secured the plant to investigate allegations of environmental crimes. Following this event, the production of pits ceased, never again to resume. In 1992, Rocky Flats was officially closed. The reasons for its closure were: encroaching communities; the requirement to conduct extensive environmental remediation; and the recognition that the nation did not need a facility the size of Rocky Flats to maintain the nuclear weapons stockpile.

In 1996, DOE issued a ROD following issuance of the SSM PEIS. The ROD announced DOE’s decision to “reestablish the capability, with an attendant small, interim capacity, for pit

[17] See Section 3.15 for a discussion of a new CPC with a smaller capacity.

fabrication at Los Alamos National Laboratory" (61 FR 68014). Also in that ROD, DOE stated that it would, at a later date, consider a larger capacity for the fabrication of pits than could be achieved in the facilities at LANL. In 2002, NNSA issued a notice of intent to prepare an EIS for a Modern Pit Facility (MPF) (67 FR 59577). While NNSA published a MPF Draft EIS, it never issued a final EIS. The analysis of proposed pit production is contained in this Complex Transformation SPEIS.

Only recently has NNSA regained the capability to manufacture pits for the stockpile, however, it is limited to a single pit type (W88) at the LANL plutonium facility within TA-55. In the 2008 Final LANL SWEIS (see Section 1.5.2.2), NNSA assessed an alternative that would increase this interim capacity. A CPC could be new construction or construction and modification of existing facilities (if LANL is the selected site). This section of this SPEIS describes the alternatives for a CPC. This section also discusses the pit production process, and lists the facility requirements necessary to this process. A new seismic study in the 2008 Final LANL SWEIS indicates that the seismic hazard at LANL is higher than previously understood. One of the purposes of that seismic hazards analysis is to define the Design Basis Earthquake (DBE) ground motion parameters. That data would then be used to determine the design parameters that any facility at LANL would need to meet and whether capacity could be increased in existing facilities.

CPC Requirements and Assumptions

- A CPC would provide the facilities and equipment to perform pit manufacturing, pit surveillance, and plutonium research and development.

- Stockpile requirements are based on national security requirements established by the President and funded by the Congress based on joint recommendations from DOE and DoD. CPC capacity and production output would be designed to meet national security requirements, which could include production of new pits for maintenance of the legacy stockpile or replacement weapons (e.g., Reliable Replacement Warheads [RRW]).

- As described in Chapter 2, this SPEIS assumes that a CPC would provide a manufacturing capacity of 125 pits per year using a single shift, with a contingency of 200 pits per year through multiple shifts and extended work weeks. A CPC would be capable of supporting the surveillance program at a rate of one pit being destructively evaluated per pit type in the stockpile per year. For Los Alamos, this SPEIS also assesses an alternative that would result in a smaller pit production capacity (up to 80 pits per year), based on the use of the existing and planned infrastructure at that site.

- A new CPC would be built and started up over a six year period, and would be fully operational by approximately 2022. A CPC would be designed for a service life of at least 50 years.

- The sites being considered as potential locations for a CPC and consolidation of Category I/II quantities of SNM are Los Alamos, NTS, Pantex, SRS, and Y–12.

- A newly constructed CPC would consist of a central core area surrounded by a Perimeter

Intrusion Detection and Assessment System (PIDAS), which would enclose all operations involving Category I/II quantities of SNM. The enclosed area would be approximately 40 acres. A buffer area would provide unobstructed view of the area surrounding the PIDAS. All administrative and non-SNM support buildings would be located outside of the buffer area. Once operational, approximate 110 acres would be required for a new CPC (Table 3.4-1). As shown in Table 3.4-1, two CPC alternatives at Los Alamos (Upgrade Alternative and 50/80 Alternative) could reduce land area requirements by the use of existing and planned facilities and infrastructure.

Table 3.4-1—Land Requirements–CPC Alternatives

<table>
<tr><th rowspan="4">Greenfield[18] Alternative
(Los Alamos, NTS, Pantex, SRS, Y-12)</th><th>Construction (acres)</th><th colspan="2">Operation
(acres)</th></tr>
<tr><td rowspan="3">140</td><td colspan="2">110*</td></tr>
<tr><td>PIDAS</td><td>Non-PIDAS</td></tr>
<tr><td>40</td><td>70</td></tr>
<tr><td>Upgrade Alternative (Los Alamos)</td><td>13</td><td colspan="2">6.5 (All within PIDAS)</td></tr>
<tr><td>50/80 Alternative (Los Alamos)</td><td>6.5</td><td colspan="2">2.5 (All within PIDAS)</td></tr>
</table>

* Includes a buffer area that would provide unobstructed view of the area surrounding the PIDAS.

- It is assumed that CPC facilities would be constructed above ground. During design activities, studies would be performed on worker safety, security enhancements, and costs. For example, whether to locate the CPC facilities above or below-ground would be examined. All 5 sites are assumed to be able to support a buried or partially buried CPC. This SPEIS includes a discussion of the potential differences among the sites in supporting a buried or bermed facility (see Appendix A).

- If Los Alamos is not selected for the CPC mission, it is assumed that plutonium facilities at that site would be reduced to Category III or IV nuclear facilities for R&D purposes, or closed, after the CPC begins operations. Any residual non-Defense Program (DP) missions (i.e. Pu-238) that might use these plutonium facilities after NNSA's mission in those facilities ends will be responsible for the operation and maintenance of these facilities. However, as explained in Section 3.4.1.6, facilities at Los Alamos are also being considered for an upgrade to meet CPC requirements.

- SNM storage at the CPC would be based on the need to support a 3-month production period. Approximately 3 metric tons (MT) of storage is anticipated.

- Any transuranic (TRU) waste from a CPC is assumed to be disposed of at the Waste Isolation Pilot Plant (WIPP) (see Section 10.5.5).

3.4.1.1 *CPC Operations*

The following section discusses CPC operations. It begins with a summary of the pit production process. The overall process would involve three main areas: (1) Material Receipt, Unpacking,

[18] The term "greenfield" is not meant to imply that the land upon which a CPC would be constructed has never been previously utilized by DOE/NNSA. Rather, in the context of this SPEIS, greenfield refers to a completely new facility that would not use existing facilities and therefore requires significantly more acreage.

and Storage; (2) Feed Preparation; and (3) Manufacturing. In addition, a CPC would perform plutonium R&D and surveillance, as described below.

Material receipt, unpacking, and storage. Plutonium feedstock material would be delivered from offsite sources in DOE/Department of Transportation (DOT) approved shipping containers. The shipping containers would be held in Cargo Restraint Transporters (CRT) and hauled by Safeguards Transporters (SGTs). The bulk of the feedstock material would come from Pantex, in the form of pits from retired weapons. Additionally, small amounts of plutonium metal from LANL and SRS could be used.

Feed preparation. The containers would then be transferred through a secure transfer corridor to an adjacent Feed Preparation Area where plutonium metal is prepared for manufacturing. For pits that would be recycled, the pit is first cut in half and all non-plutonium components are removed. Notable among these components is EU, which would be decontaminated and then shipped to Y-12 for recycling. All of the other disassembled components would be decontaminated, to the maximum extent possible, and then disposed of as either low-level waste (LLW) or transuranic (TRU) waste, as appropriate.

There are two processes currently being evaluated for the purification of the plutonium metal. One process relies more heavily on aqueous chemistry (aqueous process) and the other on pyrochemical reactions (pyrochemical process). The primary difference between the two is that the aqueous process does not employ chloride, which means conventional stainless steel can be used to contain all of its reactions. On the other hand, the pyrochemical process requires specialized materials to contain the corrosive chloride-bearing solutions that it employs.

The pyrochemical process has the potential to be environmentally more benign than the aqueous process. As the design of a CPC develops and a final purification process is proposed, a site-specific EIS would evaluate in more detail the impacts of the process proposed for use. Additionally, for a CPC that might be constructed at SRS, this SPEIS considers using facilities and infrastructure that are to be constructed in support of the Materials Disposition Program. The Pit Disassembly and Conversion Facility (PDCF) would provide the capability to disassemble nuclear weapons pits and could be modified in the future to convert plutonium to a form suitable for producing new pits. The use of the PDCF would be consistent with the requirements of September 2000 *Agreement Between the Government of the United States and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation* and any future modifications to this Agreement. The PDCF would include a hardened plutonium processing building, conventional buildings and structures housing support personnel, systems, and equipment (see Section 3.4.1.2).

Manufacturing. Pit manufacturing work includes fabrication of plutonium components for pits and the assembly of pits. Typically, non-plutonium parts would be fabricated elsewhere. These non-plutonium components would be shipped to the CPC to be assembled with the plutonium components into pits. The CPC would require the capability to perform SNM shipping, receiving, and storage; pit disassembly and feedstock sampling; metal preparation, recovery, and refining; product forming, machining, welding, cleaning, and assembly; and product inspection (including radiography), process qualification, production surveillance, and analytical chemistry support. Support and ancillary functions (waste handling, security operations, training, maintenance, administration, process development, and testing) required to perform pit manufacturing are also included in the CPC.

Plutonium R&D. A CPC would conduct plutonium R&D that would investigate the properties and performance characteristics of plutonium. Understanding the properties and performance characteristics allows better modeling of weapon performance and provides assurance of stockpile reliability. This R&D would also assess activities required for pit processing in order to develop more efficient and environmentally benign methods.

Plutonium pit surveillance. Pit surveillance is the periodic disassembly and inspection of pits from the active stockpile to identify any defects or degradation, and to assure that nuclear weapons are safe and reliable. Evaluations include leak tests, weighing, dimensional inspection, dye penetration inspection, ultrasonic inspection, radiographic inspection, metallographic analysis, chemical analysis, pressure tests, and mechanical testing.

3.4.1.2 *CPC Facility Requirements*

In order to allow for the pit production processes described above, a CPC would require a number of facilities. Although the specific requirements of these facilities are still being developed, the general requirements are:

Process and R&D buildings. An approach being evaluated for a CPC would divide the major plant components into four separate buildings identified as Material Receipt, Unpacking, and Storage; Feed Preparation; Manufacturing; and R&D to perform the functions described in Section 3.4.1.1. The process buildings would be two-story reinforced concrete structures located aboveground. The exterior walls and roofs would be designed to resist all credible man-made and natural phenomena and comply with all security requirements. The first story of each building would include plutonium processing areas, manufacturing support areas, waste handling, control rooms, and support facilities for operations personnel. The second story of each of the three process buildings would include the heating, ventilating, and air conditioning (HVAC) supply fans, exhaust fans and high-efficiency particulate air (HEPA) filters, breathing/plant/instrument air compressor rooms, electrical rooms, process support equipment rooms, and miscellaneous support space. The buildings would be connected by secure transfer corridors.

Support buildings within the PIDAS. The major support structures located within the PIDAS would include an Analytical Support Building and a Production Support Building. The Analytical Support Building would contain the laboratory equipment and instrumentation required to provide analytical chemistry and metallurgical support for the CPC processes, including radiological analyses. The Production Support Building would provide the capability for performing classified work related to the development, testing, staging and troubleshooting of CPC processes and equipment. A number of other smaller structures also supporting a CPC would include standby generator buildings, fuel and liquid gas storage tanks, an HVAC chiller building, cooling towers, and an HVAC exhaust stack.

Support buildings outside the PIDAS. The major structures located outside the PIDAS would include an Engineering Support Building, a Commodities Warehouse, and a Waste Staging/TRU Packaging Building. This Waste Staging/TRU Packaging Building would be used for characterizing and certifying TRU waste prior to packaging and short-term storage prior to shipment to the waste disposal facility. Parking areas and storm water retention basins would also be located outside the PIDAS. In addition, a temporary concrete batch plant and construction laydown area would be required during construction. A generic layout showing the major buildings and their relationship to each other is shown in Figure 3.4.1-1. Table 3.4.1–1 shows the dimension estimates. The overall plant layout in this generic representation is a greenfield campus layout and would be adapted to each site as necessary. The actual footprint of all of the buildings, as shown in the table, should be less than the “developed” area from the generic layout. Thus, the actual developed site layout could be less than that shown in Table 3.4.1-2, and could fit any site with enough space for buildings footprint and adequate security standoff distances.

Table 3.4.1-1—Dimensions for the CPC

	Dimension
Processing Facilities Footprint (ft^2)	308,000
Support Facilities Footprint (ft^2)	280,000
Research and Development (ft^2)	57,000
Total Facilities Footprint (ft^2)	645,000
Area Developed during Construction (acres)	140
Post Construction Developed Area (acres)	110

Source: NNSA 2007.

CPC construction, operational materials and wastes. Tables 3.4.1-2 through 3.4.1-4 identify the construction and operational requirements for a CPC. As shown in Table 3.4.1-2, CPC construction requirements and wastes at LANL and SRS could be less than at all other sites because the existing plutonium infrastructure could be used. For Los Alamos, this SPEIS assumes that a CPC would not require additional construction in support of an R&D mission, as that mission currently exists at LANL. Additionally, the CMRR, a new planned facility for LANL, if built, could provide support to the CPC. For SRS, this SPEIS includes an analysis of both a stand-alone CPC and a CPC that would use the PDCF and infrastructure that are to be constructed in support of the Fissile Materials Disposition (FMD) Program (see Section 3.4.1.5 for more details). As shown in Table 3.4.1-2, NNSA has estimated that using these facilities/infrastructure could reduce construction requirements by approximately 25 percent.

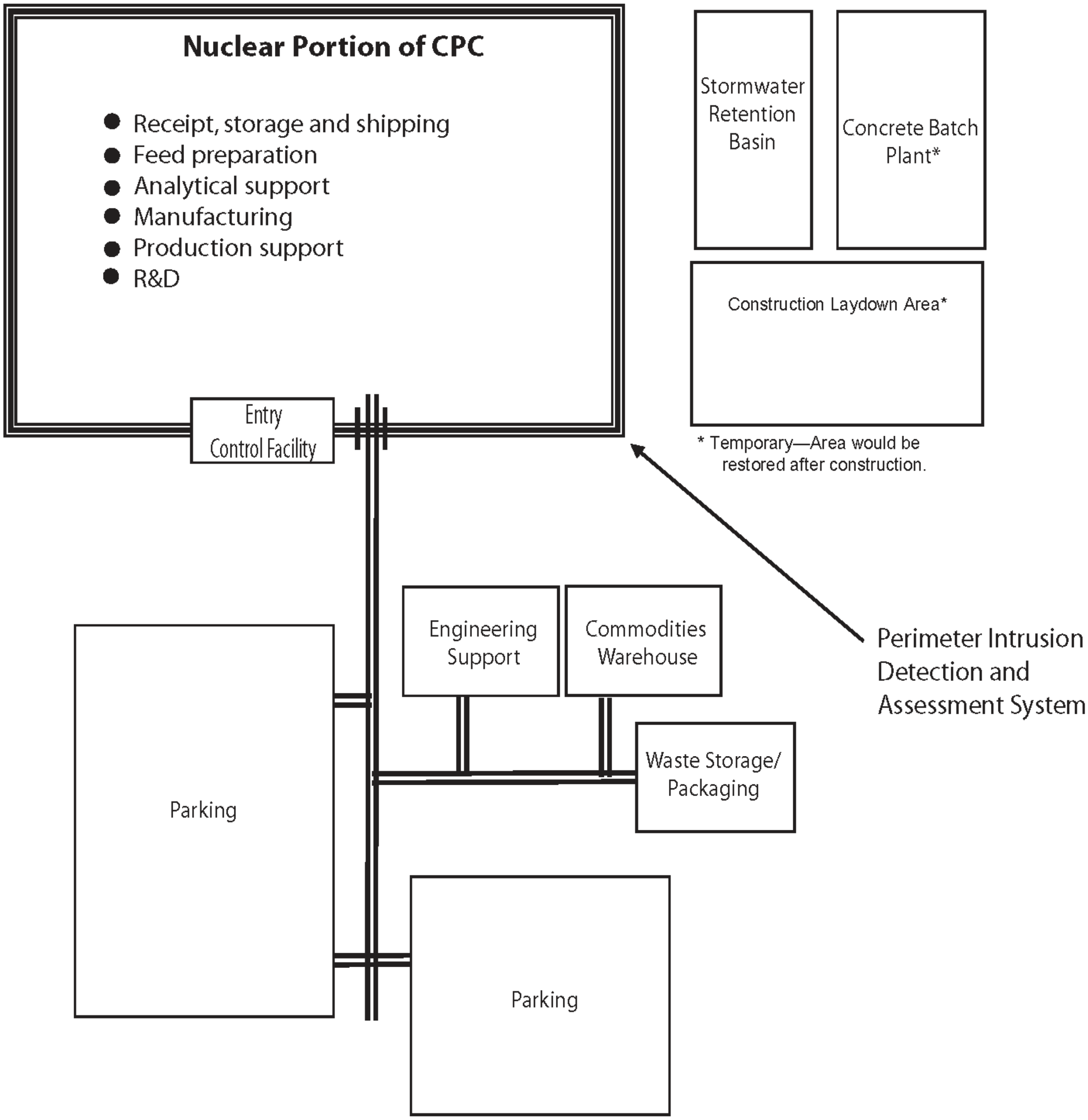


Figure 3.4.1-1—Generic Layout of a CPC

Table 3.4.1-2—CPC Construction Requirements

Requirement	Stand-alone CPC at SRS, Y-12, Pantex, NTS	CPC at Los Alamos[a]	CPC at SRS Using PDCF[a]
Electrical Energy (MWh)	13,000	12,000	12,000
Peak Electricity (MWe)	3.3	3.0	3.0
Concrete (yd^3)			
Total	308,000	280,000	280,000
Peak Yearly	107,000	97,000	97,000
Aggregate (yd^3)			
Total	288,000	262,000	262,000
Peak Yearly	79,000	72,000	72,000
Steel (tons)			
Total	44,000	40,000	40,000
Peak Yearly	11,900	10,800	10,800
Liquid Fuels (million gallons)			
Total	4.8	4.4	4.4
Peak Yearly	0.8	0.7	0.7
Gases (yd^3)			
Total	19,800	18,000	18,000
Peak Yearly	5,700	5,200	5,200
Water (million gallons)			
Total	20.9	20.9	20.9
Peak Yearly	5.6	5.6	5.6
Total Employment (Worker Years)	2900	2,650	2,650
Peak Employment (Workers)	850	770	770
Construction Period (years)	6	6	6
Hazardous Liquid Wastes (tons)	7.0	6.5	6.5
Nonhazardous Solid Wastes (yd^3)	10,900	9,800	9,800
Nonhazardous Liquid Wastes (gallons)	56,000	50,700	50,700

[a] Data in this table reflects the fact that CPC construction requirements at Los Alamos and SRS would be lower than at NTS, Pantex, and Y-12 due to the potential use of existing or planned plutonium infrastructure at those two sites.
Source: NNSA 2007

Table 3.4.1-3—CPC Operations Annual Requirements

Resources	CPC at LANL [200 pits per year (ppy) (surge)] [f]	CPC at SRS, Y-12, Pantex, NTS [200 ppy (surge) plus R&D]
Electrical Consumption[a] (MWh)	48,000	48,000
Peak Electrical (MWe)	11.0	11.0
Diesel Fuel[b] (gallons)	21,000	23,000
Nitrogen[c] (yd^3)	81,000	89,000
Argon[c] (yd^3)	2,000	2,200
Domestic Water[d] (gallons)	14,000,000	15,500,000
Cooling Tower Make-up (gallons)	66,000,000	73,000,000
Steam[e] (million pounds)	227	250
Total workers	1,170	1,780
Radiation workers	675	1,150

[a] Electrical: Based on 24 hrs/day, 365 days/yr.
[b] Diesel Fuel: Based on diesel generator testing 1 hr/week.
[c] Nitrogen and Argon: Annual consumption is based on 1 percent make-up.
[d] Domestic Water: Calculations for the annual consumption were based on 189 L/day/person, 240 days/year.
[e] Steam would require an energy source for generation. If coal were used, it would require 4,000 tons/yr. If natural gas were used, it would require 5,500,000 yd^3/yr.
[f] Los Alamos operational requirements for a CPC are less than the other four sites due to the fact that the plutonium R&D activities are part of the existing No Action Alternative at Los Alamos.
Source: NNSA 2007.

Table 3.4.1-4—CPC Operations Annual Waste Volumes

Annual Operating Waste Type	CPC at Los Alamos [200 ppy (surge)] [a]	CPC at SRS, Y-12, Pantex, NTS [200 ppy (surge) plus R&D]
TRU Solid (including Mixed TRU) (yd^3)	850	950
Mixed TRU Solid (included in TRU solid above) (yd^3)	310	340
LLW Solid (yd^3)	3,500	3,900
Mixed LLW Solid (yd^3)	2.3	2.5
Mixed LLW Liquid (yd^3)	0.4	0.4
Hazardous Solid (tons)	3.6	4.0
Hazardous Liquid (tons)	0.5	0.6
Nonhazardous Solid (yd^3)	7,400	8,100
Nonhazardous Liquid (gallons)	69,500	75,000

[a] Los Alamos operational wastes are less than the other four sites due to the fact that the plutonium R&D activities are part of the existing No Action Alternative at Los Alamos.
Source: NNSA 2007.

3.4.1.3 *CPC Transportation Requirements*

A CPC would require transportation activities as described in this section. Plutonium pit assemblies used as material feedstock would be shipped from Pantex to the CPC. EU parts would be disassembled from the pit assemblies and shipped to Y-12. Y-12 would recondition these parts and they would then be returned to the CPC, where they would be assembled with the plutonium components to produce weapons-ready pits for shipment to Pantex. During startup, and potentially at other infrequent times, additional plutonium metal could be required. This additional plutonium could be shipped to the CPC from SRS. Additionally, as discussed in Section 3.4.1.4, once a CPC becomes operational, Los Alamos would transfer its Category I/II SNM to the CPC if Los Alamos were not selected as the CPC site.

Both TRU waste and LLW would be generated at a CPC. DOE's Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, would be the destination for TRU waste from all CPC alternative sites. Three candidate sites (LANL, NTS, and SRS) have LLW disposal facilities and would dispose of LLW on-site. Although Y-12 has some LLW disposal capability, it currently ships its LLW to NTS for disposal. Pantex does not have any LLW disposal capacity and would have to ship LLW to the NTS, if Pantex were selected as the CPC site. A matrix depicting the origins, destinations, and materials shipped is provided in Table 3.4.1-5.

Table 3.4.1-5—Origins, Destinations, and Material Shipped to Support the CPC

Shipment Type	CPC at SRS	CPC at Pantex	CPC at Los Alamos	CPC at NTS	CPC at Y-12
Los Alamos Plutonium into CPC	LANL ⇒ SRS	LANL ⇒ Pantex	LANL ⇒ Los Alamos (intra-site transfer)	LANL ⇒ NTS	LANL ⇒ Y-12
Existing Pits from Pantex into CPC	Pantex ⇒ SRS	None	Pantex ⇒ Los Alamos	Pantex ⇒ NTS	Pantex ⇒ Y-12
EU from Y-12 into CPC	Y-12 ⇒ SRS	Y-12 ⇒ Pantex	Y-12 ⇒ Los Alamos	Y-12 ⇒ NTS	None
EU from CPC to Y-12	SRS ⇒ Y-12	Pantex ⇒ Y-12	Los Alamos ⇒ Y-12	NTS ⇒ Y-12	None
Pits from CPC to Pantex	SRS ⇒ Pantex	None	Los Alamos ⇒ Pantex	NTS ⇒ Pantex	Y-12 ⇒ Pantex
TRU waste out of CPC to WIPP	SRS ⇒ WIPP	Pantex ⇒ WIPP	Los Alamos ⇒ WIPP	NTS ⇒ WIPP	Y-12 ⇒ WIPP
LLW out of CPC	Onsite disposal	Pantex ⇒ NTS	Onsite disposal	Onsite disposal	Y-12 ⇒ NTS

3.4.1.4 *Phaseout NNSA Plutonium Operations and Remove Category I/II SNM from LANL*

If Los Alamos is not selected as a site for a CPC, NNSA proposes to phase-out plutonium operations and remove Category I/II SNM from Los Alamos by approximately 2022. Although the exact quantities of Category I/II SNM are classified, NNSA's Category I/II SNM at Los Alamos can be divided up into three basic categories: (1) programmatic material essential to NNSA; (2) surplus material not needed by NNSA; and (3) excess material with no certain future disposition plan.

Programmatic material. Category I/II inventories of nuclear material essential to the weapons program would be transferred to the eventual CPC or CNPC. This would involve four shipments of material. Shipments to the candidate sites (NTS, Pantex, SRS, and Y-12) were modeled and analyzed.

Surplus material. Surplus materials held at LANL would be assigned to the Fissile Material Disposition (FMD) Program. This material may be sent to SRS. In 2007, DOE prepared a Supplement Analysis (SA), which determined that the potential environmental impacts associated with the consolidation at SRS of surplus, non-pit, weapons-usable plutonium from Hanford, LLNL and LANL would not be a significant change from the potential environmental impacts associated with the alternatives analyzed in previous NEPA analyses (DOE 2007b). As a result, DOE decided to consolidate storage of surplus, non-pit, weapons-usable plutonium from

Hanford, LLNL, and LANL to SRS, pending disposition (72 FR 51807). Nonetheless, for completeness, this SPEIS includes an analysis of the transportation impact associated with disposition of all surplus plutonium from LANL to SRS. Another proposal, which is not addressed by the SA, is to transport surplus HEU to Y-12. This SPEIS assesses these impacts.

Excess material. Two scenarios have been analyzed for transporting materials at LANL designated as excess: (1) shipping excess HEU to Y-12 and excess plutonium to SRS; and (2) shipping all excess materials to SRS.

This SPEIS assesses the environmental impacts associated with:

- Packaging and unpackaging Category I/II SNM
- Transporting Category I/II SNM from LANL to receiver sites
- Phasing out Category I/II SNM operations from LANL

Table 3.4.1-6—Phaseout of NNSA Plutonium Operations at LANL

Socioeconomics	610 jobs could be affected 483 jobs would be radiation workers.
Wastes	LLW: decrease by 990 yd^3 annually. MLLW: decrease by 20 yd^3 annually TRU: decrease by 690 yd^3 annually.
Radiation Dose to Workers	Dose to workers would decrease by 90 person-rem.
50-mile Population Dose	TA-55 contributes 0.19 person-rem/yr to dose.
Air Emissions	TA-55 emits approximately 0.00082 Curies of plutonium annually.

Source: NNSA 2007.

3.4.1.5 *Candidate Sites for a CPC*

Figures 3.4.1-2 thru 3.4.1-6 identify the reference locations for a CPC at the five candidate sites. Reference locations were identified at each site, consistent with the environmental analysis in this SPEIS, to evaluate the potential environmental impacts of a CPC. These reference locations were designated by the site offices so as to not conflict or interfere with existing or planned operations. The characterization of the affected environment in Chapter 4 of this SPEIS addresses the entire candidate site and the affected region surrounding the site. Each region varies by resource, but generally extends to a 50-mile radius from the center of each site.

Two of the sites under consideration for pit production function (Los Alamos and SRS) have existing and/or planned facilities that could be used to support production activities. The facilities could influence the location of any new facilities. This SPEIS analyzes options that would use these facilities. Section 3.4.1.6 discusses the Los Alamos option. The SRS option is discussed below.

At SRS, the reference location was selected to provide proximity to the PDCF. This location would support either a greenfield CPC or use of the infrastructure associated with the PDCF. The project scope for the PDCF includes the following capabilities and modules: pit receipt, storage, and preparation; pit disassembly; plutonium recovery and oxide conversion; tritium capture and recovery or disposal; oxide blending and sampling; non-destructive assay; product canning and storage; product inspection and sampling for international inspection; product shipping; declassification of parts not made from special nuclear materials; HEU decontamination, oxide conversion, packaging, storage and shipping; and waste packaging, sampling and certification. Support areas within the main building include: an analytical laboratory; mechanical equipment rooms; maintenance shops; ventilation exhaust rooms; waste storage; truck bay; and office areas. The following functions could likely be shared between a CPC and the PDCF: pit receipt, storage, and preparation; pit disassembly; some portions of plutonium recovery and oxide conversion; analytical laboratory; packaging, storage, and shipping; and waste management packaging, sampling and certification. For all practical purposes, the shared functions could be consolidated if these were not separated facilities. The PDCF capability is sized for a higher capacity than the CPC capability. Combining shared functions of the PDCF and the CPC could yield a floor space savings of approximately 27,000 square feet of hardened floor space; thus, a smaller CPC could be built at SRS (NNSA 2007).

3.4.1.6 *Los Alamos CPC Alternatives*

For purposes of assessing a CPC at Los Alamos, this SPEIS evaluates three approaches: (1) a greenfield CPC alternative (previously discussed in Section 3.4.1), in which new nuclear facilities would be constructed; (2) an upgraded alternative in which existing and planned facilities at Los Alamos are upgraded and augmented with new facilities to achieve a baseline of 125 pits per year for single shift operations (Upgrade Alternative); and (3) an upgrade of existing and planned facilities that would provide up to 80 pits per year (50/80 Alternative[19]). These latter two approaches are described in this section.

[19] The name “50/80 Alternative” reflects the fact that this alternative would expand pit production capacity up to 80 pits per year.

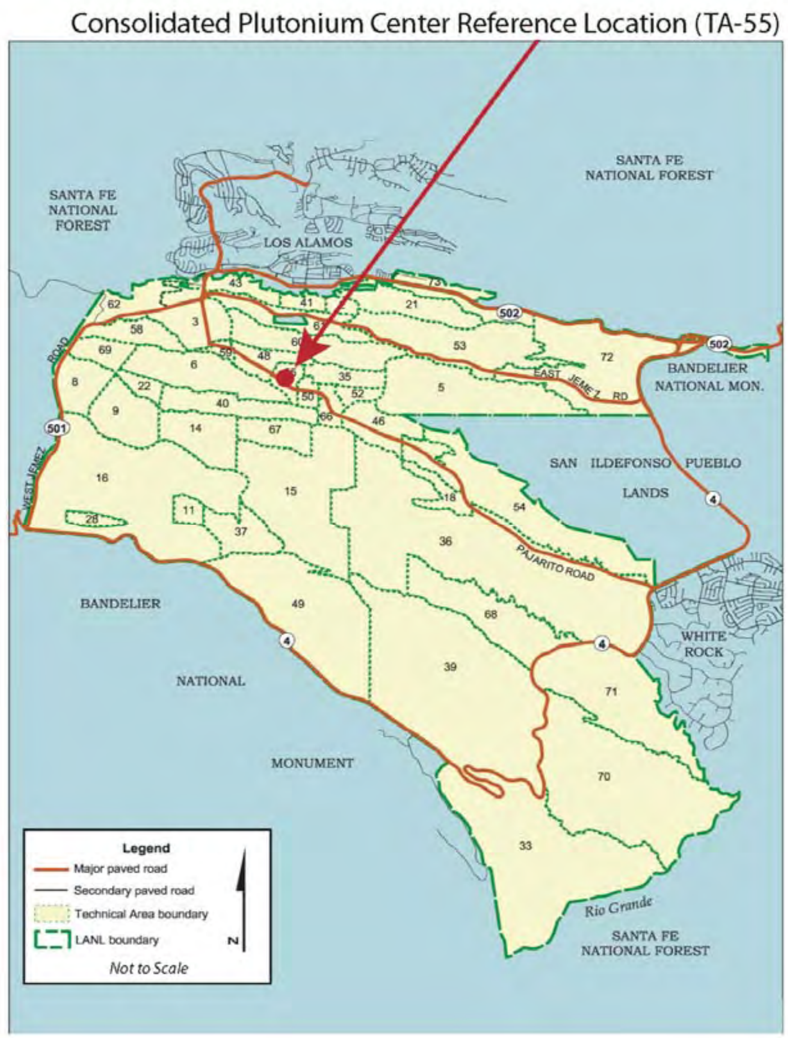


Figure 3.4.1-2—Los Alamos CPC Reference Location

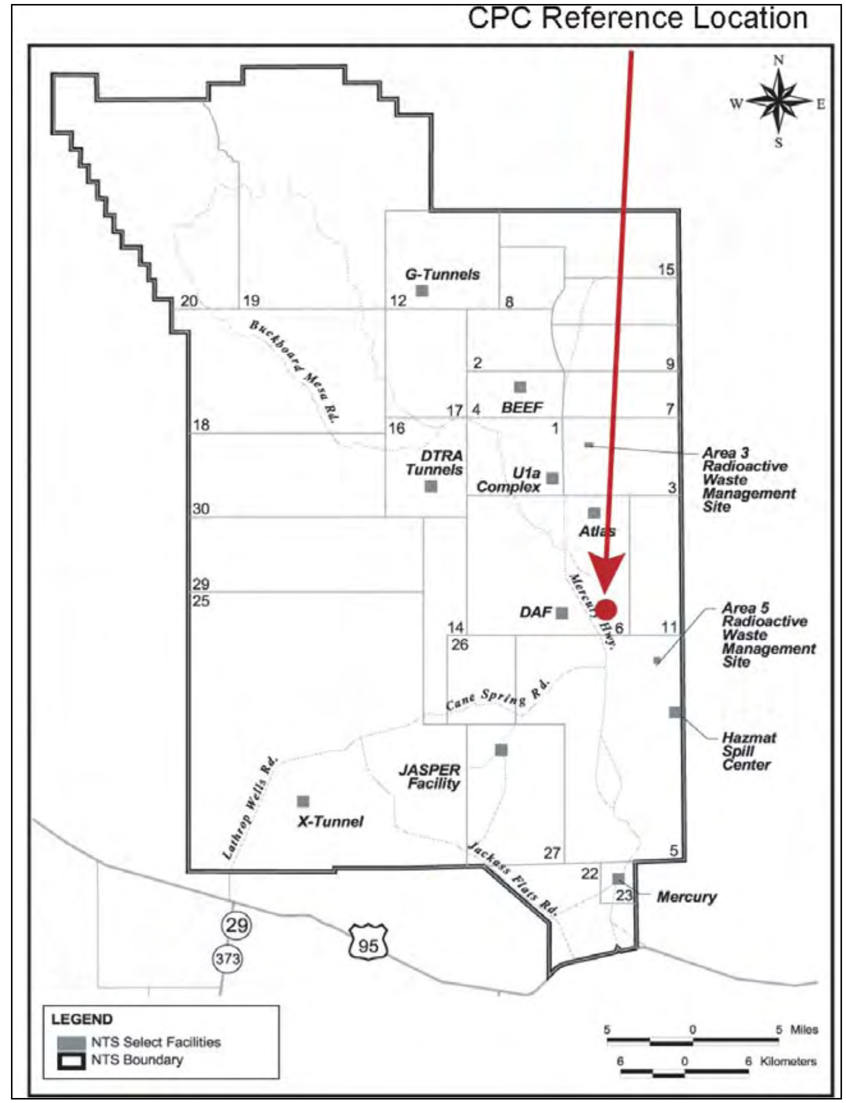


Figure 3.4.1-3—NTS CPC Reference Location

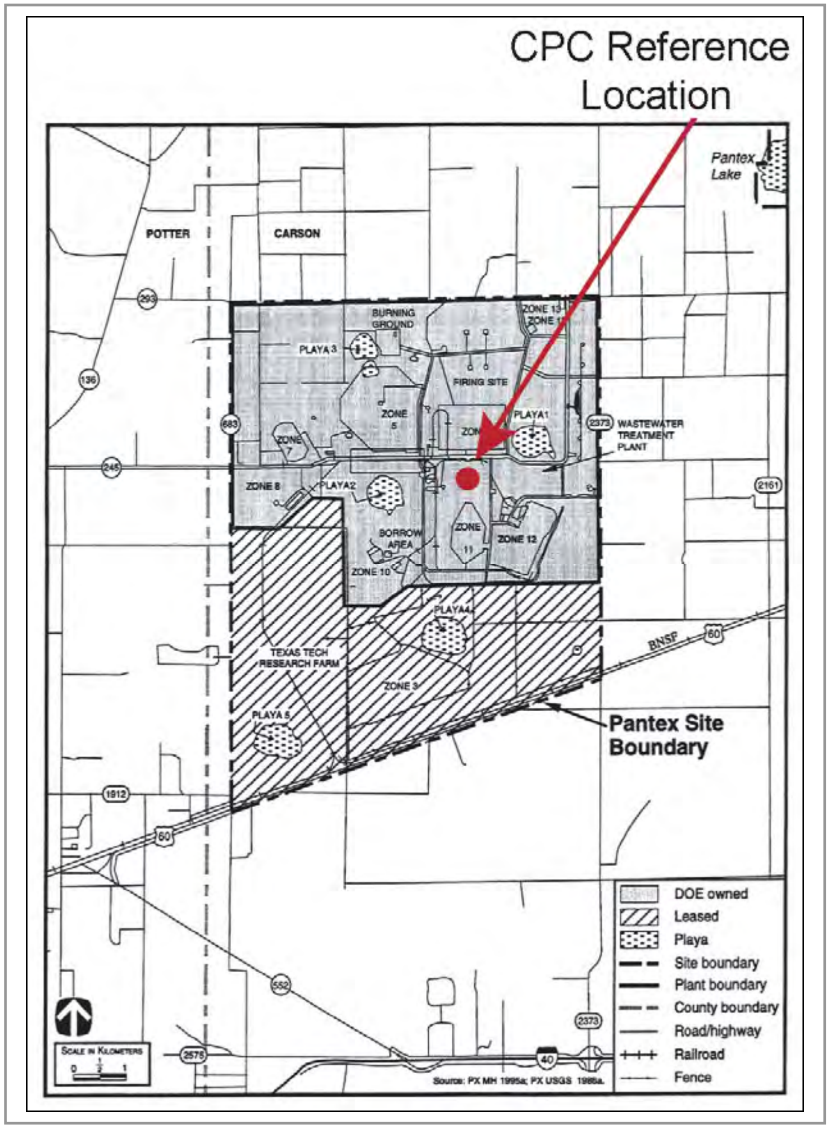


Figure 3.4.1-4—Pantex CPC Reference Location

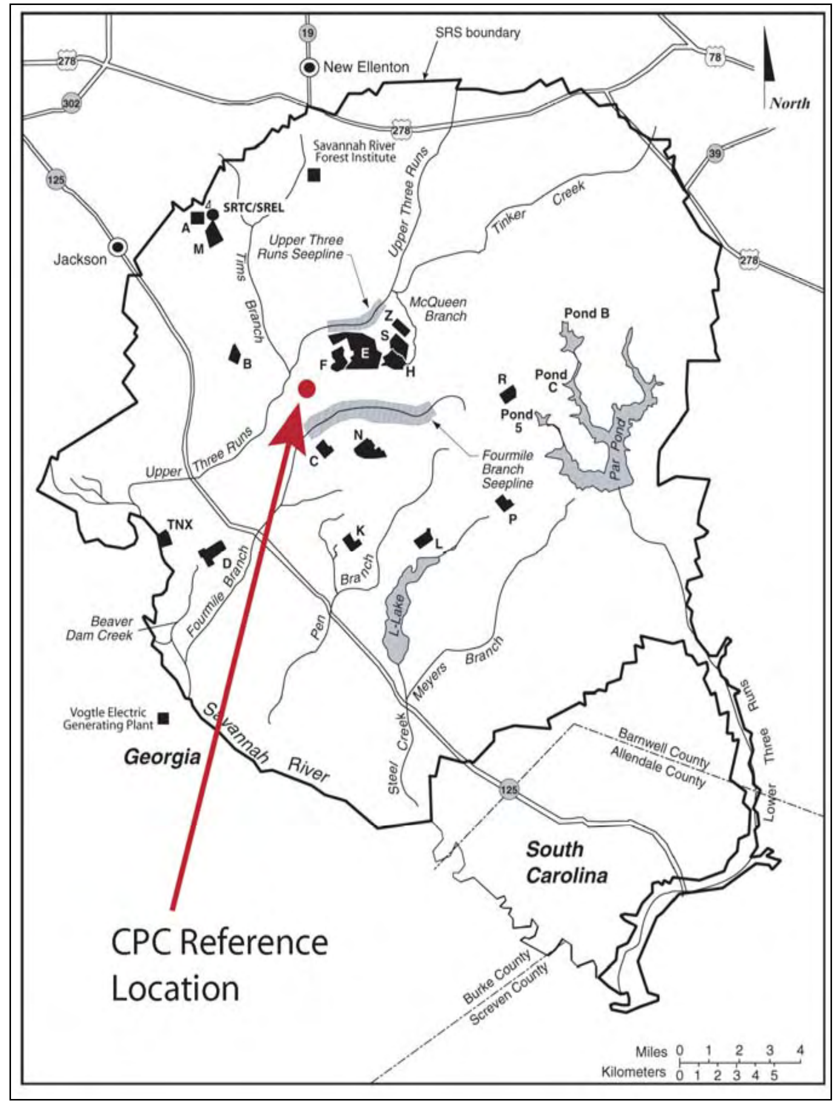


Figure 3.4.1-5—SRS CPC Reference Location

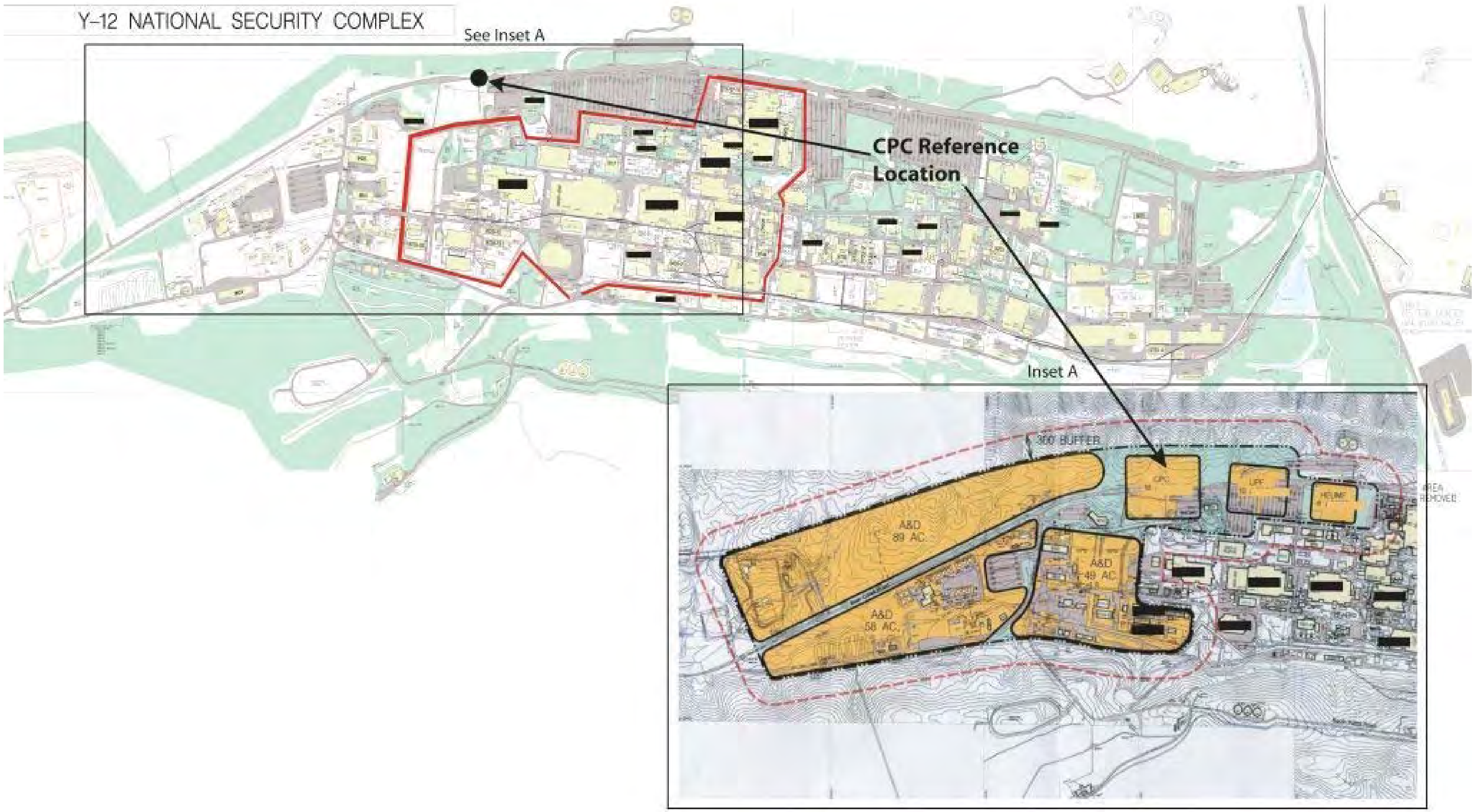


Figure 3.4.1-6—Y-12 CPC Reference Location

3.4.1.6.1 Los Alamos Upgrade Alternative

Los Alamos could support pit production requirements using existing and new facilities at TA-55, which is the current site of the Plutonium Facility (PF-4) and future site of the Chemistry and Metallurgy Research Building Replacement (CMRR) Facility. The programmatic operations at TA-55 are supported by several facilities, all of which are included in the No Action Alternative, including:

- The Radioactive Liquid Waste Treatment Facility (RLWTF);
- The solid waste characterization and disposal site (TA-54);
- The Chemistry and Metallurgy Research (CMR) Building (TA-03-29);
- The Sigma Building (TA-03-66); and
- The Radiochemistry Facility (TA-48, RC-1).

In addition, previously planned facilities that would support plutonium operations include:

- The CMRR Facility;
- A new radiography facility; and
- A new solid-waste staging facility.

Estimated modifications to support the Los Alamos Upgrade Alternative. Using the existing TA-55, the pit production capacity could be enhanced from the current capacity to approximately 125 pits per year for single shift operations by the following:

1. Expanding the scope and the size of the planned CMRR Facility; and/or
2. Constructing a new facility (known as the “Manufacturing Annex”) to augment existing pit-manufacturing capacity, the planned CMRR Facility, and related infrastructure capacity.

Both approaches would result in the addition of up to 400,000 square feet of space at TA-55, either as one or more stand-alone facilities (e.g., the Manufacturing Annex, which would be comprised of a Manufacturing Annex Nuclear Facility and a light laboratory/utility/office building [LLUOB])) or as an addition to the CMRR. As such, the environmental impacts are not expected to differ significantly. This SPEIS analyzes the environmental impacts of the addition of a Manufacturing Annex to provide the additional pit manufacturing, supply/recovery, and/or analytical chemistry support.

Based on prior planning information (NNSA 2007), the new Manufacturing Annex would be approximately the same size as the buildings in the current CMRR project (which would consist of the Chemistry and Metallurgy Research Replacement Nuclear Facility and a radiological laboratory/utility/office building [RLUOB]). This annex would be located near the existing PF-4 structure to minimize the logistics of material and personnel movements between the facilities, which would take place through hardened tunnels. An overhead conceptual view of this configuration is shown in Figure 3.4.1-7.

RLUOB=Radiological Laboratory/Utility/Office Building
CMRR NF=Chemistry and Metallurgy Research Replacement Nuclear Facility
LLUOB=Light Laboratory/Utility/Office Building

Figure 3.4.1-7—TA-55 site plan showing the Proposed CMRR and Manufacturing Annex Facilities

The impacts of construction requirements of the Manufacturing Annex would be approximately the same as those for the CMRR project with selected additions to accommodate possible remodeling of PF-4. These data are shown in Table 3.4.1-7. The Los Alamos Upgrade Alternative would be expected to operate similar to the greenfield CPC at Los Alamos. As such, the operational data in Tables 3.4.1-3 and 3.4.1-4 would be applicable to this alternative.

Table 3.4.1-7—Construction Requirements for the Los Alamos Upgrade Alternative

Requirements	Consumption/Use
Peak Electrical energy (MWe)	2.0
Diesel Generators (Yes or No)	Yes
Concrete (yd^3)	3,715
Steel (tons)	401
Water (gal)	2,111,800
Land (acre)	
Laydown Area Size	2
Parking Lots	5
Total Square Footage (ft^2)	400,000
Post-Construction Footprint	6.5
Employment	
Total employment (worker years)	1,100
Peak employment (workers)	300
Construction period (years)	3.6
Waste Generated	
Transuranic Waste Contact Handled (yd^3)	200
Low level (yd^3)	200
Nonhazardous (Sanitary and Other) tons	578

Source: NNSA 2007.

3.4.1.6.2 Los Alamos Upgrade Alternative to Produce Up to 80 Pits per Year ("50/80 Alternative")

The 50/80 Alternative is evaluated to allow NNSA to consider an alternative with a pit production capacity of less than 125 pits per year. Minor internal modifications to Building PF-4 and completion of the CMRR Facility would be needed to support production of up to 80 pits per year.[20] Within TA-55/PF-4, NNSA would remodel existing space, consolidate some missions where space is not being fully utilized, and perhaps move some activities to locations where similar activities are conducted. For the period evaluated in this SPEIS, it is assumed that the Plutonium-238 mission would remain within TA-55 and PF-4.

The 50/80 Alternative is evaluated to identify impacts from reductions in pit production needs. PF-4 at TA-55 is the only existing plutonium facility capable of being upgraded to support this level of pit production (50/80 pits per year) without major construction. Implementation of the 50/80 Alternative (if selected) would be timed to minimize disruption of LANL's interim small-scale pit production activities, which are needed to meet current requirements.

The 50/80 Alternative differs from a greenfield CPC in several important aspects. First, this alternative assumes that NNSA would produce up to 80 pits per year; a CPC would produce 125 pits per year for single shift operations and is assessed at a bounding rate of 200 pits per year multiple shifts and extended work weeks. Next, the upgraded facility may not have a design life of 50 years (the design life for a CPC) without additional upgrades because the existing facility would have already operated for 40 years by approximately 2022.

Modifications would include major upgrades to the residue recovery/metal feed facilities in the 400 Area of PF-4. Many of the gloveboxes in this part of the facility would have to be replaced. Replacement of these older gloveboxes would be required to ensure that the recovery/feed process operations are adequate to supply plutonium metal to the manufacturing operations. There would also be significant glovebox decontamination, decommissioning, and disposal operations as new process development and certification operations are moved into other areas of PF-4. In addition, various manufacturing equipment would be added or replaced in the fabrication areas of PF-4 to increase capacity and reliability. Other upgrades at TA-55 would include heating, ventilation, and air conditioning systems; PF-4 roof replacement; confinement doors in PF-4; criticality alarm system; fire sprinkler piping; fire alarm system; replacement of cooling towers; seismic upgrades; and others.

The 50/80 Alternative includes completing the previously analyzed CMRR facility. The construction of CMRR would disturb 6.5 acres during construction and add approximately 2.5 acres to the permanent TA-55 footprint.

The Radioactive Liquid Waste Treatment Facility (TA-50) and the Solid Waste Management Facility (TA-54) would be capable of processing waste streams even with an enhanced

[20] In the Draft SPEIS, a 9,000 square feet addition to the CMRR was assessed as a means to support consolidation of plutonium operations from LLNL, provide increased analytical chemistry support for increased pit production capacity, and ensure sufficient nuclear space as a contingency. Subsequent to that assessment, NNSA concluded that the 9,000 additional square feet is unnecessary to support the consolidation of plutonium activities. Therefore, NNSA is no longer considering an addition of 9,000 square feet to the CMRR.

fabrication mission of 80 pits per year. Tables 3.4.1-8 through 3.4.1-10 list the construction and operational material requirements and waste volumes for the 50/80 Alternative.

Table 3.4.1-8—Los Alamos 50/80 Alternative Construction Requirements

Requirement	Consumption/Use
Electrical Energy (MW-hr)	1.0
Concrete (yd^3)	32,750
Aggregate (yd^3)	In Concrete
Steel (tons) including rebar	3,850
Gases (yd^3)	4,000
Water (gal)	550,000
Employment	
Total (Worker Years)	430
Peak (Workers)	190
Radiation Workers	0
Construction Period (yrs)	4

Source: NNSA 2007.

Table 3.4.1-9—Los Alamos 50/80 Alternative Annual Operating Requirements

Requirement	Consumption/Use
Electrical Energy (MW-hr)	44,000
Peak Electricity (MWe)	10
Domestic Water (gal)	10,000,000 + 33,000,000 (cooling water)
Employment	
Total Workers	680
Radiation Workers	458

Source: NNSA 2007.

Table 3.4.1-10—Los Alamos 50/80 Alternative Waste Volumes

Waste	Annual Operating	Construction
TRU Waste		
Solid (includes Mixed TRU Solid) (yd^3)	575[a]	0
Liquid (yd^3)	6.5	0
Mixed TRU Waste		
Solid (included in TRU Solid) (yd^3)	2.6	0
Liquid	0	0
LLW		
Solid (yd^3)	1850	0
Liquid (yd^3)	19.5	0
Mixed LLW		
Solid (yd^3)	65	0
Liquid (yd^3)	0	0
Hazardous		
Solid (tons)	265	0
Liquid (tons)	2.6	4
Nonhazardous		
Solid (yd^3)	700	9,750
Liquid (gallons)	16,000	7,800

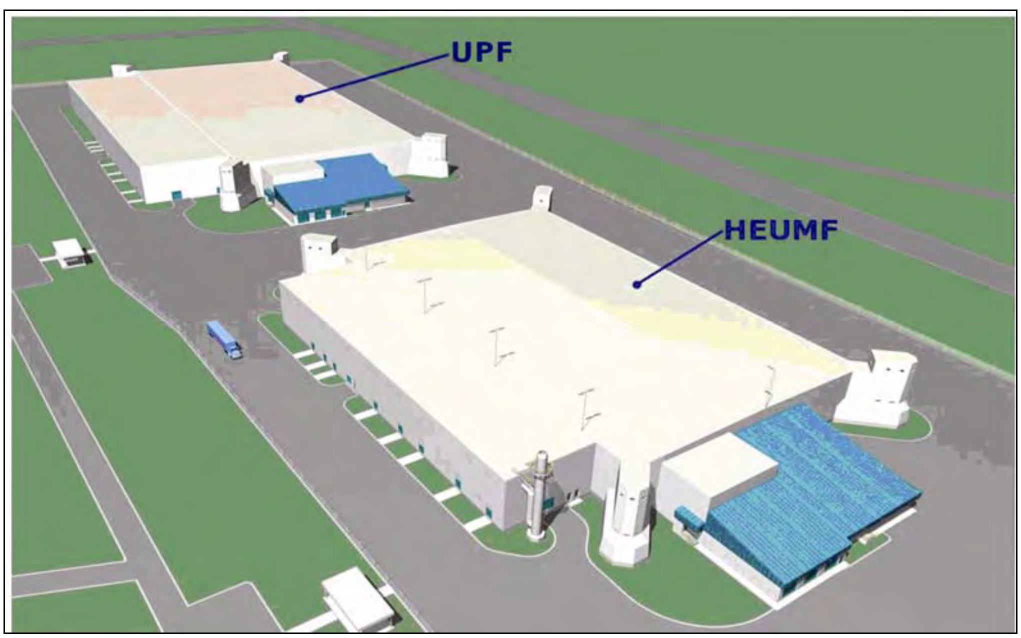
Source: NNSA 2007.

[a] Includes 75 yd^3/yr over a 10-year period to replace gloveboxes in PF-4.

3.4.2 Uranium Processing Facility at Y-12

As discussed in Section 3.2.9, Y-12 manufactures nuclear weapons secondaries, cases, and other weapons components; evaluates and performs testing of these weapon components; maintains Category I/II quantities of HEU; conducts dismantlement, storage, and disposition of nuclear weapons materials; and supplies HEU for use in naval reactors. The UPF would consolidate many of these operations into an integrated manufacturing operation sized to satisfy all identified programmatic needs. The UPF would be sited adjacent to the Highly Enriched Uranium Materials Facility (HEUMF), which recently completed construction, to allow the two facilities to function as an integrated operation. A site-wide EIS for Y-12 is currently being prepared and is assessing alternatives, including a UPF at Y-12 (70 FR 71270) (see Section 1.5.2.2). Transition of Y-12 operations to this configuration would enable the high security area to be reduced by 90 percent. As described below, would significantly improve physical protection; optimize material accountability; enhance worker, public, and environmental protections; and reduce operational costs.

The proposed UPF would replace multiple existing enriched uranium (EU) and other processing facilities. The current operating and support areas occupy approximately 633,000 square feet in multiple buildings, while a UPF would result in approximately a 33 percent reduction, to approximately 400,000 square feet in one building. Once a UPF were operational, some existing facilities would be available for decontamination and decommissioning (D&D), while other facilities could be used for non-EU processes. Figure 3.4.2-1 shows an artist's rendering of the proposed UPF. Figure 3.4.2-2 shows the location of a UPF relative to other buildings at Y-12.



Source: NNSA 2005c.

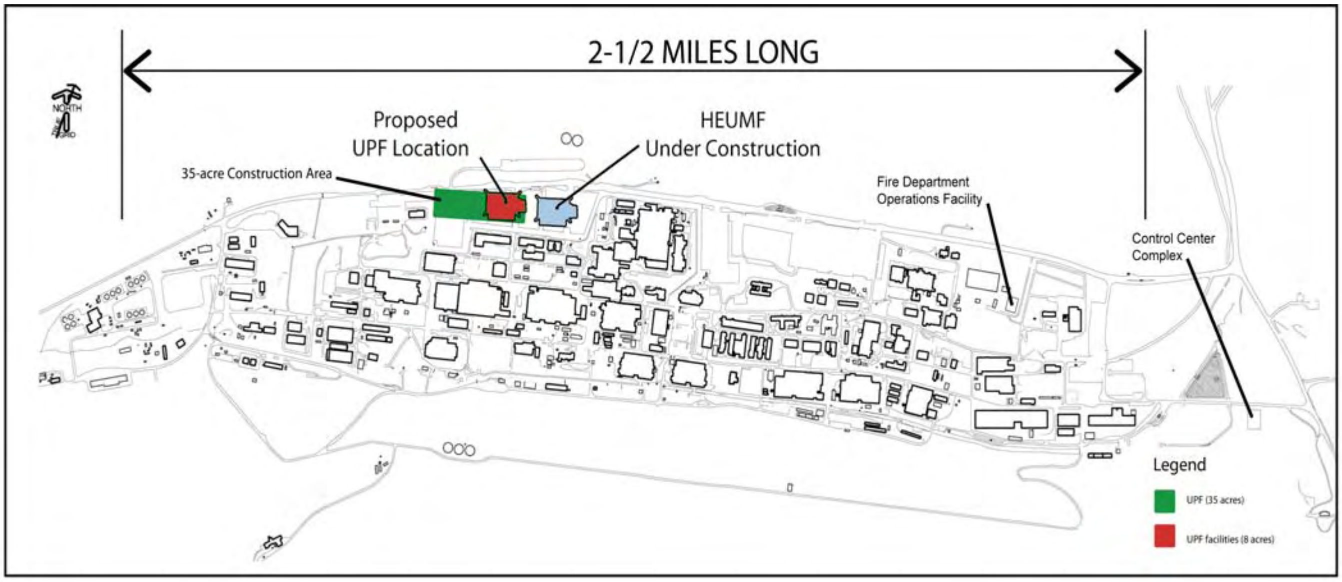
Figure 3.4.2-1—Artist's Rendering of a UPF Adjacent to the HEUMF

3.4.2.1 *UPF Construction*

The new structures and support facilities that would constitute a UPF complex include:

- UPF building;
- UPF electrical switching center;
- chiller building and chiller building switch center;
- cooling tower;
- aboveground water tank for a seismic-qualified firewater system with a firewater pumping facility;
- electrical generators; and
- modified PIDAS to encompass the UPF complex.

The design life of a UPF would be 50 years. It would be equipped with safety support systems to protect workers, the public, and the environment, and would be housed in a multistory, reinforced concrete building designed for safety and security. The main building would be a concrete structure with reinforced exterior walls, floor slabs, and roof. The preliminary schedule for the project calls for site preparation beginning in approximately 2010, with completion by approximately 2016, and operations beginning by approximately 2018. As shown on Figure 3.4.2-2, construction of a UPF would require approximately 35 acres of land, which includes land for a construction laydown area and temporary parking. Once constructed, the UPF facilities would occupy approximately 8 acres.



Source: NNSA 2007.

Figure 3.4.2-2—Proposed Location of a UPF at Y-12

Table 3.4.2-1 lists the construction material requirements and wastes for a UPF.

Table 3.4.2-1—UPF (based on a HEUMF) Construction Requirements and Estimated Waste Volumes

Requirements	Consumption
Materials/Resource	
Peak Electrical energy (MWe)	2.2
Concrete (yd^3)	200,000
Steel (tons)	27,500
Liquid fuel and lube oil (gallons)	250,000
Water (gal)	4,000,000
Aggregate (yd^3)	5,000
Land (acres)	35
Employment	
Total employment (worker years)	2,900
Peak employment (workers)	900
Construction period (years)	*6*
Waste Generated	
Low-level Waste	
Liquid (gallons)	0
Solid (yd^3)	70
Hazardous (tons)	4
Nonhazardous (Sanitary) (tons)	800

Source: BWXT 2006a.

3.4.2.2 *UPF Operations*

The core operations of a new UPF would be assembly, disassembly, quality evaluation, specialized chemical and metallurgical operations of EU processing, and product certification and inspection. The material processing areas within a UPF would use gloveboxes, inert atmosphere, negative air pressure, and other engineered controls, supported by administrative controls, to protect workers and the public from exposure to radiological and hazardous materials. Exhaust emissions for the facility would comply with applicable Federal and state requirements. In conjunction with other engineered containment measures, the ventilation system barriers would provide a layered system of protection.

Other systems in a UPF for facility operation and Environment, Safety and Health (ES&H) protection include:

- Criticality Accident Alarm System
- Emergency Notification System
- Alarm System
- Fire Suppression Alarm Systems
- Telephone and public address system
- Classified and unclassified computer network
- Personnel Monitoring System
- Security-related sensors
- Automated inventory system with continuous real-time monitoring

Table 3.4.2-2 lists the operations requirements the UPF.

Table 3.4.2-2—UPF Annual Operation Requirements and Estimated Waste Volumes

Requirements	Consumption
Materials/Resource	
Electrical energy (MWh/yr)	168,000
Peak electrical demand (MWe)	18.4
Natural gas (yd^3)	894,000
Water (gallons)	105,000,000
Plant footprint (acres)	8
Employment	
Total Workers	600
Radiation Workers	315
Waste Generated	
Low-level	
Liquid (gallons)	3,515
Solid (yd^3)	7,800
Mixed Low-level	
Liquid (gallons)	3,616
Solid (yd^3)	21
Hazardous (tons)	14
Non-hazardous (Sanitary) (tons)	7,125
Non-hazardous liquid (gallons)	50,000

Source: BWXT 2006a.

3.4.3 Upgrade Existing Enriched Uranium Facilities at Y-12

NNSA could upgrade the existing EU facilities. In that case, there would be no UPF and the current high-security area would not be reduced. The upgrade projects would be internal modifications to existing facilities and would improve protection for worker health and safety and extend the life of existing facilities. If a UPF were not constructed at Y-12, major investments above and beyond normal maintenance would be required for continued operations in the existing facilities, including structural upgrades; heating, ventilating, and air conditioning (HVAC) replacements; and fire protection system replacement/upgrades (see Appendix A for a detailed discussion of the specific upgrades). The projects would improve airflow controls between clean, buffer, and contamination zones; upgrade internal electrical distribution systems; and reinforce a number of structures to comply with current natural phenomena criteria (DOE-STD-1023-95).

For the purpose of this analysis, it is assumed that the upgrades would be performed over a 10-year period following issuance of a SPEIS ROD. This would enable NNSA to spread out the capital costs associated with the upgrades, and minimize disruption of operations. Conventional construction techniques would be used for upgrade projects. Table 3.4.3-1 lists the construction requirements associated with the upgrades. In terms of operations, there would be no change from the No Action Alternative.

Table 3.4.3-1—Construction Data for Upgrading Existing Uranium Facilities

Requirements	Consumption
Materials/Resource	
Electrical energy use (MWh)	No significant change compared to current site use
Concrete (yd[3])	No significant change compared to current site use
Steel (tons)	No significant change compared to current site use
Water (gallons/year)	4.2 million
Aggregate (yd^3)	No significant change compared to current site use
Land (Laydown Area)	<7 acres
Employment	
Total employment (worker years)	1,000
Peak employment (workers)	300
Construction period (years)	10
Wastes	
Hazardous	
Liquid (gallons)	No significant change compared to current site use
Solid (tons)	14

Note: "No change from current" represents estimated 2006 usage (see Section 4.9 for information related to current site use).
Source: BWXT 2006a.

3.5 PROGRAMMATIC ALTERNATIVE 2: CONSOLIDATED CENTERS OF EXCELLENCE

NNSA also evaluates an alternative in this SPEIS involving consolidated centers of excellence (CCE). The CCE Alternative would consolidate the three major SNM functions (plutonium, uranium, and weapon assembly/disassembly) involving Category I/II quantities of SNM into a consolidated nuclear production center (CNPC) at one site or into consolidated nuclear centers (CNC) at two sites. Depending upon the option selected, this alternative could result in the end of all nuclear weapons operations at up to two sites (e.g., Y-12 and Pantex). The program, capability, and facility requirements for the CCE alternative are described below. More details are in Appendix A.

Requirements and Assumptions

- A CCE alternative would be sized and configured to support the nuclear weapons stockpile after full implementation of the *Moscow Treaty*. The upper bound of the capacities would support delivery of 125 weapon assemblies per year to the stockpile in five-day, single-shift operations. Multiple shift operation and extended work weeks would yield up to 200 weapon assemblies per year.

- Fabrication, inspection, and assembly equipment would support the fabrication of new replacement weapons (such as RRWs), legacy weapons or a combination of both. In general, the ability to produce legacy weapons would also provide the capability to produce new replacement weapons. NNSA expects that replacement weapons such as RRWs would use fewer hazardous materials than found in most legacy weapons and require production tolerances within the range of those required for legacy weapons.

- The CCE alternative includes three major facilities: a consolidated plutonium center (CPC), consolidated uranium center (CUC), and the A/D/HE Center. As explained in Section 3.5.2, there is an option to separate the weapon A/D/HE mission to allow NNSA to consider an alternative that locates nuclear production facilities at a different site than the A/D/HE mission.

- All Category I/II SNM required by NNSA would be stored at the CCE facilities.

- CCE facilities would have a useful service life of at least 50 years without major renovation.

- CCE facilities could be located at one or more of the following sites: Los Alamos, Pantex, NTS, SRS, and Y-12.

- A modular arrangement of facilities (a campus) is assumed for the CCE options rather than separate operational wings of a single large facility under one roof. The facilities making up the CCE campus would be configured so that they can be constructed sequentially. Building a single building to house CCE functions was not considered reasonable due to the need to bring facilities on-line in sequence and the fundamental differences in uranium, plutonium, and assembly/disassembly operations.[21] The assumed schedule for the CCE facilities is shown in Table 3.5-0:

Table 3.5-0—Schedule for Consolidated Centers of Excellence Facilities:

Facility	Start Detailed Facility Design	Begin Operations
CUC	2009	2018
CPC	2012	2022
A/D/HE Center	2015	2025

- It is assumed that facilities at Y-12 and Pantex whose missions would be included in the CCE alternative would be put into brought to a safe shutdown condition as soon as possible if these sites were not selected for a CCE option.

- A CNPC or CNC would consist of a central area that includes all operations involving Category I/II quantities of SNM that would be surrounded by a PIDAS. A buffer area would provide an unobstructed view of the area surrounding the PIDAS. Support facilities requiring lower levels of security protection would be outside the PIDAS. The land requirements for operation of a CNPC and CNC are shown in Tables 3.5-1 and 3.5-2.

Table 3.5-1—Land Requirements to Operate a CNPC*

Operation (acres)	**Total Area: 545***	
	PIDAS	**Non-PIDAS**
	Total: 235 • CPC: 40 • CUC: 15 • A/D/Pu Storage: 180	**Total: 310** • Non-SNM component production: 20 • Administrative Support: 70 • Explosives Area: 120 • Buffer Area: 100

*Total land area for CNPC at Y-12 would be reduced by approximately 27 acres due to existing uranium production facilities, including the HEUMF.

Table 3.5-2—Land Requirements to Operate a CNC*

Operation (acres)	**Total Area: 195***	
	PIDAS	**Non-PIDAS**
	Total: 55 • CPC: 40 • CUC: 15	**Total: 140** • Non-SNM component production: 20 • Administrative Support: 70 • Buffer Area: 50

*Total land area for CNC at Y-12 would be reduced by approximately 27 acres due to existing uranium production facilities, including the HEUMF.

[21] The facilities that would constitute a CCE would be separate buildings in a campus because they have different and unique safety and operational requirements, and it would not be technically feasible to make them part of a single large facility without having separate systems for the operation of the three facilities and other physical features (blast wall separation, etc.) to keep them separate. They would be built in sequence because they are very complex facilities and the potential realities of construction logistics, cash flow, and start-up management would not support a single facility. Building them in sequence reduces the construction management risk and allows lessons learned from one to benefit the others. The CUC would be first because the existing uranium facilities at Y-12 (except the HEUMF) are very old. The CPC would be built second because the LANL facilities, with a CMRR, can handle the immediate need for pits. The weapons A/D/HE facilities would be built last because there is less programmatic urgency than for the CUC and CPC.

3.5.1 Consolidated Nuclear Production Center Option

This option would consolidate the three major SNM functions (plutonium, uranium, and A/D/HE) involving Category I/II quantities of SNM into a consolidated nuclear production center (CNPC) at one site. Depending upon the site selected for a CNPC, this option could result in the cessation of NNSA weapons operations at up to two sites (e.g., Y-12 and Pantex). Under this option, NNSA would construct and operate a CNPC, as described in Section 3.5, at SRS, Y-12, Pantex, NTS, or Los Alamos. The CNPC would combine three major facilities: CPC, CUC, and the A/D/HE Center. The description of the CPC is in Section 3.4.1 and is not repeated below. The sections below describe the other major CNPC facilities: the CUC (Section 3.5.1.1) and the A/D/HE Center (Section 3.5.1.2). In addition, Section 3.5.1.3 describes the transport of plutonium and HEU to the CNPC to support future NNSA needs. Finally, Section 3.5.1.4 discusses site-specific characteristics of the alternative sites that could affect the manner in which a CNPC might be implemented. For example, a CNPC located at Pantex would not require the construction of the A/D/HE Center, as Pantex currently performs that mission in existing facilities that would not require major renovations to continue operations for years. Section 3.5.1.4 also identifies the reference locations for the CNPC at each site alternative. A generic layout of the CNPC is shown in Figure 3.5.1-1.

3.5.1.1 *Consolidated Uranium Center*

A CUC would have a nuclear facility located within a heavily protected area (PIDAS), and non-nuclear support facilities outside the PIDAS. The nuclear facility would consist of a UPF, which is described in Section 3.4.2, and a storage facility for HEU.[22] The nuclear facility would process HEU, produce nuclear weapon secondary components, provide the capability to perform Category I/II HEU R&D in support of LANL and LLNL, and store HEU. The non-nuclear facilities would contain the non-nuclear production equipment, and support functions. The facility would also contain the chemical processes, fabrication operations, support functions associated with the production of lithium-hydride and lithium-deuteride components, and general manufacturing capabilities. For this analysis, it is assumed that a CUC could be built at any of the sites on approximately the same timeframe that a UPF could be built at Y-12. A CUC would be constructed over a six year period, beginning in approximately 2010, with completion by approximately 2016, and operations beginning by approximately 2018.

The land requirements for a CUC are shown in Table 3.5-3.

Table 3.5-3—Land Requirements for CUC*

Construction (acres)	**50**	
Operation (acres)	**Total Area: 35****	
	PIDAS	**Non-PIDAS**
	15	20

* At Y-12, a UPF would be constructed (see Section 3.4.2). The UPF would require a total of 8 acres rather than the 35 acres required for a CUC.
****** Includes a buffer area that would provide unobstructed view of the area surrounding the PIDAS.

[22] A CUC at Y-12 would not require construction of a new HEU storage facility because NNSA recently completed construction of a modern storage facility (the HEUMF) at that site.

3.5.1.1.1 CUC Construction

The construction discussion contained in Section 3.4.2 pertains to a UPF constructed at Y-12, and is relevant to a portion of a CUC that could be built at sites other than Y-12. As such, that discussion is not repeated here. This section presents the requirements for a CUC that could be built at sites other than Y-12. The major difference involves the addition of HEU storage and the non-nuclear support facilities outside the PIDAS. Construction of a CUC at sites other than Y-12 would require approximately 50 acres of land, which includes land for a construction laydown area and temporary parking. Once constructed, a CUC would occupy approximately 35 acres. Table 3.5.1-1 lists the construction requirements for a CUC, along with the associated waste volumes.

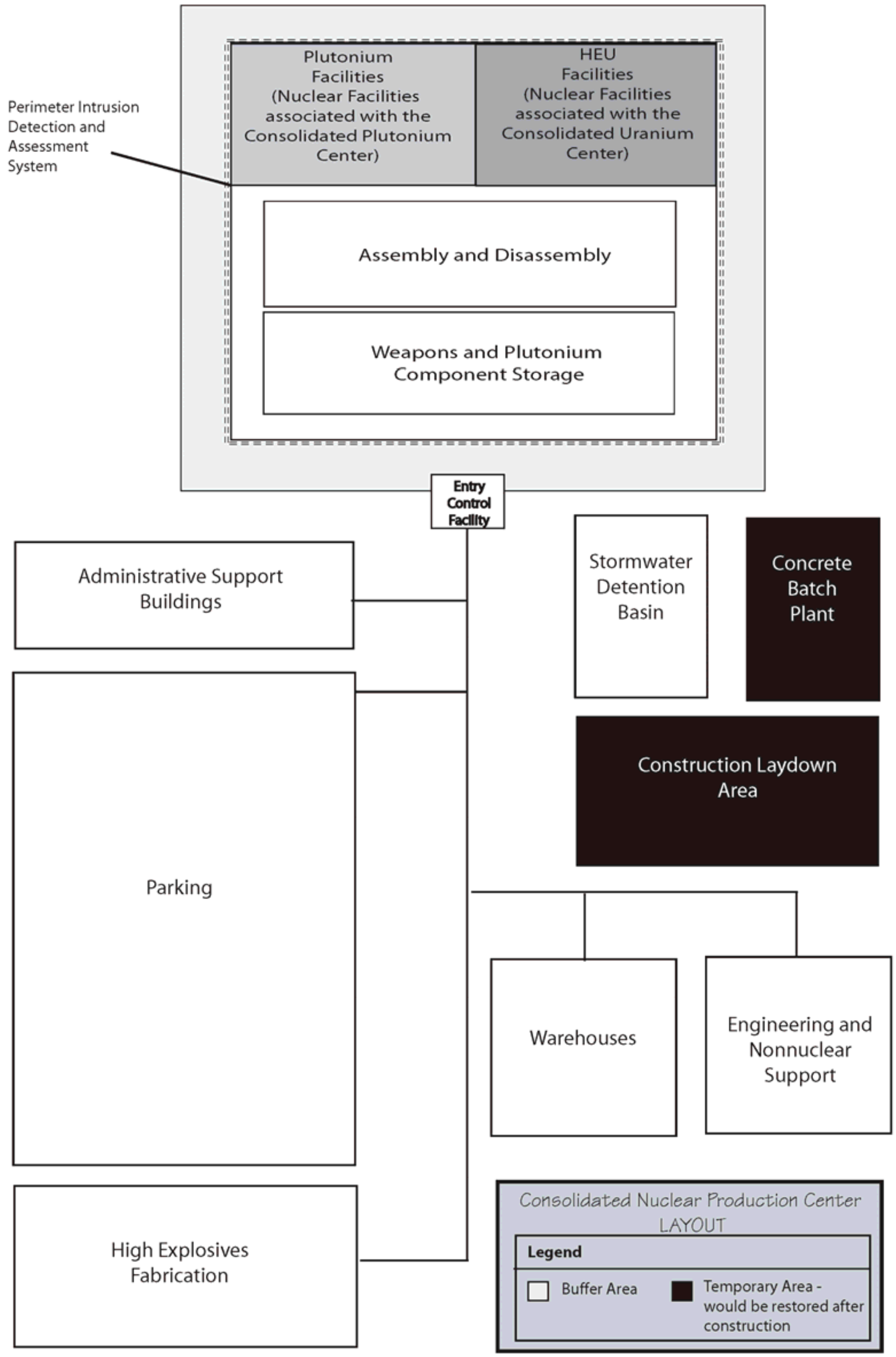


Figure 3.5.1-1—Generic Layout of the CNPC

Table 3.5.1-1—CUC Construction Requirements and Estimated Waste Volumes[23]

Requirements	Consumption
Materials/Resource	
Peak Electrical energy (MWe)	2.5
Concrete (yd^3)	230,000
Steel (tons)	29,500
Liquid fuel and lube oil (gallons)	325,000
Water (gallons)	5,200,000
Aggregate (yd^3)	6,000
Land (acre)/Laydown Area	50/22
Employment	
Total employment (worker-years)	4,000
Peak employment (workers)	1,300
Construction period (years)	6
Wastes Generated	
Low-level	
Liquid (gallons)	0
Solid (yd^3)	70
Mixed Low-level	
Liquid (gallons)	0
Solid (yd^3)	0
Hazardous (tons)	6
Nonhazardous (Sanitary) (tons)	1000

Source: NNSA 2007

The nuclear portion of a CUC would require approximately 500,000 square feet in one building. Of this, long-term storage of Category I/II HEU would account for approximately 100,000 square feet. The non-nuclear support facilities outside the PIDAS would require approximately 150,000 square feet.

3.5.1.1.2 CUC Operations

A CUC would provide secure docking for Safeguards Transporters (SGTs) to ensure the secure, transfer of secondaries and other materials containing HEU. The shipping and receiving docks at a CUC would accommodate the simultaneous loading and unloading of three SGTs. The main operational steps that would be involved in handling containers with HEU materials are presented below:

- SGT arrives at the loading dock;
- Shipping containers are offloaded and moved to the nondestructive assay (NDA) and re-containerization area;
- A transfer check is performed;
- Containers undergo NDA;
- HEU materials are placed in new containers if required;

[23] Requirements in Table 3.5.1-1 reflect a CUC consisting of both nuclear and non-nuclear facilities. At Y-12, only a UPF would be required. Section 3.4.2 identifies UPF construction requirements and estimated waste volumes for Y-12.

- Each container is entered into the computerized tracking system and is assigned a rack location;
- Each container is moved by forklift to its assigned location in the storage area; and
- Each container is connected to the automated inventory system.

The core operations of a CUC would be similar to the UPF operations described in Section 3.4.2, and are not repeated here. Table 3.5.1-2 lists the operations requirement, number of workers, and the expected waste generation for a CUC.

Table 3.5.1-2—CUC Annual Operation Requirements and Estimated Waste Volumes

Requirements	Consumption/Use
Materials/Resource	
Electrical energy (MWhr/yr)	168,000
Peak electrical demand (MWe)	18.4
Natural gas (yd^3)	894,000
Water (gallons)	105,000,000
Plant footprint (acres)	35
Employment	
Workers	935
Radiation Workers	490
Average Annual Dose	22.4 mrem/yr
Uranium Releases to Air (Curies)	0.01
Uranium Releases to Water (Curies)	0.20
NAAQS emissions (tons/yr)	71.64 ton/yr
Wastes Generated	
Low-level Waste	
Liquid (gallons)	3,515
Solid (yd^3)	8,100
Mixed Low-level	
Liquid (gallons)	3,616
Solid (yd^3)	70
Hazardous (tons)	15
Non-hazardous Solid(Sanitary) (tons)	7,500
Non-hazardous Liquid (gallons)	50,000

Source: NNSA 2007.

3.5.1.2 *Assembly/Disassembly/High Explosives Center*

The A/D/HE Center would carry out the following major missions:

- Assemble warheads;
- Dismantle weapons that are surplus to the strategic stockpile and sanitize[24], store, or dispose of components from dismantled weapons;
- Develop and fabricate explosive components; and
- Conduct surveillance related to certifying weapon safety and reliability.

[24] The process of sanitization involves the obliteration and demilitarization of classified weapons parts.

An A/D/HE Center would consist of nuclear facilities located within the PIDAS, and non-nuclear facilities outside the PIDAS. The nuclear facilities would contain the cells and bays in which maintenance, modification, disassembly, and assembly operations are conducted. The facilities would be designed to mitigate the effects of the unlikely accidental detonation of the weapon's explosive components. Bays differ from cells in that bays are designed to vent an explosion to the atmosphere while protecting adjacent facilities from the blast, while cells are designed to filter the explosion products, while also protecting the adjacent facilities from the blast. Appendix A contains a more detailed description of a bay and a cell.

As shown in Table 3.5.1-3, an area of 180 acres would be provided in the PIDAS for weapons assembly and disassembly facilities, and for weapons and component storage. Located outside the PIDAS would be a buffer zone and non-nuclear facilities for HE fabrication, administrative support, and disposal of explosive materials. This area would be approximately 120 acres. An A/D/HE Center would be constructed over a six-year period beginning in approximately 2020, with completion by approximately 2025, and operations beginning by approximately 2025. The design service life of an A/D/HE Center would be 50 years. Table 3.5.1-4 lists the construction requirements for an A/D/HE Center, along with the associated waste values.

Table 3.5.1-3—Land Requirements for A/D/HE Center*

Construction (acres)	**300**	
Operation (acres)	**Total Area: 300****	
	PIDAS	**Non-PIDAS**
	Weapons A/D/Pu Storage: 180	Administrative and High Explosives Area: 120

* At NTS, an A/D/HE Center would require 200 acres, due to use of existing infrastructure.
****** Includes a buffer area that would provide unobstructed view of the area surrounding the PIDAS.

Table 3.5.1-4—A/D/HE Construction Requirements

Requirements	**Consumption / Use**
Peak Electrical energy (MWe)	12.7
Diesel Generators (Yes/No)	Yes
Concrete (yd^3)	324,500
Steel (tons)	18,050
Liquid fuel and lube oil (gallons)	21,350,000
Water (gallons)	2,022,000
Land (acre)	300
Total Square Footage added (ft^2)	2,392,400
Employment	
Total employment (worker-years)	6,850
Peak employment (workers)	3,820
Construction period (years)	6
Wastes Generated	
Low Level Waste (yd^3)	9,900
Hazardous Waste (yd^3)	0
Non-Hazardous (Sanitary and Other) (tons)	7,100
Non-Hazardous Liquid Waste (gallons)	45,000

Source: NNSA 2007.

3.5.1.2.1 Operations Conducted at an A/D/HE Center

Assembly. Weapons assembly requires written, prescribed steps to combine separate parts to form a new weapon. Complete weapons assembly would be accomplished in the following stages:

- Physics Package assembly;
- Mechanical and Electronic Components assembly; and
- Final Package or Ultimate User Package assembly.

The physics package is a subassembly combining HE components (produced at an A/D/HE Center) and nuclear components (to be manufactured at a CPC and CUC) within a protective shell. Physics package assembly entails bonding or mating the main charge subassemblies to a nuclear pit and then inserting this subassembly into a case along with other components. Mechanical and electronic components assembly entails placing the physics package in a warhead case and then installing the components for the arming, fusing, and firing systems; the neutron generator; and the gas transfer system. The final package assembly involves installing additional components and packaging the weapon for shipment.

Dismantlement. Dismantlement consists of disassembly and disposal of weapon components. The dismantlement process begins with the arrival of the weapon at the A/D/HE Center. Disassembly would include the following activities:

- Weapons staging, including inspection and verification after receipt from DOE;
- A variety of specialty operations (e.g., X-ray examinations, leak testing, coding, packaging, painting, verification, etc.) in special purpose bays;
- Mechanical disassembly operations in bays;
- Nuclear disassembly operations in cells;
- Demilitarization and sanitization of non-nuclear weapons components, for final disposition and disposal;
- Packaging and shipping or transfer of HEU to the CUC and tritium components to the SRS;
- Packaging and shipping or transfer of pits to the CPC; and
- Segregating waste into non-hazardous, hazardous, LLW, and mixed LLW categories and appropriate storage pending disposal.

High explosives fabrication. The A/D/HE Center would manufacture the main charge HE and other small explosive components. The fabrication process for explosives involves synthesizing energetic materials (explosives) and then formulating the energetic materials with other materials as appropriate. Some of the energetic materials are manufactured at the plant, while others are procured commercially. The explosive powder is then pressed into the configurations needed and machined for use in nuclear weapons.

Surveillance. To maintain the reliability of the nation’s nuclear weapons, a statistical sample of randomly selected weapons from all active systems would be annually removed from the stockpile and returned to the A/D/HE Center. The weapons are disassembled, tested, and evaluated to ensure the operability of the weapons components. Most testing is done onsite, but some tests associated with component aging are performed at other laboratories and production facilities. Some weapons are configured as Joint Test Assemblies (JTAs) and used for flight-testing. Table 3.5.1-5 lists the operations requirement for an A/D/HE Center.

Table 3.5.1-5—A/D/HE Operation Requirements and Estimated Waste Volumes

Requirements	Consumption / Use
Annual Electrical energy (MWh)	52,000
Peak Electrical energy (MWe)	11.9
Fuel Usage (gallons)	367
Other Process Gas (N, Ar, etc.)	
Water (million gallons/year)	130
Plant footprint (acres)	350
Employment (workers)	1,785
Number of Radiation Workers	400
Average annual dose (mrem)	103
Maximum annual worker dose (mrem)	750
Radionuclide emissions and effluents-nuclides and Curies	
Tritium (Ci)	1.41×10^{-12}
Total Uranium (Ci)	7.50×10^{-5}
Total Other Actinides (Ci)	2.17×10^{-15}
NAAQS emissions (tons/year)	
Oxides of Nitrogen (tons/year)	91
Carbon Monoxide (tons/year)	31
Volatile Organic Compounds (tons/year)	31
Particulate Matter (tons/year)	18
Sulfur Dioxide (tons/year)	5
Hazardous Air Pollutants and Effluents (tons/yr)	22
Chemical Use	
Liquid (gallons)	40,000
Solid (pounds)	294,000
Wastes Generated	
Low Level Waste	
Liquid (gallons)	5,410
Solid (yd^3)	40
Mixed Low-Level	
Liquid (gallons)	6.00
Solid (yd^3)	<1
Hazardous Waste	
Liquid (gallons)	5,900
Solid (yd^3)	900
Non-Hazardous (Sanitary)	
Solid (yd^3)	15,000
Non-Hazardous (Other)	
Liquid (gallons)	46,000
Solid (yd^3)	12,000

Source: NNSA 2007.

3.5.1.3 *Transport of Plutonium and HEU to a CNPC*

If NNSA were to construct and operate a CNPC, Category I/II plutonium and HEU would be consolidated at it. This would entail three potential movements of materials: (1) transfer of LANL's Category I/II plutonium to the CNPC, if LANL is not selected as the host site for the CNPC; (2) transfer of Pantex's non-excess Category I/II plutonium to the CNPC, if Pantex is not selected as the site for the CNPC; and (3) transfer of Y-12's Category I/II HEU to the CNPC, if Y-12 is not selected as the host site for the CNPC. Each of these movements is discussed below.

- Transfer of LANL's Category I/II is discussed in Section 3.4.1.4 regarding a CPC. Transport of LANL's Category I/II plutonium to a CNPC would be the same as the transfer of the material to a CPC.
- Transfer of Pantex's non-excess Category I/II plutonium to a CNPC would occur as follows:
    - Up to 60 metric tons of plutonium, mostly in pit form, would be shipped;
    - Approximately 470 shipments would be required, beginning in approximately 2025 and lasting 5 years.
- Transfer of Y-12's Category I/II HEU to a CNPC would occur as follows:
    - Up to 252 metric tons of HEU would be shipped;
    - Approximately 540 shipments would be required, beginning after approximately 2023 and lasting 5 years.

Table 3.5.1-6 lists the origins, destinations, and materials that would be shipped to support a CNPC. The transfer of LANL, Pantex, and Y-12 Category I/II SNM would be a one-time move. Any transportation of TRU waste and LLW (for a CNPC at Pantex and Y-12) would occur on an annual basis as part of CNPC operations.

Table 3.5.1-6—Origins, Destinations, and Material Shipped to Support the CNPC

Material Transported	CNPC at SRS	CNPC at Pantex	CNPC at Los Alamos	CNPC at NTS	CNPC at Y-12
Los Alamos Plutonium	Los Alamos ⇒ SRS	Los Alamos ⇒ Pantex	LANL ⇒ Los Alamos (intra-site transfer)None	Los Alamos ⇒ NTS	Los Alamos ⇒ Y-12
Pantex Plutonium	Pantex ⇒ SRS	None	Pantex ⇒ Los Alamos	Pantex ⇒ NTS	Pantex ⇒ Y-12
Y-12 HEU	Y-12 ⇒ SRS	Y-12 ⇒ Pantex	Y-12 ⇒ Los Alamos	Y-12 ⇒ NTS	None
TRU waste	SRS ⇒ WIPP	Pantex ⇒ WIPP	Los Alamos ⇒ WIPP	NTS ⇒ WIPP	Y-12 ⇒ WIPP
LLW	Onsite disposal	Pantex ⇒ NTS	Onsite disposal	Onsite disposal	Y-12 ⇒ NTS

3.5.1.4 *Site-Specific Features Relevant to a CNPC*

This section describes a CNPC at each candidate site. While CNPC requirements would be the same at each site, the means of achieving them would vary depending upon the existing facilities and infrastructure at each candidate site. This section also identifies the reference location for a CNPC at each site.

3.5.1.4.1 Los Alamos

A CNPC located at Los Alamos would require the construction of a CPC (which could either be a "Greenfield CPC" [see Section 3.4.1] or an upgrade to existing LANL facilities [see Section 3.4.1.6.1]), a CUC (as described in Section 3.5.1.1), and an A/D/HE Center (as described in Section 3.5.1.2). There would not be enough acreage at TA-55 to locate an entire CNPC. Thus, a CNPC at LANL would be split between two TAs (TA-55 [which could be the site for a CPC and a CUC], and TA-16 [A/D/HE Center]) or completely located in its entirety at TA-16. Figure 3.5.1-2 shows the reference locations for a CPC, CUC, and an A/D/HE Center at LANL.

Because a CPC, CUC, and A/D/HE Center would be constructed sequentially, construction requirements for these three facilities would not create "parallel impacts in time" and are analyzed as sequential actions in this SPEIS. The construction data are summarized in Tables 3.4.1-2, 3.4.1-7, and 3.4.1-8 (CPC), 3.5.1-1 (CUC), and 3.5.1-3 (A/D/HE Center).

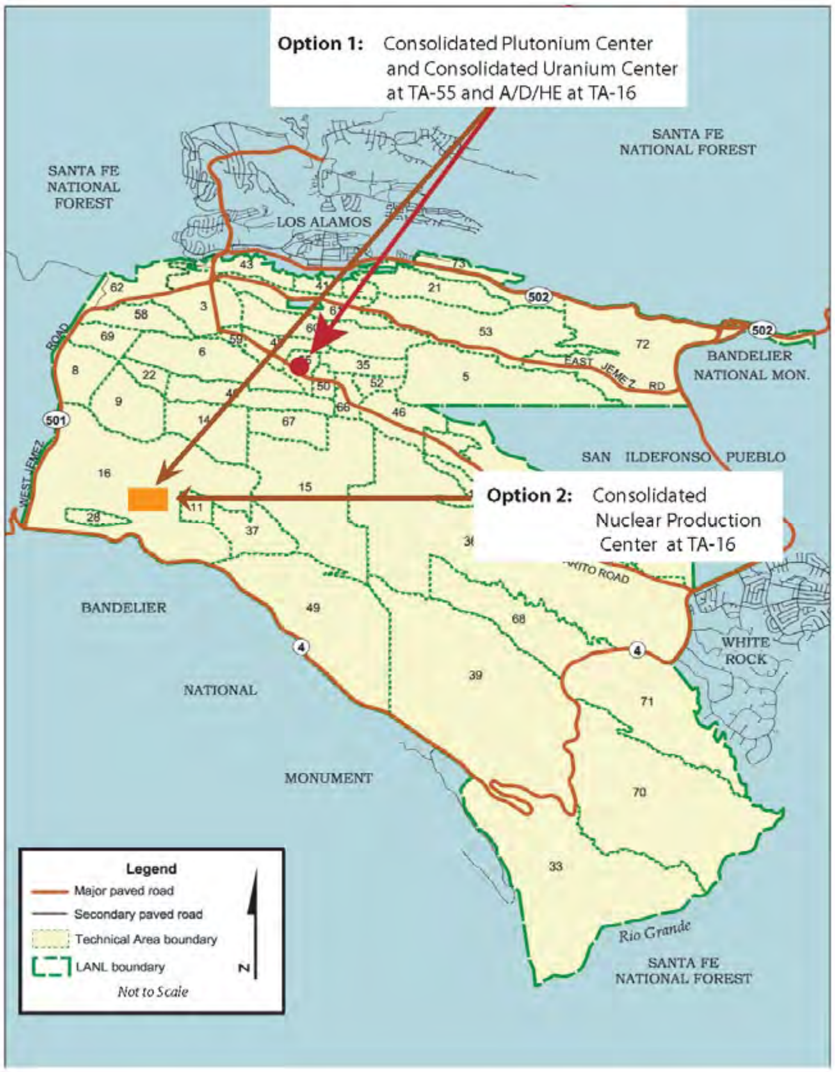


Figure 3.5.1-2—Los Alamos CNPC Reference Locations

3.5.1.4.2 NTS

A CNPC located at NTS would require the construction of a CPC (as described in Section 3.4.1), a CUC (as described in Section 3.5.1.1), and an A/D/HE Center (which would be an upgrade to the existing DAF, as described in this section). Figure 3.5.1-3 identifies the reference locations for a CPC, CUC, and an A/D/HE Center at NTS.

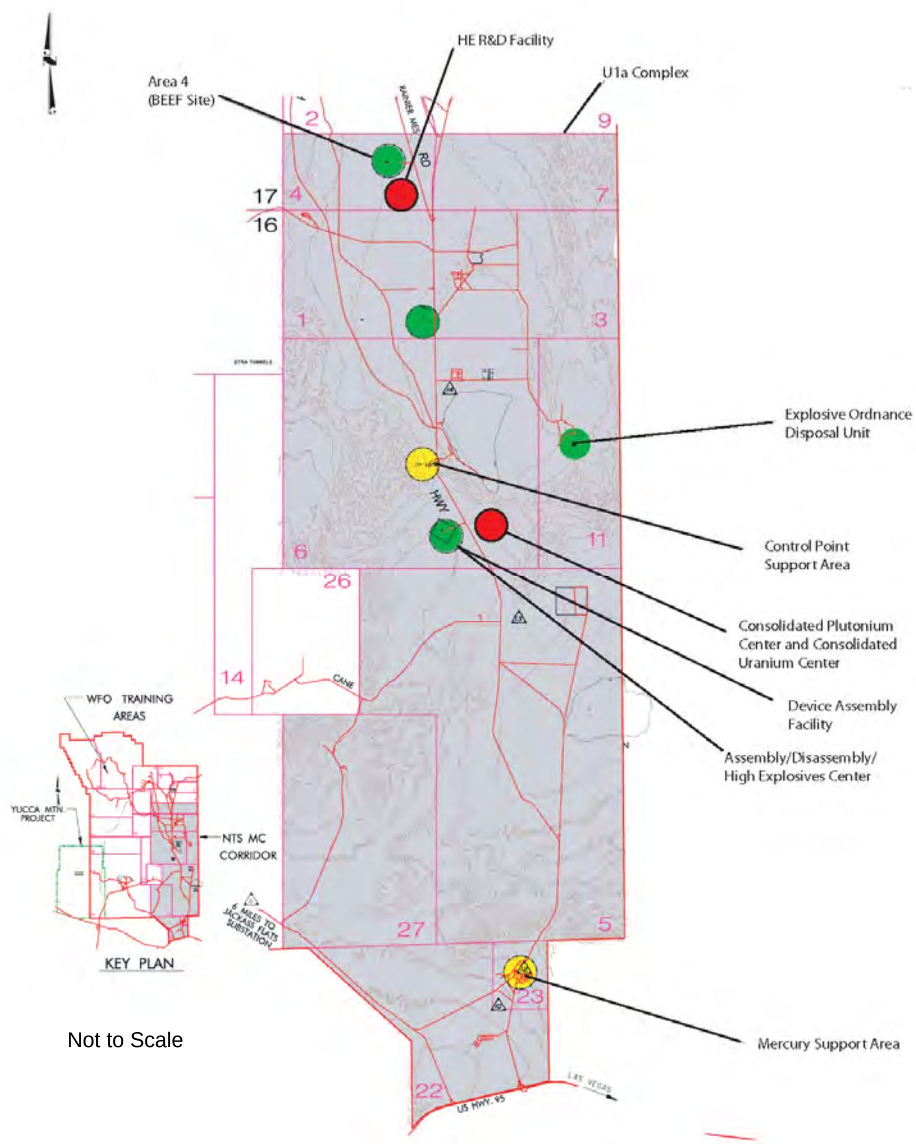


Figure 3.5.1-3—NTS CNPC Reference Locations

The construction data are summarized in Tables 3.4.1-2 (CPC), 3.5.1-1 (CUC), and 3.5.1-4 (A/D/HE Center). Once steady-state operations are achieved in approximately 2025, the operational impacts of a CPC, CUC, and an A/D/HE Center are summarized in Tables 3.4.1-3 (CPC), 3.5.1-2 (CUC), and 3.5.1-5 (A/D/HE).

At NTS, an A/D/HE Center could make use of the existing capabilities at NTS such that construction requirements would be reduced compared to a generic A/D/HE Center described above. An A/D/HE Center at NTS could use existing facilities such as the Device Assembly Facility (DAF); the underground complex of tunnels at the U1a Complex; the Big Explosive Experimental Facility (BEEF); the Explosives Ordnance Disposal Unit; an existing NTS site infrastructure and support areas at Mercury, the Control Point, and Area 6 Construction (Figure 3.5.1-3). By using these existing assets, the need for additional construction would be minimized.

The NTS alternative would use the DAF for disassembly operations. DAF could fully support disassembly operations and continue to support the existing criticality experiments that recently began in the DAF. Disassembly operations in the DAF would not require additional construction within the PIDAS or additions to the existing PIDAS. In the non-PIDAS area of the DAF and outside the buffer zones, an administrative facility and parking area would be constructed to support the increased personnel processing requirements for disassembly.

The remaining operations of assembly, longer-term storage for nuclear and non-nuclear components that are generated by disassembly activities, weapon surveillance, and strategic reserve storage of plutonium would be located approximately 950 feet underground in the tunnel complex at the U1a Complex. This alternative would include construction of new tunnels and alcoves in accordance with nuclear explosive requirements for assembly and storage operations. At the U1a Complex, access to the tunnel network is limited to two (2) vertical access/egress shafts that would require construction of a small PIDAS around the surface footprint of each shaft. Table 3.5.1-7 lists the construction requirements for the A/D/HE Center.

Table 3.5.1-7—A/D/HE Center Construction Requirements at NTS

Requirements	Consumption/Use[25]
Peak Electrical energy (MWe)	250
Diesel Generators (Yes/No)	Yes
Concrete (yd^3)	10,000
Steel (tons)	635
Liquid fuel and lube oil (gallons)	19,100,000
Water (gallons)	1,800,000
Land (acre)	200
Laydown Area Size (acre)	5
Parking lots	30
Footprint of New Construction (ft^2)	330,000
Total Square Footage added (ft^2)	330,000
Employment	
Total employment (worker years)	915
Peak employment (workers)	525
Construction period (years)	2
Wastes Generated	**Volume (yd^3)**
Low Level Waste	9,000
Hazardous Waste	0
Non-Hazardous (Sanitary and Other)	6,400

Source: NNSA 2007.

[25] Construction requirements for employment-related data are based on 85 percent reduction (330,000 square feet versus 2,100,000 square feet for generic A/D/HE Center) due to existing DAF capabilities.

Operations of an A/D/HE Center at NTS would be the same as operations of an A/D/HE Center at other sites.

3.5.1.4.3 Pantex

A CNPC located at Pantex would not require the construction of an A/D/HE Center, as Pantex currently performs these missions in existing facilities. As such, a CNPC at Pantex would entail the construction of a CPC (as described in Section 3.4.1.1) and a CUC (as described in Section 3.5.1.1). Figure 3.5.1-4 identifies the reference location for a CPC and CUC at Pantex (CNPC).

The construction data are summarized in Tables 3.4.1-2 (CPC) and 3.5.1-1 (CUC). Once steady-state operations are achieved in approximately 2022, the operational impacts of both the CPC and CUC are summarized in Tables 3.4.1-3 (CPC) and 3.5.1-2 (CUC).

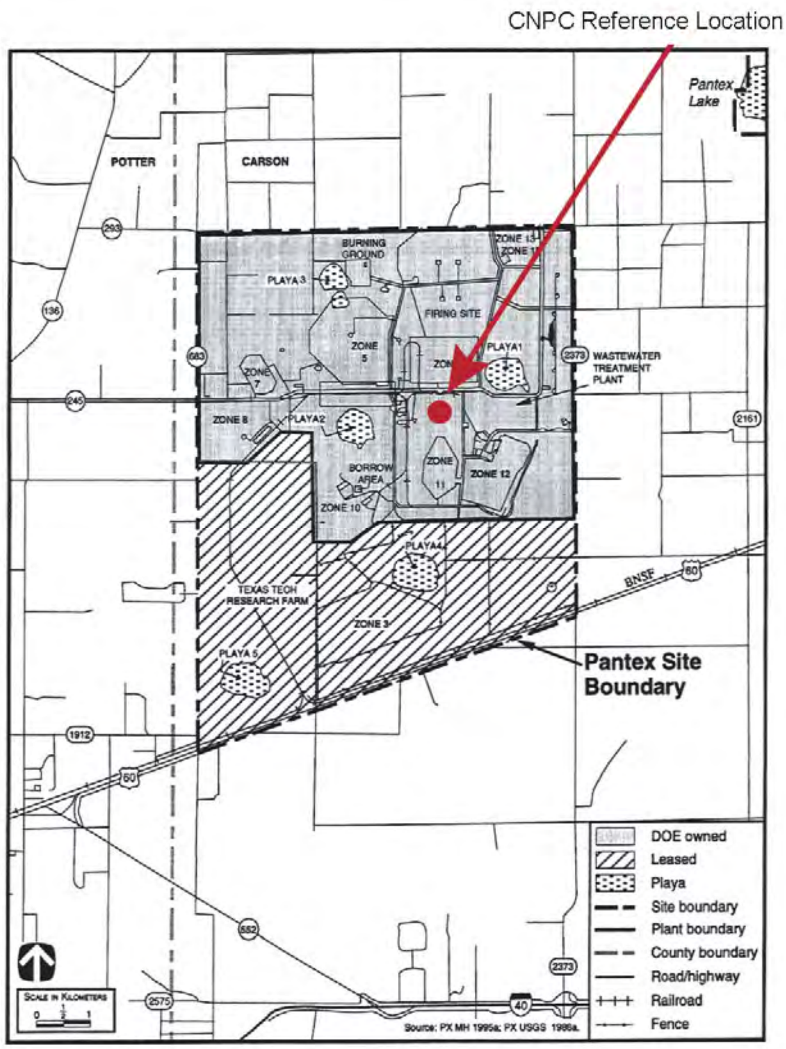


Figure 3.5.1-4—Pantex CNPC Reference Location

3.5.1.4.4 SRS

A CNPC located at SRS would require the construction of a CPC (as described in Section 3.4.1.1), a CUC (as described in Section 3.5.1.1), and an A/D/HE Center (as described in Section 3.5.1.2). Figure 3.5.1-5 identifies the reference location for the CNPC at SRS.

Because a CPC, CUC, and A/D/HE Center would be constructed in series, construction requirements for these three facilities would not create simultaneous impacts and are analyzed as sequential actions in this SPEIS. As such, the construction data in Tables 3.4.1-2 (CPC), 3.5.1-1 (CUC), and 3.5.1-3 (A/D/HE Center) form the basis for the impact analysis in this SPEIS. Once steady-state operations are achieved in approximately 2025, the operational impacts of the CPC, CUC, and the A/D/HE Center are summarized in Tables 3.4.1-3 (CPC), 3.5.1-2 (CUC), and 3.5.1-5 (A/D/HE Center).

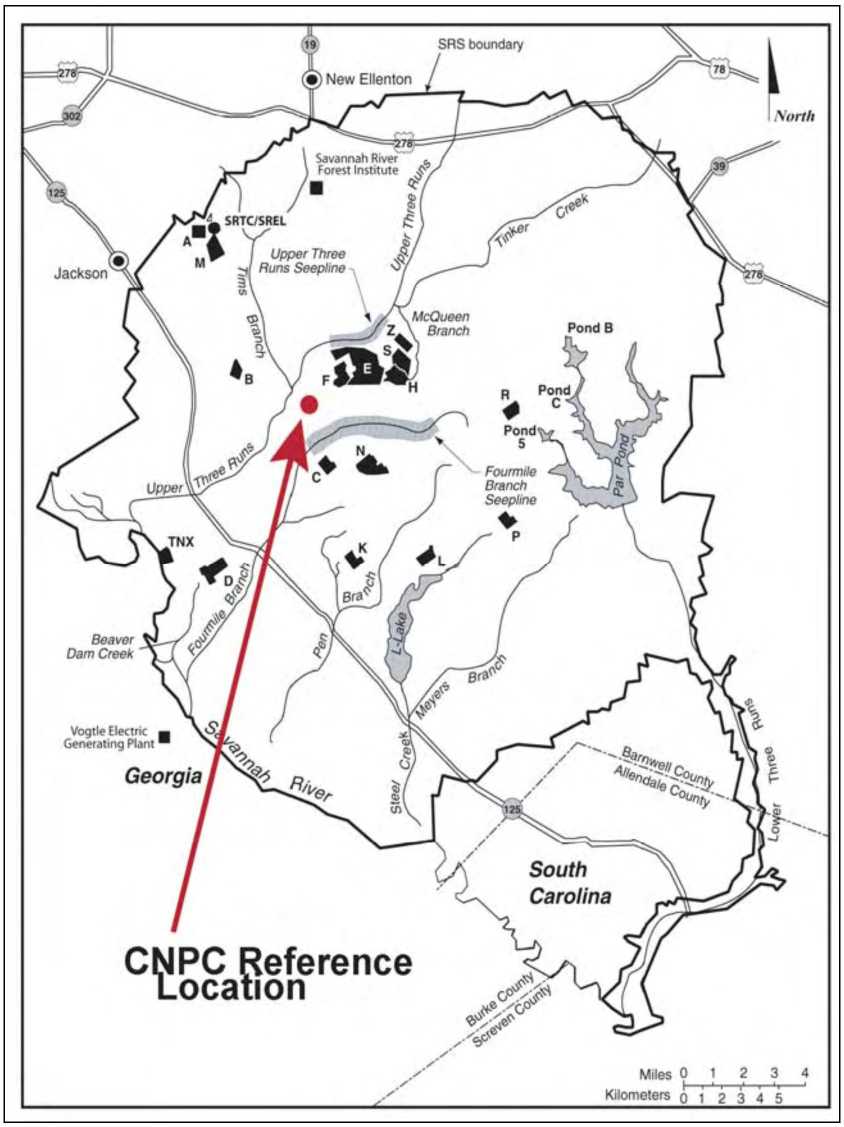


Figure 3.5.1-5—SRS CNPC Reference Location

3.5.1.4.5 Y-12

A CNPC located at Y-12 would require the construction of a CPC (as described in Section 3.4.1.1), a UPF (as described in Section 3.4.2), and an A/D/HE Center (as described in Section 3.5.1.2). A CUC at Y-12 would not require construction of a new HEU storage facility because NNSA is already building a modern storage facility. Figure 3.5.1-6 identifies the reference locations for these facilities at Y-12. The HE component of the A/D/HE mission would be located on the ORR approximately 4.5 miles west of Y-12 site due to buffer and acreage requirements.

Because a CPC, UPF, and A/D/HE Center would be constructed in series, construction requirements for these three facilities would not create simultaneous impact and are analyzed as sequential actions in this SPEIS. As such, the construction data in Tables 3.4.1-2 (CPC), 3.4.2-1 (UPF), and 3.5.1-3 (A/D/HE Center) form the basis for the impact analysis in this SPEIS. Once steady-state operations are achieved in approximately 2025, the operational impacts of the CPC, UPF, and the A/D/HE Center are summarized in Tables 3.4.1-3 (CPC), 3.4.2-2 (UPF), and 3.5.1-5 (A/D/HE Center).

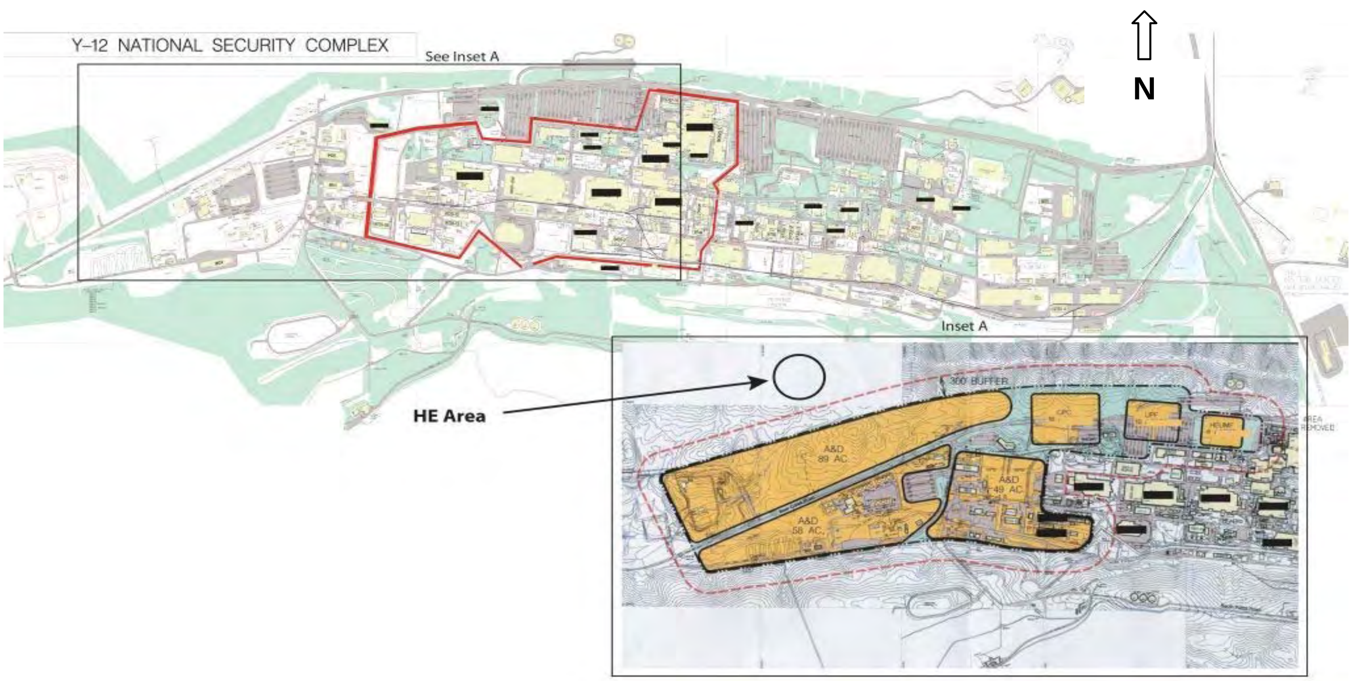


Figure 3.5.1-6—Y-12 CNPC Reference Location

3.5.2 Consolidated Nuclear Center Option

This option would separate the A/D/HE mission to allow NNSA to consider an option that locates the production facilities of a CNPC at a different site than the weapons A/D mission. Under this option, NNSA would construct and operate a CPC and CUC at one site and an A/D/HE facility at either Pantex or NTS. For purposes of this SPEIS, this option is referred to as the CNC. A generic layout of a CNC is shown in Figure 3.5.2-1.

The descriptions of the facilities, along with the representative site locations that constitute a CNC, are contained in Section 3.5.1. Operationally, the major difference between a CNPC and a CNC involves transportation impacts between the nuclear production facilities and the A/D/HE facility. For example, once steady-state operations are achieved in a CNPC, all nuclear missions would occur at a single site and there would be virtually no radiological transportation (with the exception of waste shipments and nuclear weapons shipments between DoD and NNSA). Under the CNC Alternative, radiological transportation would be required between the production facilities and the A/D/HE facility. As such, this SPEIS assesses the radiological transportation impacts per the matrix of alternative configurations shown in Table 3.5.2-1.

Table 3.5.2-1—Alternative Configurations of the CNC

If A/D/HE is at:	Then CNC would be located at one of the following locations:			
	SRS	NTS	Los Alamos	Y-12
Pantex	x	x	x	x
NTS	x		x	x

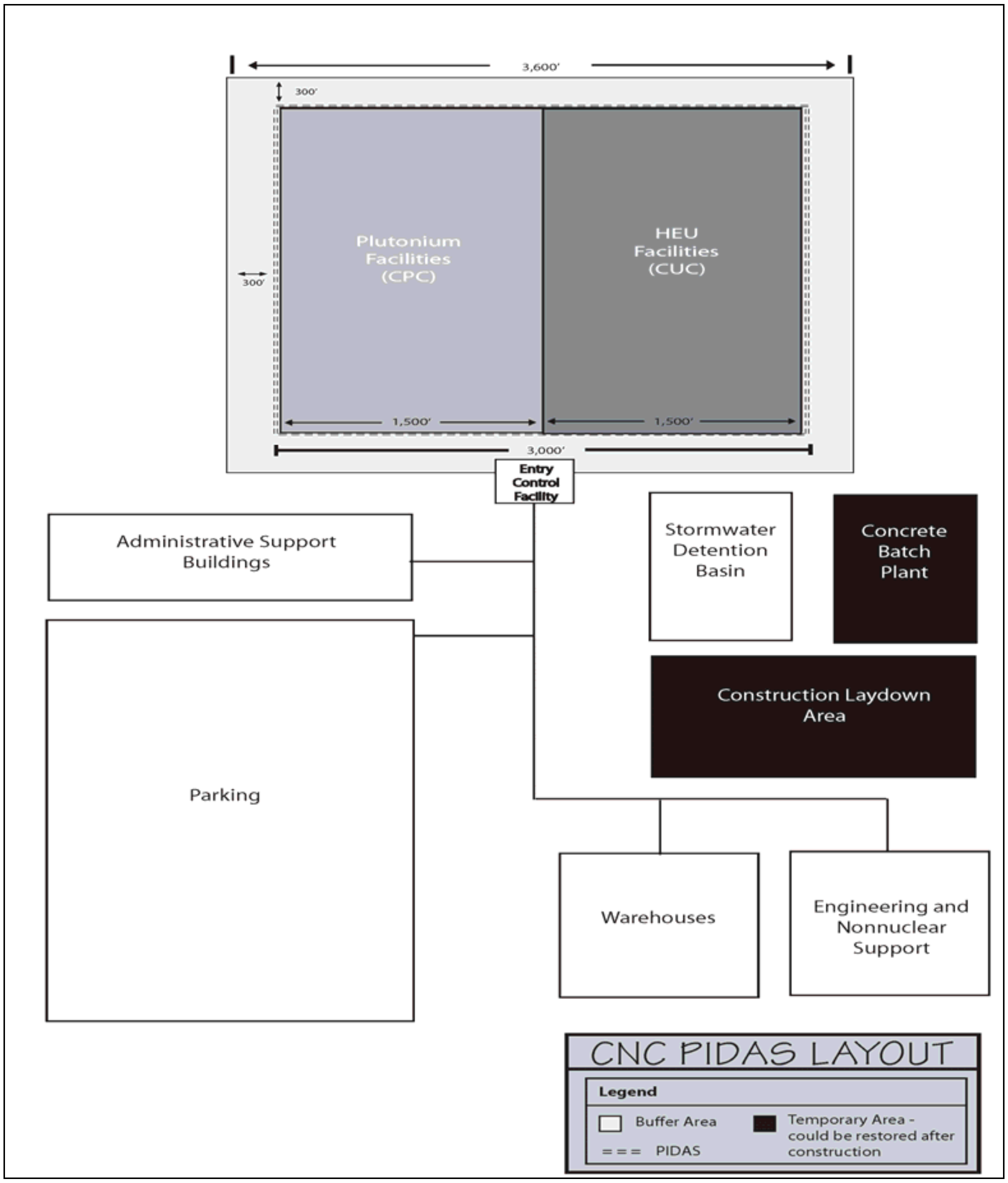


Figure 3.5.2-1—Generic Layout of the CNC

3.6 PROGRAMMATIC ALTERNATIVE 3: CAPABILITY-BASED ALTERNATIVE

The nuclear weapons stockpile and the Complex have undergone profound changes since the end of the Cold War. Since that time, more than 12,000 United States nuclear weapons have been dismantled, no new-design weapons have been produced, three former nuclear weapons plants (Mound, Pinellas, and Rocky Flats) have been closed, nuclear material production plants (Hanford, K-25 at ORR, most of SRS, and Fernald) have stopped production and are being decontaminated, and the United States is observing a moratorium on nuclear testing.

In 2002, President Bush and President Putin signed the *Moscow Treaty*, which will reduce the number of operationally deployed strategic nuclear weapons to 1,700-2,200 by 2012. In 2004, President Bush issued a directive to cut the entire U.S. stockpile—both deployed and reserve warheads—in half by 2012. This goal was later accelerated and achieved 5 years ahead of schedule in 2007. As of the end of 2007, the total stockpile was almost 50 percent below what it was in 2001. On December 18, 2007, the White House announced the President's decision to reduce the nuclear weapons stockpile by another 15 percent by 2012. This means the U.S. nuclear stockpile will be less than one-quarter its size at the end of the Cold War—the smallest stockpile in more than 50 years (D'Agostino 2008).

As these actions illustrate, the Administration's goal is to achieve a credible nuclear deterrent with the lowest possible number of nuclear warheads consistent with national security needs. NNSA's analyses in this SPEIS are based on current national policy regarding stockpile size (1,700-2,200 operationally deployed strategic nuclear warheads) with flexibility to respond to future Presidential direction to change the size. NNSA also assumes that it must continue to maintain an arsenal of some number of nuclear weapons. Maintaining a stockpile requires the ability to detect aging effects in weapons (a surveillance program), the ability to fix identified problems without nuclear testing (the stockpile stewardship program), and the ability to produce replacement components and reassemble weapons (a fully capable set of production facilities). Currently, there are some elements of the Complex that are unable to safely or reliably perform their assigned production mission (e.g., CMR at LANL and Building 9212 at Y-12). Therefore, new facilities are required to perform the essential production missions of these facilities.

Although the size of the stockpile beyond 2012 is not known, the trend suggests a significantly smaller one. Consistent with this trend, NNSA developed a programmatic alternative, referred to as the "Capability-Based Alternative," to analyze the potential environmental impacts associated with a Complex that would support stockpiles smaller than those currently planned. NNSA has assumed that such a stockpile would be approximately 1,000 operationally deployed strategic nuclear warheads. The objective of this analysis is to identify the potential environmental impacts that are particularly sensitive to assumptions about the size of the future stockpile. In addition, analysis of this alternative enhances NNSA's understanding of the infrastructure that might be appropriate if the United States continues to reduce stockpile levels. Within the Capability-Based Alternative, NNSA has analyzed two options:

(1) A Capability-Based Alternative that would maintain a basic manufacturing capability to produce nuclear weapons, as well as laboratory and experimental capabilities to support the stockpile. It would reduce the operational capacity of production facilities to a throughput of

approximately 50 weapons per year. This alternative involves pit production at LANL of 50 pits per year and reductions of production capacities at Pantex, Y-12, and SRS. This alternative is described in detail in Section 3.6.1.

(2) A No Net Production/Capability-Based Alternative that would produce a limited number of components and assembly of weapons beyond those associated with supporting surveillance, but would not involve adding new types or increased numbers of weapons to the total stockpile. This alternative involves a minimum production (production of 10 sets of components or assembly of 10 weapons per year) to maintain capability and to support a limited Life Extension Program (LEP) workload. This alternative, which NNSA added after considering public comments on the Draft SPEIS, is described in detail in Section 3.6.2.

The two options analyzed for the Capability-Based Alternative might not provide the optimum configuration of the Complex if the stockpile became much smaller. In such a situation, NNSA could make changes to the Complex beyond those described in Sections 3.6.1 and 3.6.2. Section 3.6.3 discusses further changes to the Complex that might be reasonable if the stockpile were reduced even further (to hundreds of weapons) beyond the levels considered in Sections 3.6.1 and 3.6.2. That discussion focuses on how the programmatic alternatives considered in this SPEIS could be adapted to such a small stockpile. NNSA acknowledges, however, that any decision to reduce the stockpile to those levels could result in a need to reassess the transformation options for the Complex.

3.6.1 Capability-Based Alternative for Production Facilities

For purposes of this alternative, the nuclear weapons production sites are:

- LANL—producing pits;
- Y-12—producing secondaries and cases;
- SRS—processing tritium and other tritium activities; and
- Pantex—producing HE components and performing weapons assembly/disassembly.

This section discusses how each of these sites would operate in the Capability-Based Alternative. Because LANL does not have adequate capacity to support stockpile requirements expected in the future, as do the other production facilities, LANL would proceed with the CMRR-NF which would support metallurgy chemical activities to support pit production, in order to produce as many as 50 pits per year. At other production sites, capacity could be reduced.[26]

The following sections provide specific information about each of the four production facilities.

3.6.1.1 *Capability-Based Alternative for LANL*

The LANL SWEIS (LANL 2008) assesses several alternatives, including one that would establish an interim fabrication capacity of up to 50 certified pits per year. Under the Capability-

[26] For this alternative, the SPEIS analyzes options that would maintain missions within existing facilities by reductions in place. NNSA acknowledges that new facilities such as a CPC, CNPC, or a CNC, with smaller capacities, could be built in support of a capability based alternative. However, the SPEIS already analyzes reasonably-sized new facilities that could be operated with smaller throughputs. Section 3.15 discusses why new facilities, of smaller capacities, are not analyzed in detail in this SPEIS.

Based Alternative, that would not change. The SWEIS describes the specific actions that would be required to add up to 50 certified pits per year to the stockpile. For a description and analysis of the specific actions, the reader is directed to the Final LANL SWEIS. A summary of the major pit production actions follows:

- **CMRR**. NNSA is continuing the preliminary design of the CMRR-NF. NNSA will decide whether to construct this facility after completion of this SPEIS. Should another site be selected for pit production, this nuclear facility might still be constructed at LANL in order to provide metallurgy chemical activities in support of an interim pit production capability until a new pit production facility is available. In any case, NNSA has determined that preliminary design of the CMRR-NF would be applicable to any future pit production facility at any site analyzed in this SPEIS.

- **Other upgrades at TA-55.** A series of upgrades would be made at TA-55, including: heating, ventilation, and air conditioning systems; PF-4 roof replacement; confinement doors in PF-4; criticality alarm system; fire sprinkler piping; fire alarm system; replacement of cooling towers; any necessary seismic upgrades; and others.[27]

3.6.1.2 *Capability-Based Alternative for Pantex*

Pantex is responsible for the production of HE and the assembly/disassembly of weapons. Approximately one-half of its current and future workload is associated with weapons dismantlements. Under the Capability-Based Alternative, NNSA would continue dismantlement activities at Pantex. If future stockpile requirements decreased significantly, this would result in an increased need for dismantlements at Pantex. For purposes of this analysis, it is assumed that dismantlement activities would continue at current rates for an even longer period of time compared to the No Action Alternative. As such, this alternative assumes that approximately one-half of the operations at Pantex would not change for the foreseeable future. With respect to other operations (most notably weapons assembly and HE fabrication), this alternative assumes a 50 percent reduction in these activities.

The reduction in weapons assembly and HE fabrication would reduce the number of employees; waste generation; infrastructure needs; and overall worker doses. Estimates of these reductions are in Table 3.6.1-1. Safeguard and security expenditures would remain at current levels, and other operations conducted at Pantex, such as the storage of pits, dismantlement of retired weapons, and stockpile surveillance activities, would remain at current levels, consistent with the levels described for the No Action Alternative in Section 3.3.

[27] See ROD for the continued operation of the LANL for decisions from the expanded operations alternative (see 73 FR 55833).

Table 3.6.1-1—Annual Operation Requirements and Estimated Waste Volumes for the Capability-Based Alternative at Pantex Compared to the No Action Alternative

Requirements	No Action Alternative	Capability Based Alternative[a]
Electrical Energy Use (MWh)	81,850	61,000
Water Use (gallons)	130,000,000	97,500,000
Site Employment (workers)	1,644	1230
Number of Radiation Workers	334	250
Average Worker Dose (mrem)	132	132
Total Worker Dose (person-rem)	44.1	33.0
Waste Category		
Low-level Waste (yd^3)	96.8	73
Mixed Low-level Waste (yd^3)	1.8	1.4

[a] For a 50 percent reduction in production, this alternative estimated a 25 percent reduction in infrastructure requirements, personnel requirements, emissions, and waste generation. Average worker dose would remain approximately the same, but a reduced workforce would reduce total worker dose.
Source: NNSA 2007.

3.6.1.3 *Capability-Based Alternative for Y-12*

Y-12 is responsible for producing secondaries and cases, dismantling secondaries from weapons disassembly operations, and storage of HEU. Less than one-quarter of the current and future Y-12 workload is associated with weapons dismantlements. Under the Capability-Based Alternative, NNSA would continue to dismantle secondaries at Y-12. If the future stockpile decreased significantly, dismantlements would need to increase. This alternative assumes that dismantlement activities would continue at current rates for an even longer period of time compared to the No Action Alternative. As such, this alternative assumes that less than one-quarter of the operations at Y-12 would change for the foreseeable future. With respect to other operations (most notably the production of secondaries), this alternative assumes a 50 percent reduction in these activities. With respect to producing secondaries and cases, which accounts for the majority of the Y-12 nuclear workload, this alternative assumes a 50 percent reduction in these activities.

The reduction in workload would reduce employees, waste generation, infrastructure needs, and the total worker dose. Estimates of these levels appear in Table 3.6.1-2. Safeguard and security expenditures would remain at current levels, and other operations conducted at Y-12, such as the storage of HEU and dismantlement of secondaries, would remain at current levels, consistent with the expected levels described in the No Action Alternative in Section 3.3.

Table 3.6.1-2—Annual Operation Requirements and Estimated Waste Volumes for the Capability-Based Alternative at Y-12 Compared to the No Action Alternative

Requirements	No Action Alternative	Capability Based Alternative[a]
Electrical Energy Use (MW)	360-480	220-290
Water Use (million gallons/year)	2,000	1,200
Y-12 Site Employment (workers)	6,500	3,900
Steam Plant Generation (billion pounds)	1.5	0.9
Normal Radiological/Uranium Air Emissions (Curie)	0.01	0.006
Number of EU Radiation Workers	839	500
Average worker-dose for EU Worker (mrem)	38.1	38.1
Total dose to EU Radiation Workers (person- rem)	32.0	19.1
Waste Category		
Low-level Waste		
Liquid (yd^3)	17.4	10.4
Solid (yd^3)	7,800	4,700
Mixed Low-level Waste		
Liquid (yd^3)	17.9	10.7
Solid (yd^3)	21.1	12.7

[a] For a 50 percent reduction in production, this alternative estimated a 40 percent reduction in infrastructure requirements, personnel requirements, emissions, and waste generation. Average worker dose would remain approximately the same, but a reduced workforce would reduce total worker dose
Source: NNSA 2007.

3.6.1.4 *Capability-Based Alternative for SRS*

SRS is responsible for extracting tritium (from tritium producing burnable absorber rods irradiated in a TVA reactor) and filling tritium reservoirs for nuclear weapons. Under the Capability Based Alternative, tritium activities at SRS would be reduced significantly, as NNSA could likely meet its tritium requirements through a combination of tritium recycle and limited extraction. As such, it is conceivable that tritium operations could be reduced to approximately 50 percent compared to the No Action Alternative. This reduction would require fewer employees, reduce waste generation, reduce infrastructure needs, and lower the total worker-dose. Estimates of these reductions appear in Table 3.6.1-3. Safeguards and security would remain at current levels, and other non-tritium operations conducted at SRS, such as the MOX program, would not change. Table 3.6.1-3 presents relevant operational reductions from the higher stockpile levels of the 1990s to the No Action Alternative to the Capability Based Alternative.

Table 3.6.1-3—Annual Operation Requirements and Waste Volumes for the Capability Based Operations Alternative at SRS Compared to Other Tritium Activity Levels

Requirements	Tritium Activities to Support 1990's Stockpile[a]	No Action Alternative	Capability Based Alternative
Electrical Energy Use at Tritium Facilities (MWh)	32,400	27,500	22,500
Water Use at Tritium Facilities (gallons)	43,000	36,550	30,100
Normal Tritium Air Emissions (Curies)	21,700	10,350	2,500
Number of Tritium Workers [b]	148	110	85[a]
Average worker-dose for Tritium Worker [c] (mrem)	37	37	37
Total worker-dose (person-rem)	5.5	4.1	3.1
Waste Category			
Low-level Waste Solid (yd^3)	275	138	69
Mixed Low-level Waste and Hazardous Waste Solid (yd^3)	12	6	3
Nonhazardous (Sanitary) Waste (gallons/year)	27,500	23,375	19,250

[a] Based on Tritium Extraction Facility EIS (DOE 1999i) and the EA for the Tritium Facility Modernization and Consolidation Project at SRS (DOE 1998a).
[b] Reductions in workforce would not be directly proportional to throughput reduction due to support personnel. A 50 percent reduction in throughput would reduce worker requirements by approximately 25 percent.
[c] Average worker dose would remain constant, but total workforce would be reduced for reduced throughput.
Source: NNSA 2007.

3.6.2 No Net Production/Capability-Based Alternative

In response to numerous comments stating that there was no need to build any nuclear weapons, and that NNSA failed to consider an alternative consisting of a Complex that would not manufacture weapons, NNSA added a No Net Production/Capability-Based Alternative to the Final SPEIS. This alternative would require the production of a limited number of components and assembly of weapons beyond those associated with supporting surveillance, but would not involve adding new types or increased numbers of weapons to the stockpile. This alternative would also include the capability for continued surveillance, limited life component (LLC) production, and weapon (and component) dismantlement. At the plants, surveillance would include the capabilities to disassemble weapons, conduct evaluations and component testing, and re-assemble weapons using their original or replacement components. At the laboratories, surveillance would include the capability to address any anomalies detected. NNSA would continue to need capabilities such as weapon design and certification, R&D, hydrotesting, flight testing, environmental testing, and HE R&D to assess and undertake corrective actions for detected problems.

NNSA would still need a nuclear weapons complex under this alternative to support the surveillance program, LLC production, dismantlement, and the capability for all required weapons functions. These functions would require NNSA to maintain a minimal production capacity of approximately 10 sets of components or assembly of 10 weapons per year. The

CMRR-NF could still be needed to support metallurgy chemical activities to support pit production, and a minimum UPF to replace existing facilities at Y-12 could still be needed.

Over time, a No Net Production/Capability-Based Alternative could result in a declining stockpile due to accelerated consumption of components for re-assembly of surveillance units and possibly due to problems identified in an aging stockpile. Sections 3.6.2.1 through 3.6.2.7 discuss the No Net Production/Capability-Based Alternative for each of the Complex sites. The environmental impacts of this alternative are presented in Section 5.1 through 5.9.

3.6.2.1 *No Net Production/Capability-Based Alternative at LANL*

Under this alternative, LANL would continue nuclear design, perform Pu R&D, perform pit surveillance, maintain the capability to produce pits and non-nuclear components, and perform HE R&D and hydrotesting. LANL operations would also include non-weapons activities and work for others. The CMRR-NF would be constructed and would replace the CMR.

Most changes at LANL for this alternative would be minimal for all resource areas except worker health, waste management, and transportation. Worker dose is estimated to decrease to approximately 45 person-rem (a 50 percent reduction compared to 20 ppy production, and a reduction of approximately 80 percent compared to 80 ppy production). LLW from plutonium operations would be reduced to 68 cubic yards per year, and TRU waste generation would be reduced to 42 cubic yards per year. The reduced pit production and wastes would require proportionately less transportation (NNSA 2008).

3.6.2.2 *No Net Production/Capability-Based Alternative at LLNL*

Under this alternative, LLNL would maintain its weapons design and certification mission, and would continue nuclear weapons activities related to stockpile stewardship requiring unique facilities at the main site (e.g. NIF and HEAF). LLNL would cease hydrotesting and environmental testing at Site 300 for NNSA's weapons program. LLNL would continue to conduct non-weapons activities and work for others at both the LLNL main site and Site 300. Also, NNSA would continue activities needed to sustain capabilities to complete weapon design and certification without a commitment to complete new designs or LEPs under this alternative.

The LLNL main site would maintain existing capabilities and conduct ongoing research and development activities. Site 300 capabilities would be maintained for non-weapons activities and work for others. There could be a slight decrease in operations at Site 300 as fewer research and development tests are conducted; however, the requirement to keep the facility operational would not change. A small portion of Site 300 consisting of high explosives waste treatment, high explosives magazine storage, and support functions for HEAF would remain in operation. This alternative would not be significantly different from the No Action Alternative at LLNL.

3.6.2.3 *No Net Production/Capability-Based Alternative at NTS and TTR*

There would be no changes at NTS or TTR for this alternative.

3.6.2.4 *No Net Production/Capability-Based Alternative at Pantex*

Under this alternative, NNSA would maintain the capability to disassemble and re-assemble weapons, perform HE R&D, and conduct surveillance testing to ensure maintenance of capability for all active weapon types at Pantex. Pantex would continue to support surveillance, dismantlement, and HE R&D activities to fully support NNSA missions. In addition, Pantex would perform approximately 44 weapon assemblies per year in order to maintain assembly capabilities across all programs. This quantity represents a combination of surveillance rebuilds and LEP assemblies, and would be required to ensure that Production Technicians maintain qualification.

Staffing would be reduced commensurate with reduced production needs and would impact workers in production, radiation support, systems and process engineering, and indirect services. This reduced workload would create approximately 10 excess production facilities; however, these facilities would be maintained in a "ready-to-use" state, in the event changes were directed by the President. The utility infrastructure would need to be maintained to support fire suppression systems, ventilation, freeze prevention, steam, and chilled and potable water. The security posture would remain consistent. Table 3.6.2.4-1 presents the major changes expected at Pantex under this alternative.

Table 3.6.2.4-1—Annual Operation Requirements at Pantex for a No Net Production/Capability-Based Alternative

Requirements	No Action Alternative	Capability Based Alternative	No Net Production/ Capability-Based Alternative
Electrical Energy Use (MWh)	81,850	61,000	54,000
Water Use (gallons)	130,000,000	97,500,000	85,800,000
Site Employment (workers)	1,644	1230	1,085
Number of Radiation Workers	334	250	220
Average Worker Dose (mrem)	132	132	132
Total Worker Dose (person-rem)	44.1	33.0	29.0
Waste Category			
Low-level Waste (yd^3)	96.8	73	64
Mixed Low-level Waste (yd^3)	1.8	1.4	1.2
Hazardous Waste (yd3)	711	530	470
Nonhazardous Waste (yd3)	6,375	4,800	4,200

Source: NNSA 2007, NNSA 2008.

3.6.2.5 *No Net Production/Capability-Based Alternative at SNL/NM*

Under this alternative, SNL/NM would continue non-nuclear design and engineering missions, perform limited life component manufacture, and perform HE R&D, major environmental testing, and flight testing activities. The only major change at SNL/NM would involve workforce reductions. Site employment would be reduced from approximately 8,730 to 8,450. The number of radiation workers would be reduced from approximately 270 to 260.

3.6.2.6 *No Net Production/Capability-Based Alternative at SRS*

Under this alternative, SRS would continue tritium extraction and reservoir loading and unloading at a reduced rate required to support the stockpile and retain a viable, responsive capability to supply tritium. Limited tritium R&D would be maintained. No significant changes are expected for the major annual operation requirements or the workforce.

3.6.2.7 *No Net Production/Capability-Based Alternative at Y-12*

Under this alternative, NNSA would maintain capability to produce a limited number of weapons components for Life Extension Program work at Y-12. Support for the Life Extension Program would be in the range of 12-15 subassemblies per year (slightly over one a month) to ensure maintenance of capability for all active weapon types. This capacity is slightly higher than 10 subassemblies per year due to the need to keep varying equipment and production staff fully qualified on systems necessary to support the different LEP stockpile variants. In this alternative, Y-12 would continue to support surveillance, dismantlement, and storage activities to fully support NNSA missions, and provide uranium support to all other NNSA and non-NNSA customers. To support this alternative, Y-12 would build a small Uranium Processing Facility (UPF) at Y-12. This “minimum UPF”[28] would maintain all capabilities for fabricating limited LEP subassemblies, and capabilities for planned dismantlement, surveillance and uranium work for other NNSA and non-NNSA customers. Other Y-12 production facilities which are not included in the UPF would remain consistent with the Capability-Based Alternative: production facilities for lithium, depleted uranium, special materials and general manufacturing would retain capabilities but produce much smaller quantities. The HEUMF would remain to provide the capability for SNM storage.

Although many of the current production facilities would not be fully utilized, NNSA would need to maintain them in a “ready-to-use” state in the event changes were directed by the President. This means unused capacity would be exercised periodically and standard preventative maintenance and minimal corrective maintenance would be performed on all equipment that could be required for future needs. The related effects on other plant operations of this alternative would include a small reduction in utility usage and waste generation, a reduction in staffing below the Capability-Based Alternative, and a steady security posture. Table 3.6.2.7-1 presents the operational information for the Y-12 No Net Production/Capability-Based Alternative.

[28] The primary difference between a minimum UPF and the UPF considered under the Distributed Centers of Excellence Alternative would be capacity. In order to maintain the basic capability to perform the enriched uranium missions, all of the required enriched uranium processes must be included in the facility. In many cases, installing the basic processes in the facility would allow the facility to support multiple units per year. The "minimum UPF" would be a smaller facility that contains all processes but less equipment; however, the facility would not be significantly smaller than the current UPF design.

Table 3.6.2.7-1—Annual Operational Requirements for the Y-12 No Net Production/Capability-Based Alternative

Requirements	No Action Alternative	Capability Based Alternative	No Net Production/ Capability-Based Alternative
Electrical Energy Use (MW)	360-480	220-290	200-260
Water Use (million gallons/year)	2,000	1,200	1,080
Y-12 Site Employment (workers)	6,500	3,900	3,400
Steam Plant Generation (billion pounds)	1.5	0.9	0.8
Normal Radiological/Uranium Air Emissions (Curie)	0.01	0.006	0.005
Number of EU Radiation Workers	839	500	450
Average worker-dose for EU Worker (mrem)	48.6	48.6	48.6
Total dose to EU Radiation Workers (person- rem)	40.8	24.3	21.6
Waste Category			
Low-level Waste			
Liquid (yd^3)	17.4	10.4	9.6
Solid (yd^3)	7,800	4,700	4,400
Mixed Low-level Waste			
Liquid (yd^3)	17.9	10.7	9.9
Solid (yd^3)	21.1	12.7	11.7

Source: NNSA 2008.

3.6.3 Further Stockpile Reductions

This section presents a qualitative analysis of the possible effects on programmatic alternatives if the President directed stockpile reductions beyond those described in Sections 3.6.1 and 3.6.2. Any such change in requirements would depend on two factors, (1) when a decision is made to reduce the stockpile; and (2) the size of the future stockpile.

With respect to maintaining the core competencies of the United States in nuclear weapons, and the technical problems of maintaining the safety and reliability of a smaller, aging stockpile in the absence of nuclear testing, NNSA does not believe that stockpile size alone would change the need for the nuclear weapons *laboratory* facilities unless the nation were to abandon the option of returning to a nuclear weapons state. On a gradual path to a very small stockpile (for example, if the President were to direct that the stockpile be reduced to several hundred weapons), size alone could change the need for nuclear weapons *production* facilities. For example, at some point on a path of denuclearization, closure and further consolidation of production sites could become reasonable, rather than reducing facilities in-place.

3.6.3.1 *Distributed Centers of Excellence Alternative*

Assuming that NNSA proceeds with the DCE Alternative, if the nuclear weapons stockpile were significantly reduced, NNSA would be in position to reduce production activities to the levels that could be supported by the capability-based alternatives described in Section 3.6.1 and 3.6.2. Because both Y-12 and Pantex would need to support increased dismantlements, these facilities would continue to operate. If NNSA decides to proceed with a CPC, depending upon the date when the President directs even further reductions in the stockpile, NNSA would assess alternatives for reducing the facility, consolidating additional missions into the CPC, or upgrading LANL plutonium facilities (if LANL is not chosen as the site for the CPC).

At some point following completion of the bulk of dismantlements, closure and further consolidation of production sites could become reasonable. In such a case, NNSA currently envisions that such a Complex might be reconfigured as follows:

- LLNL, LANL, and SNL could become smaller R&D laboratories;
- The CPC site or Y-12 (assuming a UPF is built there) could become the location for production of all components involving Category I/II quantities of SNM;
- NTS could become the site for A/D/HE operations and any high-hazard testing;
- SRS would remain the tritium production site;
- Pantex would be closed; and
- Y-12 would be closed if not selected for a CPC and a UPF is not built there.

Transitioning to a complex such as the one described above would produce the greatest environmental changes at Pantex, which would be closed (and perhaps Y-12, if it were closed). The impacts of D&D associated with such closure are addressed in this SPEIS in Sections 5.5.15 and 5.9.15, as part of the analysis for locating a CNPC at sites other than Pantex and Y-12. The impacts of such D&D are not repeated in this section. Once D&D was complete these sites could be used for a variety of purposes from industry to wildlife refuges, as happened at the former Rocky Flats Plant. The future use would in large part determine the potential environmental impacts. Minor impacts would be expected at LLNL, LANL, and SNL, which would continue R&D missions, but could be further downsized.

Transitioning to a much smaller Complex would result in minimal impacts at SRS. Tritium operations would be further reduced, which would have positive impacts related to the amount of wastes generated, the number of radiological workers, tritium emissions, and radiological exposures to both workers and the public. However, as described in Section 5.8, the impacts from tritium operations do not result in significant impacts; as such, any reductions in impacts would not be major. Major additional quantities of SNM might be declared surplus, which could create a need to extend ongoing disposition activities, some of which are currently conducted at SRS. Surplus plutonium could be used for mixed-oxide fuel for commercial reactors, or as a fuel source for advanced reactors that might be fueled with transuranic materials, or dispositioned with other surplus plutonium. Surplus HEU could be down-blended as fuel for commercial reactors, or used a fuel source for future naval reactors.

Transitioning to a much smaller Complex could result in mission changes at NTS, as the A/D/HE mission could be transferred to this site. For the small throughputs needed to support reduced operations, the DAF would likely be large enough to support this mission. The DAF is a collection of more than 30 individual buildings connected by a rectangular common corridor. The entire complex, covered by compacted earth, covers an area of 100,000 square feet. Safety systems include fire detection and suppression, electrical grounding, independent heating, ventilation and air-conditioning systems with high-efficiency particulate air filters, loud speaker and alarm systems, and warning lights. In operational areas, pairs of blast doors, designed to mitigate the effects of an explosion, are interlocked so that only one door may open at a time.

The DAF contains five assembly cells; four high bays; three assembly bays; one of which houses a glove box, and one of which houses a down draft table; and two radiography bays. Five staging bunkers provide space for staging nuclear components and high explosives. Minor new construction would likely be required to produce HE components.

3.6.3.2 *Consolidated Centers of Excellence Alternative*

If NNSA were to decide to pursue the Consolidated Centers of Excellence Alternative (with either a CNPC or CNC), the difference in nuclear floor space required to meet programmatic production requirements would probably not impact the design and construction of the facility to any appreciable extent (in comparison to overall costs of the project) due to the minimum amount of equipment necessary to achieve specific capacities and the corresponding floor space required. For example, the amount of equipment to produce one pit has an inherent capacity to produce a larger quantity. There are few differences in the amount of equipment needed for capacities of 20 to 80 pits compared to 125 pits to significantly alter the amount of floor space required such that significant cost savings would be accrued in comparison to total project costs. In addition, the operating costs would not be significantly different because a large portion of the costs are associated with maintaining the facilities and their operation.

If the stockpile were reduced to several hundred weapons and the decision was made to reduce the stockpile after the new facilities (e.g. uranium, plutonium, and assembly/disassembly) called for under this alternative were in place, there would be floor space in excess of what would be required. However, the costs and benefits of the excess space would have to be weighed against a number of factors. There would be cost benefits from having the facilities needed to transform the stockpile quickly, and allowing for further reduction of the stockpile. In addition, consolidation of nuclear material would still bring cost savings; and synergy between plutonium and uranium component infrastructure would remain. Any decision to reduce the stockpile would increase dismantlement activities and reduce production activities. Transition of personnel from one activity to another would be facilitated more quickly with the personnel already at the site. Although the facilities might be larger than necessary, much of the costs to maintain the facilities, due to the safety and security aspects of handling Category I/II levels of material would still be realized regardless of the facility size. Additional space would also serve as a contingency should there be changes in requirements for the stockpile or other NNSA responsibilities.

The candidate sites for a CNPC or CNC if the stockpile were reduced to several hundred weapons would not be different than the ones under consideration now. The possibility of stockpile reductions to the level of several hundred would make alternatives that locate more capabilities at a single site more attractive. A small stockpile requires less work in all mission areas. Therefore, total consolidation allows greater flexibility in cross-training and cross-utilization of key skills. The sites to be considered for a total consolidation would be the same as the sites considered for larger stockpiles.

Any new structures NNSA may decide to build would probably not be constructed at the same time the President makes a decision to reduce the stockpile further. During the construction of CNPC or CNC facilities, savings could occur through redesign of facilities in line with the new stockpile. However, NNSA would have to evaluate whether there would be significant cost benefits in redesigning and constructing the facility or continuing based on the status of the project and programmatic requirements. NNSA believes that the Consolidated Centers of Excellence Alternative (especially with a CNPC) would be the least adaptable alternative if the stockpile were reduced to hundreds of weapons.

3.6.3.3 *Capability-Based Alternatives*

Both the Capability-Based Alternative and the No Net Production/Capability-Based Alternative would support a smaller stockpile in a similar way as described for the Distributed Centers of Excellence. NNSA notes that the Capability-Based Alternatives would move the nation more closely to the path that would best support a stockpile of hundreds of weapons.

3.7 CATEGORY I/II SNM CONSOLIDATION ALTERNATIVES

Category I/II quantities of SNM are stored at six NNSA sites: LLNL, LANL, NTS, Pantex, SRS, and Y-12. NNSA is seeking to reduce security costs and increase safety through SNM consolidation. As a result, the future complex is expected to have fewer sites and fewer locations within sites with Category I/II quantities of SNM. This section describes proposals related to Category I/II SNM consolidation alternatives.

As defined in section 11 of the *Atomic Energy Act* of 1954, SNM are: (1) plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which DOE or the U.S. Nuclear Regulatory Commission determines to be SNM; or (2) any material artificially enriched by plutonium or uranium 233 or 235. Quantities of SNM are grouped into security Categories I, II, III, and IV based on the type, attractiveness level, and quantity of material. This enables DOE to use a cost-effective, graded approach to providing safeguards and security.

In 2008, NNSA completed the removal of Category I/II SNM from SNL/NM. SNL/NM no longer stores or uses Category I/II SNM quantities on an ongoing basis, although it may use such quantities for future activities on a campaign basis. NNSA has begun the removal of Category I/II SNM from LLNL, and plans to complete this activity by 2012. Additionally, as described in Section 3.4.1.4, NNSA would remove Category I/II SNM from LANL if LANL were not selected as a site for either plutonium consolidation or a CNPC/CNC. Removal of Category I/II SNM from LANL would be accomplished by approximately 2022 if plutonium operations are not consolidated at Los Alamos. Additionally, this SPEIS analyzes an alternative that would consolidate Category I/II SNM currently stored at Pantex in Zone 4 to Zone 12 at Pantex.

The alternatives for consolidating Category I/II SNM are described in the sections below. The No Action Alternative (Section 3.7.1) focuses on the Category I/II SNM stored at LLNL and Pantex, as those materials are being considered for transfer (in the case of LLNL) and movement to a new location within the site (in the case of Pantex). The No Action Alternative also describes Category I/II SNM storage at LANL, because LANL would ultimately receive the LLNL Category I/II SNM that is still required for NNSA missions. Because there are no *project-specific* proposals or alternatives to consolidate Category I/II SNM from Y-12, NTS, and SRS, those sites are not addressed in this section; however, Section 5.12 discusses the potential impacts associated with the storage of LLNL Category I/II SNM at NTS, which is being considered as an interim storage location.

As part of the programmatic analysis to decide whether and where to construct a CPC, this SPEIS also assesses the impacts of consolidating Category I/II plutonium from LANL to the CPC site, if Los Alamos is not chosen as the host site for a CPC. That assessment is described in Section 3.4.1.4. Additionally, as part of the programmatic analysis to decide whether and where to construct a CNPC, this SPEIS also assesses the impacts of consolidating Category I/II SNM from LANL, Pantex, and Y-12 to the CNPC site, if any of those sites are not chosen as the host site for the CNPC. That assessment is described in Section 3.5.1.3.

Section 3.7.2 describes the analysis for removing the LLNL Category I/II SNM, which is included in the No Action Alternative. Section 3.7.3 describes the alternative of consolidating

Category I/II SNM currently stored in Zone 4 at Pantex to Zone 12 at Pantex, which could be carried out under any of the programmatic action alternatives. The analysis of the environmental impacts of these alternatives is contained in Section 5.12.

3.7.1 No Action Alternative

3.7.1.1 *Lawrence Livermore National Laboratory*

LLNL uses radioactive materials in a wide variety of operations including scientific and weapons R&D, diagnostic research, and research on the properties of materials. Based on facility design and operation, LLNL establishes administrative limits for fissile, special use, radioactive, and sealed materials. An administrative limit establishes the maximum amount of a particular material that is allowed at a facility. Actual inventories are classified. Non-waste management facilities at LLNL authorized to have Category I/II SNM quantities are Building 332, Building 334, and Building 239. However, only Building 332 stores this material. As such, only Building 332 is discussed below.

The Building 332 Plutonium Facility is part of the Superblock, a protected area located in the southwest quadrant of the Livermore Site (see Figure 3.7-1). This building has a total area of 104,687 square feet, including radioactive materials laboratories, mechanical shops, change rooms, storage vaults, a fan loft, basement, equipment rooms, and offices. There are currently 24 laboratories in which radioactive materials can be handled within the radioactive material areas (RMAs) of the facility (DOE 2005a).

The mission of Building 332 includes R&D on the physical, chemical, and metallurgical properties of plutonium and uranium isotopes, compounds and alloys. Although the quantities of Category I/II SNM in Building 332 are classified, the administrative limits are as follows:

Plutonium	1,400 kg
Enriched uranium	500 kg

With respect to waste management facilities with Category I/II SNM, the Decontamination and Waste Treatment Facility (DWTF) and Building B625 manage TRU waste that would be shipped to WIPP.

As described in Section 1.5.2.1, DOE has analyzed the transfer of surplus non-pit weapons-usable plutonium materials from LLNL to SRS for consolidated storage.

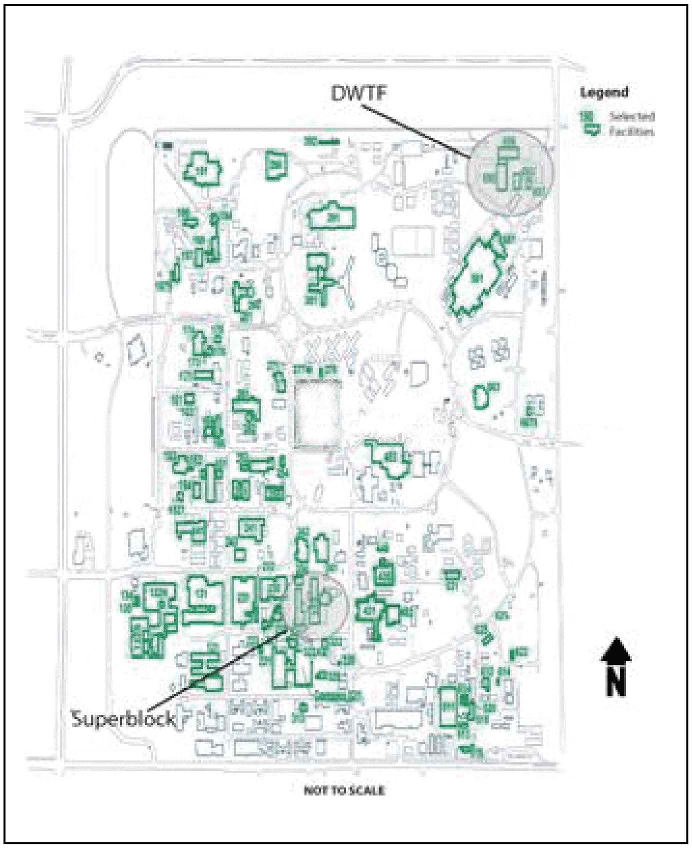


Figure 3.7-1—Location of Superblock (Building 332) and Decontamination and Waste Treatment Facility (DWTF) at LLNL

Those transfers are being accomplished under the No Action Alternative.

3.7.1.2 *Pantex*

As shown on Figure 3.7-2, after removal from nuclear weapons, pits are stored at Pantex. The majority of pits are stored in magazines, commonly referred to as “igloos,” in Zone 4. Zone 4 operations include weapon and SNM staging. These storage operations require access control, security, and electricity. The storage area in Zone 4 is approximately 74,200 square feet. In general, these facilities were built in 1949.

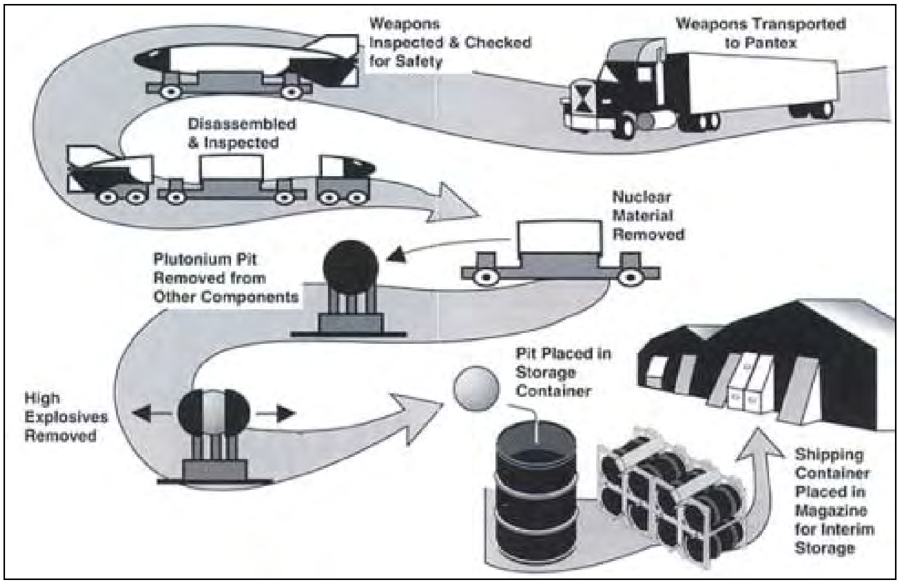


Figure 3.7-2—Pit Storage at Pantex

There are two types of igloos used for pit storage: Modified Richmond and Steel Arch Construction (SAC). Both types are 39 feet deep, 25 feet wide, and a maximum of 15 feet high. Figure 3.7-3 shows a typical igloo. There are more than 10,000 pits in storage at Pantex, the majority of which are destined for processing at the Pit Disassembly and Conversion Facility (PDCF), which is to be constructed at the Savannah River Site. PDCF is currently projected to be operational in 2019.

Figure 3.7-3—Typical Storage Igloos at Pantex

Pits are stored and packaged inside cylindrical containers. The packaging also thermally insulates the pits and makes the problem of cooling more difficult. Currently, pit storage magazines are cooled by natural convection. A draft is created by the heat generated inside the magazine which results in air circulation through intake vents, and out through a ventilation stack. In 1999, Pantex began repackaging pits from AL-R8 containers into AL-R8 Sealed Insert containers to improve storage conditions (see Figure 3.7-4). The repackaging effort started in 1999 is complete. Pit packaging into sealed inserts is a continuing process as pits are removed from weapons as a part of dismantlement.

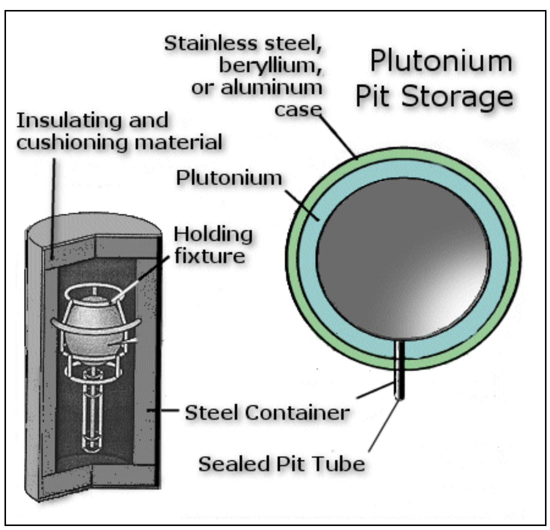


Figure 3.7-4—Simplified illustration of a pit with AL-R8 storage container

3.7.1.3 *Los Alamos National Laboratory*

LANL uses radioactive materials in a wide variety of operations including scientific and weapons R&D, diagnostic research, research on the properties of materials, and plutonium pit production. The TA-55 Plutonium Facility Complex (TA-55 Complex) encompasses about 40 acres and is located about 1 mile southeast of TA-3 (Figure 3.7-5), and is where existing pit production capacity is located. Most of TA-55 is situated inside a restricted area surrounded by a double security fence. The main complex has five connected buildings: the Administration Building, Support Office Building, Support Building, Plutonium Facility, and Warehouse.

The Plutonium Facility, a two-story laboratory of approximately 151,000 square feet, is the major plutonium R&D facility in the complex (see Figure 3.4.1-7), and is where existing pit production capacity is located. The Plutonium Facility provides storage, shipping, and receiving activities for the majority of the LANL SNM inventory (up to approximately 7.3 metric tons), which is mainly plutonium.

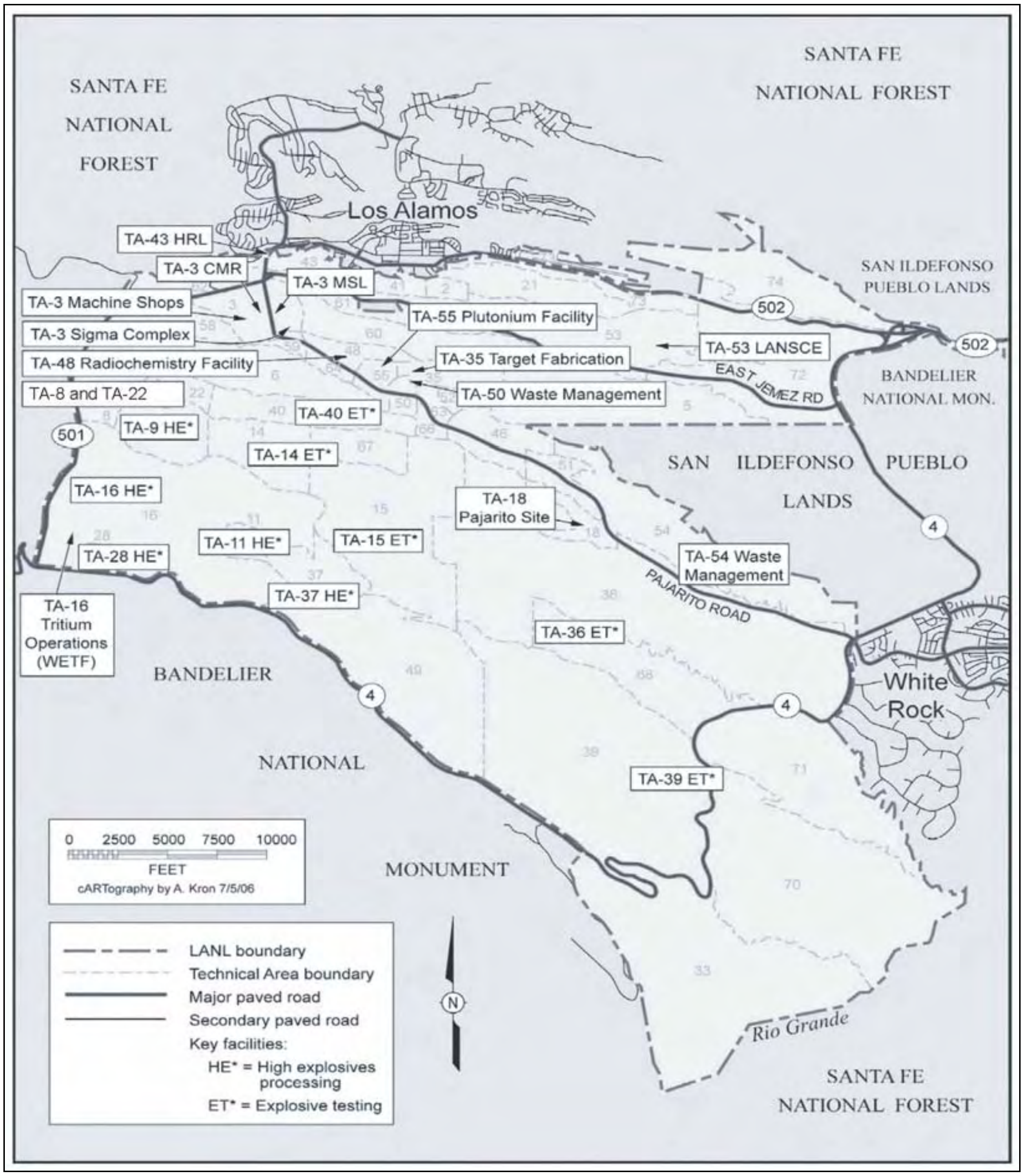


Figure 3.7-5—Major Technical Areas (TAs) at LANL, including TA-55

3.7.2 Transfer Category I/II SNM from LLNL to Other Sites and Phase-out Operations Involving Category I/II quantities of SNM at Superblock

NNSA is planning the removal of Category I/II SNM from LLNL by 2012, and the phase-out of operations at the Superblock involving Category I/II quantities of SNM. Although the exact quantities of Category I/II SNM are classified, the Category I/II SNM at LLNL can be divided up into three basic categories, in the percentages indicated, along with the receiver site for this material, and the number of trips required (see Table 3.7-1).

Table 3.7-1—Category I/II SNM at LLNL

Category I/II SNM Category	Percentage	Receiver Site	# Trips
SNM Excess to Programmatic Missions[29]	56	SRS	10
SNM Required for Programmatic Missions	28	LANL[30]	5
Waste[31]	16	WIPP	3

Source: NNSA 2008.

The LLNL SWEIS (DOE 2005a) assesses the environmental impacts of transporting SNM to and from LLNL and other NNSA sites, SRS, and the WIPP. That analysis includes consideration of transportation actions involving greater quantities of SNM and more shipments than are identified in Table 3.7-1 (see DOE 2005a, Appendix J, Section J.5.3). The Record of Decision for the LLNL SWEIS (70 FR 71491) authorized operations for the Proposed Action Alternative, which allows approximately 538 shipments annually of hazardous and radioactive materials and wastes. As such, the transportation activities identified in Table 3.7-1 are included in the existing No Action Alternative. For completeness, however, this SPEIS assesses the environmental impacts associated with:

- Packaging and Unpackaging Category I/II SNM
- Transporting Category I/II SNM from LLNL to Receiver Sites
- Storage of Category I/II SNM at Receiver Sites
- Phasing out Category I/II SNM Operations from LLNL

With respect to shipments, the maximum number of containers per shipment would be 75, the maximum number of shipments per year would be approximately 4, and all shipments would be made by truck. Shipping is expected to be complete by 2012.

- All oxide and non-weapon component metal would be packaged to meet the DOT 9975 Type B shipping container requirements.
- All weapon components would be packaged to meet DPP-1 Type B shipping container requirements. Mass in containers is dependent on weapon type.
- All Enriched Uranium oxide would be packaged to meet Type B shipping container requirements.
- Enriched Uranium excess metal would be packaged to meet DOT 6M, ES3100, or DPP-2 Type B shipping container requirements.
- All TRU would be shipped in TRUPAC-II containers.
- All TRU shipped to WIPP would meet the WIPP waste acceptance criteria (WAC).

[29] In 2007, DOE prepared a Supplement Analysis (SA) that evaluated the potential environmental impacts of consolidation at SRS of surplus, non-pit, weapons-usable plutonium from Hanford, LLNL and LANL. The SA concluded that this consolidation would not produce a significant change to the potential environmental impacts identified in previous NEPA reviews (DOE 2007b). As a result of this SA, DOE determined that no additional NEPA review is required prior to transferring surplus non-pit weapons-usable plutonium from LLNL to SRS for consolidated storage. Nonetheless, for completeness, this SPEIS includes an analysis of the transportation impacts associated with disposition of all surplus plutonium from LLNL to SRS.

[30] This analysis also evaluates NTS as an interim storage location for the LLNL Category I/II SNM required for programmatic missions. Under this option, the material would be transferred to NTS for interim storage in the DAF until eventual transfer to LANL, or to the site of a CPC or CNPC.

[31] The waste material would be transported to the Idaho National Laboratory (INL) prior to transportation to WIPP. Consequently, this SPEIS includes an analysis of the impacts of transporting this material from LLNL to INL to WIPP.

After phase-out of Category I/II SNM the Superblock facilities would continue to operate with Category III quantities of SNM. During Complex Transformation the Superblock facilities would continue to perform machining, foundry operations, analytical chemistry, and materials characterization on SNM originating from LANL facilities.

3.7.3 Transfer Category I/II SNM from Pantex Zone 4 to Zone 12

Under this alternative, NNSA would transfer pits currently stored at Pantex in Zone 4 to Zone 12. There are two options under this alternative. Under option one, NNSA would transfer all of the more than 10,000 pits stored in Zone 4 to Zone 12. Because there is insufficient storage space in existing Zone 12 facilities, NNSA would need to build a new storage facility capable of storing approximately 60 MT of plutonium. Table 3.7-2 presents the construction requirements for this new underground storage facility. Transfer of the pits from Zone 4 to Zone 12 would enable all Category I/II SNM at Pantex to be consolidated at a central location, close to the assembly, modification, and disassembly operations. This new facility would permit the storage of all surplus and non-surplus pits in Zone 12 in the event there is a delay in the completion of the Pit Disposition and Conversion Facility (PDCF) at SRS. This would reduce the area at Pantex requiring a high level of security. Once this storage facility in Zone 12 is completed and the pits transferred from Zone 4 to Zone 12, Zone 4 would undergo D&D.

Under option two, NNSA would transfer only the non-surplus pits from Zone 4 to Zone 12. The surplus pits would be shipped directly to SRS from Zone 4 for processing in the PDCF, which is currently projected to be operational in 2019. Because there is insufficient storage space in existing Zone 12 facilities for even this reduced quantity, NNSA would need to build a new smaller storage facility to store the non-surplus pits. Table 3.7-2 presents the construction requirements for this new smaller underground storage facility capable of storing approximately 30 MT of plutonium. When the shipment of surplus pits to the PDCF is completed and the non-surplus pits transferred to Zone 12, the area at Pantex requiring a high level of security would be reduced and Zone 4 would undergo D&D.

Under either option, NNSA would ship surplus pits to SRS for disposition at the PDCF in accordance with existing plans, schedules, and decisions made as a part of the Surplus Plutonium Disposition Program. Option 1 would provide the flexibility to store surplus pits in a new storage facility in Zone 12 pending shipment to PDCF while Option 2 would only provide storage for the non-surplus pits in Zone 4. In either case, pit shipment schedules to SRS from Pantex would not be affected.

Table 3.7-2—Construction Requirements for New Zone 12 Pit Storage Facility

Data Required	Maximum Sized Storage Facility Consumption/Use	Minimum-Sized Storage Facility Consumption/Use
Land		
Total Square Footage of New Construction	142,800	95,900
Total Area Disturbed (Facility Footprint) (acres)	57	42
Laydown Area Size (acres)	2.6	2.6
Parking Lots (acres)	1.5	1.5
Water requirement (total construction) (in gallons)	2,950,000	1,500,000
Employment		
Total construction employment (worker years)	480	240
Peak construction employment (workers)	120	60
Construction period (years)	5	5

Source: NNSA 2008

ALTERNATIVES TO RESTRUCTURE R&D AND TESTING FACILITIES

3.8 HIGH EXPLOSIVES R&D

This section describes the alternatives for High Explosives (HE) Research and Development (R&D). The affected environments at sites involved in HE R&D are presented in Sections 4.1 (LANL), 4.2 (LLNL), 4.3 (NTS), 4.5 (Pantex), and 4.6 (SNL/NM). The environmental impacts of the HE R&D alternatives are presented in Section 5.13. Section 3.16 contains a summary of the environmental impacts of the HE R&D alternatives. Together, these sections provide the environmental impact information for the HE R&D alternatives.

Introduction. Energetic materials (high explosives [HE], propellant, and pyrotechnic powders) provide the specific quantities of energy needed for a nuclear weapon to function. Stewardship of the current stockpile and modernization of the weapons in the future require a broad spectrum of energetic material R&D. In the nuclear portion of a weapon system, HE is used for the main charge and associated triggering systems. More specifically, HE R&D is required to assure stability and dependability of HE in nuclear weapons.

Section 3.8.1 describes the No Action Alternative for HE R&D. As described in that section, HE R&D is currently conducted at five sites within the weapons complex. LLNL and LANL are where most of the R&D related to main charge explosives is performed. SNL has responsibility for the cradle-to-grave of the non-nuclear explosive components such as gas generators, ignitors, actuators, and timer-drivers. In addition to extensive manufacturing operations, HE R&D is conducted at the Pantex Plant, principally for safety and quality control purposes and manufacturing process development and improvement. Pantex also partners with the National Labs in conducting HE R&D activities to meet stockpile and other national defense needs. NTS is used for testing of larger quantities of high explosives.

Section 3.8.2 describes the alternatives being considered for HE R&D. Within Section 3.8.2, there are two types of alternatives: Section 3.8.2.1 describes the "Minor"[32] Downsizing/Consolidation Alternatives and Section 3.8.2.2 describes the "Major"[33] Downsizing/Consolidation Alternatives. The analysis of the environmental impacts of these alternatives is contained in Section 5.13.

High Explosives R&D Alternatives
• **No Action.** Continue operations at LLNL, LANL, SNL/NM, NTS, and Pantex • **Minor Consolidation.** Multiple options to consolidate or transfer some operations, but operations would continue at all sites • **Major Consolidation.** Multiple options to consolidate or transfer operations to fewer sites, and discontinue operations at sites that transfer missions

[32] "Minor" alternatives would not completely transfer the HE R&D experimentation and fabrication activities from a site.
[33] "Major" alternatives could completely transfer the HE R&D experimentation and fabrication activities from a site.

3.8.1 Alternative 1—No Action Alternative

This section describes the HE R&D facilities and missions currently conducted at weapons complex sites.

3.8.1.1 *Lawrence Livermore National Laboratory*

HE R&D at LLNL is carried out primarily in two facilities—the High Explosives Application Facility (HEAF) at the main Livermore site, and the Chemistry, Materials and Life Sciences Facility at Site 300. The HEAF is an R&D facility which performs the following missions:

- explosive characterization and lab-scale development;
- performance and safety testing; and
- modeling and simulation of explosive properties and reactions.

The HEAF includes laboratory areas approved for handling explosives in quantities up to 10 kilograms, and office space for the research and support staff. The net usable area of the facility is approximately 65,000 square feet. An aerial view of the HEAF is shown in Figure 3.8-1.

Figure 3.8-1—The LLNL HEAF

Note: The facility section at the bottom of the image is the office area; the area behind that houses the laboratory areas including firing tanks.

The Chemistry, Materials and Life Sciences Facility at Site 300 provides the capability for larger scale synthesis and formulation, HE R&D part fabrication (e.g. pressing, radiography, machining and assembly), and explosives waste packaging, storage and treatment. These capabilities are provided by the Chemistry Area, the Process Area, the Explosive Waste Storage Facility, and the Explosive Waste Treatment Facility. There are approximately 175 scientists, engineers, and technicians associated with the HE R&D mission at LLNL.

The Chemistry Area is made up of the following buildings:

- **B8251**. 2-inch mechanical presses;
- **B826.** Small deaerator/loader;
- **B827 complex.** 50-pound deaerator/loader; heating ovens;
  2-gallon to 5-gallon mixers; melt cast kettles, synthesis pilot plant, slurry kettles, grinders, reaction vessels; and
- **HE storage magazines.** Long term and temporary storage.

The Process Area is made up of the following buildings:

- **B809 complex.** 25-inch isostatic press, drying ovens;

- **B817 complex.** 14- and 18-inch isostatic presses, drying oven;
- **B823 complex.** 9-MeV, 2-MeV, 120-keV radiography of HE R&D parts;
- **B806 complex.**
- **B807.** Machining of HE R&D parts;
- **B855 complex.** Large HE part machining;
- **B810 complex.** Assembly of HE R&D parts;
- **B805.** General machine shop, explosives waste packaging; and
- **HE storage magazines.** Long term and temporary storage.

The Explosives Waste Storage Facility contains 5 HE storage magazines. The Explosives Waste Treatment Facility has a State of California permit for Open Burn/Open Detonation of explosives waste.

Apart from the alternatives analyzed in this SPEIS, LLNL is seeking a permit that would allow larger open-air detonation experiments at Site 300. If granted, the permit would govern all open-air explosives activities that are currently performed under an exemption to permitting in the San Joaquin Valley Air Pollution Control District's Rule 2020. Much of this work would support activities of the Departments of Defense and Homeland Security.

The permit would allow larger open-air detonations and activities (up to 350 pounds net explosives weight) that could include:

- evaluation the effectiveness of countermeasures to potential terrorist devices and actions;
- training on countermeasures for other government agencies;
- study of explosively-driven electro-magnetic pulse generators;
- development of effective conventional (non-nuclear) munitions for use by the Department of Defense such as enhanced-effects and low-collateral damage explosives and devices;
- study of blast effects damage to structures and equipment from accidental and deliberate explosions;
- measurement of explosives shock, directional effects, heat transfer and fragmentation within and near explosive devices;
- development of explosives containment/confinement vessels;
- equipment testing such as explosives shipping containers;
- study of the explosives dispersal of surrogates for hazardous materials; and
- studies of the explosives reaction rates.

The permit application contains specific limits on metals that are hazardous air pollutants (HAPs). Currently, LLNL performs outdoor detonation experiments that produce HAPs emissions below that allowed under the exemptions. If the permit were granted, beryllium (used extensively in outdoor experiments from the late 1950's to 2002) would no longer be allowed in outdoor experiments.

3.8.1.2 *Los Alamos National Laboratory*

LANL conducts HE R&D activities in nine technical areas (TAs), as discussed below. While the LANL HE R&D facilities share some common spaces with the hydrodynamic program, this SPEIS focuses on HE R&D activities at LANL in three areas (HE Science, HE Fabrication, and HE Firing Sites), with 31 buildings (each >1000 square feet), which includes magazines and firing points. The major TAs with HE R&D facilities are discussed below and shown on Figure 3.7-5.

TA-9 This TA is located on the western edge of LANL. Fabrication feasibility and the physical properties of explosives are explored at this site, and new organic compounds are investigated for possible use as explosives. Storage and stability problems are also studied.

TA-14 Located in the northwestern part of LANL, this TA is one of fourteen firing areas. Most operations are remotely controlled and involve detonations, certain types of high explosives machining, and permitted burning. This site is currently permitted to treat waste through open detonation or open burning under the RCRA.

TA-16 Fabrication of precision explosive assemblies, from powder pressing to machining and inspection, occurs at TA-16 to support HE R&D experimentation.

TA-22 This TA, located in the northwestern portion of LANL, houses the Los Alamos Detonator Facility. Construction of a new Detonator Production Facility began in 2003. Research, development, and fabrication of high-energy detonators and related devices are conducted at this facility.

TA-36 TA-36 is in a remotely located area in the eastern portion of LANL that is fenced and patrolled. It has two active firing sites that support the HE R&D mission (it has two other firing sites that support the hydrotesting mission). The sites are used for a wide variety of non-nuclear ordnance tests.

TA-39 TA-39 is located at the bottom of Ancho Canyon. The behavior of non-nuclear weapons is studied here, primarily by photographic techniques.

TA-40 TA-40, centrally located within LANL, is used for studies of explosive initiation, detonation, and shock wave response of other materials related to weapon systems. In addition, surveillance and qualification studies of War Reserve (WR) detonators are conducted.

TA-46 TA-46, located between Pajarito Road and the San Ildefonso Pueblo, is one of LANL's basic research sites. Current operations include studies of the response of small quantities of explosive to thermal and mechanical stimuli.

TA 53 At TA-53, LANL has developed Proton Radiography, which has the ability to capture a sequence of images, creating a movie of an explosive event (up to 33 frames, currently). Proton radiography shots are currently limited to 10 pounds TNT equivalent in a containment vessel.

Reductions in HE activities have been previously analyzed at LANL in the *Environmental Assessment for the Proposed Consolidation of Certain Dynamic Experimentation (DX) Division Activities at the Two Mile Mesa Complex of LANL* (hereafter, LANL DX Consolidation Plan) (LANL 2003). Based on that Environmental Assessment and FONSI, LANL is reducing the footprint of HE and is transforming from open-air to contained firing for most experiments under 10 kg TNT equivalent. LANL consolidation is underway, as exhibited by closure of Buildings TA-16-340, TA-16-430 with consolidation into TA-16-260, closure of the TA-40-4 firing site, D&D of TA-9-35 and TA-9-42, and the transfer of TA-39-2 to Threat Reduction Directorate.

3.8.1.3 *Pantex Plant*

Research at Pantex includes studying the use of insensitive HE for increased safety as well as refinement of HE manufacturing methods and safety procedures. Pantex performs HE synthesis, formulation, machining, extrusion, testing, process development, and analytical operations in performing its HE research and development and production missions. These operations are performed in Zone 11 or Zone 12 using HE materials stored in Zone 4 East remote firing sites (see Figure 3.8-2). HE R&D activities and HE production mission work at Pantex both occur in common facilities and work areas.

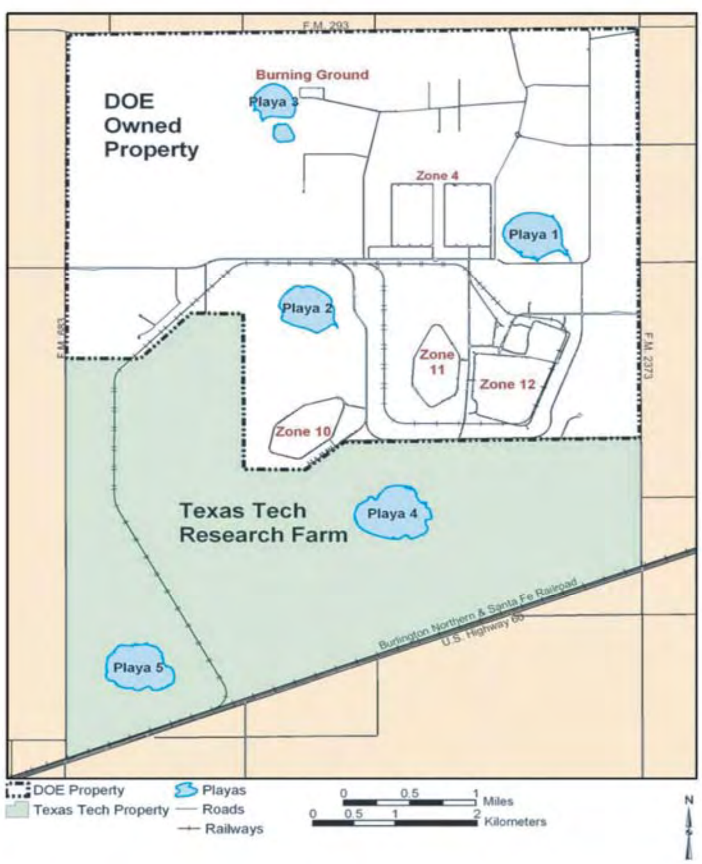


Figure 3.8-2—Relevant Zones at Pantex for HE R&D

3.8.1.4 *Sandia National Laboratories/NM*

Figure 3.8-3—Explosive Component Facility (ECF); SNL/NM Bldg 905

The major SNL/NM facilities and laboratories involved in NNSA activities that conduct HE R&D are described below. The Explosive Component Facility (ECF), shown in Figure 3.8-3, was built specifically to conduct the SNL/NM work on explosive components. The ECF includes over 100,000 square feet of laboratories, diagnostic centers and performance facilities for the research and development of advanced explosive technology and sits on 22 acres in Tech Area II (see Figure 3.8-4). Unique facility features include explosives labs qualified for all types of explosives, HE chambers and firing pads, explosive component disassembly area, explosives receiving area, and explosives storage. The ECF includes the ability to handle, store, test and model all types of explosive materials, conduct performance testing and material compatibility studies, and surety assessments related to safety and reliability. Approximately 80 people work at the ECF.

The Terminal Ballistics Facility (TBF), located in TA-III, includes a 1,000 square-foot indoor and a 100-acre outdoor firing range that accommodate testing and firing of guns ranging in size from 0.17 caliber to 8-inch. The facility retains the world's fastest launch capability for masses of 300 to 2,000 grams. The site also conducts static firings of solid fuel rocket motors of up to 100,000 pounds thrust. The firing site can accommodate explosive detonation tests up to the equivalent of 50 pounds of TNT. As many as 12 people work at the TBF, depending upon the test being conducted.

Currently there are two facilities used for explosive storage: the “6000 Igloos” and Manzano. They are owned by Kirtland AFB. The 6000 Igloo storage area has a total of 21,000 square feet in 21 facilities (10 of 21 are for classified storage). The Manzano storage area includes 43 facilities, of which 13 are used for explosive storage. Approximately 18 people maintain the storage facilities.

The Explosives Applications Department utilizes facilities in Sites 9930, 9939, 9920 in Coyote Canyon to conduct research, design, development, manufacture and testing of explosive components, explosive systems, and arming and firing system hardware. The department also operates laboratories in Tech Area IV and the Explosives Applications Laboratory (Site 9930) in Coyote Canyon. Approximately 36 people support this mission.

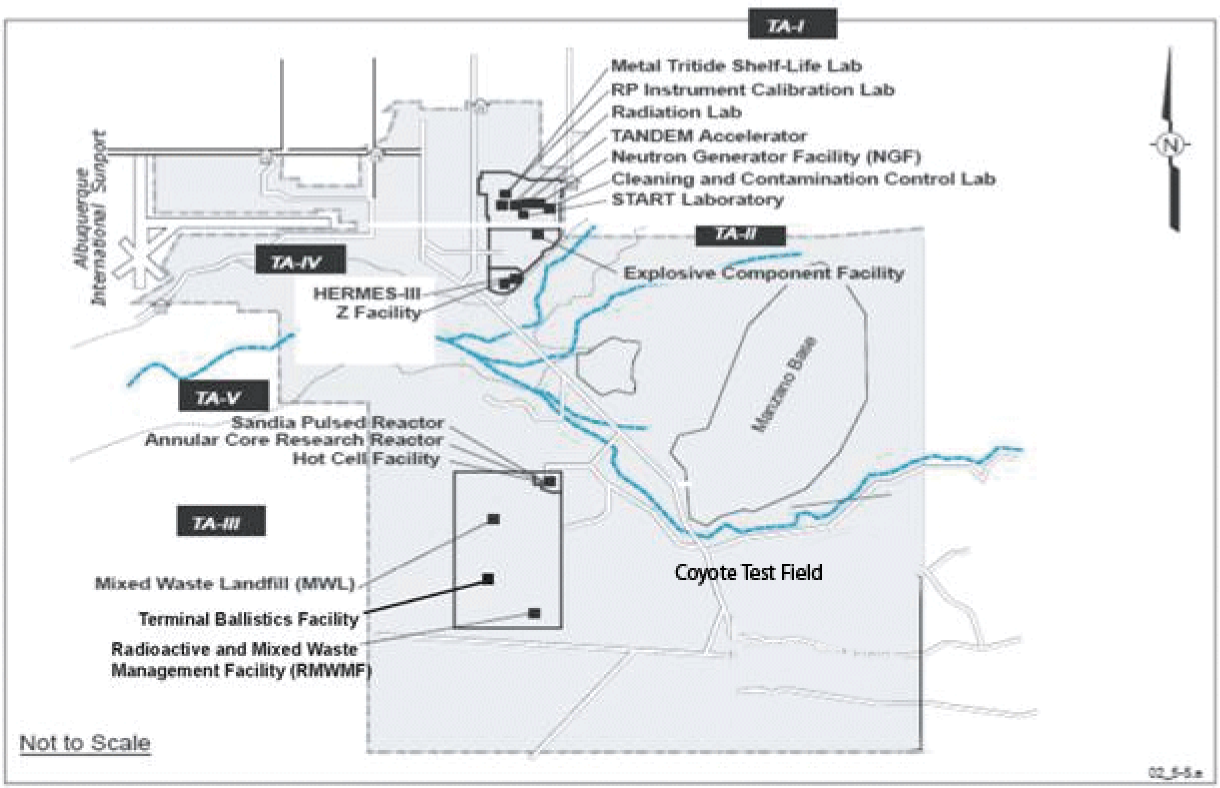


Figure 3.8-4—SNL/NM Technical Areas

3.8.1.5 *NTS*

NTS facilities for HE R&D also support hydrotesting. Section 3.11.1.3 discusses these facilities.

3.8.2 HE R&D SPEIS Alternatives

As explained in Section 3.8.1, HE R&D activity is currently distributed among five primary sites within the nuclear weapons complex based on their respective roles in support of the nuclear weapons stockpile. This SPEIS analyzes a full spectrum of alternatives associated with HE R&D as shown on Table 3.8-1. Each of these alternatives is described in this section.

3.8.2.1 *HE R&D Minor Reduction/Consolidation Alternatives*

Alternatives 2a–2e would reduce or consolidate various functions related to HE R&D, but not transfer the entire HE R&D mission from one site to another site. Each alternative is described below:

Table 3.8-1—HE R&D Alternatives

Downsize/Consolidate Alternatives		Donor Site	Receiver Site
1	No Action Alternative	N/A	N/A
2a	Downsize in Place	N/A	N/A
2b	Relocate HE Processing & Fabrication from Site 300	LLNL	Pantex, LANL
2b'	LLNL HEAF Annex for local part fabrication	LLNL	Pantex, HEAF, LANL, Private industry
2c	Consolidate open-air 1-10 kg HE R&D experiments from LANL and SNL/NM to HEAF; and over 10 kg-100 kg HE R&D experiments at LANL or NTS	1-10 kg HE R&D LANL, SNL/NM, Pantex 10-100 kg HE R&D LLNL, SNL/NM	1-10 kg HE R&D LLNL, NTS 10-100 kg HE R&D LANL or NTS
2d	Consolidate unconfined firing to one or no sites	ALL	One Site or No Site
2e	Consolidate Main Charge HE R&D Experiments and Testing to one or both nuclear labs	SNL/NM	LANL, LLNL
3a	Consolidate HE R&D Experimentation and Fabrication Activities to LANL	SNL/NM, LLNL, Pantex	LANL
3b	Consolidate HE R&D Experimentation and Fabrication Activities to LLNL	SNL/NM, LANL, Pantex	LLNL
3c	Consolidate HE R&D Experimentation and Fabrication Activities to Pantex	SNL/NM, LANL, LLNL	Pantex
3d	Consolidate HE R&D Experimentation and Fabrication Activities to SNL/NM	LANL, LLNL, Pantex	SNL/NM
3e	Consolidate HE R&D Experimentation and Fabrication Activities from LANL to LLNL or Pantex or NTS	LANL	LLNL, Pantex, NTS
3f	Consolidate HE R&D Experimentation and Fabrication Activities from LLNL to LANL or Pantex or NTS	LLNL	LANL, Pantex, NTS
3g	Consolidate HE R&D Experimentation and Fabrication Activities from LANL and LLNL to Pantex or NTS	LANL, LLNL	Pantex, NTS
3h	Consolidate HE R&D Experimentation and Fabrication Activities to NTS	LANL, LLNL, SNL/NM, Pantex	NTS

3.8.2.1.1 Alternative 2a—Downsize in place

Under this alternative, the following actions would take place:

At LLNL, B825/B826, B817, and some machining bays in B806/B807 would close. No construction would be required for this alternative, however, B825 and B826 would be decommissioned. There would be no staffing change for this alternative (175 scientists, engineers, and technicians) and no significant change in effluents, emissions, or waste compared to the No Action Alternative. As some buildings close, work would transfer to existing buildings.

As discussed in Section 3.8.1.2, LANL is reducing the footprint of HE and is transforming from open-air to contained firing for most experiments under 10 kg TNT equivalent. However, under option 2a, additional reductions at LANL would occur to the HE R&D capability as part of Complex Transformation. This reduction could include establishing a smaller footprint with fewer contained firing chambers, than identified in the LANL DX Consolidation Plan. These actions, however, would be bounded by previous plans and would have no different environmental impacts.

At SNL/NM, the DP-related explosives R&D work substantially decreased its footprint in 1995 when the ECF (Bldg 905) was built. The footprint for the DOE explosive work decreased from 210 to 22 acres in this consolidation event, and the lab and office space decreased from a total of 110,000 square feet, over a dozen buildings (offices, labs and storage) to approximately 100,000 square feet now located one building—the ECF. Currently all the facilities that house explosives-related R&D are functioning close to full capacity or are unique to the function that they perform. SNL/NM's 9920, 9930, 9939, 9940 sites and Thunder Range are being used to full capacity. As such, no additional reductions are proposed under this alternative. No changes would occur at Pantex or NTS.

3.8.2.1.2 Alternative 2b—Relocate HE Processing & Fabrication from Site 300

Under this alternative, NNSA would discontinue HE processing and fabrication at Site 300. The activities and configuration of the HEAF, as described in the No Action Alternative, would remain unchanged. However, the HE R&D facilities at Site 300 would be closed, and HE R&D parts that are currently fabricated at Pantex or LANL would be shipped to LLNL for testing in HEAF.[34] The facilities at Site 300 that would close under this alternative are: B825, B826, B827 Complex, B809 Complex, B817 Complex, B823 Complex, B806 Complex, B807, B855 Complex, B810 Complex, and B805. No construction at LLNL, LANL, or Pantex would be required for this alternative.

3.8.2.1.3 Alternative 2b'—Construct HEAF Annex at LLNL for Local Part Fabrication

Under this alternative, NNSA would implement alternative 2b, construct an annex to HEAF for local fabrication of HE R&D parts. The annex would be constructed adjacent to HEAF's explosive processing cells and support areas (e.g. control room, explosive storage) to provide fabrication capability that is currently provided at Site 300. Construction information for this annex is presented in Section 5.13.1.3.

3.8.2.1.4 Alternative 2c—Move Open-Air Experiments Using 1–10 kg HE from LANL and SNL/NM to LLNL HEAF and Experiments Using 10–100 kg HE to LANL or NTS

Under this alternative, NNSA would consolidate open-air 1-10 kilograms HE from LANL and SNL/NM to LLNL[35] HEAF and consolidate experiments using more than 10 kilograms up to 100 kilograms at LANL or NTS. There would be no new construction at LANL.

At LLNL, available office space near HEAF would provide temporary office/work space for LANL or SNL/NM staff while they are at LLNL. To accommodate the higher firing load at HEAF, more LLNL staff would be required in addition to the staff that LANL and SNL/NM

[34] This alternative could only be implemented if other activities at Site 300 that require a HE processing and fabrication infrastructure, specifically hydrotesting at the Contained Firing Facility (see Section 3.11.2.2) and system environmental testing at the Environmental Test Facility (see Section 3.12.3), are transferred to new facilities, freeing space for this testing to occur.
[35] Processing capability could handle up to 15 kg, but testing would be less than 10 kg.

would rotate in for their experiments. It is assumed in this alternative that alternatives 2b and 2b' are not adopted.[36] No new facilities would be required for this alternative.

At SNL/NM, the maximum shot size at the ECF is 1 kilogram of TNT equivalence. As a result, this alternative would not eliminate HE R&D experiments and testing that are conducted at the ECF, nor would it decrease the laboratory space required to do this work. The work at the TBF is also not likely to experience major impacts in this alternative. The SNL/NM firing sites most likely affected by this alternative would be 9920, 9930, 9939, 9940 and Thunder Range, which are mostly used and funded by work for other agencies.

At LANL, consolidation of open-air 1-10 kilograms shots at HEAF with simultaneous consolidation of 10-100 kg shots at LANL would be expected to have no significant net effect on operations. Consolidation of 1-10 kilograms shots to HEAF would result in the transfer of the firing and assembly of approximately 200-250 shots per year. At LANL, conducting the 10-100 kilogram shots would impact the planned reductions/closure of LANL's firing points in order to perform these additional tests. This would include receiving shots from LLNL's 850 and 851, SNL/NM's 9920, 9930, 9939, 9940, Thunder Range, and surveillance and destructive testing from Pantex. This is in contrast to the LANL downsizing that is occurring under the No Action Alternative, as firing points are being replaced with containment vessels. However, given LANL's current permitted status, this work could be accepted without additional environmental impacts.

NTS does not currently have an independent HE R&D program, but utilizes specific capabilities at various facilities to conduct high explosive activities. These facilities include the BEEF, Baker site, U1a Complex, and the tunnels U12P and U25X, as well as the Nonproliferation Test and Evaluation Complex (NPTEC). Each site is suitable and has the capabilities necessary to conduct HE R&D experiments up to approximately 100 kilograms using hazardous materials.

NTS's primary open air firing site is the BEEF complex. The facility contains one instrumented shot table, a control/diagnostic bunker, and a high speed camera bunker. Surrounding the 60 ft x 60 feet shot table are three steel diagnostic blast enclosures. A shot rate of greater than one shot per day could likely be accommodated in existing firing tables.

3.8.2.1.5 Alternative 2d—Consolidate Unconfined Firing to One Site or Eliminate It

Under this alternative, all unconfined firing operations would be consolidated at one site or eliminated. In any case, unconfined firing operations would be eliminated at LLNL. Currently, HE R&D unconfined firing at LLNL is limited to destruction of excess explosive parts and explosives waste, through open burn or open detonation (OB/OD) at the Explosives Waste Treatment Facility located at Site 300. No new facilities are required in this alternative. At LLNL, Building 845 would be decommissioned.

LANL currently operates an Emergency Management and Response (EM&R) site that includes open detonation of suspect/terrorist threat devices for the Laboratory and the County of Los Alamos. This site is a destruct site that will always require some outdoor capability (for example

[36] This alternative is not possible if either alternative 2b or 2b' is implemented.

destruction of a "car bomb"; this could be characterized as an emergency). In addition, LANL uses the existing OB/OD permit to eliminate "Class L" explosives and to sanitize classified remains of hydrodynamic experiments. OB/OD is a separately permitted function that does not allow dual use of facilities. For example, a contained firing vessel for programmatic testing may not also be used as a waste treatment facility, unless permitted. Replacement of all OB/OD requires either additional construction or modification of an existing facility to develop a separately permitted contained destruct capability (e.g. incineration, super critical water oxidation, base hydrolysis or molten salt reactors). Construction of a 2000-square foot facility would be worst case, and would fall within the bounding condition set by the DX Consolidation Plan which is covered under the No Action Alternative.

Receiving all unconfined firing would force limited closure of LANL's firing points in order to meet the needs of these demands. This would include receiving shots from LLNL's 850 and 851, SNL/NM's 9920, 9930, 9939, 9940, Thunder Range, and surveillance and destructive testing from Pantex.

The NTS Area 11 Explosive Ordinance Disposal Unit (EODU) is used to conduct open detonations for the destruction of excess explosive materials in accordance with appropriate RCRA permits. . An area near tunnel U25X has a firing site that was used for HE experiments containing beryllium. No additional facilities are required.

3.8.2.1.6 Alternative 2e—Consolidate Main Charge HE R&D Experiments and Testing at One or Both Nuclear Labs

In this alternative, main charge HE R&D experiments at SNL/NM would be transferred to LANL and/or LLNL. Pantex main charge experiments are considered part of production plant support, or surveillance, and not HE R&D, and are therefore not in the scope of this alternative.

If the SNL/NM experiments were transferred to LLNL, they could be accommodated in existing laboratories in HEAF. The main charge HE R&D effort is small at SNL/NM, so there is a negligible impact on current HEAF activities. No construction or new facilities are required for this alternative.

If the SNL/NM experiments were transferred to LANL, LANL has the current infrastructure to absorb main charge HE R&D experiments and testing that SNL/NM is currently conducting at its site, with minimal or no impact. No new facilities are required in this alternative.

If SNL/NM had LLNL or LANL conduct its experiments instead, this would not decrease the need for supporting work at SNL/NM. SNL/NM would design components and experiments up to the point of HE assembly at SNL/NM. SNL/NM also has components that utilize secondary HE, which is the same family of explosives as the main charge explosives. SNL uses these same capabilities for the explosive materials in the non-nuclear components. If work on the main charge explosives ceased at SNL/NM, work would continue on the other explosive materials that are in the non-nuclear components. No change in personnel would occur and there would be no net reduction in facility footprints. Consolidation to one or both nuclear laboratories would reduce costs associated with maintenance of duplicative facilities.

3.8.2.2 *HE R&D Major Reduction/Consolidation Alternatives*

Alternatives 3a–3g would transfer the entire HE R&D experimental and fabrication activities from one site to one or more other sites. It is noted that the R&D *mission* that has been assigned to each laboratory and plant would continue to be conducted by the scientists and engineers at those sites, although they may have to travel to a "user facility" at the consolidation site. It is the *capability*; i.e. facilities, machines, and equipment, that would be consolidated at a single site or smaller number of sites. Some personnel (facility operating staff and technicians) might move with the capability to the consolidation site. Each alternative is described below.

3.8.2.2.1 Alternative 3a—Consolidate HE R&D Experimentation and Fabrication Activities at LANL

Under this alternative, HE R&D experimentation and fabrication activities would be consolidated at LANL. The following actions at the potentially affected sites would occur:

LANL. Consolidating HE R&D at LANL would involve an increase of capacity for the types of experiments and capabilities that currently exist at LANL. LANL would need approximately 170,000 square feet of office and laboratory space to absorb the LLNL and SNL/NM experimental and fabrication activities. Figure 3.8-5 shows the proposed location for this new facility. No additional construction would be needed to absorb the Pantex HE R&D experimentation and fabrication activities.

LLNL. Under this alternative, LLNL would cease HE R&D experimentation and fabrication.

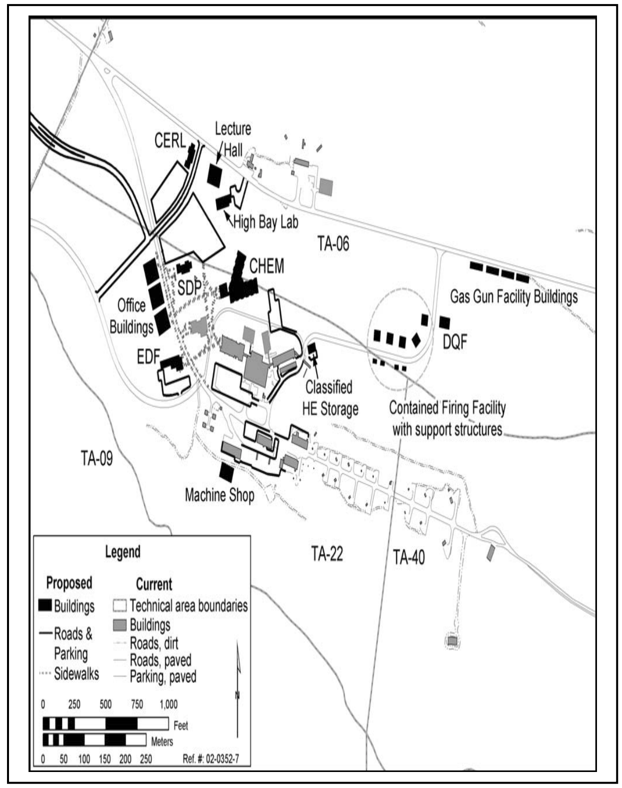


Figure 3.8-5—New Construction Location for LANL Consolidation Alternative

SNL/NM. Under this alternative, SNL/NM would cease HE R&D experimentation and fabrication.

Pantex. Under this alternative, Pantex would cease HE R&D experimentation and fabrication. However, because there are currently no Pantex facilities or personnel dedicated entirely to HE R&D experimentation and fabrication, no major changes in facility operations would result.

3.8.2.2.2 Alternative 3b—Consolidate HE R&D Experimentation and Fabrication Activities at LLNL

Under this alternative, HE R&D experimentation and fabrication would be consolidated at LLNL. The following actions would occur:

LLNL. Construction of a new facility at LLNL would be necessary to provide capacity.[37] A new experimental facility with about 400,000 square feet and 300 offices is projected. The new facility would be located near HEAF, as shown below in Figure 3.8-6.

LANL. Under this alternative, LANL would cease HE R&D experimentation and fabrication.

SNL/NM. Under this alternative, SNL/NM would cease HE R&D experimentation and fabrication.

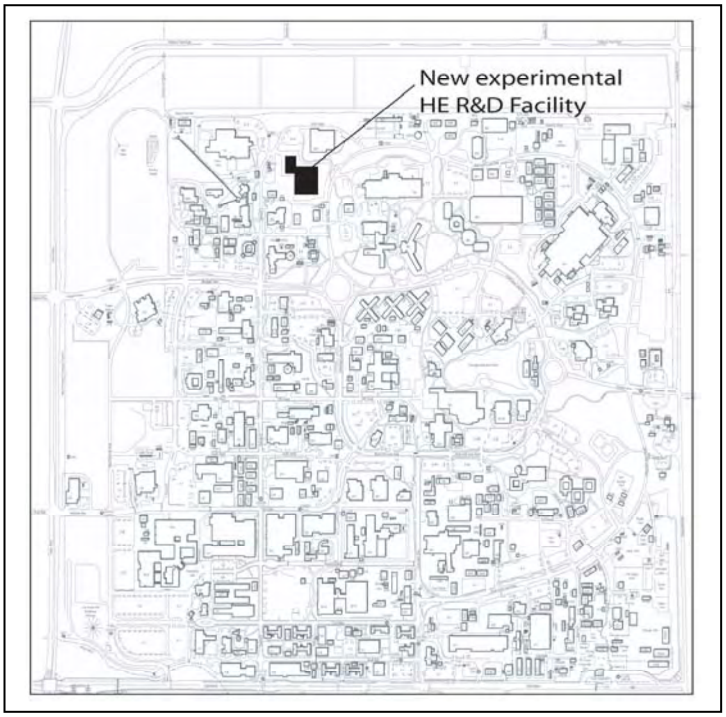


Figure 3.8-6—Location for New HE R&D Facility at LLNL

Pantex. Under this alternative, Pantex would cease HE R&D experimentation and fabrication. However, because there are currently no facilities or personnel dedicated entirely to HE R&D experimentation and fabrication at Pantex, no major changes in facility operations would result.

3.8.2.2.3 Alternative 3c—Consolidate HE R&D experimentation and fabrication activities at Pantex

Under this alternative, HE R&D experimentation and fabrication activities would be consolidated at Pantex. The following actions would occur:

Pantex. Consolidating HE R&D experimentation and fabrication activities at Pantex would result in the need for both new construction and modifications to existing facilities. Pantex would need approximately 100,000 square feet of office and laboratory space to absorb the LLNL, LANL, and SNL/NM HE R&D experimental and fabrication activities.

LANL. Under this alternative, LANL would cease HE R&D experimentation and fabrication.

LLNL. Under this alternative, LLNL would cease HE R&D experimentation and fabrication.

[37] For this alternative, HE R&D at Site 300 would have to continue – alternatives 2b or 2b' could also be adopted.

SNL/NM. Under this alternative, SNL/NM would cease HE R&D experimentation and fabrication.

3.8.2.2.4 Alternative 3d—Consolidate HE R&D experimentation and fabrication activities at SNL/NM

Under this alternative, HE R&D experimentation and fabrication would be consolidated to SNL/NM. The following actions would occur:

SNL/NM. SNL/NM could conduct the HE R&D experimentation and fabrication activities currently performed at Pantex and activities from LANL and LLNL conducted at outdoor firing sites without additional construction. In order to transfer operations from the LLNL HEAF, Site 300, and LANL, an additional 480,000 square feet of office and laboratory space would be required. The construction would likely be located in TA-2, near the ECF shown on Figure 3.8-4.

No construction would be required to accommodate the work that is currently conducted at Pantex. New firing sites would not be required. About half of the new construction represents office space for traveling scientists and engineers, and the remainder as laboratory space.

LANL. Under this alternative, LANL would cease HE R&D experimentation and fabrication.

LLNL. Under this alternative, LLNL would cease HE R&D experimentation and fabrication.

Pantex. Under this alternative, Pantex would cease HE R&D experimentation and fabrication. However, because there are currently no facilities or personnel dedicated entirely to HE R&D experimentation and fabrication, no major changes in facility operation would result.

3.8.2.2.5 Alternative 3e—Move HE R&D Experimentation and Fabrication Activities from LANL to LLNL, Pantex or NTS (for NTS, see Section 3.8.2.2.8)

Under this alternative, HE R&D experimentation and fabrication activities would be transferred from LANL to either LLNL or Pantex. The following actions would occur:

LANL. Under this alternative, LANL would cease HE R&D experimentation and fabrication.

LLNL (if receiver). Construction of a new facility at LLNL would be necessary to provide capacity. The facility would be similar to the facility identified under alternative 3b.

Pantex (if receiver). Construction of a new facility and modifications to existing facilities would be necessary to support the HE R&D capacity from LANL. The facility would be similar to the facility identified under alternative 3c.

3.8.2.2.6 Alternative 3f—Move HE R&D Experimentation and Fabrication Activities at LLNL to LANL, Pantex, or NTS (for NTS, see Section 3.8.2.2.8)

Under this alternative, HE R&D experimentation and fabrication would be transferred from LLNL to either LANL or Pantex. The following actions would occur:

LANL. Consolidating the LLNL HE R&D experimentation and fabrication at LANL would involve an increase of capacity for the types of experiments and capabilities that currently exist at LANL. LANL would need approximately 65,000 square feet of office and laboratory space to absorb the LLNL experimentation and fabrication activities.

LLNL. Under this alternative, LLNL would cease HE R&D experimentation and fabrication.

Pantex (if receiver). Construction of a new facility and modifications to existing facilities at Pantex (similar to those identified under Alternative 3c) would be necessary to support the HE R&D experimentation and fabrication capacity from LLNL.

3.8.2.2.7 Alternative 3g—Move HE R&D Experimentation and Fabrication Activities from LANL and LLNL to Pantex or NTS (for NTS, see Section 3.8.2.2.8)

Under this alternative, HE R&D experimentation and fabrication activities would be transferred from LLNL and LANL to Pantex. The following actions would occur:

Pantex (if receiver). Consolidating HE R&D experimentation and fabrication at Pantex would result in the need for both new construction and modifications to existing facilities. The facility and modifications would be similar to those identified under alternative 3c.

LANL. Under this alternative, LANL would cease HE R&D experimentation and fabrication.

LLNL. Under this alternative, LLNL would cease HE R&D experimentation and fabrication.

3.8.2.2.8 Alternative 3h—Move HE R&D Experimentation and Fabrication Activities to NTS

Under the major HE R&D consolidation alternatives, NTS is being considered for the following: (1) consolidation of LANL HE R&D experimentation and fabrication to NTS; (2) consolidation of LLNL HE R&D experimentation and fabrication to NTS; (3) consolidation of LANL and LLNL HE R&D experimentation and fabrication to NTS; and (4) consolidation of all HE R&D experimentation and fabrication at NTS.

To consolidate HE R&D experimentation and fabrication activities to the NTS would require a 100,000 square feet Explosive Components type facility to conduct SNL/NM activities. An additional 200,000 square feet of mix use space would be required for HE R&D activities currently being conducted at LANL, LLNL, and Pantex.

3.9 TRITIUM R&D

This section describes the alternatives for Tritium Research and Development (R&D). The affected environments at sites involved in Tritium R&D are presented in Sections 4.1 (LANL), 4.2 (LLNL), and 4.8 (SRS). The environmental impacts of the Tritium R&D alternatives are presented in Section 5.14. Section 3.16 contains a summary of the environmental impacts of the Tritium R&D alternatives. Together, these sections provide the environmental impact information for the Tritium R&D alternatives.

Introduction. Tritium, a radioactive isotope of hydrogen, is an essential component of every warhead in the nuclear weapons stockpile. Tritium is used to boost the yield of warheads. Tritium has a half-life of about 12 years, so replacement tritium must be produced in reactors, purified, and put into storage vessels (reservoirs). Because warheads depend on tritium to perform as designed, there is a need for tritium R&D. Tritium R&D involves activities such as: storage, purification, separation, engineering and physics performance, aging, analysis of surveillance data, diagnostics, enhanced surveillance, modeling and simulation, and compatibility testing.

Over the past fifteen years there has been substantial consolidation of tritium activities. Today, the NNSA tritium mission includes several basic elements: irradiation of tritium targets, tritium extraction, tritium recycle and reservoir fill, Gas Transfer System (GTS) surveillance, design support, and R&D. For ease of discussion, the irradiation of tritium targets, tritium extraction, recycle and reservoir fill, and GTS surveillance are referred to as “Tritium Production”, and the design support and tritium R&D as “Tritium R&D.” With the exception of the irradiation of tritium targets (which occurs at the TVA Watts Bar commercial nuclear reactor), all other elements of “Tritium Production” are currently conducted at SRS. The “Tritium R&D” missions are largely performed at LANL, with lesser amounts performed at both LLNL and SRS.

Section 3.9.1 describes the facilities for the Tritium R&D No Action Alternative, Section 3.9.2 describes an alternative of consolidating Tritium R&D at SRS, Section 3.9.3 describes an alternative of consolidating Tritium R&D at LANL, and Section 3.9.4 describes the alternative of reducing Tritium R&D in place. The analysis of the environmental impacts of the reasonable alternatives is contained in Section 5.14.

Tritium R&D Alternatives

- **No Action.** Continue operations at LLNL, LANL, SRS, and SNL/NM[1]
- **Consolidate tritium R&D at SRS.** Move gas transfer system R&D support from LLNL[2] and LANL to SRS
- **Consolidate tritium R&D at LANL.** Move gas transfer system R&D support from LLNL to LANL
- **Reduce tritium R&D in place.** LLNL, LANL, and SRS would reduce operations

[1] Tritium Operations at SNL/NM are primarily associated with the Neutron Generator Production Facility, which is unaffected under all alternatives.
[2] Does not include National Ignition Facility (NIF) target R&D and NIF production target filling. Those operations would remain at LLNL under all alternatives.

3.9.1 Tritium R&D No Action Alternative

Under the No Action Alternative, NNSA would continue ongoing tritium activities at current sites. This would entail the following tritium operations.

3.9.1.1 *Lawrence Livermore National Laboratory*

The LLNL Tritium Facility is located within the Superblock (see Figure 3.9-1) at the main Livermore site. The facility has an administrative limit of 35 grams of tritium, and a material-at-risk limit of 30 grams. The primary tritium mission of the Tritium Facility is NIF target R&D with target filling to be added in support of the NIF Ignition Campaign beginning in 2009. Under all alternatives, the NIF target R&D and target filling would remain at LLNL. The facility also hosts limited GTS R&D experiments conducted by SNL/CA researchers, which are engaged in neutron generator development and provide maintenance and recertification services for the UC-609 Type B tritium shipping package. These R&D activities, which occur in one glove box and involve less than 10 people, could be affected by the alternatives in this SPEIS.

Figure 3.9-1—LLNL Tritium Facility

3.9.1.2 *Los Alamos National Laboratory*

The LANL Weapons Engineering Tritium Facility (WETF) is located at TA-16, a remote area with controlled access (that is, a limited security area) (Figure 3.9-2). The WETF performs tritium R&D in support of LANL's stockpile stewardship mission, primarily the gas transfer system (GTS) design mission for use in weapons. Support of the GTS mission requires flexibility to quickly react to issues that are discovered in the stockpile. The primary use of tritium in the stockpile is in GTSs which require large quantities of tritium. Typical WETF tritium processing activities include: (1) loading and unloading; (2) removing tritium decay products and other impurities from gaseous tritium; (3) mixing tritium with other gases; (4) analyzing tritium as mixtures; (5) loading tritium onto various metals and metal alloys; (6) repackaging tritium and other gases to user specifications; (7) environmental storage and conditioning of GTS components; (8) performing various user-defined experiments with tritium; (9) unloading (depressurizing) containers of tritium; and (10) functionally testing R&D GTSs.

Figure 3.9-2—Aerial Photo of the WETF

All tritium R&D at LANL is supported by 25 people. The number of programmatic R&D researchers is approximately 10 FTEs, with portions of R&D support staff providing the remaining 15 FTEs (performing gas analysis, gas mixing, R&D material preparation, R&D apparatus construction/maintenance, etc.).

3.9.1.3 *Savannah River Site*

The SRS Tritium Facilities, shown in Figure 3.9-3, support the NNSA Stockpile Stewardship missions for tritium target extraction; tritium unloading, purification and enrichment; tritium and non-tritium reservoir loading; reservoir reclamation; and GTS surveillance. These are collectively referred to as the "tritium production" missions, although the actual production of new tritium is carried out in a Tennessee Valley Authority reactor, with extraction taking place at SRS in the Tritium Extraction Facility (TEF), which became operational in late 2006. Final processing of new tritium gas from TEF, as well as all other tritium gas processing, is carried out in the H-Area New Manufacturing Facility (HANMF). This facility became operational in 1994 and was also designed for a 40 year service life. The Tritium Facility Modernization & Consolidation Project, completed in 2004, significantly expanded the tritium gas processing capabilities in the HANMF and added surveillance capabilities in a new 234-7H facility.

Figure 3.9-3—Aerial Photo of SRS Tritium Facilities

The SRS Tritium Facilities, shown in Figure 3.9-3, are located adjacent to H-Area near the center of the site and about 7 miles from the nearest site boundary. All tritium gas processing is done within secondary containment glove-boxes or modules which have either nitrogen or argon atmospheres. The glovebox and module atmospheres are continuously re-circulated through stripper systems to recover any tritium which may leak out of piping or components. All gas streams released to the environment are processed through a recovery system to reduce emission to as low as reasonably achievable. The tritium R&D at SRS is related to the process and is a very small segment of the overall Tritium R&D. It is conducted primarily to support the ongoing tritium extraction, loading and surveillance missions at SRS.

3.9.1.4 *Sandia National Laboratories/NM*

Tritium Operations at SNL/NM are primarily associated with the Neutron Generator Production Facility (NGPF). The primary responsibility of the NGPF is to produce and manufacture neutron generators, which fuse deuterium and tritium to produce neutrons used to initiate the fission reaction in nuclear weapons. The neutron generator is a “limited-life” component of a nuclear weapon that uses tritium and must be replaced periodically due to the relatively short half-life of tritium. SNL/NM also performs weapons research qualification and testing on neutron tube and generator materials, process and lot samples, sub-components, and post-mortem examinations on final product. The department also performs technical studies that characterize processes and products in collaboration with production and development and design organizations. Section 3.15 describes why no alternatives were studied in detail for changing the SNL/NM tritium missions.

3.9.2 Consolidate Tritium R&D at SRS Alternative

Under this alternative, tritium R&D currently conducted at LLNL[38] and LANL would be consolidated at SRS into existing facilities (primarily in the TEF, HANMF, and the 234-7H facility, but may also include the H-Area Old Manufacturing Building and facilities at the Savannah River National Laboratory). No new construction would be necessary to consolidate these missions. With this option, an on-site office, staffed with approximately 25 personnel to perform tritium R&D, would be required. Office space exists at SRS to support these personnel. Personnel from LANL would travel to SRS to conduct experiments, as necessary. Approximately 25 personnel at LANL could be affected by the transfer of tritium R&D to SRS. Upon completion of the transition to SRS, funding associated with tritium R&D activities at LANL would no longer be required.

Transferring the LLNL tritium R&D (not NIF tritium work) to SRS would basically amount to adding one glove box, which could be accommodated in the HANMF without any significant changes. Phasing out tritium R&D operations at LLNL would have no significant effect on tritium emissions, wastes, and exposure to personnel. Personnel from LLNL would travel to SRS to conduct experiments, as necessary.

[38] This does not include NIF target R&D and NIF production target filling. Those operations would remain at LLNL under all alternatives (see Section 3.9.5.4).

3.9.3 Consolidate Tritium R&D at LANL Alternative

Under this alternative, tritium R&D currently conducted at LLNL[39] would be consolidated at LANL into the WETF. No new construction would be necessary to consolidate these missions. Transferring the LLNL tritium R&D to LANL would basically amount to one glove box system, which could be accommodated in the WETF without any significant changes. LANL already performs same type work within WETF.

3.9.4 Reduce Tritium R&D in Place Alternative

Under this alternative, no changes in assigned tritium R&D missions would result. Instead, LLNL, LANL, and SRS would reduce tritium operations in-place. This alternative would result in the least transition impacts in the Complex. All three sites would increase efficiencies in tritium operations by improving planning and scheduling of activities. Any reductions in tritium emissions, wastes, and exposure to personnel are expected to be small, as these are a function of the work requirements and would not be significantly affected by improved planning and scheduling.

[39] This does not include NIF target R&D and NIF production target filling. Those operations would remain at LLNL under all alternatives (see Section 3.9.5.4).

3.10 NNSA Flight Test Operations for Gravity Weapons

This section describes the alternatives for NNSA Flight Testing. The affected environments at sites involved in NNSA Flight Testing are presented in Sections 4.3 (NTS), 4.4 (Tonopah Test Range), and 4.7 (White Sands Missile Range). The environmental impacts of the HE R&D alternatives are presented in Section 5.15. Section 3.16 contains a summary of the environmental impacts of the NNSA Flight Testing alternatives. Together, these sections provide the environmental impact information for the NNSA Flight Testing alternatives.

Introduction. SNL manages Flight Test Operations for gravity weapons (bombs) to assure compatibility of the hardware necessary for the interface between weapons and the delivery system, and to assess weapon system functions in realistic delivery conditions. The actual flight tests are conducted with both the B83 and B61 weapons, which are pulled from the stockpile and converted into units called Joint Test Assemblies (JTAs). These flight tests are presently conducted at the Tonopah Test Range (TTR), a 280 square-mile site, located about 140 air-miles northwest of Las Vegas, Nevada. TTR activities include: stockpile reliability testing; structural development R&D; arming, fuzing, and firing testing; testing delivery systems; and environmental restoration. NNSA operates this facility under the terms of a land use agreement with the United States Air Force (USAF) entitled "Department of the Air Force Permit to the NNSA To Use Property Located On The Nevada Test and Training Range, Nevada.".

Conversion of nuclear weapons into JTAs is a multi-step operation. Pantex denuclearizes the weapons that become JTAs. The JTAs are not capable of producing nuclear yield. They may then be further modified at SNL. JTAs are then dropped from aircraft at various altitudes and velocities. Depleted uranium usually remains in JTAs, but because there is no explosive event, the depleted uranium is contained within the weapon case and completely recovered after each test. There is no contamination of the soil as the result of a flight test. In some cases, JTAs are flown at velocities and altitudes of interest and not dropped. In such cases, the aircraft returns to its base with the JTA on-board. In an average year, ten JTAs are tested at TTR. Historically, JTAs included SNM, but NNSA does not plan to use SNM in JTAs after 2008. Therefore, all alternatives assume that SNM would not be present in future JTAs.

In addition to analyzing the impacts associated with the No Action Alternative, four alternatives for conducting NNSA flight test operations are evaluated in this SPEIS. These alternatives are as follows: (1) upgrade the Flight Test Program at TTR; (2) operate the program at TTR in a "campaign" mode; (3) transfer the program to White Sands Missile Range (WSMR) in New Mexico; and (4) transfer the program to NTS. Specific locations within WSMR and NTS are being evaluated to assure that the required geological conditions exist to successfully support all flight testing requirements. The locations are also being evaluated for the sufficiency of flight corridors for movement of test aircraft to the target areas. Infrastructure such as power and roads would also be needed at these new locations or they would have to be constructed to support flight testing activities. NNSA has conducted flight tests at facilities other than TTR, on occasion, when specific test requirements could not be met at TTR. Under any of the alternatives considered in this SPEIS, NNSA may continue to conduct one or more flight tests at a different facility, consistent with environmental reviews for that site.

Section 3.10.1 describes the No Action Alternative, Section 3.10.2 describes the alternative to upgrade TTR, Section 3.10.3 describes the alternative to operate TTR in a campaign mode, Section 3.10.4 describes the alternative to transfer NNSA's flight testing mission to WSMR, and Section 3.10.5 describes the alternative to transfer the mission to NTS. Analysis of the environmental impacts of the alternatives is contained in Section 5.15. The analysis of alternatives does not affect NNSA's responsibilities at TTR relating to post-weapons testing by the Atomic Energy Commission, a predecessor agency of DOE (See Section 4.4.6.2.1). Any remediation related to such post-weapons testing is independent of decisions to be made as a result of this SPEIS.

NNSA Flight Test Operations Alternatives

- **No Action.** Continue operations at TTR
- **Upgrade Alternative.** Continue operations at TTR and upgrade equipment with state-of-the-art mobile technology
- **Campaign Mode Operations.** Continue operations at TTR but reduce permanent staff and conduct tests with DOE employees from other sites. Three options are assessed:
    - Option 1—Campaign from NTS: Reduce mission staff and relocate remaining Sandia staff to NTS; O&M and Security taken over by NTS. Additional contract for technical support of equipment is needed for maintenance and upgrade.
    - Option 2—Campaign Under Existing Agreement: Reduce mission staff at TTR; campaign additional staff for each test series; SNL to retain O&M responsibilities at TTR; Agreement would be retained in current form; security responsibilities would be transferred to the Air Force.
    - Option 3—Campaign Under Reduced Footprint Agreement: Reduce mission staff at TTR; campaign additional staff for each test series; SNL to retain O&M responsibilities at TTR; Agreement would be reduced to potentially less than 1 square mile; security, emergency services, power line and road maintenance responsibilities transferred to the Air Force.
- **Transfer to WSMR.** Move NNSA Flight Testing from TTR to WSMR
- **Transfer to NTS.** Move NNSA Flight Testing from TTR to NTS

3.10.1 No Action Alternative

Under the No Action Alternative, NNSA would continue to conduct the flight test mission at TTR. This section describes the NNSA test program currently being conducted at TTR. Figure 3.10–1 shows the location of TTR. There would be no construction required at TTR for this alternative. The current facilities would remain serviceable. Minimal investments in equipment would be required for the No Action Alternative, as described below:

Radar. This would include a replacement of one radar with a modern unit, maintenance of a second radar; and the acquisition of an Identification, Friend or Foe (IFF) system. The acquisition of this IFF system would allow elimination of 2 existing maintenance-intensive radar systems.

Optics. Three distinct functional upgrades would include: (1) addition of a Time-Space

Positioning Information (TSPI) section to collect precise positional data; (2) addition of an Event Optics section using telescope tracking mounts to record event data; and (3) addition of a Photometrics section using both high speed fixed camera arrays to augment the existing still photography capability.

Facilities. TTR would continue to use the existing facilities and maintain them within the normal budget process. A new HVAC system for the control facility and a roof and siding repair on one building would be required under this alternative. Repair to the electrical grid and road surfaces would also be required. In addition to these repairs, there are several structures that must undergo D&D in order to continue ongoing operations at TTR.

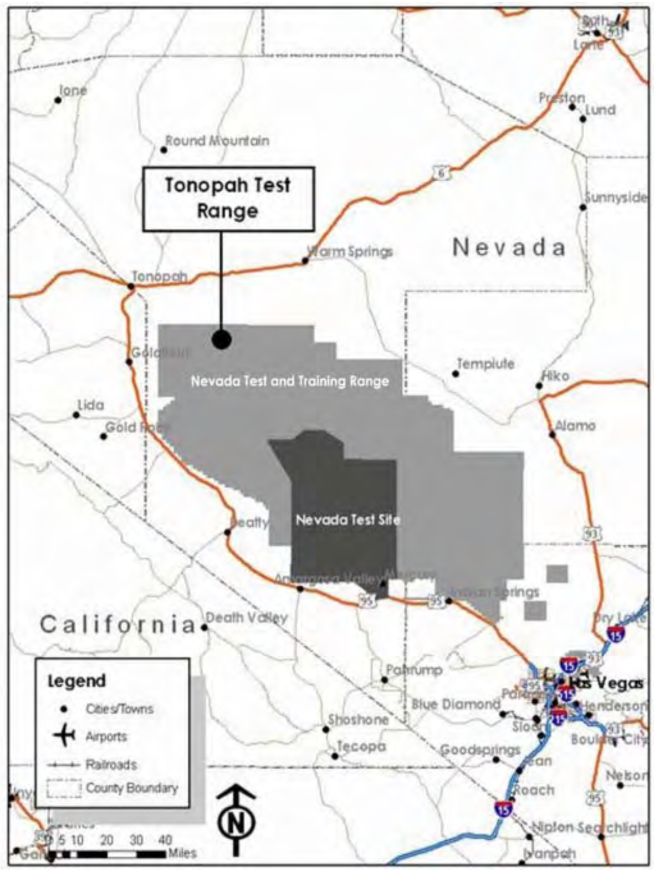


Figure 3.10-1—Location of TTR and NTS

3.10.2 Upgrade of Tonopah Test Range Alternative

This alternative, the HTM Upgrade Alternative, would use High-Tech Mobile (HTM) equipment to reduce the operational costs at TTR through the introduction of newer, more efficient, and more technologically advanced equipment. This alternative would lower the work force requirement and keep test equipment highly reliable and operational between test dates, thereby reducing recalibration and start-up costs. Under this alternative, additional range campaign activities could be considered and conducted with minimal additional costs.

A vision of a HTM Upgrade Alternative is shown in Figure 3.10-2. It would include the acquisition of modern digital equipment that is compatible with other national test range standards. The emphasis is on highly mobile command, telemetry, communications, and radar units which could be readily moved to the different testing locations at TTR. This would not only eliminate the need for duplicative permanent structures, but would also eliminate costly start-up calibration.

The actions required for the HTM Upgrade Alternative are as follows:

Documentary/time-space-position information (TSPI) optics. This action would include an additional five combined mount [TSPI and documentary telescopes] units with a separate optics Control Trailer for remote control operations. Encryption capability would be included.

Radar. The proposal is equivalent to that described for the No Action Alternative.

Telemetry. New trailers, fully equipped with telemetry equipment and antennas, would be purchased and all trailers would be DOT certified. This would allow the telemetry equipment and the antennas to be fully mobile.

Operations control equipment. Two operational control trailers, fully equipped, would be acquired to replace the operations that currently take place in the operational control tower at TTR. Test coordination, communications, and safety would all be housed in these trailers. Operation displays would provide continuous coverage of the test in progress.

Facilities. The proposal is identical to that described for the No Action Alternative.

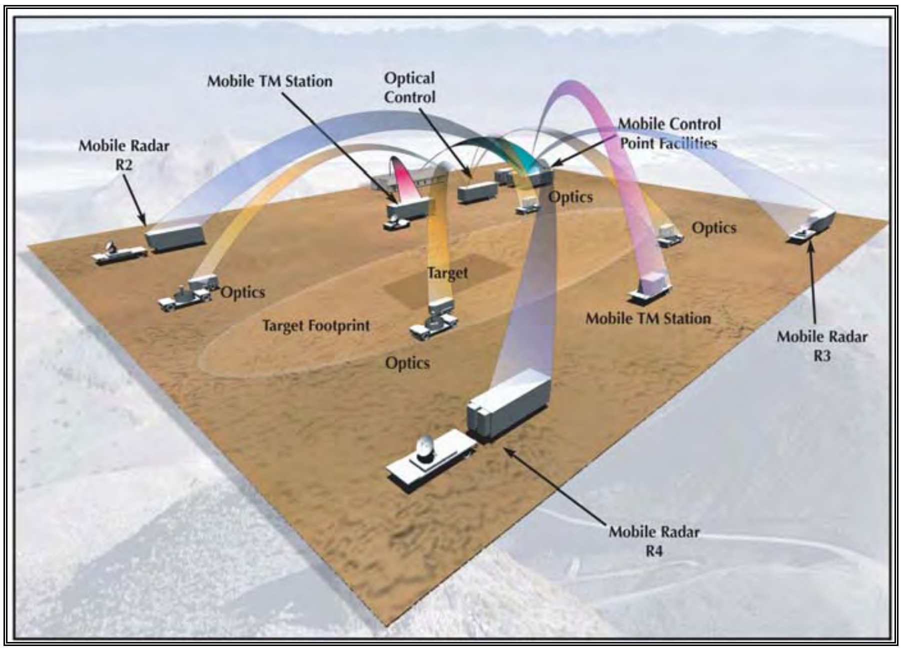


Figure 3.10-2—HTM Upgrade Alternative

There would be no construction required for the HTM Upgrade Alternative. It would use existing infrastructure and personnel, without any increases in the number or intensity of tests and the operational resource requirements would be about the same as for the No Action Alternative. TTR would continue to use the existing facilities and maintain them within the normal budget process. A new HVAC system for the control facility and a roof and siding repair on one building would be required under this alternative. Repair to the electrical grid and road surfaces would also be required. In addition to these repairs, there are several structures that must undergo D&D in order to continue ongoing operations at TTR

3.10.3 Campaign Mode Operation of TTR

An alternative to relocating NNSA's flight test operations from TTR to another site would be to conduct the JTA tests at TTR on a campaign basis, bringing in employees from other NNSA sites to conduct tests. SNL would continue as the program manager for this operation. Under this alternative, three options are evaluated, as described in Table 3.10.3-1.

Table 3.10.3-1—Options for the Campaign Mode Operation of TTR

	Option 1-- Campaign from NTS	Option 2—Campaign under existing Agreement	Option 3-- Campaign under reduced footprint Agreement
Sandia Staff	Approximately ½ of current TTR staff work from NTS	Approximately ½ of current staff stay at TTR	Approximately ½ of current staff stay at TTR
Campaign Staff	Up to 20 test support personnel campaigned from NTS, Sandia NM & CA	Up to 20 test support personnel campaigned from NTS, Sandia NM & CA	Up to 20 test support personnel campaigned from NTS, Sandia NM & CA
Campaign Period	Each mission would require two week assignment	Each mission would require two week assignment	Each mission would require two week assignment
Campaign Frequency	Up to approximately 12 deployments per year + 1 training period per year	Up to Approximately 12 deployments per year + 1 training period per year	Up to Approximately 12 deployments per year + 1 training period per year
Land Use Agreement	280 sq miles	280 sq miles	Potentially less than 1 sq mile
Technical Contract	New contract required to maintain equipment at TTR during year	None required	None required
O&M Contract	Contractor Managed by NTS	Contractor managed by Sandia	Contractor managed by Sandia
Security	Provided by NTS	Provided by the USAF	Provided by the USAF
Medical and Emergency Services	Provided by NTS	Downsized -Occupational Medicine and Rescue retained	Downsized -Occupational Medicine and Rescue retained
Infrastructure Maintenance	Provided by NTS	Provided through Sandia contract	Provided by the USAF
Road and Power Line Maintenance	Provided by NTS	Provided through Sandia contract	Provided by the USAF
Deep Recovery of JTAs	Provided by NTS	Provided through Sandia contract	Provided through Sandia contract
Equipment investment –	New mobile and transportable equipment	Upgrades to existing equipment	Upgrades to existing equipment

USAF = U.S. Air Force
Source: NNSA 2008a.

Campaign from NTS – additional details:

1. Equipment investment:
   - Radar: Convert one fixed radar to mobile radar and completely refurbish pedestal;
   - Optics: Purchase 3 new documentary telescopes and upgrade 7 cinetheodolites (highly sophisticated optical tracking devices);
   - Telemetry: Replace equipment at risk and refurbish telemetry dish and mounts;
   - Communication Infrastructure: Create Ethernet cell configuration along lake beds and connect Ethernet cells using new fiber optic cable.
2. By the end of 2015, NNSA might decide to:
   - Discontinue NNSA Flight Testing at TTR in approximately 2019 and use the interim period to transition equipment and establish needed infrastructure at NTS or WSMR; or
   - Renew the USAF – DOE permit at TTR (which expires in 2019) and continue work at that site, managed by the Nevada Site Office and SNL.

Campaign Under Existing Permit or Reduced Footprint Permit – additional details:

1. Equipment investment:
   - Radar: Replace electronics in one fixed radar and perform depot level maintenance on pedestal;
   - Optics: Replace all film still and video cameras with modern high frame rate digital units and replace control and pedestal discrete electronics with modern personal computer based commercial-off-the-shelf equipment;
   - Telemetry: Replace equipment at risk and refurbish telemetry dish and mounts;
   - Communication Infrastructure: Use existing radio frequency and fiber backbone and convert custom communications interface to modern commercial-off-the-shelf Ethernet backbone.

3.10.4 Transfer to WSMR Alternative

This alternative involves transferring NNSA flight test operations conducted at TTR to WSMR, near White Sands, New Mexico. Figure 3.10–3 shows the location of WSMR. WSMR is the largest installation in the DoD, and is a major range and test facility base under the Department of the Army Test and Evaluation Command, Developmental Test Command. WSMR possesses extensive capabilities and infrastructure used by the Army, Navy, Air Force, NNSA and other government agencies as well as universities, private industry and foreign militaries. No NNSA activities currently take place on the WSMR. WSMR covers 3,420 square miles on the ground and 10,026 square miles of contiguous restricted airspace managed, scheduled and controlled by the WSMR. Holloman Air Force Base is adjacent to the range’s east boundary and has capabilities for aircraft support and staging.

WSMR has a full suite of flight test instrumentation including radar, telemetry and optical equipment, which would allow complete coverage of NNSA gravity weapons flight testing. As a major range and test facility base, the range's infrastructure and instrumentation are funded by DoD. WSMR has extensive experience conducting flight tests with requirements and flight scenarios similar to the NNSA program, including penetrating weapons, weapons recovery and handling of classified material and special nuclear materials.

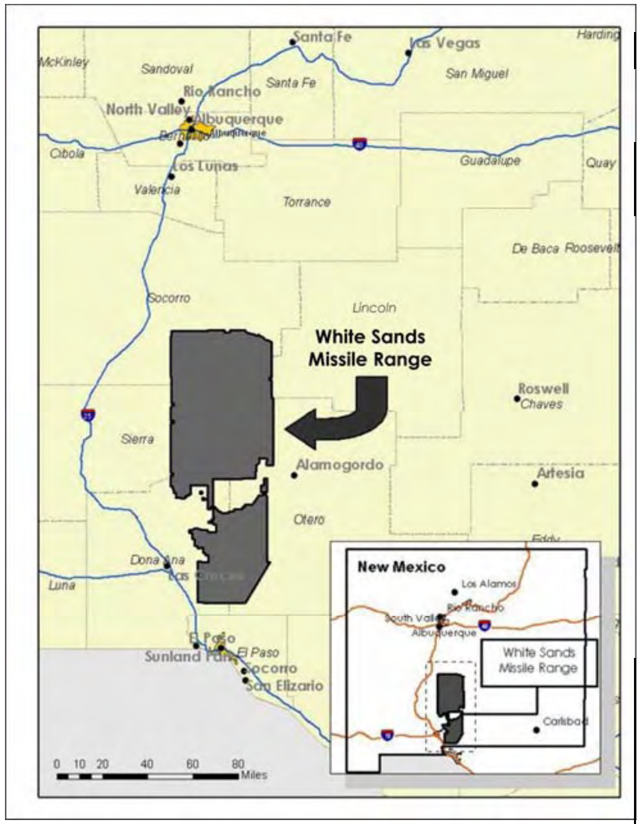


Figure 3.10-3—Location of White Sands Missile Range

3.10.4.1 *Siting Locations*

The northwest area of the WSMR would provide several sites suitable for flight testing. Preliminary drilling was conducted at several specific locations within WSMR to determine that the required geological conditions exist to successfully support all flight testing requirements. The locations are being evaluated to assure that the geology would support penetrator testing as well as the sufficient flight corridors for ingress and egress of test aircraft to target areas. Infrastructure such as power and roads would also need to exist or would need to be constructed to support flight testing activities. A review of the preliminary data indicate that this area of the WSMR could accommodate the safety footprints of all current flight test scenarios. Appropriate NEPA analysis would be required prior to any detailed drilling of any of the candidate sites in order to assess the environmental impacts associated with the required construction of pads and a target and the operations associated with flight testing.

The only construction that would be required to support the JTA flight test operations at the WSMR would be the installation of a circular concrete target. The target aids in recovery of the JTAs used in flight test drops. The concrete target would be constructed of non-reinforced concrete, 500 feet in diameter, with a depth of 12 inches.

Under this alternative, NNSA Flight Testing at TTR would be discontinued. The environmental impacts of discontinuing flight testing at TTR are addressed in Section 5.15.4.2.

3.10.5 Transfer to NTS Alternative

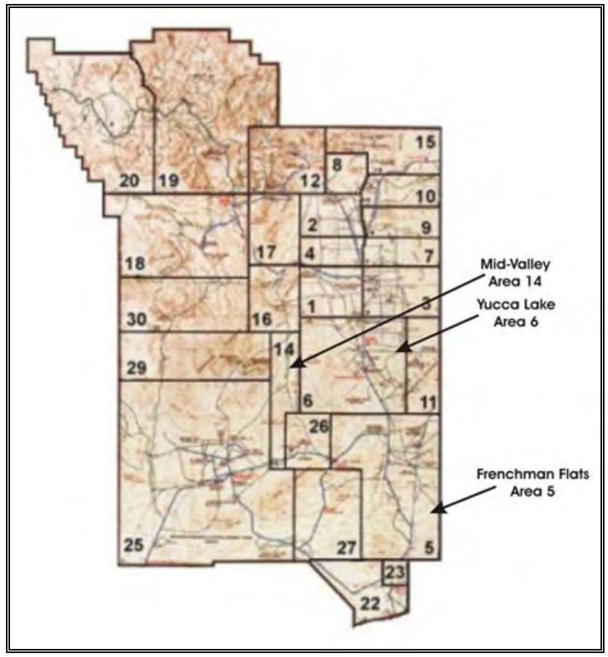


Figure 3.10-4—Potential Flight Test Target Locations at NTS

This alternative involves transferring NNSA Flight Test Operations to NTS (Figure 3.10-4). It is estimated that a site of about two acres would be required. A review of three possible Areas at NTS (five separate sites) was conducted (see Figure 3.10-4). NNSA evaluated these locations at NTS to determine if flight testing could be conducted safely with the appropriate ingress and egress corridors for flight test aircraft and if the soil geology was suitable for testing requirements. Preliminary drilling was conducted to assure that the location would have the required soil geology. Appropriate NEPA analysis would be required prior to any detailed drilling of any of the candidate sites in order to assess the environmental impacts associated with the required construction of pads and a target and the operations associated with flight testing. Although the isolation of the NTS is a benefit for security and flight path purposes, the remoteness of these site locations could require an investment in road and utility infrastructure. A preliminary assessment indicates that these sites meet the necessary safety criteria for flight paths and target location to permit the program to use these areas of NTS. Other sites may be available at NTS, but these three sites meet the mission needs and provide a reasonable number of site alternatives for consideration.

If this alternative were to be selected, transition from TTR to NTS could occur as early as the latter part of 2009 and the beginning of 2010. Upgrades would only begin after the construction of the needed facilities was completed and transition of personnel and equipment completed. NNSA would need to construct pads and a target and possibly some road and utility infrastructure. [a1]Flight Test Program system upgrades would only begin after completion of the required NEPA analysis, construction of required infrastructure and facilities, and the completion of transition. The JTA Flight Test Program staff would be housed in CP-40, an existing NTS facility that includes office space and an available high-bay area, which could accommodate high-tech mobile equipment. Minor building preparation could be required. The concrete target would be constructed of non-reinforced concrete, 500 feet in diameter with a depth of 12 inches.

Under this alternative, NNSA Flight Testing at TTR would be discontinued. The environmental impacts of discontinuing this testing are addressed in Section 5.15.4.2.

3.11 HYDRODYNAMIC TESTING

This section describes the alternatives for hydrodynamic testing. The affected environments at sites involved in hydrodynamic testing are presented in Sections 4.1 (LANL), 4.2 (LLNL), 4.3 (NTS), 4.5 (Pantex), and 4.6 (SNL/NM). The environmental impacts of the hydrodynamic testing alternatives are presented in Section 5.16. Section 3.16 contains a summary of the environmental impacts of the hydrodynamic testing alternatives. Together, these sections provide the environmental impact information for the hydrodynamic testing alternatives.

Introduction. Hydrodynamic testing (hydrotesting) use high-explosive experiments to assess the performance and safety of nuclear weapons. Data from hydrotesting and other experiments, combined with modeling and simulation using high performance computers, are used to certify the safety, reliability, and performance of the physics packages of nuclear weapons without underground testing. The alternatives for hydrotesting are explained in the sections that follow. Section 3.11.1 discusses the No Action Alternative, which would continue operations at the existing facilities at LANL, LLNL, NTS, SNL/NM, and Pantex. Section 3.11.2.1 discusses an alternative which would reduce the number of existing hydrotesting facilities at LANL, LLNL, and NTS, and discontinue hydrotesting at SNL/NM and Pantex. Section 3.11.2.2 discusses an alternative that would consolidate non-fissile hydrotesting activities at LANL (the Big Explosives Experimental Facility [BEEF] at NTS would also still be required). Section 3.11.2.3 discusses a next generation alternative which would consolidate all hydrotesting activities at the NTS. The analysis of the environmental impacts of the alternatives is contained in Section 5.16.

Hydrodynamic Testing Alternatives

- **No Action.** Continue hydrotesting at LLNL, LANL, NTS, Pantex, and SNL/NM
- **Downsize in place**
  - Consolidate LLNL hydrotesting at Contained Firing Facility (CFF)
  - Consolidate LANL hydrotesting at Dual Axis Radiographic Hydrodynamic Test (DARHT) facility
  - Consolidate NTS hydrotesting at single confined and single open-air sites
  - Discontinue hydrotesting at Pantex and SNL/NM
- **Consolidate at LANL**
  - Integrate hydrotesting program at LANL
  - Construct new CFF-like facility at LANL
  - Discontinue hydrotesting at LLNL once CFF-like facility is operational
  - Maintain BEEF at NTS
  - Discontinue hydrotesting at Pantex and SNL/NM
- **Consolidate at NTS**[1]
  - Integrate hydrotesting program at NTS
  - Construct new DARHT-like facility at NTS
  - Construct new CFF-like facility at NTS
  - Discontinue hydrotesting at LLNL, LANL, Pantex, and SNL/NM

[1]The NTS Alternative is considered a "next generation" alternative because NNSA is not proposing these changes at this time.

3.11.1 No Action Alternative

This section describes the hydrotesting facilities and missions currently conducted at NNSA sites. More details regarding hydrotesting requirements and existing facilities are contained in Appendix A.

3.11.1.1 *Hydrotesting Facilities at LLNL*

LLNL's Site 300 has been used since 1955 to perform experiments that measure variables important to nuclear weapons' behavior, safety, conventional ordnance,, and accidents (such as fires) involving explosives. These experiments are conducted without fissile material. The facilities used for Site 300 activities include four firing point complexes and associated support facilities. The locations of the four firing complexes are indicated in Figure 3.11-1. The Building 801 Complex is comprised of Buildings 801A, 801B, and 801D, and encompasses approximately 51,000 square feet. The Building 801 Complex is in the northeast quadrant of the site, called the east firing area.

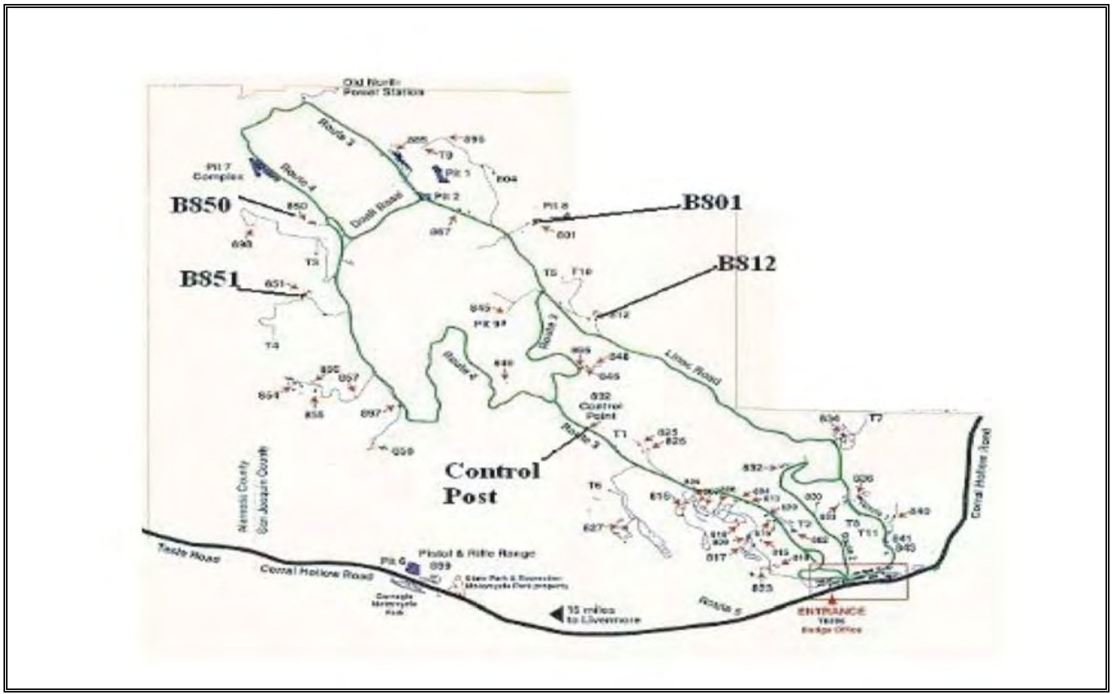


Figure 3.11-1—Locations of B801, B812, B850, and B851 at Site 300

The Contained Firing Facility (CFF) is located at the Building 801 Complex and is one of the more important facilities in NNSA's science-based SSP, as it is capable of full-scale dynamic weapons radiography (Figure 3.11-2). The CFF drastically reduces emissions to the environment and minimize the generation of hazardous waste, noise, and blast pressures, although emissions from open air testing are well within current environmental standards. LLNL's Hydrodynamic Test Program employs 56 workers. Thirty of these employees are at the Building 801 Complex, of which 10 are at the CFF. Appendix A, Section A.9, provides additional information on the LLNL hydrotesting facilities.

Figure 3.11-2—The Contained Firing Facility at the LLNL Site 300 Building 801 Complex

3.11.1.2 *Hydrotesting Facilities at LANL*

The hydrotesting facilities at LANL are located within one of the TAs that contain HE R&D facilities. TA-15, located approximately 3 miles from the main administrative area, in the central portion of LANL, is the location of two firing sites: the DARHT, which has an intense high-resolution, dual-machine radiographic capability, and Building 306 (R306), a multipurpose facility where primary diagnostics are performed (see Figure 3.11-3). Currently, there exists no permanent radiographic capability at R306. Figure 3.11-3 shows the location of TA-15 at LANL. The Pulsed High Energy Radiation Machine Emitting X-Rays (PHERMEX) Facility, a multiple-cavity electron accelerator capable of producing a very large flux of x-rays, was disabled in 2004. D&D of this facility is ongoing and has not yet been completed. LANL conducts about 100 hydrotest experiments per year composed of both large scale and smaller scale “focused” experiments. LANL has a Hydrodynamic Test Program staff of 34 employees, of which 29 are at the DARHT.

DARHT is a state-of the-art, full scale radiography facility and is used to investigate weapons functioning and systems behavior in non-nuclear testing. DARHT is designed to include two high intensity x-ray machines whose beams cross at right angles. Each machine has been designed to generate radiographs of far higher resolution than anything previously obtainable—the resolution required for stockpile stewardship without underground nuclear testing. The first axis became operational in 1999 and the second axis was tested in late 2002. In 2003, LANL began refurbishing failing accelerator cells Facility Axis II in order to bring them up to design specifications.

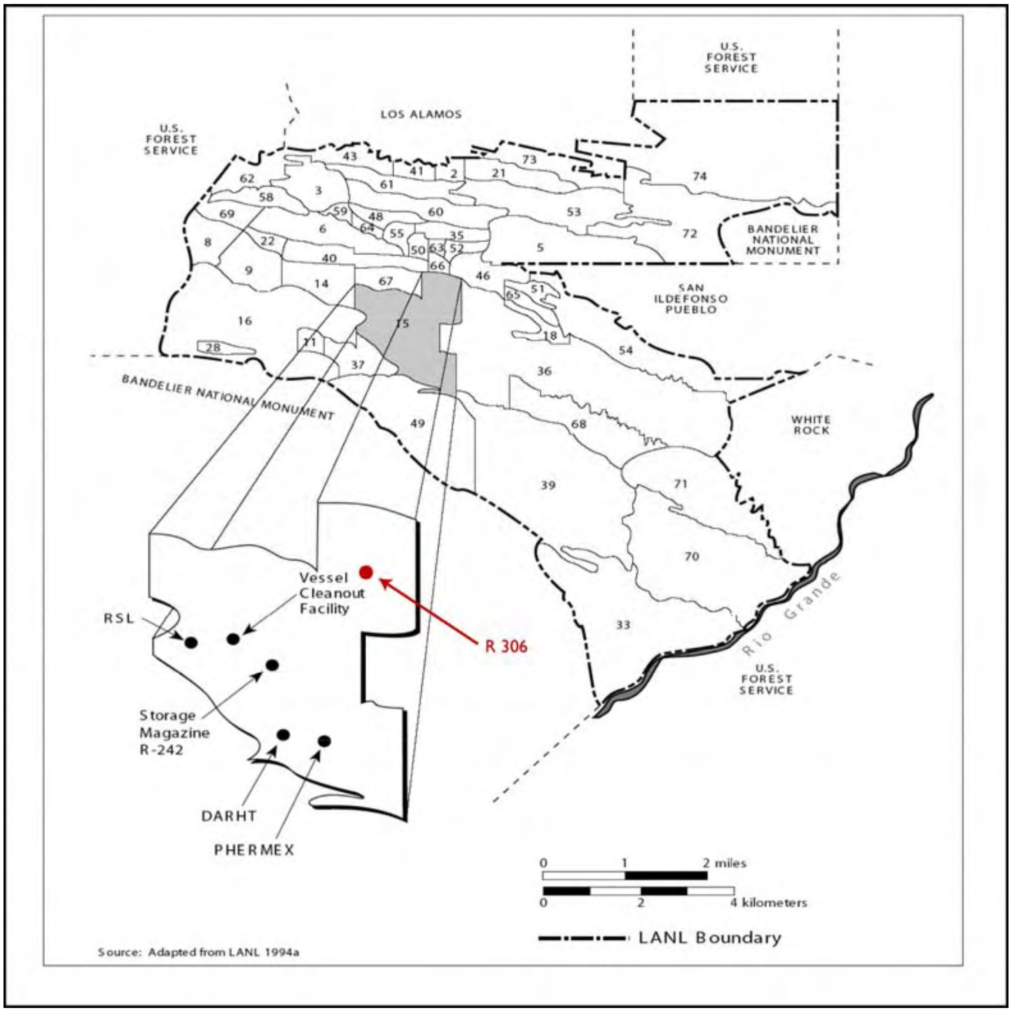


Figure 3.11-3—TA-15 at LANL

The injector for the second axis of DARHT is now being "tuned" in preparation for undergoing commissioning tests. When DARHT becomes fully operational, its multi-axis large scale hydrodynamic tests will allow researchers to obtain three-dimensional as well as time-resolved radiographic information. Figure 3.11-4 shows the DARHT facility.

Additional facilities required to support hydrotesting are located in six other TAs at LANL. The Test Device Assembly is one such facility. The Test Device Assembly provides the capacity to assemble test devices ranging from full-scale nuclear-explosive-like assemblies (where fissile material has been replaced by inert material) to materials characterization tests. In addition, LANL has several idle hydrotesting facilities, such as the PHERMEX, awaiting closure. Appendix A, Section A.9, provides additional information on the LANL hydrotesting facilities.

Figure 3.11-4—The DARHT at LANL

3.11.1.3 *Hydrotesting Facilities at Pantex, SNL/NM, and NTS*

Smaller hydrotest facilities, which are not capable of dynamic weapons radiography, are also located at Pantex, SNL/NM, and NTS. Both Pantex and SNL/NM have several outside blasting table facilities which are primarily used for HE R&D activities and can only handle small hydrotesting experiments. NTS has several facilities which are utilized for very large explosion-type experiments. The BEEF is one such facility at NTS. It is the only NNSA facility where experiments requiring more than 2000 pounds of HE can be conducted. Similarly, the U1a Complex is the only facility capable of subcritical experiments.

Several specialized NTS facilities are maintained and available to meet both hydrotesting and HE R&D requirements. LANL, LLNL, SNL/NM, DoD, and the Department of Homeland Security (DHS) sponsor experiments at these facilities. They feature an array of diagnostic equipment and expertise to support a variety of hydrotest and HE experiments, including flash x-ray systems, high-speed digitizers, fast-framing cameras, and high-speed digital video systems.

Hydrotest and HE capabilities and facilities at the NTS are as follows:

Big Explosives Experimental Facility (BEEF). Located on a 9-acre site in Area 4 of the NTS, BEEF is an open-air HE test bed for large hydrodynamic and weapons physics experiments, shaped-charge development, and render-safe experiments. BEEF is designed and certified with an operational HE limit of 70,000 pounds (TNT equivalent).

Baker site. Located within Area 27 of the NTS, Baker Site serves as an inspection, storage, assembly (including hand-packing or forming uncased plastic explosives), and disassembly area for HE or HAZMAT and components.

U1a Complex. Located within Area 1 of the NTS, the U1a Complex is an underground laboratory for performing hazardous experiments with HE and SNM, primarily subcritical experiments. It consists of a series of horizontal drifts, each about one-half mile in length and mined at the base of three approximately 950-foot-deep vertical shafts.

Other explosives storage. Located in Area 12 of the NTS, this storage includes four single-story metal explosives magazines. The total HE storage quantity is limited to 70,000 pounds (TNT equivalent). The magazines are generally used for the receipt of large orders of explosive materials and provide for bulk storage of high explosives, blasting agents, and detonators.

Explosive Ordinance Disposal Unit (EODU). Located in Area 11 of the NTS, EODU is an open burn or open detonation (OB/OD) site designed and constructed specifically for the storage and demolition of waste explosive materials. It consists of three explosives storage structures and an EOD pad on which to detonate explosives. Activities are limited to the receipt, storage, and detonation of explosives and explosive materials.

Three additional and similar facilities, at Pantex, conduct both HE R&D and hydrotesting experiments. All three would require upgrades within the next several years. The upgrades would include two open-air firing sites with bunkers and one facility containing indoor firing chambers. SNL/NM has several small HE R&D firing sites and the Explosives Component Facility and ancillary facilities, which have been used for hydrodynamic tests. Because none of SNL/NM's facilities are used primarily for hydrotesting, they are described more completely in the No Action Option for HE R&D in Section 3.8. The Explosives Component Facility and its ancillary locations support the design, development, and life cycle management of all explosive components outside the nuclear package. There are no employees assigned to the Hydrodynamic Test Program at Pantex, SNL/NM, or NTS. Appendix A, Section A.9, provides additional information on the hydrotesting facilities at these sites.

3.11.2 Action Alternatives

3.11.2.1 *Downsize-in-Place Alternative*

The Downsize-in-Place Alternative would continue hydrotesting activities by consolidating LANL activities at the DARHT, consolidating LLNL activities at Building Complex 801 and the CFF, closing the smaller facilities at both of these sites, and moving tests requiring larger amounts of HE to the BEEF at NTS.

This alternative would entail the closure of a number of facilities at LLNL and LANL. It would also entail the closure of facilities at Pantex and SNL/NM. At LLNL, this would entail the closing of Building 812, the Building 850 Complex, and the Building 851 Complex, if they cannot be turned over to another user. The associated support facilities probably would not be impacted by this alternative, as they are smaller multi-purpose facilities which could be of use to other program activities. At LANL, this would entail the closing of all hydrotesting facilities at TA-15, except for DARHT, and TA-36. Closure of the idle PHERMEX would commence. At Pantex, at least six outdoor burn areas, primarily utilized for HE R&D, but sometimes used in conjunction with hydrodynamic test experiments, could be closed. Because none of the facilities at SNL/NM are used primarily for hydrotesting, options for downsizing are discussed in

Section 3.8, High Explosives R&D. NTS would maintain BEEF operational to conduct large tests and continue operations at the U1a Complex.

Closure of approximately a dozen facilities at the above sites would entail a substantial clean-up and D&D effort. Although not heavily contaminated, these facilities all have a substantial amount of reinforced concrete and steel structures designed to withstand sizeable HE explosions. It is estimated that at least 100,000 square feet of hardened concrete and steel structures would have to be dismantled and disposed of.

3.11.2.2 *Consolidation at LANL*

The Consolidation at LANL Alternative would integrate all large-scale hydrotesting at the single location of LANL. Since LLNL and NTS both have capabilities not presently at LANL, this alternative would entail the construction of a new facility at LANL that would have the capabilities of the CFF and Building 801 Complex at LLNL.[40] For a description of what such a new facility would entail, see Section 3.11.1.1, Building 801 Complex. There are three potential sites at LANL where such a "CFF–like" facility could be constructed. Figure 3.11-5 displays these three locations at LANL.

Until such time as these capabilities could be established at LANL, the CFF capabilities at LLNL might have to remain in operation. In addition, it is not anticipated that it would be possible to transfer the capability to conduct experiments requiring very large amounts of HE, presently being conducted at NTS, to LANL. Accordingly, under this alternative, operations at the BEEF and the U1a Complex at NTS would still be required. This alternative would entail a large amount of clean-up and D&D associated with the closure of all hydrodynamic test facilities at LLNL, SNL/NM (based on a joint agreement of the HE R&D Program and the Hydrotesting Program), and Pantex and a substantial number of smaller, idle facilities at LANL. Appendix A, Section A.9, provides additional information on these hydrotesting facilities. It is estimated that this alternative would entail the closure and clean-up of close to 170,000 square feet of hardened concrete and steel structures designed to withstand very large HE explosions.

[40] This SPEIS addresses the closure of the CFF in Section 5.16.3.1. Closing the CFF at LLNL Site 300 could occur whether or not a new CFF-like facility is constructed at LANL.

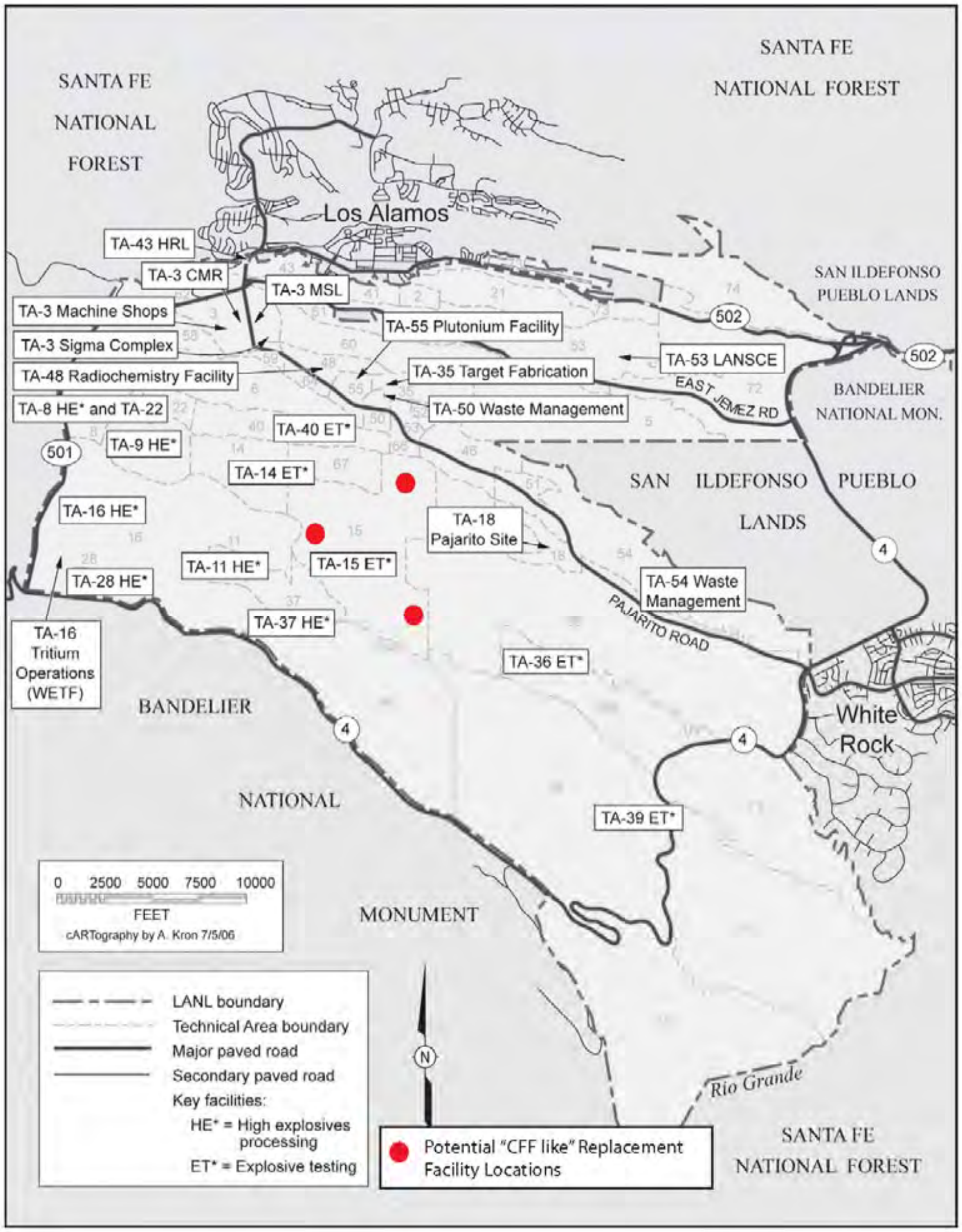


Figure 3.11-5—Potential Locations of "CFF-Like" Replacement Facility at LANL

3.11.2.3 *Consolidation at NTS—A Next Generation Alternative*

Moving hydrodynamic testing to NTS would consolidate the capabilities currently at LANL, LLNL, SNL/NM, and Pantex to the NTS and provide next generation capabilities required to maintain the nuclear deterrent in the 2020 to 2050 time frame. This alternative would require the construction of DARHT-2 and CFF-2 facilities at NTS. Both facilities would be more technically advanced than the existing DARHT and CFF. The design to provide the required capabilities would be addressed when a proposal for these next generation facilities is needed and developed. The discussion below provides reasonable and conservative estimates and options of how the NNSA might proceed.

Gas cavity radiography would require high energy (16 MeV) multi-time multi pulse radiography. Depending on requirements this capability may be provided with DARHT-like technology, proton radiography, or emerging accelerator and detector technology. The architecture of the facility would depend on specific requirements for dynamic SNM experiments. One option is a consolidated facility using large, flexible firing chambers and additional containment vessels for SNM experiments. This facility could be located above or below ground depending on operational and construction costs. Another option is two separate facilities because of the difference in operational requirements between SNM and surrogate experiments.

The complex experiment requirements could be met by utilizing two firing chambers optimized for wide angle, medium (≥6MeV) or high (≥16MeV) radiography, velocimetry, high-speed cameras, and pin diagnostics. Such an approach provides the capacity necessary to address focused experiments as well as integrated weapons experiments (IWE's), and still provide for risk mitigation in the event of a single point of failure in one of the firing chambers.

Any next generation hydrodynamic experimental facility, either aboveground or underground, would require new construction and considerable infrastructure (i.e., facilities, equipment, and personnel) to support tests. Existing infrastructure at NTS might be used to the extent practical. In addition to the impacts of construction, the operational requirements for a next generation hydrodynamic test facility might well be greater than that of the combination of the DARHT and CFF facilities. The impacts associated with construction and operation of facilities would depend on the technological approach used to meet requirements. For example, the use of proton radiography could require an accelerator comparable to other large accelerators operated by DOE.

NNSA estimates that over 250 additional workers would be needed for construction and operation of a next generation hydrodynamic test facility. Construction and operation of a next generation hydrodynamic test facility is not anticipated to use large quantities of water. New construction activities are expected to result in an increase in short-term air emissions. Operations of the next generation of hydrodynamic test facilities are expected to have a minimal impact on the air quality considering the impacts of DARHT operations. A next generation hydrodynamic test facility is not expected to impact existing community infrastructure or services in the area; however, depending on the specific design, a proton accelerator could require significant electrical power resources. Waste volumes are not expected to increase substantially over existing operations at NTS, and waste management associated with dynamic experiments with plutonium at NTS could require additional infrastructure. A new CFF-like facility at NTS would be similar to the facility described in the LANL Consolidation Alternative (see Section 3.11.2.2).

3.12 MAJOR ENVIRONMENTAL TEST FACILITIES

This section describes the alternatives for Major Environmental Test Facilities (ETFs). The affected environments at sites with Major ETFs are presented in Sections 4.1 (LANL), 4.2 (LLNL), 4.3 (NTS), and 4.6 (SNL/NM). The environmental impacts of the alternatives are presented in Section 5.16. Section 3.16 contains a summary of the environmental impacts of the Major ETF alternatives. Together, these sections provide the environmental impact information for the Major ETF alternatives.

Introduction. Environmental testing helps NNSA maintain and demonstrate the safety, reliability and performance of the nation's nuclear weapons. The environmental testing facilities (ETFs) are divided into two categories – base ETFs and system ETFs. The base ETFs are those facilities and laboratory scale (or "table-top") items used to evaluate components or subassemblies in the environments defined by the Stockpile-to-Target Sequence (STS) and the Military Characteristics requirements for each nuclear weapon in the stockpile. Every laboratory within the NNSA complex has some base capability essential for day-to-day operations. The system ETFs are those facilities used to test full-scale weapons systems (with or without SNM or assembly/disassembly) or those unique major facilities that are used for development and certification of components, cases, accessories, subsystems and systems. This SPEIS analyses alternatives involving base and system environmental testing facilities, referred to as "major" ETFs that are costly to maintain or have potentially significant environmental impacts. Major ETFs are located at LANL, SNL/NM, LLNL, and NTS.

Section 3.12.1 discusses the No Action Alternative, which would continue operations at the existing facilities at LANL, SNL/NM, LLNL, and NTS. Section 3.12.2 discusses an alternative which would downsize facilities in-place. Section 3.12.3 discusses an alternative that would consolidate major ETFs at one site (NTS or SNL/NM), with an option to move the LLNL Building 334 and the LLNL Site 300 Building 834 Complex ETF capabilities to Pantex. The analysis of the environmental impacts of the alternatives is contained in Section 5.17.

Major ETF Alternatives
• **No Action.** Maintain status quo at each site. All facilities would be maintained, or upgraded to meet safety and security standards. • **Downsize-in-place.** No duplication of capability within a given site, but there may be duplication from site to site—phase out aging and unused facilities. • **Consolidate ETF capabilities at one site (NTS or SNL/NM).** Would entail closings at sites not selected and construction of new facilities if NTS were selected. This alternative also includes an option to move the LLNL Building 334 ETF capabilities and the LLNL Site 300 Building 834 Complex to Pantex.

3.12.1 No Action Alternative

Under the No Action Alternative, NNSA would maintain the status quo at each existing site. Only those upgrades and maintenance required to meet safety and security standards would take place. ETFs are located at three national laboratories (SNL/NM, LANL, and LLNL) and NTS. It should be noted that ETF laboratories and capabilities also exist at Pantex and SRS. These facilities, however, are not involved in the R&D or weapon system/component design and qualification process, but instead, utilize ETF capabilities as an integral part of the production/certification process. Without these ETF capabilities, these sites could not complete their missions. Accordingly they have not been included in this analysis. Table 3.12.1-1 lists the existing ETF facilities at the three NNSA laboratories and the NTS.

Table 3.12-1—ETFs at LANL, SNL/NM, LLNL, and NTS

Facility	Size (ft^2)
LANL	
K Site Environmental Test Facility	8,452
Weapons Component Test Facility	22,075
Thermo-Conditioning Facility (5 structures)	6,795
PIXY with Sled Track	6,245
Total	**43,567 ft^2**
SNL	
Simulation Tech Lab (HERMES and RHEPP)	56,886
PBFA Saturn and Sphinx	42,052
ACRR and Sandia Pulsed Reactor Facility	13,793
Radiation Metrology Lab`	1,774
Gamma Irradiation Facility	12,514
Low Dose Rate Gamma Irradiation Facility	206
Auxiliary Hot Cell Facility	13,358
Model Validation and System Certification Test Center	18,842
Centrifuge Complex (including outdoor centrifuge)	15,360
Complex Wave Test Facility	3,459
Sled Track Facility	9,368
Light Initiated HE Test Facility	4,138
Aerial Cable Facility and Control Building	6,808
Radiography Building and Nondestructive Test Facility	6,397
Photometrics/Data Acquisition Complex	13,079
Mechanical Shock Facility	6,600
Mobile Guns Complex	2,400
Thermal Test Complex	15,712
Vibration Acoustics and Mass Properties Lab	8,950
Engineered Sciences Experimental Facility	19,416
Component Environmental Test & Advanced Diagnostic Facility	44,091
Electromagnetic/Environ./Light Strategic Def	103,185
SNL/California Environmental Test Complex	65,964
Total	**484,352 ft^2**
LLNL	
Dynamic Testing Facility (836 Complex)	12,913
Thermal Test Facility (834 Complex)	4,289
Hardened Engineering Test Bldg (334 in Superblock)	6,300
Total	**23,502 ft^2**
NTS	
Device Assembly Facility Area (ETF Portion only)	4,790
U1a Complex (Above ground portion only)	2,100
Total	**6,890 ft^2**
Complex Total	**558,311 ft^2**

3.12.1.1 *Environmental Test Facilities at LANL*

LANL has four primary ETFs located within three different Tech Areas: (1) the K Site Environmental Test Facility (ETF); (2) the Weapons Component Test Facility, (3) the Thermo-Conditioning Facility; and (4) the Pulsed Intensive X-Ray Facility (PIXY) with Sled Track. The K Site is a large complex consisting of eleven major structures and is located at TA-11. The total size of all facilities at the K Site is 8,452 square feet. Both the Weapons Component Test Facility and the Thermo-Conditioning Facility are located at TA-16. Together these two facilities total 28,870 square feet. The PIXY facility is a 6,245 square feet facility located on 194 acres at TA-36. In all the ETF structures at LANL total 43,567 square feet and are operated by a staff of about 30. A description of these facilities is contained in Appendix A.

3.12.1.2 *Environmental Test Facilities at LLNL*

LLNLs ETF program is conducted in three separate facilities: (1) Building 334 (also referred to as the Hardened Engineering Test Building); (2) Building 834 Complex at Site 300; and (3) Dynamic Testing Facility (836 Complex) at Site 300. These three facilities consist of a total area of 23,502 square feet occupying a total site area of seventeen and three quarter acres. There is not a specific and dedicated crew of test technicians or engineers assigned to any of the individual test facilities at LLNL. The Weapons Test Group (WTG), which operates the ETF facilities, has stewardship to maintain all the facilities and provides support staff to the appropriate building in order to conduct and complete the necessary testing. The WTG has a total of 6 workers to support the three LLNL ETF facilities. A description of the LLNL ETF facilities is contained in Appendix A. Figure 3.12-1 shows some of the ETF capabilities in Building 334.

Figure 3.12-1—Photos of Building 334, Hardened Engineering Test Building (left to right): view of environmental test facilities bay and view of INRAD bay

3.12.1.3 *Environmental Test Facilities at SNL/NM*

SNL/NM has twenty-two major ETF complexes, each with multi-operational capability. In all, these facilities have a combined area of 418,388 square feet. These facilities consist of accelerator facilities, radiation testing facilities, a drop tower complex, and a number of other shake, bake, rattle, and roll type laboratories used as part of the SNL/NM mission of support of the SSP, non-nuclear component design and certification, and system engineering and qualification. SNL/NM has a mobile gun complex, an aerial drop tower complex, a rocket-sled, a centrifuge complex, an irradiation facility, a hot cell facility, and a number of other facilities which can subject weapons, weapons components, and associated components to the entire spectrum of electric, radioactive, thermal and other such insults necessary to determine design, performance, and surveillance parameters. Approximately 224 employees are involved in the SNL/NM ETF effort. Besides testing nuclear weapons, SNL/NM has the added responsibility to provide assurance that all nuclear warhead use-control equipment, shipping containers, transportation vehicles and handling equipment meet the performance requirements dictated by the Military Characteristics and can survive the normal, abnormal, and hostile environments described within the Stockpile-to-Target-Sequence requirements documents. Figure 3.12-2 shows a drop tower facility at SNL/NM. A description of the SNL/NM ETF facilities is contained in Appendix A.

Figure 3.12-2—Drop Tower Facility at SNL/NM

3.12.1.4 *Environmental Test Facilities at NTS*

NTS has two Environmental Test Facilities, the Device Assembly Facility (DAF) and the U1a Complex (Figure 3.12-3). Together, these two facilities occupy a floor-space of 6,890 square feet. It should be noted the U1a Complex is an underground facility with only the small portion of the total facility size included in this number. Both DAF and the U1a Complex are considered "user facilities," operated by LLNL and LANL, respectively, on behalf of the NNSA with support from the site Management and Operations (M&O) contractor, primarily in the area of facility maintenance. Under this concept, the facilities are maintained in a "warm standby" condition ready to accept programmatic work. The assigned personnel maintain the facility, its authorization basis, and ensure that programmatic work is properly authorized. The actual programmatic work is conducted by project teams that deploy to the facility to conduct their activities. Thus, staffing levels presented here, only reflect the personnel required to maintain the facility in a "warm standby" condition and not programmatic work. Fully staffed, both facilities would employ 170. Current employment to maintain "warm standby" is 107. A description of these two ETF facilities is contained in Appendix A.

Figure 3.12-3—U1a Complex Environmental Test Facility at NTS

3.12.2 Downsize in Place Alternative

Under the Downsize in Place Alternative, facilities which are duplicative, in need of major upgrades to enable continued operations, or no longer used would be closed. The facilities that would close as a result of this Alternative are shown in Table 3.12-2.

Table 3.12-2—ETF Closures for Downsize in Place Alternative

LANL	LLNL	Sandia National Labs
Thermo-Conditioning Facility (5 structures)	Building 836 Complex	Sandia Pulsed Reactor Facility[1]
PIXY	Building 834 Complex	Low Dose Rate Gamma Irradiation Facility
		Auxiliary Hot Cell Facility
		Centrifuge Complex
		SNL/CA Environmental Test Complex[2] (4 structures)

Source: NNSA 2007.
[1]The reactor, itself has been moved to NTS
[2] These buildings might not be demolished and undergo D&D, but would be reused for other purposes.

The scheduled closure of SNL facilities in Table 3.12-2 is contingent on completion and phasing of existing programmatic work at the sites. The Auxiliary Hot Cell Facility is currently planned to be used thru 2017 to continue the removal and de-inventory of Category III SNM at SNL/NM. The Downsize-In-Place Alternative would not effect the SNL/CA facilities

The Low Dose Gamma Irradiation Facility would be maintained to support the nuclear weapons program mission for characterization of long term exposure of nuclear weapons components and satellite components and would be placed in cold standby if not required or until an alterative capability is operational.

SNM associated with the Sandia Pulsed Reactor material as well as the reactor, itself, was transferred to NTS. Further D&D of the infrastructure is dependent upon the successful demonstration of the Qualification Alternatives for Sandia Pulsed Reactor (QASPR) project.[41] However, timing of D&D of the reactor facility and infrastructure is dependent on proven success of QASPR to ensure minimal risk to the NNSA Office of Defense Programs. The reactor facility and infrastructure at the site also support the national nuclear criticality safety program as well as engineering data requirements for the Yucca Mountain Project, and D&D would be scheduled after this time in conjunction with the QASPR project schedule.

3.12.3 Alternative to Consolidate ETF Capabilities at One Site (NTS or SNL/NM)

There are two options for an alternative to consolidate all major ETF capabilities to one site. One option would consolidate ETF capabilities to the NTS. This option would close ETFs at LANL, LLNL, and SNL/NM and require construction of new facilities at NTS to replace some of the capabilities lost through closures. The two ETFs at NTS at the DAF and the U1a Complex would remain in operation. The Engineered Test Bay (Building 334) at LLNL, Building 834 Complex at LLNL Site 300, and three of the facilities at SNL/NM (considered to be capabilities critical to the continuance of the ETF Program) would remain open until the replacement facilities at NTS are operational. A listing of the facilities that would close as a result of this Alternative is shown in Table 3.12-3.

Table 3.12-3—ETF Closures for the NTS Consolidation Alternative

LANL	LLNL	Sandia National Lab
K Site Environmental Test Facility	Building 834 Complex	Centrifuge Complex (8 structures)
Weapons Component Test Facility	Dynamic Testing Facility (836 Complex)	Auxiliary Hot Cell Facility
Thermo-Conditioning Facility (5 facilities)	Building 334	Low Dose Rate Gamma Irradiation Facility
PIXY		ACRR and Sandia Pulsed Reactor Facility[1]

[41] The demonstrated ability of QASPR to apply modeling and simulation to predict the response of weapon components to meet weapon reliability criteria is the planned solution for future weapons component analysis. See SNL 2008 for more information relative to the QASPR.
(http://www.sandia.gov/pcnsc/research/research-briefs/2007/QASPR_Science_in_the_Physical,_Chemical,_and_Nano_Sciences_Center_-_Overview_by_S._M._Myers.pdf

Table 3.12-3—ETF Closures for the NTS Consolidation Alternative (continued)

LANL	LLNL	Sandia National Lab
		Simulation Tech Lab (HERMES and RHEPP)
		PBFA Saturn and Sphinx
		Radiation Metrology Lab
		Gamma Irradiation Facility
		25 Foot Centrifuge
		Model Validation and System Certification Test Center
		Complex Wave Test Facility
		Light Initiated HE Test Facility
		Sled Track Facility
		Aerial Cable Facility and Control Building
		Radiography Building and Nondestructive Test Facility
		Mobile Guns Complex
		Thermal Test Complex
		Vibration Acoustics and Mass Properties Lab
		Engineered Sciences Experimental Facility
		Component Environmental Test & Advanced Diagnostic Facility
		Electromagnetic/Environmental/Light Strategic Defense Facility
		SNL/CA Environmental Test Complex (4 structures)

Source: NNSA 2007.
[1]The reactor, itself has been moved to NTS

The alternative to consolidate ETF capabilities at NTS would require the construction of five new facilities at NTS: (1) an ACRR-like facility (replacing SNM testing capability lost at SNL); (2) an Engineering Test Bay (ETB) (replacing LLNL's Building 334, a required capability); (3) an Aerial Cable Test Facility (replacing capability lost at SNL); (4) a Building 834 Complex (replacing LLNL Site 300 Building 834 Complex); and (5) a sled track (replacing a required capability lost at LANL and SNL), which could be constructed above or below ground. A description of these new facilities and assessment of the environmental impacts of constructing and operating these facilities is contained in Section 5.17.4.1.4.

A second option would consolidate ETF capabilities at SNL/NM. This alternative would close ETFs LANL and LLNL, but would continue operations of the two ETFs at NTS and some of the existing facilities at SNL/NM. Under this alternative, the ETF activities in Building 334 at LLNL and at Building 834 Complex at LLNL Site 300 would be transferred to either NTS (as discussed above) or to Pantex (see Section 3.12.4). A listing of the facilities that would close is found in Table 3.12-4.

Table 3.12-4—ETF Closures for the SNL Consolidation Alternative

LANL	LLNL	Sandia National Lab
K Site Environmental Test Facility	Building 834 Complex	ACRR and Sandia Pulsed Reactor Facility [1]
Weapons Component Test Facility	Dynamic Testing Facility (Building 836 Complex)	Low Dose Rate Gamma Irradiation Facility
PIXY with Sled Track	Building 334	Auxiliary Hot Cell Facility
Thermo-Conditioning Facility		SNL/CA Environmental Test Complex (4 structures)[2]

[1]The reactor, itself has been moved to NTS
[2]SNL/CA Environmental Test Complex is a Sandia National Laboratory run program near LLNL in California. For environmental impacts, SNL/CA facilities are included in LLNL analysis since this is where the majority of the impacts are incurred.
Source: NNSA 2007.

The scheduled closure of SNL facilities in Table 3.12-4 would be contingent upon completion and time phasing of existing programmatic work at the sites, as previously discussed in Section 3.12.2.

3.12.4 ETF Pantex Option

As an option for the consolidation alternatives discussed in Section 3.12.3, this SPEIS considers the transfer of LLNL ETF activities to Pantex. As discussed in Section 3.12.3, consolidation to one site would require the construction of several new facilities. One such facility is a Building 334-like facility to allow for critical activities presently being conducted at Building 334 (also known as the Hardened Engineering Test Building) at LLNL. Another such facility is Building 834 Complex at LLNL Site 300. The Building 834 Complex is used for thermal and humidity testing of weapons components and systems and can accommodate HE detonations of up to 200 pounds. As an alternative to constructing this new Building 334-like facility and the Building 834 at NTS, an additional option would be for equipment presently located at Building 334 and at the Building 834 Complex to be relocated to Pantex.

Pantex presently conducts activities that are similar to those being conducted at Building 334 and the Building 834 Complex, although not with SNM. As part of its ongoing modernization efforts, Pantex is currently planning the construction of a Weapons Surveillance Facility (WSF), which would replace the existing facility where these operations are conducted. Under this option, the ETF work presently being conducted at LLNL Building 334 and at the Building 834 Complex would be transferred to the WSF. No new construction or additional security considerations would be required for this option.

3.13 SANDIA NATIONAL LABORATORIES, CALIFORNIA (SNL/CA), WEAPONS SUPPORT FUNCTIONS

This section describes the alternatives for SNL/CA Weapons Support Functions alternatives. The affected environments for sites involved in this action are presented in Sections 4.2 (SNL/CA) and 4.6 (SNL/NM). The environmental impacts of the alternatives are presented in Section 5.17. Section 3.16 contains a summary of the environmental impacts of the SNL/CA Weapons Support Functions alternatives. Together, these sections provide the environmental impact information for the SNL/CA Weapons Support Functions alternatives.

Introduction. In 1956, SNL established the SNL/CA facility to design non-nuclear components in support of the Lawrence Livermore National Laboratory's (LLNL) design work. SNL/CA evolved into an engineering research and development laboratory by the early 1960s and into a multi-program engineering and science laboratory during the 1970s. The SNL/CA facilities at Livermore consist of 72 buildings, including laboratories and offices. Major facilities include Building 910, Building 914, Building 916, Building 927, the Micro and Nano Technologies Laboratory (MANTL), and the Distributed Information Systems Laboratory (DISL). Section 3.13.1 discusses the No Action Alternative, which would continue operations at the existing facilities at SNL/CA. Section 3.13.2 discusses the alternative that would transfer the weapons support functions to SNL/NM. The analysis of the environmental impacts of the alternatives is in Section 5.18.

SNL/CA Weapons Support Functions
• **No Action.** Maintain current non-nuclear component design and engineering work at SNL/CA with SNL personnel
• **Consolidate SNL/CA non-nuclear component design and engineering work at SNL/NM**

3.13.1 No Action Alternative

Under the No Action Alternative, NNSA would continue to conduct the existing weapons non-nuclear component design and engineering work at the SNL/CA facilities as shown in Figure 3.13-1. A description of the major SNL/CA facilities is as follows:

Building 910. Building 910 is used to conduct weapons research and development (R&D) activities. The facility conducts science-based engineering and technology R&D in a wide variety of sciences including advanced electronics prototype and development, surface physics, neutron detector research, and telemetry systems. Building 910 is a low-hazard non-nuclear facility that consists of offices and space for weapons test assembly work. It is a multistory steel frame masonry structure of approximately 89,000 square feet, of which 48,000 square feet is laboratory and office space. The following spaces are located in the facility:

- Lobby;
- 128 offices;
- Loading dock (provides gas bottle storage area);
- Large liquid nitrogen tank; and
- 35 primary research and development light laboratories.

Generally, the activities are focused on electronics and microelectronics prototypes. Materials that are studied include ceramics, semiconductors, organic polymers, and metals. Specific activities include:

- Advanced electronics prototype and development;
- Surface physics;
- Neutron detector research; and
- Telemetry systems research and development.

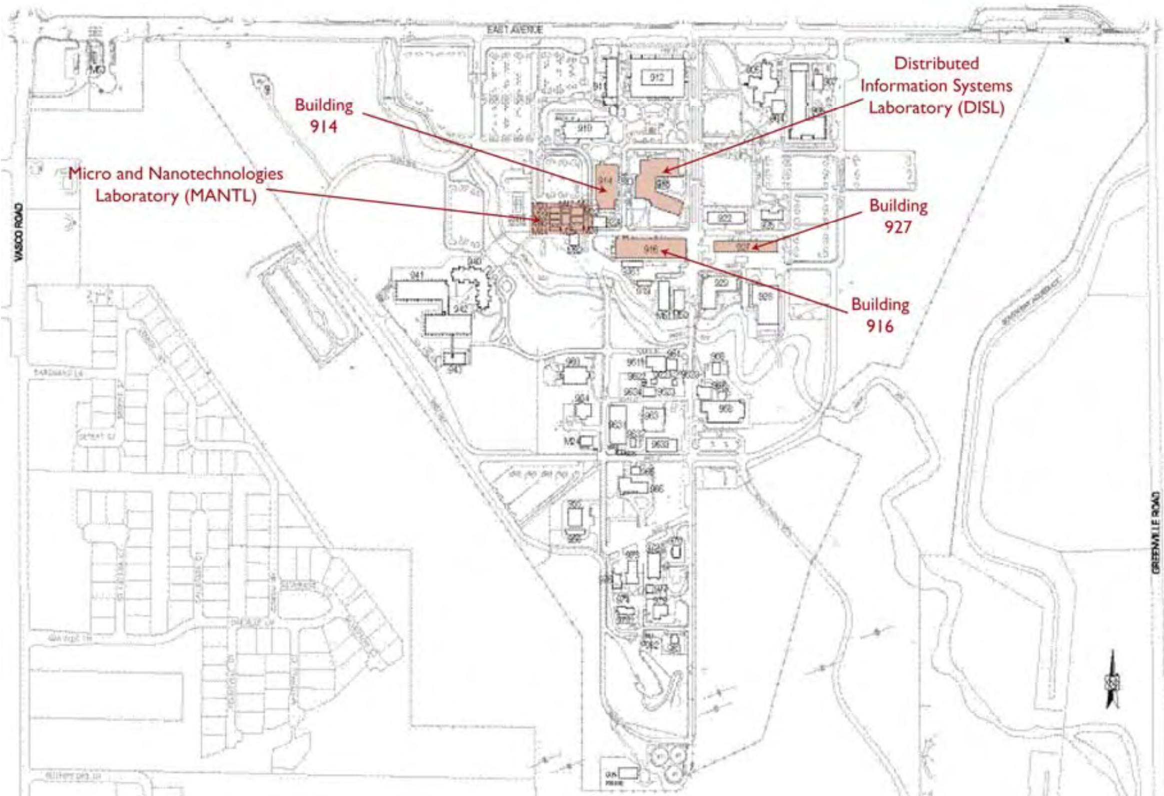


Figure 3.13-1—SNL/CA Weapons Support Facilities

Building 914. Building 914 is used to conduct weapons test assembly and machine shop activities. The facility supports SNL/CA’s primary mission of ensuring that the U.S. nuclear weapons stockpile is safe, secure, and reliable. Building 914 is a low-hazard non-nuclear facility that consists of offices and laboratory space for weapons test assembly work. It is a single-story, steel frame masonry structure of approximately 25,000 square feet, of which 19,000 square feet is laboratory and office space. The following spaces are located in the facility:

- 17 offices;
- 4 electronic laboratories;
- 1 large machine shop;
- 1 high-bay test assembly; and
- Several small utility, vault, and storage rooms.

The operations conducted at Building 914 generally are focused on two distinct capabilities that support the mission of U.S. nuclear weapons stockpile maintenance: machine shop activities and test assembly operations.

Building 916. Building 916 is used to conduct materials chemistry R&D activities. Areas of research include thin film interface science, mechanics, ion implantation, gases in metals, hydrogen storage, plasma, annealing, detectors, science-based modeling, microsystems, and fluidics. Building 916 is a low-hazard non-nuclear facility that consists of offices and laboratory space for research and development activities. It is a single story building of approximately 42,000 square feet, of which 32,000 square feet is laboratory and office space. The following spaces are located in the facility:

- Lobby;
- Conference room;
- 53 offices;
- Loading dock (provides gas bottle storage area);
- Large liquid nitrogen tank; and
- 22 primary research and development light laboratories.

Generally, the activities are focused on materials studies including chemical and physical properties and characteristics (phases). Materials that are studied include ceramics, semiconductors, organic polymers, and metals. A wide variety of capabilities are employed in areas of material science, lithography, surface analysis, electronics, and microsystems engineering.

Building 927. Building 927 is used to store small quantities of nuclear and classified materials, assemble sub-systems, conduct system verification, and store equipment. No testing with explosives or other hazardous materials is conducted at this location. Building 927 is a low-hazard facility. It consists of a single story warehouse of approximately 22,000 square feet. The building provides a safeguard storage facility for special materials. Building 927 has four operations:

- Nuclear Material Control;
- Classified Material Control
- Assembly test facility; and
- Storage.

Micro and Nanotechnologies Laboratory (MANTL). The mission of the MANTL (Buildings 940, 941, 942, and 943) is to develop and integrate manufacturing technology to produce micro- and nano-products. MANTL is a low-hazard non-nuclear facility complex that consists of an administrative building and three separate laboratory buildings. All of the buildings are of steel-framed masonry construction, and total approximately 85,000 square feet. The following facilities are located in the complex:

- 22,778 square foot administrative building including lobby, offices, and a small auditorium;

- 30,218 square foot building with primary research and development light laboratories;
- 25,740 square foot building with primary research and development light laboratories; and
- 7,182 square foot building with primary research and development light laboratories.

MANTL activities include a wide variety of operations micro-machining, miniature component fabrication, fuel cell research and development, and sensors and signal processing. Areas of materials research and development include characterization, chemistry, composite and lightweight components, engineered materials (welding, brazing, and joining), science-based modeling, and radiography. Specific operations include materials evaluation laboratories, materials synthesis and processing laboratories, microsystems processing laboratories, and nanolithography equipment development. MANTL has 10 areas of capabilities:

- Integrated Manufacturing;
- Microsystems;
- Fuel Cell Prototyping;
- Materials Characterization;
- Materials Chemistry;
- Lightweight Components;
- Engineered Materials;
- Science-Based Modeling;
- Sensors; and
- Radiography.

Distributed Information Systems Laboratory (DISL). The DISL (Building 915) provides research and development in areas of distributed information systems. The new facility is a state-of-the-art, two-story structure containing approximately 70,400 square feet; housing offices, computer laboratory space, research and development space, and collaborative group areas. The space is divided into the following:

- 12,000 square feet of computer laboratory space;
- 17,650 square feet of research and development space;
- 4,730 square feet for collaborative group areas;
- 8,220 square feet for support areas;
- Ancillary laboratories; and
- Secure vault-type rooms.

DISL operations focus on the following technologies:

- Secure networking;
- High performance distributed computing;
- Visualization and collaboration technologies; and
- Design and manufacturing of productivity environments.

Laboratory activities consist primarily of connecting off-the-shelf hardware components into multimedia and network systems, computer model development, testing and validation, and distributed computing.

3.13.2 Move Activities to SNL/NM

This alternative would move some or all of the weapons non-nuclear component design and engineering work to SNL/NM where it would be consolidated with similar ongoing weapons activities presently being conducted there. The majority of the buildings at SNL/CA are in good repair and could be occupied by other programs. No new construction would be expected at SNL/NM, as existing facilities could accept all personnel and equipment associated with this move to SNL/NM.

3.14 POTENTIAL CHANGES AT ALTERNATIVE SITES

This section presents a summary of the potential actions, displayed by site, which could occur based upon the alternatives presented in Sections 3.3 through 3.12. The purpose of this section is to provide a convenient format to understand the range of actions that could occur at each site potentially affected by the Complex Transformation SPEIS proposed action and alternatives.

3.14.1 Los Alamos National Laboratory

Programmatic Alternatives

- Continue current activities (Section 3.3.1)
- Be selected for a Greenfield CPC (Section 3.4.1) or Upgrade (Section 3.4.1.6.1) or 50/80 (Section 3.4.1.6.2)
- Be selected to receive the CNPC (Section 3.5.1) or CNC (Section 3.5.2) and Category I/II SNM from other sites (Section 3.5.1.3)
- Receive Category I/II SNM from LLNL (Section 3.7.2)
- If Los Alamos is not selected for CPC, phase-out plutonium manufacturing capability and transfer all Category I/II SNM to CPC site (Section 3.4.1.4)
- Establish a Capability Based pit production capacity (Section 3.6.1.1)

Project-Specific Alternatives

- Continue current activities related to Category I/II SNM storage (Section 3.7.1), HE R&D (Section 3.8.1), Tritium R&D (Section 3.9.1), Hydrotesting (Section 3.11.1), and ETFs (Section 3.12.1)
- Transfer HE R&D activities to other sites (Section 3.8.2)
- Receive HE R&D activities from other sites (Section 3.8.2)
- Transfer tritium R&D activities to SRS (Section 3.9.2)
- Receive tritium R&D activities from SRS and LLNL (Section 3.9.3)
- Reduce tritium R&D activities in place (Section 3.9.4)
- Reduce hydrotesting facilities in place (Section 3.11.2.1)
- Consolidate hydrotesting mission at LANL (Section 3.11.2.2)
- Consolidate ETFs in place (Section 3.12.2)
- Transfer ETFs to SNL/NM or NTS (Section 3.12.3)

3.14.2 Lawrence Livermore National Laboratory

Programmatic Alternatives

- Continue current activities related to Category I/II SNM storage (Section 3.7.1)
- Transfer Category I/II SNM to other sites (Section 3.7.2)

Project-Specific Alternatives

- Continue current activities related to HE R&D (Section 3.8.1), Tritium R&D (Section 3.9.1), Hydrotesting (Section 3.11.1), and ETFs (Section 3.12.1)
- Transfer HE R&D activities to other sites (Section 3.8.2)
- Receive HE R&D activities from other sites (Section 3.8.2)
- Transfer tritium R&D activities to SRS (Section 3.9.2)

- Transfer tritium R&D activities to LANL (Section 3.9.3)
- Reduce tritium R&D activities in place (Section 3.9.4)
- Reduce hydrotesting facilities in place (Section 3.11.2.1)
- Transfer hydrotesting mission to LANL (Section 3.11.2.2)
- Consolidate ETFs in place (Section 3.12.2)
- Transfer ETFs to SNL/NM or NTS (Section 3.12.3)
- Perform Category III SNM operations on material originating from LANL facilities (Section 3.7.2)

3.14.3 Nevada Test Site

Programmatic Alternatives

- Continue current activities (Section 3.3.1)
- Be selected for a Greenfield CPC (Section 3.4.1)
- Be selected to receive the CNPC (Section 3.5.1) or CNC (Section 3.5.2) and Category I/II SNM from other sites (Section 3.5.1.3)
- Receive Category I/II SNM from LLNL for interim storage (Section 3.7.2)

Project-Specific Alternatives

- Continue current activities related to HE R&D (Section 3.8.1), Hydrotesting (Section 3.11.1), and ETFs (Section 3.12.1)
- Receive HE R&D activities from other sites (Section 3.8.2)
- Receive NNSA flight test operations
- Be the M&O contractor for campaign mode flight test operations
- Reduce hydrotesting facilities in place (Section 3.11.2.1)
- Transfer hydrotesting mission to LANL (Section 3.11.2.2)
- Receive consolidated hydrotesting missions (next generation) (Section 3.11.2.3)
- Consolidate ETFs in place (Section 3.12.2)
- Consolidate ETFs to NTS (Section 3.12.3)

3.14.4 Pantex Plant

Programmatic Alternatives

- Continue current activities (Section 3.3.1)
- Be selected for a Greenfield CPC (Section 3.4.1)
- Be selected to receive the CNPC (Section 3.5.1) or CNC (Section 3.5.2) and Category I/II SNM from other sites (Section 3.5.1.3)
- Transfer Category I/II SNM storage from Zone 4 to Zone 12 (Section 3.7.2)
- Transfer A/D/HE activities to another site if a site other than Pantex is selected for CNPC/CNC; Pantex would close and undergo D&D (Section 3.5)
- Establish a Capability Based Assembly/Disassembly/HE Production (Section 3.6.1.2)

Project-Specific Alternatives

- Continue current HE R&D activities (Section 3.8.1), and Hydrotesting (Section 3.11.1)
- Transfer HE R&D activities to other sites (Section 3.8.2)
- Receive HE R&D activities from other sites (Section 3.8.2)

- Receive ETF Mission from LLNL Building 334 and, Building 834 Compex (Section 3.12.4)

3.14.5 Sandia National Laboratories/NM

Programmatic Alternatives
- None

Project-Specific Alternatives
- Continue current activities related to HE R&D (Section 3.8.1), Tritium R&D (Section 3.9.1), Hydrotesting (Section 3.11.1), and ETFs (Section 3.12.1)
- Transfer HE R&D activities to other sites (Section 3.8.2)
- Receive HE R&D activities from other sites (Section 3.8.2)
- Reduce hydrotesting facilities in place (Section 3.11.2.1)
- Consolidate ETFs in place (Section 3.12.2)
- Consolidate ETFs to SNL/NM or NTS (Section 3.12.3)
- Receive SNL/CA Weapons Support Functions (Section 3.13)

3.14.6 Savannah River Site

Programmatic Alternatives
- Continue current activities (Section 3.3.1)
- Be selected for a Greenfield CPC (Section 3.4.1)
- Be selected to receive the CNPC (Section 3.5.1) or CNC (Section 3.5.2) and Category I/II SNM from other sites (Section 3.5.1.3)
- Establish a Capability Based tritium production capacity (Section 3.6.1.4)

Project-Specific Alternatives
- Continue current activities Tritium R&D (Section 3.9.1)
- Receive tritium R&D activities from LLNL and LANL (Section 3.9.2)
- Transfer tritium R&D activities to LANL (Section 3.9.3)
- Reduce tritium R&D activities in place (Section 3.9.4)

3.14.7 Tonopah Test Range

Programmatic Alternatives
- None

Project-Specific Alternatives

- Continue current activities related to NNSA Flight testing (Section 3.10.1)
- Upgrade TTR (Section 3.10.2)
- Operate TTR in Campaign Mode (Section 3.10.3)
- Transfer NNSA Flight Testing to WSMR (Section 3.10.4)
- Transfer NNSA Flight Testing to NTS (Section 3.10.5)

3.14.8 Y-12

Programmatic Alternatives

- Continue current activities (Section 3.3.1)
- Be selected for a Greenfield CPC (Section 3.4.1)
- Be selected to receive the CNPC (Section 3.5.1) or CNC (Section 3.5.2) and Category I/II SNM from other sites (Section 3.5.1.3)
- Transfer Enriched Uranium operations to another site if a site other than Y-12 is selected for CNPC/CNC; Y-12 would close and undergo D&D (Section 3.5)
- Establish a Capability Based Enriched Uranium operations (Section 3.6.1.3)

Project-Specific Alternatives

- None

3.14.9 White Sands Missile Range

Programmatic Alternatives

- None

Project-Specific Alternatives

- Continue current activities (Section 3.2.7)
- Receive NNSA Flight Testing Mission from Tonopah Test Range (Section 3.10.4)

3.14.10 Sandia National Laboratories/CA

Programmatic Alternatives

- None

Project-Specific Alternatives

- Transfer Weapons Support Functions to Sandia National Laboratories/NM (Section 3.13)

3.15 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

NNSA considered alternatives other than those presented in Sections 3.3 through 3.13. NNSA concluded, however, that these alternatives were not reasonable and eliminated them from detailed analysis. This section identifies the alternatives that were considered but eliminated from detailed study, and discusses the reasons why they were eliminated.

Consolidate the three nuclear weapons laboratories (LLNL, LANL and SNL). The three weapons laboratories possess most of the nation's core intellectual and technical competencies in nuclear weapons. The laboratories perform the basic research, design, engineering, testing, and certification of weapon performance. Two of the laboratories (LANL and LLNL) focus on the weapons physics package and the third (SNL) focuses on non-nuclear components and systems engineering. In 1995, President Clinton concluded that the continued vitality of all three laboratories was essential to the nation's ability to fulfill the requirements of stockpile stewardship in the absence of underground testing (White House 1995). More recently, the Secretary of Energy Advisory Board Task Force on the Nuclear Weapons Complex of the Future (SEAB 2005) affirmed that three design laboratories are currently needed to certify nuclear weapons without underground testing. As a result of the continuing challenges of certification without underground testing, the need for robust peer review, benefits of intellectual diversity from competing physics design laboratories, and uncertainty over the details future stockpiles, NNSA does not consider it reasonable to evaluate laboratory consolidation at this time. While this conclusion has not changed, NNSA continues to make the laboratories more efficient and effective, as indicated by the alternatives to consolidate, relocate, or eliminate duplicative facilities and programs.

Pursue dismantlement and refrain from designing and building new nuclear weapons. Dismantlement coupled with no capabilities to design and build new nuclear weapons was not evaluated because it is not consistent with maintaining a safe, secure, and reliable nuclear weapons stockpile over the long-term. This SPEIS assesses reasonable alternatives for maintaining a nuclear weapons stockpile. The alternatives include actions to continue dismantlement consistent with Presidential direction to reduce the nuclear weapons stockpile. However, all of the alternatives would maintain weapons design, R&D, and manufacturing capabilities because these are necessary to maintain the stockpile.

This SPEIS includes two options for a Capability-Based Alternative (Sections 3.6.1 and 3.6.2) that would support a stockpile much smaller than currently planned, and a discussion of how the reasonable alternatives might be adapted if the President were to direct even further reductions in the stockpile (Section 3.6.3). The No Net Production/Capability-Based Alternative (Section 3.6.2) would require the production of a limited number of components and assembly of weapons beyond those associated with supporting surveillance, but would not result in the addition of new types or increased numbers of weapons to the total stockpile.

Curatorship Alternative. This programmatic alternative was proposed during public scoping meetings and later public meetings on the Draft SPEIS. The written comments submitted made reference to a document that provides a description of *curatorship* as a strategy for managing the

Stockpile Stewardship Program (SSP) and the description that follows is excerpted from that report.[42]

> ***Curatorship.*** *This option is based upon reliance on the surveillance and non-nuclear testing program to determine when repairs are necessary to nuclear weapons. Only if there is compelling evidence that components have degraded, or will soon degrade, and could cause a significant loss of safety or reliability, would DOE replace the affected parts with new ones that would be remanufactured as closely to their original design as possible. A core philosophy of this approach is that absent detectable changes, the well designed and thoroughly tested warheads in the stockpile will remain as safe and reliable as the laboratories have certified them to be today. No separate action would be taken to recertify each warhead annually. This places a heavy responsibility on the surveillance and testing program to assure timely warning of any problem that could materially impair a significant fraction of the nuclear weapons stockpile.*
>
> *Under the Curatorship Option, DOE would take a very cautious approach to making any changes to the weapons in the current stockpile. The approach is like that of a museum curator, whose first priority is to preserve the pieces under his charge and only restore them if they suffer unacceptable degradation. DOE would make the minimum number of changes to warheads in the stockpile that are believed necessary to maintain current levels of safety and reliability. Nuclear explosive components would be remanufactured and replaced only when there is compelling evidence from the surveillance and testing program that they have degraded, or will soon degrade, to a degree that will cause a significant loss of performance. Then, DOE would replace such components with others as close to the originals as possible, and always meeting the specifications previously associated with adequate nuclear performance. Non-nuclear components would be replaced only when detected degradation threatens to impair safety or weapon reliability. The burden of proof would be on those in the surveillance program to demonstrate that a component must be replaced to maintain historical levels of confidence in safety and reliability. No attempts at improving performance in either of these areas would be made.*
>
> *DOE would support state-of-the-art testing and engineering capabilities to examine components. It would retain sufficient scientific and computing capabilities to apply current models and normal evolutionary improvements in analytical models to appraise potential problems with weapons systems. Weapons design and development capabilities would be allowed to atrophy, however, and most of DOE's weapons related research and experimentation programs would be suspended. Existing manufacturing capabilities would be retained and facilities would be refurbished only as needed to remanufacture components to previous designs. Changes in materials and production techniques would be limited to those dictated by environmental, health, and safety requirements, or by the unavailability at reasonable cost of products and processes used in a component's original manufacturing process. The*

[42] Managing the U.S. Nuclear Weapons Stockpile—A Comparison of Five Strategies, A Report for Tri-Valley CAREs by Dr. Robert Civiak, July 2000.

> *production complex would be smaller than under the first two options, since components would be replaced less frequently. Functioning components would rarely be replaced with improved versions.*

This definition of *curatorship* comprises many aspects of NNSA's current Stockpile Stewardship Program. One section of Dr. Civiak's report, i.e., "Assessment of the Options for Managing the U.S. Nuclear Weapons Stockpile," identifies two potential differences between the current SSP and curatorship.

- Unlike the current SSP, curatorship would involve giving up the capabilities to design and develop replacement nuclear weapons.
- Unlike the current SSP, curatorship would involve reduction of NNSA's manufacturing capabilities, as NNSA would rely more on surveillance and remanufacturing and less on production of newly designed components.

The report states that "weapons design and development would be allowed to atrophy" in the suggested curatorship alternative. This statement assumes that there is a significant difference in the technical capabilities needed to maintain the weapons in the legacy stockpile from those required to design new weapons. The technical capabilities of the SSP, such as the experimental and computational capabilities, are largely defined by the technical characteristics of the aging stockpile and the moratorium on nuclear testing. The legacy weapons in the stockpile are not simple in that they were generally designed to provide the maximum nuclear yield within the weight and volume constraints of the delivery vehicle's capabilities. The weapon's nuclear yield, reliability, safety and security characteristics all compete for the same weight and volume capacities. Thus, weapon design is a result of complex "systems engineering" wherein design features affect one another and are traded-off against each other. When a problem is detected or suspected, laboratories must make technical judgments on the nature and extent of the problem and the proposed solution, because they are the ones most technically competent to do so. The concept of science-based stockpile stewardship was developed to enable a more fundamental scientific understanding of legacy weapons for the purpose of making competent judgments about their safety and reliability in the absence of nuclear testing. The technical merit of any particular feature of the SSP, such as a specific experimental capability, will always be subject to uncertainty. Nonetheless, as a whole, the SSP is technically designed for maintenance of the legacy stockpile. Allowing any aspects of this capability to atrophy would impair NNSA's ability to assess and, if necessary, address issues regarding the safety, security, and reliability of a nuclear weapon.

In regard to the second point on surveillance and remanufacture, this aspect of curatorship may not differ significantly from the existing SSP. In practice, the SSP is probably more cautious in making changes to legacy weapons than implied in the definition of curatorship. For example, a number of stockpile problems have been corrected by changes to DoD maintenance, operating or management procedures, thus avoiding the need to return the weapons to NNSA for more complicated and expensive fixes. However, the ability of DoD to repair nuclear weapons is minimal and inherently limited by the weapon's complex design and construction. The thousands of parts in weapons do not function as individual items that can be separately changed out, like an electrical fuse in a home or car. Generally, the weapon has to be returned to Pantex for safe disassembly and replacement of components or subassemblies. In general, there is no practical, safe, or cost effective way to fix individual defects in isolation or just-in-time as implied by curatorship proposals. This is the main reason that legacy "life extension programs" are planned, so as to repair all known or potential problems at one time while the weapons are disassembled.

The No Net Production/Capability-Based Alternative includes many facets of a Curatorship Alternative: (1) not adding new types or increased numbers of weapons to the total stockpile; (2) state-of-the-art testing and engineering capabilities to examine components and detect and appraise problems; and (3) maintaining the capabilities to replace components, as needed.

In summary, a curatorship alternative does not define a programmatic alternative outside the range of alternatives evaluated in this SPEIS.

Smaller CNPC/CUC/CNC/A/D/HE Center Alternative. This SPEIS includes an analysis of Capability-Based Alternatives (Section 3.6) that would produce as few as 10-50 components and assemble 10-50 weapons per year to maintain capability and to support a limited LEP. Additionally, for both the Distributed Centers of Excellence Alternative and Consolidated Centers of Excellence Alternative, this SPEIS considers production of as few as 80 pits per year. Similarly, NNSA also considered whether to assess a smaller CUC, CNC, or CNPC. In determining whether, to assess a smaller CUC, CNC, or CNPC, NNSA considered three different factors-- programmatic risk, cost effectiveness and environmental impacts. These factors are discussed below.

Programmatic risk. Section 2.3.3.2 describes the technical considerations for planning pit production capacity. In summary, current surveillance data and special studies indicate that pits in legacy weapons are aging without significant problems. Also, pit reuse may be a viable way to avoid some new pit production for some weapons, but it cannot be relied on as a complete substitute for new production due to the technical limitations described in Section 2.3.3.2. However, an advantage of pit reuse is that the work could possibly be done at the weapons A/D site in existing facilities. Thus, the increased programmatic risk of planning a lower-than-base-case production capacity for new pits might be judged acceptable. This same kind of judgment about programmatic risk was made for pits in the 1996 SSM PEIS.

Section 2.3.3.3 describes the technical considerations for planning secondary production capacity. In summary, current surveillance data and studies indicate that the secondary components in some legacy weapons are not holding up as well as they age beyond their intended design life. Further, there is no risk mitigating option for secondary components similar to the pit reuse. Secondary components have been disassembled and completely rebuilt in recent life extension programs. For planning purposes, rebuilding a secondary is not significantly different from building a completely new secondary.

Pit and secondary component installation and removal are done at the weapons A/D site, so its planning assumption for production capacity must be at least as high as the higher of the two components. In addition, because the weapons A/D site is the only location for safe disassembly of nuclear weapons, it is unlikely that the base case for this function would be reduced even if pit and secondary component production levels were reduced. It would not be prudent to overly limit this function in the event that weapons needed to be disassembled quickly for some unforeseen reason, not the least of which would be a nuclear safety problem.

Cost effectiveness. If new nuclear production facilities were built for pit or secondary components, lower production capacities are not likely to have a significant effect on the cost of these facilities. The number of pieces of unique equipment and factory floor space required will not change significantly at lower capacity levels. Pit and secondary components both contain SNM and these materials require a substantial factory infrastructure regardless of production rate—an infrastructure needed for compliance with environment, health and safety requirements and nuclear safeguards and security. In addition to facility requirements being similar because of the use of SNM, the uranium and plutonium components use many of the same manufacturing technologies (welding, machine tools, etc.). The lack of sensitivity of facility size and cost to lower production rates is illustrated by an SRS study on pit production capacity (NNSA 2007). The study identified 84 pieces of equipment to produce 75 pits per year, but only 87 pieces of equipment to produce 125 pits per year. This translates into less than a 2 percent difference in the floor space needed for 75 pits per year versus 125 pits per year. Similarly small differences would be expected for smaller production capacities.

In regard to constructing new facilities for the weapon A/D function, the cost sensitivities are different based on the differences in facility design and utilization. Nuclear facilities for SNM processing and component production are very complex and expensive. Weapon A/D facilities are not designed for SNM processing and all that entails. They are designed to mitigate the effects of an accidental detonation of a weapon's high explosive during operations. The construction cost for a weapon A/D type facilities is very much less than the cost of facilities for pit production and secondary component production. Cost would not play a significant role in relation to programmatic risk.

Environmental impacts. Because the square footage of a new pit, secondary, or weapon A/D facility is not very sensitive to changes in production rates between 10 and 125 units per year, the environmental impacts of construction are not expected to be significantly different than for the current alternatives. The environmental impacts of operations estimated in this Final SPEIS are proportional to production rates and bounded on the low side by the impact of the Capability-Based Alternatives.

In conclusion, lower pit production rates may be an acceptable programmatic risk in view of the pit surveillance data, and the existence of a potential pit reuse option and cost. The same is not true for secondary components and weapon A/D functions since recent history on the secondary components indicates there is a higher programmatic risk associated with secondary longevity resulting in a need to work on weapons under the life extension program. The environmental impacts for the secondary component and weapon A/D functions would not change significantly by creating a new alternative based on a planning assumption of 50/80 units per year. Based on this conclusion, NNSA decided to eliminate a smaller CUC[43], CNC, and CNPC from detailed analysis.

[43] As discussed in Section 3.6.2.7, NNSA does consider a "minimum UPF" for the No Net Production/Capability-Based Alternative. Although the "minimum UPF" would be a smaller facility, the facility would not be significantly smaller than the current UPF design.

Regarding the CPC, NNSA identified the following potential alternatives, but eliminated them for the reasons set forth below:

New CPC with a smaller capacity. NNSA considered whether it would be reasonable to build a new CPC with a capacity of fewer than 125 pits per year (single shift). In a detailed report published in September 2007 (NNSA 2007), NNSA concluded that if it constructed a new pit facility with a capacity to produce 80 pits per year, the reduction in square footage would be small (less than a few percent) compared to a new facility designed for 125 pits per year (single shift). The reason for this is that the reduction in the number of equipment processing stations is only 6 stations from the total estimated requirement of 132 major processing stations. Reductions in the processing stations based on a lower production requirement only decreases a small amount of equipment that would be needed to provide production assurances in the capacity increase from 80 pits per year to 125 pits per year (single shift). From a design perspective for a new facility, 125 pits per year plant is an optimal minimum. The expected environmental impacts on construction and operation of a new CPC at 125 pits per year would not be significantly different from 80 pits per year and the larger capacity provides better assurance of meeting the purpose and need for production of pits. This conclusion would also be true for the Capability-Based Alternatives, which evaluates impacts for pit production at capacities of 10-50 pits per year.

Purchase pits. While there is no national policy that prohibits purchase of defense materials such as pits from foreign sources, NNSA has determined that the uncertainties associated with obtaining them from foreign sources render this alternative unreasonable for an assured long-term supply.

Upgrade Building 332 at Lawrence Livermore National Laboratory. Building 332 at LLNL is located in what is known as the "Superblock." This building is a plutonium R&D facility containing a wide variety of plutonium processing and fabrication technologies but offering minimal production capabilities. Activities in Building 332 include demonstrating improved technologies for plutonium metal preparation, casting, fabrication, and assembly; fabrication of components for subcritical tests; surveillance of LLNL pits; support for LANL pit surveillance; and fundamental and applied research in plutonium metallurgy. Building 332 does not have a pit manufacturing mission and is small in comparison to the production facilities at LANL. Additionally, because of the significant population around LLNL, an upgrade alternative at LLNL is undesirable.

Consider other sites for the CPC. In order to determine the reasonable site alternatives for a CPC, all existing, major DOE sites were initially considered as a location for a CPC. Because one of NNSA's main purposes is to consolidate Category I/II SNM, sites that do not maintain Category I/II SNM were eliminated from consideration. Likewise, NNSA eliminated sites that do not conduct major NNSA program activities, as these sites would further expand the NNSA Complex. Other NNSA sites were not considered reasonable locations because they do not satisfy certain criteria such as low surrounding populations, mission compatibility, or synergy with the site's existing mission. Following this process, NNSA decided that Los Alamos, NTS, Pantex, SRS, and Y-12 are the reasonable site alternatives for a CPC (71 FR 61731).

Redesign of weapons to require less or no plutonium. The pits in the nuclear weapons stockpile were designed and built with plutonium, and in an era when nuclear testing was used to verify these designs. Replacing these pits with new ones that would use little or no plutonium (i.e., they would use highly enriched uranium instead of plutonium) for the sole purpose of not building a long-term, assured pit production facility would not be reasonable. Underground testing would likely be required to verify performance of a design that uses uranium instead of plutonium. In addition, these new pits would require costly changes in weapon delivery systems.

Do not produce new pits. The latest studies on pit aging indicate that the pits currently in the stockpile may be viable for more than 85 years. It may become necessary to manufacture new pits for a number of reasons including new weapon design, changes in other components in the weapon that might require a new pit (for example a change in the HE to be used or unavailability of certain materials or components). Prudent management of NNSA's mission dictates that NNSA have the ability to produce all components necessary for the nuclear weapons stockpile to adequately manage all potential risks to the stockpile. However, NNSA has considered a No Net Production/Capability-Based Alternative (Section 3.6.2) that would produce as few as 10 pits per year, which would be the minimum production needed to maintain capability and to support a limited LEP workload.

NNSA flight testing. In addition to the WSMR, NNSA considered three other DoD flight test ranges. A team of NNSA officials visited these sites, discussed their availability and assets with the sites' technical staff and management, and evaluated their ability to conduct NNSA flight test operations. However, as explained below, NNSA eliminated them from further consideration because they are unreasonable from the standpoint of technical risk.

NNSA considered areas B-70 and B-75, on the west side of Eglin Air Force Base. Eglin is one of the Air Force's largest bases, and is a primary test center for non-nuclear munitions. Located on the coast of the panhandle of Florida, the base covers 724 square miles of land, and has 97,963 miles of water ranges in the Gulf. NNSA has conducted discrete flight tests at Eglin in the past and may do so in the future. However, the geological features, including the terrain and short depth to groundwater, present problems for more routine flight tests (e.g., penetration testing, difficult recovery of units after testing). Thus, Eglin would not provide a suitable environment for most flight testing.

NNSA also considered China Lake, an airborne weapons testing and training range operated by the U.S. Navy. It is located in the northeast of California's Mojave Desert in northwestern San Bernardino County. China Lake is the US Navy's largest single holding of land, covering of 1.1 million acres. Although the technical assets at China Lake are sufficient to support NNSA Flight Test Operations, the geology and soils are not considered adequate for testing all gravity weapons.

NNSA also considered the Utah Test and Training Range (UTTR). UTTR is a vast military area in northern Utah, about 70 miles west of Salt Lake City. UTTR is the nation's largest combined restricted land and closed "special use" airspace area. The existing assets, such as optical systems, radar, and communications are all dated and its management has no plans for upgrading or replacing them. Soil composition is moist and soft over the entire range and was not considered suitable for conducting all NNSA Flight Test Operations.

Additionally, in response to public comments on the Draft SPEIS, NNSA considered additional alternatives that would not relocate NNSA's flight test operations from TTR, but would conduct tests at TTR on a campaign basis. This led to the development of three options that are presented in Section 3.10.3.

Tritium R&D alternatives: With the exception of the irradiation of tritium targets (which occurs at the TVA Watts Bar commercial nuclear reactor), all other elements of tritium production are currently conducted at SRS. Tritium production activities are conducted in new, state-of-the-art facilities that were specially designed and built for this mission. There are no existing facilities at sites other than SRS for performing these missions. As such, any proposal to transfer the tritium production mission from SRS was considered to be unreasonable.

Changing tritium missions at SNL/NM. As noted in Section 3.9.1, SNL/NM has very small inventories of tritium in conjunction with its neutron tube target loading. Projected inventories are not expected to increase and will not represent increases to security and infrastructure requirements. Expanding SNL/NM to take on additional tritium R&D missions would require additional increase in infrastructure requirements, limits etc. Thus, for a future mission or decision, this site is essentially equivalent to a "greenfield" site and was considered unreasonable for consolidation activities. Likewise, the programmatic need to conduct neutron tube loading R&D in conjunction with the neutron tube target loading makes transfer of this mission from SNL/NM unreasonable.

Consolidate tritium R&D at LLNL. Although LLNL has a low tritium inventory, the site will be able to accommodate approximately 35 grams of tritium in the near future. The facility infrastructure will support the loading of tritium targets for the NIF. In comparing LLNL's tritium limit and inventories to existing inventories and limits at LANL and SRS, it falls far short of what would be necessary to accommodate these missions. To accommodate the tritium R&D mission, LLNL would need to increase projected tritium limits about 10 fold or slightly higher. As such, LLNL was recommended for consideration as a "donor" site for tritium R&D rather than as a "receiver" site.

Transfer NIF tritium target loading from LLNL. LLNL is in the process of developing a capability to fill tritium targets for NIF experiments. The success of the NIF experiments, particularly to achieve target ignition is very sensitive to impurities in the target. One of these impurities is Helium-3 which accumulates in the target at the rate of 6.4 atomic parts per million per hour from tritium decay. Any tritium consolidation option that moves NIF target tritium loading to a location not colocated with NIF, introduces additional time and handling of the NIF targets before the experiments can be conducted. It seems unlikely targets produced at a site other than at LLNL could be brought to NIF and used in experiments within the time constraints stated for experimental success, particularly since most of the 36 hours is required for target conditioning and characterization at NIF itself. As such, NNSA has concluded that it is unreasonable to transfer the NIF tritium target loading from LLNL.

3.16 COMPARISON OF IMPACTS

Comparison of potential environmental impacts is based on the information in Chapter 4, Affected Environment, and analyses in Chapter 5, Environmental Impacts. Its purpose is to present the impacts of the alternatives in comparative form. For the programmatic alternatives to restructure SNM facilities, Table 3.16–1 (at the end of the chapter) presents a comparison of the potential impacts of construction and operation associated with the No Action Alternative, DCE Alternative, CCE Alternative, and Capability Based Alternative. The No Action Alternative is presented in Table 3.16-1 as a benchmark for comparison of the impacts associated with the action alternatives. Table 3.16-2 presents a summary comparison of the Category I/II SNM Consolidation for LLNL and Table 3.16-3 presents a summary comparison of the Category I/II SNM Consolidation at Pantex.

A detailed analysis of the project-specific alternatives is contained in Section 5.13 (HE R&D), Section 5.14 (Tritium R&D), Section 5.15 (Flight Testing), Section 5.16 (Hydrodynamic Testing), Section 5.17 (Major Environmental Test Facilities), and Section 5.18 (Non-Nuclear Weapons Support Functions at SNL/CA). For the project-specific actions, Tables 3.16-4 through 3.16-8 are provided.

In addition to the comparison presented in Table 3.16-1, this section presents an overview of the major environmental impacts associated with the programmatic alternatives presented in this SPEIS. This presentation is an overview, focusing on the major discriminator between the programmatic alternatives with respect to land use, employment, transportation, and accidents. A detailed analysis of the environmental impacts associated with all alternatives (by site) is presented in Chapter 5, Sections 5.1 through 5.9. A detailed transportation analysis is presented in Section 5.10.

3.16.1 Land Use for Programmatic Alternatives

For land use, both the No Action Alternative and the Capability Based Alternative have the least impacts, in that the total area of the seven Complex sites analyzed in this SPEIS (LANL, LLNL, NTS, Pantex, SNL, SRS, and Y-12) remains the same at approximately 1,000,000 acres.

For the DCE Alternative, the Complex would remain the same size, but a CPC would be constructed at one of five site alternatives. This would disturb an area of approximately 140 acres during construction, resulting in a 110 acre facility within the existing boundaries of one of these sites. For Los Alamos, this disturbed land could be a bit smaller, as an alternative to use existing and planned pit manufacturing facilities is being considered along with a Greenfield CPC alternative. At Y-12, if the UPF were constructed, consolidation from existing facilities could ultimately reduce the area associated with nuclear production activities from 150 acres to approximately 15 acres.

Under the Consolidated Centers of Excellence (CCE) Alternative, the Complex’s size could be reduced. Depending upon the option (Consolidated Nuclear Production Center [CNPC] or Consolidated Nuclear Centers [CNC]), this alternative would involve the construction of facilities at one or two sites, and could resulting in a 545-acre facility at one of five candidate sites. If Los Alamos, NTS, or SRS were selected as the site for CCE facilities, both Pantex and Y-12 could be closed. This could reduce the size of the Complex by 16,777 acres. If Pantex (but not Y-12) were selected for CCE facilities, Y-12 could close and the size of the Complex reduced by approximately 800 acres. If Y-12 (but not Pantex) were selected for CCE facilities, Pantex could close and the Complex would be reduced by 15,977 acres.

3.16.2 Impacts on Complex Facilities for Programmatic Alternatives

Under the No Action Alternative, NNSA would continue the trend of closing, replacing, and upgrading older facilities consistent with previous decisions. Surplus facilities with no inherent value to DOE, NNSA, or the community would ultimately be dispositioned or undergo decontamination and decommissioning (D&D). For example, at Y-12, many excess buildings and infrastructure have been closed over the past decade, and approximately 244 buildings, with more than 1.1 million square feet, have been demolished or removed. In the future, as part of the environmental cleanup strategic planning, DOE and NNSA are developing an Integrated Facility Disposition Project (IFDP). The IFDP is a strategic plan for disposing of legacy materials and facilities at Oak Ridge National Laboratory (ORNL) and Y-12 that uses an integrated approach. Under the IFDP, the D&D of approximately 188 facilities at ORNL and 19 facilities at Y-12, as well as the remediation of soil and groundwater contamination there, would occur over the next decade. The IFDP will be conducted as a remedial action under CERCLA. Similar activities at other NNSA sites are ongoing. For instance, at LLNL, approximately 20 facilities with a combined floor space of 234,443 square feet are being deactivated.

With respect to the programmatic alternatives, if a site other than Y-12 or Pantex is selected for a CNPC, Pantex and Y-12 could be closed. At Pantex, this would involve closing approximately 400 buildings totaling 1.8 million square feet. At Y-12, approximately 5.3 million square feet of floor space and approximately 390 facilities would be closed. For each of the programmatic action alternatives, moving plutonium storage to Zone 12 at Pantex would result in closing more than 74,200 square feet of storage facilities in Zone 4.

3.16.3 Impacts on Complex Facilities for Project-Specific Alternatives

With respect to potential cumulative impacts, project specific actions could also affect the total number of facilities and square footage devoted to NNSA weapons activities. This could result in additional facility closures or transfer of facilities from the NNSA to another user. For example, if flight testing were moved from TTR, approximately 195 buildings, covering approximately 180,000 square feet, could be closed or transferred to another user.[45] For the Hydrodynamic Testing Downsize-in-Place Alternative, 29 facilities at LANL, LLNL, and SNL/NM, with a combined floor space of 56,475 square feet could be closed or transferred. For alternatives that move HE R&D from LLNL Site 300, up to 17 acres of facilities, involving more than 35,000 square feet, could be closed or transferred. If NNSA were to ultimately close Site 300, up to 115 buildings with a floor space of approximately 340,000 square feet could be closed or transferred.

[45] This SPEIS does not identify future users or uses of facilities that may or may not be closed. Any such actions are premature and would be more appropriately addressed if and when facilities become excess.

3.16.4 Employment Under the Programmatic Alternatives

For employment, the No Action Alternative would have the least impacts with the workforce remaining at the current level of approximately 27,000 management and operating contractors at the major sites analyzed in this SPEIS.

For the DCE Alternative, a new CPC could be constructed at Los Alamos, NTS, Pantex, SRS, or Y-12. If constructed, approximately 850 construction jobs and an operational workforce of approximately 1,780 could be added to the Complex.

The CCE Alternative has the greatest potential for employment impacts. The construction of CCE facilities could require more than 4,000 construction jobs and an operational workforce of approximately 4,500 could be added to the selected site(s). If Pantex is not selected for CCE facilities, Pantex could be closed, resulting in a loss of approximately 1,650 jobs. If CCE facilities are not located at Y-12, Y-12 could be closed with a loss of approximately 6,500 jobs.

For the Capability Based Alternative, the reduced level of production would entail the loss of approximately 3,000 jobs (400 at Pantex, 15 at SRS, and 2,600 at Y-12).

3.16.5 Transportation Under the Programmatic Alternatives

For the No Action Alternative, there would be no impacts to the existing transportation requirements of the Complex. Pits would continue to be transported from LANL to Pantex, Canned subassemblies (CSAs) would continue to be transported from Y-12 to Pantex, tritium reservoirs would continue to be transported between SRS and Pantex, and other required parts and materials would be transported among various NNSA sites.

For the DCE Alternative, transportation related to pit production could increase if a CPC were located at a site other than Pantex. If the CPC were located at Pantex, no off-site transportation related to pit production would be required.

For the CCE Alternative, if facilities were located at sites other than Y-12 and Pantex, up to 60 metric tons of plutonium, mostly in pit form, presently being stored at Pantex would be transported to the CNPC, and 252 tons of HEU would be transported from Y-12 to the CNPC. For the CNPC option, annual transportation related to nuclear production would cease once the CNPC becomes operational. For the CNC option, there would be annual transportation related to pits and CSAs between the CPC, CUC, and A/D/HE Center.

For the Capability Based Alternative, transportation requirements would be the same as for the No Action Alternative, except that the number of CSAs that would need to be transported from Y-12 to Pantex, would be reduced by approximately 50 percent and tritium shipments could be reduced by approximately 50 percent.

3.16.6 Accidents and Malicious Acts in Programmatic Alternatives

For the No Action Alternative and the Capability-Based Alternative, accident risks and consequences would remain the same. For the DCE and CCE Alternatives, the construction of new facilities would, in general, tend to reduce the risks and consequences of accidents due to advances in building design features. In general, if missions were moved to locations with populations lower than the populations at the sites where those missions are currently conducted, potential consequences would likely decrease. For example, if a CNPC were located at NTS, potential consequences associated with the A/D/HE mission, the CUC mission, and the CPC mission would be reduced compared to the No Action Alternative because of the greater distance to the site boundary and the smaller population within the surrounding area.

NNSA has prepared a classified appendix to this SPEIS that evaluates the potential impacts of malevolent, terrorist, or intentional destructive acts. Substantive details of terrorist attack scenarios, security countermeasures, and potential impacts are not released to the public because disclosure of this information could be exploited by terrorists to plan attacks. Appendix B (Section B.12.3) discusses the methodology used to evaluate potential impacts associated with a terrorist threat and the methodology by which NNSA assesses the vulnerability of its sites to terrorist threats and then designs its response systems. As discussed in that section, NNSA's strategy for the mitigation of environmental impacts resulting from extreme events, including intentional destructive acts, has three distinct components: (1) prevent or deter successful attacks; (2) plan and provide timely and adequate response to emergency situations; and (3) progressive recovery through long-term response in the form of monitoring, remediation, and support for affected communities and their environment.

Depending on the intentional destructive acts, impacts would be similar to or exceed the impacts of accidents analyzed in the SPEIS. These analyses provide NNSA with information upon which to base, in part, decisions regarding transformation of the Complex. The classified appendix evaluates several scenarios involving intentional destructive acts for alternatives at the following sites (LANL, LLNL, NTS, SRS, Pantex, and Y-12) and calculates consequences to the noninvolved worker, maximally exposed individual, and population in terms of physical injuries, radiation doses, and LCFs. Although the results of the analyses cannot be disclosed, the following general conclusion can be drawn: the potential consequences of intentional destructive acts are highly dependent upon distance to the site boundary and size of the surrounding population -- the closer and higher the surrounding population, the higher the consequences. In addition, it is generally easier and more cost-effective to protect new facilities, as new security features can be incorporated into their design. In other words, protection forces needed to defend new facilities may be smaller due to the inherent security features of a new facility. New facilities can, as a result of design features, better prevent attacks and reduce the impacts of attacks. Impacts from intentional destructive acts would be much lower for the project-specific alternatives than for the programmatic alternatives due to the fact that the programmatic alternatives involve significant quantities of special nuclear materials.

3.16.7 Infrastructure Demands for the Programmatic Alternatives

Electricity. Under the No Action Alternative, all sites have an adequate existing electrical infrastructure to support current and planned activities.

LANL has adequate electricity to support all of the alternatives.

At NTS, the existing infrastructure would be adequate to support all construction requirements. However, to support operations for a CUC, CNC, or CNPC, NTS would need to procure additional power.

At Pantex, the existing infrastructure would be adequate to support all construction requirements. However, to support operations for a CUC or CNPC, Pantex would need to procure additional power.

At SRS and Y-12, the existing infrastructure would be adequate to support the construction and operation of all alternatives. Construction and operation would have a negligible impact on current site infrastructure.

Water. Under the No Action Alternative, all sites have an adequate existing water infrastructure to support current and planned activities.

LANL has adequate water rights to support a CPC, CUC, or A/D/HE Center. However, operation of multiple new facilities (CNPC) would exceed the current LANL water rights.

At NTS, the sustainable site capacity for water would be adequate to support the construction and operation of all alternatives.

At Pantex, the existing wellfield capacity would be adequate to support the construction and operation of all alternatives.

At SRS and Y-12, the existing water infrastructure would be adequate to support the construction and operation of all alternatives.

3.17 PREFERRED ALTERNATIVES

CEQ regulations require an agency to identify the alternative it prefers for achieving its purpose in a Final EIS (40 CFR 1502.14(e)). NNSA's preferred alternative is described below. It is based on NNSA's consideration of environmental impacts described in this Final SPEIS, as well as other factors such as mission and infrastructure compatibility, economic analyses, safety, safeguards and security, and workforce training and retention. **The preferred alternative described below reflects NNSA's current preference, but it is not a decision. NNSA will announce any decisions in one or more Records of Decision and may select an alternative other than the preferred alternative identified below.**

3.17.1 Preferred Alternatives for Restructuring SNM Facilities

- **Plutonium manufacturing and R&D:** Los Alamos would provide a consolidated plutonium research, development, and manufacturing capability within TA-55 enabled by construction and operation of the Chemistry and Metallurgy Research Replacement—Nuclear Facility (CMRR-NF). The CMRR-NF is needed to replace the existing Chemistry and Metallurgy Research (CMR) Facility (a 50-year old facility that has significant safety issues that cannot be addressed in the existing structure), to support movement of plutonium R&D and Category I/II quantities of SNM from LLNL, and consolidate weapons-related plutonium operations at Los Alamos. Until completion of a new Nuclear Posture Review in 2009 or later, the net production at Los Alamos would be limited to a maximum of 20 pits per year. Other national security actinide needs and missions would continue to be supported at TA-55 on a priority basis (e.g., emergency response, material disposition, nuclear energy).

- **Uranium manufacturing and R&D:** Y-12 would continue as the uranium center producing components and canned subassemblies, and conducting surveillance and dismantlement. NNSA has completed construction of the HEUMF and will consolidate HEU storage in that facility.[46] NNSA would build a Uranium Processing Facility (UPF) at Y-12 in order to provide a smaller and modern highly-enriched uranium production capability to replace existing 50-year old facilities. The site-specific impacts and candidate locations for a UPF will be analyzed in a new SWEIS for Y-12 that NNSA is currently preparing.

- **Assembly/disassembly/high explosives production and manufacturing:** Pantex would remain the Assembly/Disassembly/High Explosives production and manufacturing center. NNSA would consolidate non-destructive surveillance operations at Pantex.

- **Consolidation of Category I/II SNM:** NNSA would continue to transfer Category I/II SNM from LLNL under the No Action Alternative and phase out Category I/II operations at LLNL Superblock by the end of 2012. NNSA would consolidate Category I/II SNM at Pantex within Zone 12, and close Zone 4.

[46] The environmental impacts at HEUMF and its alternatives are analyzed in the 2001 Y-12 SWEIS (DOE 2001a).

3.17.2 Preferred Alternatives for Restructuring R&D and Testing Facilities

HE R&D. NNSA would reduce the footprint of its HE production and R&D related to nuclear weapons; and reduce the number of firing sites. Use of energetic materials (greater than 1 kg) for environmental testing conducted at SNL/NM would continue (e.g., acceleration or sled tracks, shock loading, or in explosive tubes) and is not included in HE R&D. NNSA would consolidate weapons HE R&D and testing within the following locations, without constraining transfer and operation of weapons programs firing sites to other NNSA, DoD, and national security sponsors, as follows

- Pantex would remain the HE production (formulation, processing, and testing) and machining center. All HE production and machining to develop nuclear explosive packages would continue at Pantex. HE experiments up to 22 kg HE would remain at Pantex;
- NTS would remain the testing center for large quantities of HE (greater than 10 kg);
- LLNL would be the HE R&D center for formulation, processing, and testing (processing capability to handle up to 15 kg and testing less than 10 kg) HE at the High Explosives Applications Facility (HEAF); formulation and processing of HE would be conducted either at a new HEAF Annex built adjacent to HEAF, or at existing Site 300 facilities (but using less space than currently used for these activities);
- SNL/NM would remain the HE R&D center for non-nuclear explosive package components (less than 1 kg of HE) at the Explosive Components Facility (ECF); and
- LANL would produce war reserve main charge detonators, conduct HE R&D experimentation and support activities, and move towards contained HE R&D experimentation.
- Each site would maintain one weapons program open-burn and one open-detonation area for safety and treatment purposes.

Tritium R&D. NNSA would consolidate tritium R&D at SRS. SRS would remain the site for tritium supply management and provide R&D support to production operations and gas transfer system development. Neutron generator target loading at SNL/NM and production of National Ignition Facility targets at LLNL, which involve small quantities of tritium, would continue and would not be included in this consolidation. NNSA would move bulk quantities of tritium from LANL to SRS by 2009; and remove tritium materials above the 30 gram level from the Weapons Engineering Tritium Facility (WETF) at LANL by 2014.

NNSA flight test operations. Campaign Mode Operation of Tonopah Test Range (TTR) (Option 3—Campaign under Reduced Footprint Permit). NNSA would reduce the footprint of TTR, upgrade equipment with mobile capability, and operate in campaign mode. NNSA expects it would not use Category I/II SNM in future flight tests.

Major Hydrodynamic Testing. By the end of fiscal year 2008, NNSA would contain the hydrodynamic testing (consisting of Integrated Weapons Experiments and Focused Experiments) at LLNL at the Contained Firing Facility (CFF) and at LANL at the Dual-Axis Radiographic Hydrodynamic Test (DARHT) facility. At LANL, firing site operations for weapon programs required by NNSA's hydrodynamic test program would be moved to contained firing. In addition:

- Hydrotesting at LLNL Site 300 would be consolidated to a smaller footprint by 2015.
- The goal is to minimize open-air testing at LANL. Open-air hydrotests at LANL's DARHT, excluding SNM, would only occur if needed to meet national security requirements.
- NNSA would allow open-air firing at LANL TA-36 until adequate radiographic capabilities and associated supporting infrastructure are available for open-air firing at NTS.

Major Environmental Test Facilities. NNSA would consolidate major environmental testing at SNL/NM and, infrequently conduct operations requiring Category I/II SNM in security campaign mode there. NNSA would close LANL's and LLNL's major environmental testing facilities by 2010 (except those in LLNL Building 334 and the Building 834 Complex). NNSA would move environmental testing of nuclear explosive packages and other functions currently performed in LLNL Buildings 334 and 834 to Pantex by 2012.

Sandia National Laboratories, California Weapons Support Functions. NNSA would continue operations under the No Action Alternative.

As to any other programmatic and project-specific alternatives not mentioned above, NNSA's preferred alternative at this time is to continue with the No Action Alternatives. Section 5.20 of this Final SPEIS provides a summary of the environmental impacts of the preferred alternatives.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
Land Use							
LANL	Current and planned activities would continue as required to accomplish assigned missions. LANL has approximately 2,000 structures with approximately 8.6 million square feet under roof, spread over an area of approximately 25,600 acres.	*Greenfield CPC*: Potential disturbance of 140 acres for construction and 110 acres for operation. *Upgrade*: Potential disturbance of 13 acres for construction and 6.5 acres for operation. *50/80*: Potential disturbance of 6.5 acres for construction and 2.5 acres for operation. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be less than 1% of LANL total land area.	Potential disturbance of 50 acres for construction and 35 acres for operation. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be less than 1% of LANL total land area	Potential disturbance of 300 acres from construction and 300 acres from operation. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be approximately 1.2% of LANL total land area.	195 acres (includes 50 acre buffer area) needed to operate CNC. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be approximately 1% of LANL total land area.	545 acres (includes 100-acre buffer area) needed to operate CNPC. Land uses would remain compatible with surrounding areas and with land use plans. Two non-contiguous TAs would be used for the CNPC. Land required would be approximately 2.3% of LANL total land area. Y-12 and Pantex would close, reducing the size of the Complex by 16,777 acres.	Potential disturbance of 6.5 acres. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be less than 1% of LANL total land area.
NTS	Current and planned activities would continue as required to accomplish assigned missions. Approximately 45 percent of NTS is currently unused or provides buffer zones for ongoing programs or projects, while about 7-10 percent (60,000 – 86,500 acres) of the site has been disturbed.	Potential disturbance of 140 acres for construction and 110 acres for operation. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be less than 1% of NTS total land area.	Potential disturbance of 50 acres for construction and 35 acres for operation. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be less than 1% of NTS total land area.	Because NTS would use existing capabilities at the DAF, potential land disturbance for construction and operation would be approximately 200 acres. Land required would be less than 1% of NTS total land area.	195 acres (includes 50-acre buffer area) needed to operate CNC. Land uses would remain compatible with surrounding areas and with land use plans.	445 acres (includes 100-acre buffer area) needed to operate CNPC. Land uses would remain compatible with surrounding areas and with land use plans. Y-12 and Pantex would close, reducing the size of the Complex by 16,777 acres.	NTS would be unaffected by the Capability Based Alternative.
Pantex	Preferred Alternative**:** Current and planned activities would continue on the 15,977- acre site as required to accomplish assigned missions. No new land disturbance expected.	Potential disturbance of 140 acres for construction and 110 acres for operation. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be less than 1% of Pantex total land area.	Potential disturbance of 50 acres for construction and 35 acres for operation. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be less than 1% of Pantex total land area.	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	545 acres (includes 100-acre buffer area) needed to operate CNPC. Land uses would remain compatible with surrounding areas and with land use plans. Y-12 would close, reducing the size of the Complex by approximately 800 acres.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
SRS	Current and planned activities would continue on the 198,420-acre site as required to accomplish assigned missions. Approximately 77 acres of additional land would be disturbed by construction of the Mixed-Oxide (MOX) Fuel Fabrication Facility which broke ground August 2007 and the Pit Disassembly and Conversion Facility (PDCF) scheduled to break ground in 2010.	Potential disturbance of 140 acres for construction and 110 acres for operation. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be less than 1% of SRS total land area.	Potential disturbance of 50 acres for construction and 35 acres for operation. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be less than 1% of SRS total land area.	Potential disturbance of 300 acres from construction and 300 acres from operation. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be less than 1% of SRS total land area	195 acres (includes 50 acre buffer area) needed to operate CNC. Land uses would remain compatible with surrounding areas and with land use plans.	545 acres (includes 100 acre buffer area) needed to operate CNPC. Land uses would remain compatible with surrounding areas and with land use plans. Y-12 and Pantex would close, reducing the size of the Complex by 16,777 acres.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Y-12	Current and planned activities would continue on the 800-acre site located on the 35,000-acre Oak Ridge Reservation as required to accomplish assigned missions.	Potential disturbance of 140 acres for construction and 110 acres for operation. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be approximately 17.5% of Y-12 total land area	Preferred Alternative**:** UPF could disturb approximately 35 acres for construction and 8 acres for operation at Y-12. Land uses would remain compatible with surrounding areas and with land use plans. UPF would enable protected area to be reduced by 90%.	Potential disturbance of 300 acres for construction and 300 acres for operation. Land uses would remain compatible with surrounding areas and with land use plans. Land required would be approximately 37.5% of Y-12 total land area.	Y-12 performs the CUC mission; therefore the impact of a CNC at this site is identical to the CPC impact.	518 acres (includes 100 acre buffer area) needed to operate CNPC. Land uses would remain compatible with surrounding areas and with land use plans. Pantex would close, reducing the size of the Complex by 15,977 acres.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
	Visual Resources						
LANL	Current and planned activities would continue as required resulting in no additional impacts.	Short-term, temporary visual impacts from construction. New facilities would be visible from higher elevations beyond LANL boundary; however, change would be consistent with currently developed areas. No change to VRM Classification.	Short-term, temporary visual impacts from construction. New facilities would be visible from higher elevations beyond LANL boundary; however, change would be consistent with currently developed areas. No change to VRM Classification.	Short-term, temporary visual impacts from construction. New facilities would be visible from higher elevations beyond LANL boundary; however, change would be consistent with currently developed areas. No change to VRM Classification.	New facilities would be visible from higher elevations beyond LANL boundary; however, change would be consistent with currently developed areas. No change to VRM Classification.	Short-term, temporary visual impacts from construction. New facilities would be visible from higher elevations beyond LANL boundary; however, change would be consistent with currently developed areas. No change to VRM Classification.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
NTS	Current and planned activities would continue as required resulting in no additional impacts.	Short-term, temporary visual impacts from construction. New facilities would not be visible outside of NTS boundary. No change to VRM Classification.	Construction activities would create short-term, temporary visual impacts. No change to VRM Classification.	Short-term, temporary visual impacts from construction. New facilities would not be visible outside of NTS boundary. No change to VRM Classification.	New facilities would not be visible outside of NTS boundary; change would be consistent with currently developed areas. No change to VRM Classification.	Short-term, temporary visual impacts from construction. New facilities would not be visible outside of NTS boundary. No change to VRM Classification.	NTS would be unaffected by the Capability Based Alternative.
Pantex	Current and planned activities	Short-term, temporary visual	Construction activities	No A/D/HE Center is	Pantex performs the	New facilities would be	Planned activities

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
	would continue as required resulting in no additional impacts.	impacts from construction. The reference location is obstructed from off-site view. Changes to visual appearance would be consistent with currently developed areas. No change to VRM Classification.	would create short-term, temporary visual impacts. The reference location is obstructed from off-site view. Changes to visual appearance would be consistent with currently developed areas. No change to VRM Classification.	proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	obstructed from off-site view. Change would be consistent with currently developed areas. No change to VRM Classification.	would continue as required to support smaller stockpile requirements resulting in no additional impacts.
SRS	Current and planned activities would continue with short-term impacts to visual resources resulting from construction of the MOX/PDCF facilities in the F-Area. Changes would be consistent with existing structures of the area and no change to VRM classification would be required.	Short-term, temporary visual impacts from construction. The reference location is obstructed from off-site view. Changes to visual appearance would be consistent with currently developed areas. No change to VRM Classification.	Construction activities would create short-term, temporary visual impacts. The reference location is obstructed from off-site view. Changes to visual appearance would be consistent with currently developed areas. No change to VRM Classification.	Short-term, temporary visual impacts from construction. The reference location is obstructed from off-site view. Changes to visual appearance would be consistent with currently developed areas. No change to VRM Classification.	New facilities would be obstructed from off-site view. Change would be consistent with currently developed areas. No change to VRM Classification.	Short-term, temporary visual impacts from construction. The reference location is obstructed from off-site view. Changes to visual appearance would be consistent with currently developed areas. No change to VRM Classification.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Y-12	Current and planned activities would continue as required resulting in no additional impacts.	Short-term, temporary visual impacts from construction. Changes to visual appearance would be consistent with currently developed areas. No change to VRM Classification.	Changes to visual appearance would be consistent with currently developed areas. No change to VRM Classification.	Short-term, temporary visual impacts from construction. Changes to visual appearance would be consistent with currently developed areas. No change to VRM Classification.	Y-12 performs the CUC mission, therefore the impact of a CNC at this site is identical to the CPC impact.	Short-term, temporary visual impacts from construction. Changes to visual appearance would be consistent with currently developed areas. No change to VRM Classification.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Site Infrastructure							
LANL	Current and planned activities would continue as required resulting in no additional impacts. The current power pool peak power capacity is 150 megawatts-electric [MWe]). The available site capacity is 63 MWe.	Under all approaches, existing infrastructure would be adequate to support construction and operation requirements. Operation of a CPC would have the potential to use approximately 17.5% of the peak power capacity that is available.	Existing infrastructure would be adequate to support construction and operation requirements. Operation of a CUC would have the potential to use approximately 29.2% of the peak power capacity that is available.	Operation of A/D/HE Center would have the potential to use approximately 18.9% of the peak power capacity that is available.	Operation of a CNC would have the potential to use approximately 45.1% of the peak power capacity that is available.	Operation of a CNPC would have the potential to use approximately 65.6% of the peak power capacity that is available.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
NTS	Current and planned activities would continue as required resulting in no additional impacts. NTS would be expected to continue using	Existing infrastructure would be adequate to support construction and operation requirements. Power requirements would be 64%	Existing infrastructure would be adequate to support construct requirements. Power requirements would be	Existing infrastructure would be adequate to support construction. . Power requirements would be 69% of	Power requirements would be 288% of available site electrical energy capacity. For operations, NTS would need to procure additional	Power requirements would be 357% of available site electrical energy capacity. For operations, NTS would need to procure additional	NTS would be unaffected by the Capability Based Alternative.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
	101,377 MWh of electricity per year. Electrical usage is below current site capacity.	of available site electrical energy capacity.	224% of available site electrical energy capacity. For operations, NTS would need to procure additional power.	available site electrical energy capacity.	power.	power.	
Pantex	Current and planned activities would continue as required resulting in no additional impacts to site infrastructure. Pantex would be expected to continue using about 81,850 MWh of electricity per year.	Existing infrastructure would be adequate to support construction and operation requirements. Power requirements would be 40% of available site electrical capacity.	Existing infrastructure would be adequate to support construction requirements. During operations, power requirements would be 140% of available site electrical energy capacity. To support a CUC, Pantex would have to procure additional power.	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	During operations, power requirements would be 148% of available site electrical energy capacity. To support a CNPC, Pantex would have to procure additional power.	Planned activities would continue as required to support smaller stockpile requirements. Infrastructure needs would be reduced.
SRS	Current and planned activities would continue, with the increased electrical usage from the MOX/PDCF facilities for a electrical use of 405,000 MWh/yr (370,000 MWh/yr existing plus 35,000 MWh/yr for the MOX/PDCF facilities)	Existing infrastructure would be adequate to support construction and operation requirements. Construction and operation requirements would have a negligible impact on current site infrastructure.	Existing infrastructure would be adequate to support construction requirements. Construction and operation requirements would have a negligible impact on current site infrastructure.	Existing infrastructure would be adequate to support construction requirements. Construction and operation requirements would have a negligible impact on current site infrastructure.	Existing infrastructure would be adequate to support operation requirements. Operation would require 15% of available electrical site capacity. Operation requirements would have a negligible impact on current site infrastructure.	Existing infrastructure would be adequate to support construction requirements. Operation requirements would have a negligible impact on current site infrastructure.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Y-12	Current and planned activities would continue as required resulting in no additional impacts to site infrastructure. Y-12 would be expected to continue using about 350,000 MWh of electricity per year.	Existing infrastructure would be adequate to support construction and operation requirements. During operations, power requirements would be <1% of available site electrical capacity.	Existing infrastructure would be adequate to support construction and operation requirements. During operations, power requirements would be <1% of available site electrical capacity.	Existing infrastructure would be adequate to support construction requirements. During operations, power requirements would be 1.5% of available site electrical capacity.	By definition, there is no CNC at Y-12.	Existing infrastructure would be adequate to support operation requirements. During operations, power requirements would be 7.1% of available site electrical capacity.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
	Air Quality						
LANL	Current and planned activities would continue as required resulting in no additional impacts. The area encompassing LANL and Los Alamos County is classified as an attainment area for all six criteria pollutants. Simultaneous operation of LANL's air emission sources	Construction activities would create temporary increase in air quality impacts, but would not result in violations of the National Ambient Air Quality Standards (NAAQS). Operations would result in incremental increases less than 5% of baseline for most	Construction activities would create temporary increased in air quality impacts similar to CPC. For operations, CUC contribution to nonradiological emissions would not cause any standard or guideline to be exceeded.	Construction activities would create temporary increase in air quality impacts that could result in exceeding PM_{10} regulatory limits. Operations could have the potential to exceed the 24-hour standard for nitrogen	Operations would result in incremental increases less than 5% of baseline for most pollutants. The greatest increase would occur for total suspended particulates (TSP), which could increase by approximately 28%.	Operations could have the potential to exceed the 24-hour standard for nitrogen dioxide and the 24-hour standard for TSP.	The higher level of pit production would result in the annual emission of an additional 0.000019 curies per year of plutonium from the Plutonium Facility Complex.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
	at maximum capacity, as described in the Title V permit application, would not exceed any state or Federal ambient air quality standards.	pollutants. The greatest increase would occur for total suspended particulates (TSP), which could increase by approximately 28%.		dioxide and the 24-hour standard for TSP.			
NTS	Current and planned activities would continue as required resulting in no additional impacts. No emission limits for any criteria air pollutants or HAPS have been exceeded. Measured concentration of nonradiological criteria pollutants are below regulatory requirements. The estimated annual dose to the public from radiological emissions from current and past NTS activities is well below the 10 millirem per year dose limit.	Negligible impacts to air quality for construction and operation. No NAAQS exceeded.	Negligible impacts to air quality for construction and operation. No NAAQS exceeded.	Negligible impacts to air quality for construction and operation. No NAAQS exceeded.	Negligible impacts to air quality for construction and operation. No NAAQS exceeded.	Negligible impacts to air quality for construction and operation. No NAAQS exceeded.	NTS would be unaffected by the Capability Based Alternative.
Pantex	Current and planned activities would continue as required resulting in no additional impacts. Pantex is in compliance with all National Ambient Air Quality standards.	Negligible impacts to air quality for construction and operation. No NAAQS exceeded.	Negligible impacts to air quality for construction and operation. No NAAQS exceeded.	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	Negligible impacts to air quality for construction and operation. No NAAQS exceeded.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
SRS	Emissions from current and planned MOX/PDCF facilities would result in no additional impacts. SRS is in compliance with all National Ambient Air Quality standards.	Negligible impacts to air quality for construction and operation. No NAAQS exceeded.	Negligible impacts to air quality for construction and operation. No NAAQS exceeded.	Negligible impacts to air quality for construction and operation. No NAAQS exceeded.	Negligible impacts to air quality for operations. No NAAQS exceeded.	Negligible impacts to air quality for operations. No NAAQS exceeded.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Y-12	Current and planned activities would continue, resulting in no additional impacts. Y-12 is designated non-attainment area for 8-hour ozone and is in compliance with all other National Ambient Air Quality standards.	Temporary increases in pollutant emissions due to construction activities are too small to result in violations of the NAAQS beyond the Y-12 site boundary, with the exception of PM-2.5 and PM-10 concentrations (which could be mitigated using dust suppression), and the 8-hour	Temporary increases in pollutant emissions due to construction activities are too small to result in violations of the NAAQS beyond the Y-12 site boundary, with the exception of PM-2.5 and PM-10 concentrations (which could be mitigated	Temporary increases in pollutant emissions due to construction activities are too small to result in violations of the NAAQS beyond the Y-12 site boundary, with the exception of PM-2.5 and PM-10 concentrations (which could be mitigated	Y-12 performs the CUC mission, therefore the impact of a CNC at this site is identical to the CPC plus UPF impact.	Potential to exceed PM-10 and ozone levels due to high background levels.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
		ozone concentration. The 8-hour ozone concentration exceedance is not a result of Y-12-specific activities. No new hazardous air emissions would result from the facility operation. Additionally, 90 percent of emissions at Y-12 are from operation of the steam plant, which would be relatively unaffected by CPC operations.	using dust suppression), and the 8-hour ozone concentration. The 8-hour ozone concentration exceedance is not a result of Y-12-specific activities. No new hazardous air emissions would result from the facility operation. Additionally, 90 percent of emissions at Y-12 are from operation of the steam plant, which would be relatively unaffected by UPF operations.	using dust suppression), and the 8-hour ozone concentration. The 8-hour ozone concentration exceedance is not a result of Y-12-specific activities. No new hazardous air emissions would result from the facility operation. Additionally, 90 percent of emissions at Y-12 are from operation of the steam plant, which would be relatively unaffected by A/D/HE Center operations.			
	Noise						
LANL	Current and planned activities would continue as required resulting in no additional impacts.	Construction activities and additional traffic would generate temporary increases in noise, but would not extend far beyond the boundaries of the construction site. Noise from operations similar to existing operations.	Same as CPC.	Same as CPC.	Same as CPC.	Same as CPC.	Same as No Action Alternative.
NTS	Current and planned activities would continue as required resulting in no additional impacts.	Construction activities and additional traffic would generate temporary increases in noise, but would not extend far beyond the boundaries of the construction site. Noise from operations similar to existing operations.	Same as CPC.	Same as CPC.	Same as CPC.	Same as CPC.	NTS would be unaffected by the Capability Based Alternative.
Pantex	Current and planned activities would continue as required resulting in no additional impacts.	Construction activities and additional traffic would generate temporary increases in noise, but would not extend far beyond the boundaries of the construction site. Noise from operations similar to existing operations.	Same as CPC.	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	Same as CPC.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
SRS	Construction of the MOX/PDCF facilities and additional traffic supporting this construction would	Construction activities and additional traffic would generate temporary increases in noise, but would not extend	Same as CPC.	Same as CPC.	Same as CPC.	Same as CPC.	Planned activities would continue as required to support smaller stockpile

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
	temporarily generate additional noise impacts. Construction noise not expected off-site.	far beyond the boundaries of the construction site. Noise from operations similar to existing operations.					requirements resulting in no additional impacts.
Y-12	Current and planned activities would continue, with traffic as the primary contributor to noise to the surrounding population, and no additional impacts expected.	Construction activities and additional traffic would generate temporary increases in noise, but would not extend far beyond the boundaries of the construction site. Noise from operations similar to existing operations.	Same as CPC.	Same as CPC.	Y-12 performs the CUC mission, therefore the impact of a CNC at this site is identical to the CPC impact.	Same as CPC.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Water Resources							
LANL	Current and planned activities would continue as required resulting in no additional impacts. Approximately 380 million gallons of groundwater are used at LANL. Discharges were in compliance with discharge permits.	For construction and operation of the Greenfield CPC, annual groundwater use would increase by approximately 21%. However, LANL water use would remain within water rights.	For construction and operation, the increase in groundwater consumption would be approximately 27.6%. LANL water use would remain within water rights.	For construction and operation, annual groundwater use would increase by approximately 34.2%. LANL water use would be within water rights.	Annual groundwater use would increase by approximately 48.6%. LANL groundwater use would exceed water rights by approximately 23 million gallons/year.	Annual groundwater use would increase by approximately 104%. LANL groundwater use would exceed water rights by approximately 233 million gallons/year.	Same a No Action Alternative.
NTS	Current and planned activities would continue with an expected demand for groundwater of 634 million gallons per year. The annual maximum production capacity of site potable supply wells is approximately 2.1 billion gallons per year while the sustainable site capacity is estimated to be approximately 1.36 billion gallons per year	For construction and operation, annual groundwater use would require approximately 7% of sustainable site water capacity. No impact on groundwater availability or quality is anticipated.	For construction and operation, annual groundwater use would require less than 8% of sustainable water capacity. No impact on groundwater availability or quality is anticipated.	For construction and operation, annual groundwater use would require approximately 10% of sustainable water capacity. No impact on groundwater availability or quality is anticipated.	Operation of the CNC would use approximately 14.2% of the sustainable site water capacity. No impact on groundwater availability or quality is anticipated.	Operation of the CNPC would use approximately 23.7% of the sustainable site water capacity. No impact on groundwater availability or quality is anticipated.	NTS would be unaffected by the Capability Based Alternative.
Pantex	Current and planned activities would continue as required with an expected demand for water of 130,000 million gallons per year. Pantex obtains its water from the City of Amarillo, which obtains water from the	For construction and operation, annual groundwater use would increase by 68% compared to existing use. No impact on groundwater availability or quality is anticipated from construction activities.	For construction and operation, annual groundwater use would increase by approximately 81% compared to existing use. No impact on groundwater availability or quality is anticipated from	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	CNPC operations would increase groundwater use by approximately 150% compared to existing use. CNPC would require total of approximately 315.5 million gallons/year. The Pantex wellfield has a	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
	Ogallala aquifer.	Pantex's total contribution to the depletion of the Ogallala Aquifer from operation of the CPC would be approximately 0.0003 percent of the estimated annual total depletion.	construction activities. Pantex's total contribution to the depletion of the Ogallala Aquifer from operation of the CUC would be approximately 0.0004 percent of the estimated annual total depletion.			water capacity of approximately 422.7 million gallons/ year. Pantex's total contribution to the depletion of the Ogallala Aquifer from operation of the CNPC would be less than 1 percent of the estimated annual total depletion.	
SRS	Current and planned activities would continue as required with an expected demand for water (groundwater and surface water) of 3.5 billion gallons/yr plus a small increase for the operation of the MOX/PDCF facilities.	For construction and operation, annual water use would increase by approximately 2% compared to existing use.	For construction and operation, annual water use by 3% compared to existing use.	For construction and operation, annual water use would increase by approximately 4% compared to existing use.	Operation of CNC would increase water use by approximately 5% compared to existing use.	Operation of CNPC would increase water use by 9% compared to existing use.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Y-12	Current and planned activities would continue as required with an expected demand for water of approximately 2,000 million gallons per year.	For construction and operation, annual water use would increase by approximately 4% compared to existing use.	For construction and operation, annual water use would increase by approximately 5% compared to existing use.	For construction and operation, annual water use would increase by approximately 7% compared to existing use.	Y-12 performs the CUC mission, therefore the impact of a CNC at this site is identical to the CPC impact.	Operation of CNPC would increase water use by approximately 20% compared to existing use.	Planned activities would continue as required to support smaller stockpile requirements.
	Geology and Soils						
LANL	Current and planned activities would continue as required resulting in no additional impacts.	Under all approaches impacts would be minor. Appropriate mitigation measures would minimize soil erosion and impacts. All facilities would be designed and constructed in accordance with DOE Order 420.1.	Same as CPC.	Same as CPC.	Same as CPC.	Same as CPC.	Same a No Action Alternative.
NTS	Current and planned activities would continue as required resulting in no additional impacts.	Impacts would be minor. Appropriate mitigation measures would minimize soil erosion and impacts.	Same as CPC.	Same as CPC.	Same as CPC.	Same as CPC.	NTS would be unaffected by the Capability Based Alternative.
Pantex	Current and planned activities would continue as required with no expected impacts on the Pullman and Randall soil series, or other geological and soil resources.	Impacts would be minor. Appropriate mitigation measures would minimize soil erosion and impacts.	Same as CPC.	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	Same as CPC.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
SRS	Construction of the MOX/PDCF facilities would have minor impacts to the Coastal Plain sediments and other soil resources, but would be small and mitigated by erosion and runoff controls.	Impacts would be minor. Appropriate mitigation measures would minimize soil erosion and impacts.	Same as CPC.	Same as CPC.	Same as CPC.	Same as CPC.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Y-12	Current and planned activities would continue as required with no expected impacts to soils in an area highly prone to erosion.	Impacts would be minor. There is a moderate seismic risk at Y-12, but this should not impact the construction and operation of the CPC and UPF. Appropriate mitigation measures would minimize soil erosion and impacts.	Same as CPC.	Same as CPC.	Y-12 performs the CUC mission, therefore the impact of a CNC at this site is identical to the CPC impact.	Same as CPC.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Biological Resources							
LANL	Current and planned activities would continue as required resulting in no additional impacts.	TA-55 contains core and buffer areas of environmental interest for the Mexican Spotted Owl. Potential impacts would be within previously and substantially developed areas.	TA-55 contains core and buffer areas of environmental interest for the Mexican Spotted Owl. Potential impacts would be within previously and substantially developed areas.	Potential impacts at TA-16 would be within previously and substantially developed areas.	Potential impacts would be within previously and substantially developed areas.	Same as CNC.	Same a No Action Alternative.
NTS	Current and planned activities would continue as required resulting in no additional impacts.	Construction would not impact biological resources because new facilities would be sited on previously disturbed land. Operations would not impact biological resources because activities would be located in previously disturbed or heavily industrialized portions that do not contain habitat sufficient to support biologically diverse species mix.	Construction would not impact biological resources because new facilities would be sited on previously disturbed land.	Same as CUC.	Reference location is in highly developed area, impacts would be minimal.	Same as CNC.	NTS would be unaffected by the Capability Based Alternative.
Pantex	Current and planned activities would continue as required resulting in no additional impacts.	Construction would not impact biological resources because new facilities would be sited on previously disturbed land.	Construction would not impact biological resources because new facilities would be sited on previously disturbed land.	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC	Reference location is in highly developed area, impacts would be minimal.	Planned activities would continue as required to support smaller stockpile requirements

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
		Operations would not impact biological resources because activities would be located in previously disturbed or heavily industrialized portions that do not contain habitat sufficient to support biologically diverse species mix.			Operation in next column.		resulting in no additional impacts.
SRS	Some animals and birds could be temporarily displaced by construction of the MAX/PDCF facilities, but this would be small due to the areas existing partial development.	Construction would not impact biological resources because new facilities would be sited on previously disturbed land. Operations would not impact biological resources because activities would be located in previously disturbed or heavily industrialized portions that do not contain habitat sufficient to support biologically diverse species mix.	Construction would not impact biological resources because new facilities would be sited on previously disturbed land.	Same as CUC.	Operations would not impact biological resources because activities would be located in previously disturbed or heavily industrialized portions that do not contain habitat sufficient to support biological diverse species mix.	Same as CNC.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Y-12	Current and planned activities would continue as required resulting in no additional impacts.	Short-term impacts could occur during construction activities. Facilities would be sited on previously disturbed land. Operations would not impact biological resources because activities would be located in previously disturbed or heavily industrialized portions that do not contain habitat sufficient to support biologically diverse species mix.	Same as CPC.	Short-term impacts could occur during construction activities. Facilities would be sited on previously disturbed land.	Y-12 performs the CUC mission, therefore the impact of a CNC at this site is identical to the CPC impact.	Reference location is in highly developed and previously disturbed area, therefore there would be no impacts to biological resources.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
	Cultural Resources						
LANL	Current and planned activities would continue as required resulting in no additional impacts.	Under all approaches there is a potential for resources to be disturbed. The number of resources impacted would increase as the number of acres disturbed increases.	Under all approaches there is a potential for resources to be disturbed. The number of resources impacted would increase as the number of acres	Same as CUC.	No impacts are anticipated from operation activities.	Same as CNC.	Same a No Action Alternative.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
			disturbed increases.				
NTS	Current and planned activities would continue as required resulting in no additional impacts.	There is a low probability of impacts to cultural resources to occur.	There is a low probability of impacts to cultural resources to occur.	Same as CUC.	No impacts to cultural resources are anticipated from operation activities.	Same as CNC.	NTS would be unaffected by the Capability Based Alternative.
Pantex	Current and planned activities would continue with no expected impacts on the 69 identified archeological sites located on the Pantex site.	No cultural resources would be impacted. Probabilities for impacts at other areas on the site would depend on the locations since some area on the site can exhibit a higher density of cultural resources. There would be no impacts from operation activities.	No cultural resources would be impacted. Probabilities for impacts at other areas on the site would depend on the locations since some area on the site can exhibit a higher density of cultural resources.	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	There would be no impacts from operation activities.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
SRS	Construction of the MOX/PDCF facilities is not expected to impact any of the approximately 800 recorded archeological and culturally significant sites at SRS. Prior to any soil disturbance a registry search and on-site inspection would take place.	The reference location is located in an Archaeological Zone 2 (area with moderate archaeological potential) and close to a Zone 1 (high archaeological potential) area. Therefore there is a high probability that resources are located w/in the reference location and would be impacted by construction activities. There would be no additional impacts from operation activities.	The reference location is located in an Archaeological Zone 2 (area with moderate archaeological potential) and close to a Zone 1 (high archaeological potential) area. Therefore there is a high probability that resources are located w/in the reference location and would be impacted by construction activities.	Same as CUC.	There would be no impacts to cultural and archaeological resources from operation activities.	Same as CNC.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Y-12	Current and planned activities would continue with no impacts to an area rich in historical and cultural resources and no identified Native American resources.	Construction of the CPC and UPF would be compatible and consistent with the current status of cultural resources and activities would take place in areas outside of the proposed historic district. There would be no impacts as a result of operational activities.	Same as CPC.	Construction of the CPC and UPF would be compatible and consistent with the current status of cultural resources and activities would take place in areas outside of the proposed historic district.	Y-12 performs the CUC mission, therefore the impact of a CNC at this site is identical to the CPC impact.	There would be no impacts as a result of operational activities.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Socioeconomic Resources							
LANL	Current and planned activities would continue as required resulting in no additional impacts. Employment at LANL is expected to continue	*Greenfield CPC:* 770 workers during the peak year of construction. Total of 2,650 jobs. 1,780 operational workers, total of 3,667 jobs	1,300 workers during the peak year of construction. Total of 2,678 jobs. No appreciable changes to regional socioeconomic	3,820 jobs during peak year of construction. Total 7,869 jobs. No appreciable changes to regional socioeconomic	2,715 operational workers. No appreciable changes to regional socioeconomic characteristics expected.	4,500 operational workers. No appreciable changes to regional socioeconomic characteristics expected.	Employment at LANL is expected to continue to rise due to increased pit production.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
	to rise due to both increased pit production and increased remediation and D&D activities. If LANL's employment rate were to continue increasing at the same level experienced from 1996 through 2005 (2.2 percent annually), approximately 15,400 individuals could be employed at LANL by the end of 2011.	*Upgrade 125:* 300 workers during peak year of construction. Total of 618 jobs. 1,780 operational workers, total of 3,667 jobs. *50/80:* 190 workers during peak year of construction. Total of 391 jobs 680 operational workers, total of 1,401 jobs. Under all approaches there would be no appreciable changes to regional socioeconomic characteristics expected.	characteristics expected.	characteristics expected.		Pantex and Y-12 could be closed, resulting in a loss of approximately 8,150 jobs.	
LANL Plutonium Phaseout: If LANL is not selected as the site for the CPC or CNPC, NNSA proposes to phase-out NNSA plutonium operations and remove Category I/II SNM from LANL by approximately 2022. Phasing out the plutonium operations from TA-55 would result in a loss of approximately 610 jobs representing a decrease of 4.5 % of the workforce. The total loss of jobs in the economic area would be 1,260.							
NTS	Current level of NTS employment is expected to continue. Current and planned activities would continue as required resulting in no additional impacts.	850 workers during the peak year of construction. Total of 1,676 jobs. 1,780 operational workers. No appreciable changes to regional socioeconomic characteristics expected.	1,300 workers during the peak year of construction. Total of 2,563 jobs. 935 operational workers. No appreciable changes to regional socioeconomic characteristics expected.	525 jobs during peak year of construction. Total 1,560 jobs. 1,285 operational workers. No appreciable changes to regional socioeconomic characteristics expected.	2,715 operational workers. No appreciable changes to regional socioeconomic characteristics expected.	4,500 operational workers. No appreciable changes to regional socioeconomic characteristics expected. Pantex and Y-12 could be closed, resulting in a loss of approximately 8,150 jobs.	NTS would be unaffected by the Capability Based Alternative.
Pantex	Pantex is expected to continue present operations with an employment level of about 3,800 employees.	850 workers during the peak year of construction. Total of 1,527 jobs. 1,780 operational workers. No appreciable changes to regional socioeconomic characteristics expected.	1,300 workers during the peak year of construction. Total of 2,336 jobs. 935 operational workers. No appreciable changes to regional socioeconomic characteristics expected.	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	2,715 operational workers. Total of 5,319 jobs. No appreciable changes to regional socioeconomic characteristics expected. Y-12 could be closed, resulting in a loss of approximately 6,500 jobs.	Reduced operations would reduce the workforce from 1,644 to 1,230. This workforce, which currently represents approximately 1.3% of area employment, would fall to 1.2%. No major impact would occur.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
SRS	The current level of employment at SRS is about 15,000, which is expected to be increased by the construction of the MOX/PDCF facilities which would add an additional 1,968 construction workers and once operational an additional 1,120 employees.	850 workers during the peak year of construction. Total of 1,461 jobs. 1,780 operational workers. No appreciable changes to regional socioeconomic characteristics expected.	1,300 workers during the peak year of construction. Total of 2,234 jobs. 935 operational workers. No appreciable changes to regional socioeconomic characteristics expected.	3,820 workers during the peak year of construction. Total of 6,561 jobs. 1,785 operational workers. No appreciable changes to regional socioeconomic characteristics expected.	2,715 operational workers. No appreciable changes to regional socioeconomic characteristics expected	4,165 operational workers. No appreciable changes to regional socioeconomic characteristics expected. Pantex and Y-12 could be closed, resulting in a loss of approximately 8,150 jobs.	Reduced operations would reduce the workforce by approximately 25 workers. This reduction would be inconsequential relative to the total site workforce.
Y-12	Y-12 is expected to continue present operations with an employment level of about 6,500 employees.	850 workers during the peak year of CPC construction. During operations, CPC would employ 1,780. No appreciable changes to regional socioeconomic characteristics expected.	Construction of UPF would require approximately 900 workers during the peak year of construction During operations, UPF would employ 600. No appreciable changes to regional socioeconomic characteristics expected.	3,820 workers during the peak year of construction. Total of 19,864 jobs. 1,285 operational workers. No appreciable changes to regional socioeconomic characteristics expected.	Y-12 performs the CUC mission, therefore the impact of a CNC at this site is identical to the CPC impact.	4,500 operational workers. No appreciable changes to regional socioeconomic characteristics expected. Pantex could be closed, resulting in a loss of approximately 1,650 jobs.	Reduced operations would reduce the workforce from 6,500 to 3,900 workers. The loss of 2,600 direct jobs could result in the loss of up to 10,920 indirect jobs for a total of 13,520 jobs lost. This would represent 6.5 percent of the total ROI employment.
Environmental Justice							
LANL	Current and planned activities would continue as required resulting in no additional impacts.	Minority population: 57 percent within the census tracts containing LANL Low-Income population: 9.3 percent of ROI Construction or operation activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Construction or operation activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Same as CUC.	Operation activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Same as CNC.	Same a No Action Alternative.
NTS	Current and planned activities would continue as required resulting in no additional impacts.	Minority population: 50 percent of ROI Low-Income population: 11 percent of ROI Construction or operation activities would not result in any disproportionately high or adverse effects on minority or	Construction activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Same as CUC.	Operation activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Same as CNC.	NTS would be unaffected by the Capability Based Alternative.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
		low-income populations.					
Pantex	Current and planned activities would continue resulting in no disproportionate impacts to the 21% minority population or the 44,312 individuals living near the Pantex Plant identified as living below the Federal poverty level.	Minority population: 30.1 percent of ROI Low-Income population: 14 percent of ROI Construction or operation activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Construction activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	Operation activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
SRS	Current activities and the construction and operation of the MOX/PDCF facilities are not expected to disproportionately impact the minority groups or 109,296 identified as living below the Federal poverty threshold living near SRS.	Minority population: 40.1 percent of ROI Low-Income population: 9 percent of ROI Construction or operation activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Construction activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Same as CUC.	Operation activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Same as CNC.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
Y-12	Current and planned activities would continue resulting in no disproportionate impacts to the 7 % minority population or the 122,216 individuals living near Y-12 identified as living below the Federal poverty level.	Minority population: 11.1 percent of ROI Low-Income population: 12 percent of ROI Construction and operation activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Same as CPC.	Construction activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Y-12 performs the CUC mission, therefore the impact of a CNC at this site is identical to the CPC impact.	Operation activities would not result in any disproportionately high or adverse effects on minority or low-income populations.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
	Health and Safety						
LANL	Current and planned activities would continue as required resulting in no additional impacts. SRS operations expected to cause total dose to the offsite MEI of 1.7 mrem/yr. Worker dose from pit production at TA-55 would be approximately 90 person-rem per year.	*Greenfield CPC:* Potential worker fatalities during construction: 0.6 *Upgrade:* 0.2 *50/80:* 0.1 *Greenfield CPC and Upgrade:* Collective dose to population during operations: 6.0×10^{-4} person-rem; 4×10^{-7} latent cancer fatalities (LCFs)	Potential worker fatalities during construction: 0.9. Collective dose to population during operations: 0.23 person-rem; 1×10^{-4} LCFs annually MEI dose: 0.077 mrem; 5×10^{-5} LCFs annually	Potential fatalities during construction: 2.6. Collective dose to population during operations: 1.3×10^{-4} person-rem; 7.8×10^{-8} LCFs annually MEI dose: 5.8×10^{-5} mrem; 3.5×10^{-11} LCFs annually	Collective dose to population during operations: 0.23 person-rem; 1×10^{-4} LCFs annually MEI dose: 0.077 mrem; 5×10^{-5} LCFs annually Worker dose: 344 person-rem; 0.21 LCFs annually.	Collective dose to population during operations: 0.23 person-rem; 1×10^{-4} LCFs annually MEI dose: 0.077 mrem; 5×10^{-5} LCFs annually Worker dose: 386 person-rem; 0.23 LCFs annually.	Collective dose to population during operations: 2.5×10^{-8} person-rem ; 1×10^{-11} LCFs. Worker dose from increased pit production at TA-55 would increase from 90 person-rem per year to 220

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
		MEI dose: 1.5 × 10^{-4} mrem; 9×10^{-11} LCFs annually. Worker dose: 333 person-rem; 0.20 LCFs annually. *50/80:* Collective dose to population during operations: 3.2×10^{-5} person-rem; 2 × 10^{-8} LCFs MEI dose: 7.7 × 10^{-6} mrem; 5 × 10^{-12} LCFs annually Worker dose: 154 person-rem; 0.09 LCFs annually.	Worker dose: 11 person-rem; 0.006 LCFs annually.	A/D/HE Center worker dose: 42 person-rem; 0.24 LCFs annually.			person-rem per year
LANL Plutonium Phaseout: If LANL is not selected as the site for the CPC or CNPC, NNSA proposes to phase-out NNSA plutonium operations and remove Category I/II SNM from LANL by approximately 2022. Phasing out the plutonium operations from TA-55 would result in a decrease in the potential health impacts to LANL employees and the population surrounding LANL. Radiation doses to workers would be expected to decrease by approximately 220 person-rem. Plutonium emissions would decrease by approximately 0.00084 Curies.							
NTS	Current and planned activities would continue as required resulting in no additional impacts. NTS operations expected to produce MEI dose of approximately 0.2 mrem/yr.	Potential worker fatalities during construction: 0.7. Collective dose to population during operations: 2.4 × 10^{-5} person-rem; 1×10^{-8} LCFs. MEI dose: 1.1 × 10^{-5} mrem; 6×10^{-12} LCFs annually. Worker dose: 333 person-rem; 0.20 LCFs annually.	Potential worker fatalities during construction: 0.9. Collective dose to population during operations: 9.5×10^{-3}person-rem; 6×10^{-6}LCFs. MEI dose: 4.1×10^{-3}mrem; 2×10^{-9} LCFs annually. Worker dose: 11 person-rem; 0.006 LCFs annually.	Potential worker fatalities during construction: 0.2. Collective dose to population during operations: 7.3×10^{-6} person-rem; 4.0×10^{-9} LCFs annually MEI dose: 3.1×10^{-6}mrem; 1.9 ×10^{-12} LCFs annually Worker dose: 42 person-rem; 0.24 LCFs annually.	Collective dose to population during operations: 9.5×10^{-3}person-rem; 6×10^{-6}LCFs. MEI dose: 4.1×10^{-3}mrem; 2×10^{-9} LCFs annually Worker dose: 344 person-rem; 0.21 LCFs annually.	Collective dose to population during operations: 9.5×10^{-3}person-rem; 6×10^{-6}LCFs. MEI dose: 4.1×10^{-3}mrem; 2×10^{-9} LCFs annually Worker dose: 386 person-rem; 0.23 LCFs annually.	NTS would be unaffected by the Capability-Based Alternative.
Pantex	Current and planned activities would result in a dose to the MEI of 4.28 x 10 $^{-9}$ person-rem per year.	Potential worker fatalities during construction: 0.7. Collective dose to population during operations: 8.1×10^{-5} person-rem; 5×10^{-8} LCFs. MEI dose: 4.1×10^{-5} mrem;	Potential worker fatalities during construction: 0.9 Collective dose to population during operations: 0.033 person-rem; 2×10^{-5} LCFs.	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	Collective dose to population during operations: 0.033 person-rem; 2×10^{-5} LCFs. MEI dose: 0.016 mrem; 1×10^{-8} LCFs annually.	Reduced operations would reduce the number of workers involved in radiological operations from approximately 334 to 250. Total

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
		2×10^{-11} LCFs annually. Worker dose: 333 person-rem; 0.20 LCFs annually.	MEI dose: 0.016 mrem; 1×10^{-8} LCFs annually. Worker dose: 11 person-rem; 0.006 LCFs annually.			Worker dose: 386 person-rem; 0.23 LCFs annually.	worker dose reduced from 44.1 person-rem to 33 person-rem. Statistically, LCFs would be reduced from 2.6×10^{-2} to 2.0×10^{-2}.
SRS	Current dose to the MEI from SRS operations is approximately 0.05 mrem/yr. Operation of the MOX/PDCF facilities is expected to add less than 1.8 person-rem to the 50 mile population surrounding SRS.	Potential worker fatalities during construction: 0.7. Collective dose to population during operations: 1.5×10^{-4} person-rem; 9×10^{-7} LCFs. MEI dose: 2.0×10^{-6}mrem; 1×10^{-12} LCFs annually Worker dose: 333 person-rem; 0.20 LCFs annually.	Potential worker fatalities during construction: 0.9. Collective dose to population during operations: 0.06 person-rem; 4×10^{-5} LCFs. MEI dose: 8.2×10^{-4} mrem; 5×10^{-10} LCFs annually. Worker dose: 11 person-rem; 0.006 LCFs annually.	Potential worker fatalities during construction: 2.6. Collective dose to population during operations: 4.5×10^{-5} person-rem; 2.7×10^{-8} LCFs. MEI dose: 6.2×10^{-7} mrem; 3.7×10^{-12} LCFs annually. Worker dose: 42 person-rem; 0.24 LCFs annually.	Collective dose to population during operations: 0.06 person-rem; 4×10^{-5} LCFs. MEI dose: 8.2×10^{-4} mrem; 5×10^{-10} LCFs annually Worker dose: 344 person-rem; 0.21 LCFs annually	Collective dose to population during operations: 0.06 person-rem; 4×10^{-5} LCFs. MEI dose: 8.2×10^{-4} mrem; 5×10^{-10} LCFs annually Worker dose: 386 person-rem; 0.23 LCFs annually.	Reduced tritium operations would reduce the total tritium worker dose from 4.1 person-rem to 3.1 person-rem. Statistically, the number of LCFs would be reduced from 2.5×10^{-3} to 1.9×10^{-3}.
Y-12	Current and planned activities are expected to result in a dose to the MEI of about 0.4 mrem/yr.	Potential worker fatalities during construction of CPC: 0.6 Collective dose to population during CPC operations: 3.2×10^{-3} person-rem; 2×10^{-6} LCFs. MEI dose: 4.5×10^{-4} mrem; 3×10^{-10} LCFs annually. Worker dose: 333 person-rem; 0.20 LCFs annually.	Potential worker fatalities during construction of UPF: 0.7. Collective dose to population during UPF operations: 1.2 person-rem; 7×10^{-4}LCFs. MEI dose: 0.2 mrem; 1×10^{-7} LCFs annually. UPF worker dose: 12.6 person-rem; 0.008 LCFs annually.	Potential worker fatalities during construction: 0.2. Collective dose to population during A/D/HE Center operations: 9.2×10^{-4} person-rem; 6×10^{-7} LCFs. MEI dose: 1.3×10^{-4}mrem; 8×10^{-10} LCFs annually Worker dose: 42 person-rem; 0.24 LCFs annually.	Y-12 performs the CUC mission, therefore the impact of a CNC at this site is identical to the CPC impact.	Collective dose to population during operations: 1.2 person-rem; 7×10^{-4}LCFs. MEI dose: 0.2 mrem; 1×10^{-7} LCFs annually. Worker dose: 386 person-rem; 0.23 LCFs annually.	Reduced operations would reduce the number of workers involved in radiological operation from approximately 839 to 500, reducing the total worker dose from 32. person-rem to 19.1 person-rem. Statistically, the number of LCFs would be reduced from 1.9×10^{-2} to 1.1×10^{-2}.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
Facility Accidents							
LANL	Current and planned activities would continue as required resulting in no additional impacts. Under all alternatives analyzed in the LANL SWEIS, the facility accident with the highest radiological risk to the offsite population would be a lightning strike fire at the Radioassay and Nondestructive Testing Facility located in TA-54. If this accident were to occur, there could be 6 additional LCFs in the offsite population.	Accident with the highest consequences to the offsite population is the beyond evaluation basis earthquake and fire. Approximately 26 LCFs in the offsite population could result from such an accident. Offsite maximally exposed individual (MEI) would receive a dose of 87.5 rem. Statistically, MEI would have 1 chance in 19 of LCF. When probabilities are taken into account, the accident with the highest risk is the explosion in a feed casting furnace. For this accident, the LCF risk to the MEI would be approximately 9×10^{-4}, or approximately 1 in 1,000. For the population, the LCF risk would be 0.19, or approximately 1 in 5.	Accident with the highest consequences to the offsite population is the fire in the EU warehouse. Approximately 0.06 LCFs in the offsite population could result from such an accident. Offsite MEI individual would receive a maximum dose of 0.249 rem. Statistically, the MEI would have 1 chance in 7,000 of LCF. When probabilities are taken into account, the accident with the highest risk is the design-basis fire for HEU storage. For this accident, the maximum LCF risk to the MEI would be approximately $1.6\text{x}10^{-7}$, or less than one in a million. For the population, the LCF risk would be $7.2 \text{ x } 10^{-5}$, or approximately 1 in 10,000.	Accident with the highest consequences to the offsite population is the explosive driven plutonium and tritium dispersal from an internal event Approximately 3 LCFs in the offsite population could result from such an accident. Offsite MEI would receive a dose of 73.8 rem. Statistically, this MEI would have 1 chance in 23 of an LCF. When probabilities are taken into account for this accident, the LCF risk to the MEI would be approximately 9×10^{-6}, or approximately 1 in 100,000. For the population, the LCF risk would be 3×10^{-4}, meaning that an LCF would statistically occur once every 3,000 years in the population.	See CPC and CUC.	See CPC and CUC and A/D/HE.	Same as No Action Alternative.
LANL Plutonium Phaseout: If LANL is not selected as the site for the CPC or CNPC, NNSA proposes to phase-out NNSA plutonium operations and remove Category I/II SNM from LANL by approximately 2022. Phasing out the plutonium operations from TA-55 would result in a decrease in the potential accident impacts to LANL employees and the population surrounding LANL.							
NTS	Current and planned activities would continue as required resulting in no additional impacts. The maximum reasonably foreseeable accident at the NTS would be a non-nuclear explosion involving high explosives in a storage bunker, which has al probability of occurrence of 1 in 10,000,000. The following consequences are estimated if	Accident with the highest consequences to the offsite population is the beyond evaluation basis earthquake and fire. Approximately 0.5 LCFs in the offsite population could result from such an accident. An offsite MEI would receive a dose of approximately 2 rem. Statistically, the MEI would have a 0.001 chance of	Accident with the highest consequences to the offsite population is fire in the EU warehouse. Approximately 0.0008 LCFs in the offsite population could result from such an accident. An offsite MEI would receive a maximum dose of 0.0037 rem. Statistically, the LCF risk to the MEI would be approximately $2\text{x}10^{-6}$, or	Accident with the highest consequences to the offsite population is the explosive driven plutonium and tritium dispersal from an internal event. Approximately 0.06 LCFs in the offsite population could result from such an accident. An offsite MEI would receive a dose of 0.29	See CPC and CUC.	See CPC and CUC and A/D/HE.	NTS would be unaffected by the Capability Based Alternative.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
	such an accident occurs: MEI dose of 34 rem, which would result in a 0.02 probability of an LCF; population dose of 5,800 to 110,000 person-rem, which would result in 3-55 LCFs.	developing a LCF (i.e., about 1 chance in 1,000 of an LCF). When probabilities are taken into account, the accident with the highest risk to the MEI is the explosion in a feed casting furnace. For this accident, the LCF risk to the MEI would be 6×10^{-6}, or approximately 1 in 150,000. For the population, the LCF risk would be approximately 2×10^{-3}, meaning that an LCF would statistically occur once every 400 years in the population.	about 1 in half a million. When probabilities are taken into account, the accident with the highest risk is the design-basis fire for HEU storage. For this accident, the maximum LCF risk to the MEI would be approximately $2x10^{-9}$, or about 1 in half a billion. For the population, the LCF risk would be approximately $9x10^{-7}$, or about 1 in a million.	rem. Statistically, this MEI would have a 2×10^{-4} chance of developing a LCF (i.e., about 1 chance in 57,000 of an LCF). When probabilities are taken into account for this accident, the LCF risk to the MEI would be approximately $2x10^{-8}$, or less than 1 chance in a million. For the population, the LCF risk would be approximately $7x10^{-6}$, or approximately 1 in 150,000.			
Pantex	Current and planned activities would continue as required resulting in no additional impacts. Potential accident scenarios and impacts for the No Action Alternative would be the same as presented in the A/D/HE facility column.	Accident with the highest consequences to the offsite population is the beyond evaluation basis earthquake and fire. Approximately 5.9 LCFs in the offsite population could result from such an accident. An offsite MEI would receive a dose of 23.1 rem. Statistically, the MEI would have a 0.01 chance of developing a LCF (i.e., about 1 chance in 100 of an LCF). . When probabilities are taken into account, the accident with the highest risk to the MEI is the explosion in a feed casting furnace. For this accident, the LCF risk to the MEI would be approximately $8x10^{-5}$, or approximately one in 10,000. For the population, the LCF risk would be $3x10^{-2}$, meaning that an LCF would statistically occur once every 31 years in the population.	Accident with the highest consequences to the offsite population is the aircraft crash into the EU facilities. Approximately 0.02 LCFs in the offsite population could result from such an accident. An offsite MEI would receive a maximum dose of 0.07 rem. Statistically, this MEI would have a 0.00004 chance of developing a LCF, or about 1 in 25,000. When probabilities are taken into account, the accident with the highest risk is the design-basis fire for HEU storage. For this accident, the maximum LCF risk to the MEI would be approximately $3x10^{-8}$, or approximately 1 in 33 million. For the population, the LCF risk would be $1x10^{-5}$, or approximately 1 in 100,000.	Accident with the highest consequences to the offsite population is the explosive driven plutonium and tritium dispersal from an internal event. Approximately 0.9 LCFs in the offsite population could result from such an accident. An offsite MEI would receive a dose of 3.6 rem. Statistically, this MEI would have a 0.002 chance of developing a LCF (i.e., about 1 chance in 500 of an LCF). When probabilities are taken into account for this accident, the LCF risk to the MEI would be $2x10^{-7}$, or approximately 1 in 5 million. For the population, the LCF risk would be approximately $9x10^{-5}$, or approximately 1 in 10,000.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	See CPC and CUC and A/D/HE.	Planned activities would continue as required to support smaller stockpile requirements. It is anticipated that performing an operation less frequently would have a linear reduction in the overall probability that an accident would occur.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
				Note: the accidents described above are for the existing A/D/HE mission. No A/D/HE Center is proposed at Pantex because Pantex currently conducts this mission.			
SRS	Current and planned activities would continue as required resulting in no additional impacts. The bounding accident at SRS, which is associated with the plutonium disposition program, would cause an MEI dose of approximately 8.8 rem. The maximum population dose was 21,000 rem, which would equate to approximately 12.6 LCFs.	Accident with the highest consequences to the offsite population is the beyond evaluation basis earthquake and fire. Approximately 10.5 LCFs in the offsite population could result from such an accident. An offsite MEI would receive a dose of approximately 3 rem. Statistically, the MEI would have a 0.002 chance of developing a LCF, or about 1 in 500. When probabilities are taken into account, the accident with the highest risk to the MEI is the explosion in a feed casting furnace. For this accident, the LCF risk to the MEI would be 1×0^{-5}, or approximately 1 in 100,000. For the population, the LCF risk would be approximately 6×10^{-2}, meaning that an LCF would statistically occur once every 18 years in the population.	Accident with the highest consequences to the offsite population is the aircraft crash into the EU facilities. Approximately 0.03 LCFs in the offsite population could result from such an accident. An offsite MEI would receive a maximum dose of 0.01 rem. Statistically, this MEI would have a $7\text{x}10^{-6}$ chance of developing a LCF, or about 1 in 150,000. When probabilities are taken into account, the accident with the highest risk is the design-basis fire for HEU storage. For this accident, the maximum LCF risk to the MEI would be $4\text{x}10^{-9}$, or approximately 1 in 250 million. For the population, the LCF risk would be $2\text{x}10^{-5}$, or approximately 1 in 50,000.	Accident with the highest consequences to the offsite population is the explosive driven plutonium and tritium dispersal from an internal event. Approximately 1.49 LCFs in the offsite population could result from such an accident. An offsite MEI would receive a dose of 0.5 rem. Statistically, this MEI would have a 0.0003 chance of developing a LCF, or about 1 in 3,300. When probabilities are taken into account for this accident, the LCF risk to the MEI would be $3\text{x}10^{-8}$, or approximately 1 in 33 million. For the population, the LCF risk would be $1\text{x}10^{-4}$, or approximately 1 in 6,500.	See CPC and CUC	See CPC and CUC and A/D/HE	Planned activities would continue as required to support smaller stockpile requirements. It is anticipated that performing an operation less frequently would have a linear reduction in the overall probability that an accident would occur.
Y-12	Current and planned activities would continue as required resulting in no additional impacts. Potential accident	Accident with the highest consequences to the offsite population is the beyond evaluation basis earthquake	Accident with the highest consequences to the offsite population is the fire in the UPF warehouse.	Accident with the highest consequences to the offsite population is the explosive driven	Y-12 performs the CUC mission, therefore the impact of a CNC at this site is identical to the CPC	See CPC and UPF and A/D/HE	Planned activities would continue as required to support smaller stockpile

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
	scenarios and impacts for the No Action Alternative would be the same as presented in the UPF facility column.	and fire. Approximately 177 LCFs in the offsite population could result from this accident. An offsite MEI would receive a dose of 219 rem. Statistically, the MEI would have a 0.1 chance of developing a LCF, or about 1 in 10. When probabilities are taken into account, the accident with the highest risk to the MEI is the explosion in a feed casting furnace. For this accident, the LCF risk to the MEI would be 2×10^{-3}, or approximately 1 in 500. For the population, the LCF risk would be 1.07, meaning that approximately 1 LCF would statistically occur once every year in the population.	Approximately 0.4 LCFs in the offsite population could result from such an accident. An offsite MEI would receive a maximum dose of 0.7 rem. Statistically, this MEI would have a 4×10^{-4} chance of developing a LCF, or about 1 in 2,400. When probabilities are taken into account, the accident with the highest risk is the design-basis fire for HEU storage. For this accident, the maximum LCF risk to the MEI would be 4×10^{-7}, or about 1 in 2.5 million. For the population, the LCF risk would be 4×10^{-4}, or about 1 in 2,500. **Note: the accidents described above are for the UPF. No CUC is proposed at Y-12 because Y-12 currently conducts this mission.**	plutonium and tritium dispersal from an internal event. Approximately 28.9 LCFs in the offsite population could result from such an accident. An offsite MEI would receive a dose of 55 rem. Statistically, this MEI would have a 0.03 chance of developing a LCF, or about 1 in 30. When probabilities are taken into account for this accident, the LCF risk to the MEI would be 7×10^{-6}, or about 1 in 150,000. For the population, the LCF risk would be 3×10^{-3}, or about 1 in 350.	impact.		requirements. It is anticipated that performing an operation less frequently would have a linear reduction in the overall probability that an accident would occur.
	Transportation						
LANL	Current and planned activities would continue as required resulting in no additional impacts.	Under all approaches increase in traffic during construction and operation would occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels. If NNSA Category I/II SNM missions are phased out, all	Increase in traffic during construction would occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	Same as CUC.	Increased traffic from the addition of new employees would also occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	Same as CNC.	Same as No Action Alternative.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
		Category I/II inventories of radioactive material would be transferred to other sites w/in the NNSA Complex.					
LANL Plutonium Phaseout: If LANL is not selected as the site for the CPC or CNPC, NNSA proposes to phase-out NNSA plutonium operations and remove Category I/II SNM from LANL by approximately 2022. Phasing out the plutonium operations from TA-55 would result in a decrease in waste generated at LANL. LLW would decrease by approximately 11%, Mixed LLW would decrease by 14%; TRU would decrease by 80%.							
NTS	Current and planned activities would continue as required resulting in no additional impacts.	Increase in traffic during construction and operation would occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	Increase in traffic during construction would occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	Same as CUC.	Increased traffic from the addition of new employees would also occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	Same as CNC.	NTS would be unaffected by the Capability Based Alternative.
Pantex	Current and planned activities would continue as required resulting in no additional impacts.	Increase in traffic during construction and operation would occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	Increase in traffic during construction would occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	Increased traffic from the addition of new employees would also occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	Planned activities would continue as required to support smaller stockpile requirements resulting in no additional impacts.
SRS	Increases to traffic during the construction and operation period of the MOX/PDCF facilities would occur. The impacts would be small in comparison to existing traffic and during the construction period could be eased with additional security guards detailed to SRS access points during the rush hours.	Increase in traffic during construction and operation would occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels. Radiological transportation would include transport of pits from Pantex to SRS and recycle of EU parts to Y-12.	Increase in traffic during construction would occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	Same as CUC.	Radiological transportation would include the impacts associated with the CPC plus transport of EU parts to and from Pantex. There would also be a one-time transport of HEU from Y-12 to the CNC. Increased traffic from the addition of new employees would also occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	Radiological transportation would include transport of TRU waste. There would be a one-time transport of SNM from Y-12 and Pantex to the CNPC. Increased traffic from the addition of new employees would also occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	Reduction in employees would have an inconsequential impact on traffic. A reduction in tritium operations would reduce the transportation of tritium.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
Y-12	Current and planned activities would continue as required resulting in no additional impacts.	Increase in traffic during construction and operation would occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels. Radiological transportation for the CPC would include transport of pits from Pantex to Y-12, return of pits and EU parts to Pantex, and shipment of TRU waste to WIPP.	Radiological transportation for the UPF would include transport of EU parts to/from Pantex, and shipment of LLW to NTS.	Increase in traffic during construction and operation would occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	Y-12 performs the CUC mission, therefore the impact of a CNC at this site is identical to the CPC impact.	Radiological transportation of impacts associated with CPC and UPF would not occur, with the exception of TRU waste transportation. There would be a one-time transport of SNM from Pantex to the CNPC. Increased traffic from the addition of new employees would also occur. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels.	Reduction in employees could cause a short-term decrease in road congestion. Reduction operation would reduce the transportation of secondaries and cases by approximately 50% compared to the No Action Alternative.
	Waste Management						
LANL	Current and planned activities would continue as required resulting in no additional impacts. Wastes in 2005 were as follows: LLW (yd^3): 7,080 Mixed LLW (yd^3): 90 TRU Waste(yd^3): 100 Mixed TRU(yd^3): 130 Hazardous (lbs.): 43,400 Existing waste management facilities are sufficient to manage these levels and maintain compliance with all regulatory requirements.	**Construction (Greenfield/Upgrade/50/80 Upgrade)** TRU solid (yd^3): 0/200/0 LLW solid (yd^3): 0/200/0 Hazardous (yd^3): 6.5/4/4 **Operation (Greenfield/Upgrade/50/80 Upgrade)** TRU solid (yd^3): 850/850/575 Mixed TRU(yd^3):310/310/2.6 LLW solid (yd^3): 3,500/3,500/1,850 LLW liq (yd^3): 0/0/19.5 Non-hazardous solid (yd^3): 7,400/7,400/700 Non-hazardous liquid (gal): 69,500/69,500/16,000	**Construction** TRU solid (yd^3): 0 LLW solid (yd^3): 70 Mixed TRU solid (yd^3): 0 Hazardous (tons): 6 Non-hazardous solid (tons): 1,000 **Operation** TRU solid (yd^3): 0 LLW liquid (gal):3,515 LLW solid (yd^3): 8,100 Mixed LLW liquid (gal): 3,616 Mixed LLW solid (yd^3): 70 Mixed TRU solid (yd^3): 0 Hazardous solid (tons): 15 Hazardous liquid (tons): 0 Non-hazardous solid (yd^3): 7,500 Non-hazardous liquid (gal): 50,000	**Construction** TRU solid (yd^3): 0 LLW solid (yd^3): 9,900 Mixed TRU solid (yd^3): 0 Hazardous (tons): 0 Non-hazardous solid (tons): 7,100 Non-hazardous liquid (gal): 40,000 **Operation** Low Level Liquid Waste (gal): 5,410 Low Level Solid Waste (yd^3): 40 Mixed Low Level Liquid Waste (gal): 6 Hazardous waste solid (yd^3): 1,350 Hazardous waste liquid (gal): 8,850 Non-hazardous Solid Waste (yd^3): 15,000 Non-hazardous Liquid Waste (gal):46,000		TRU solid (yd^3): 850 LLW liquid (gal):8,925 LLW solid (yd^3): 11,640 Mixed LLW liquid (gal): 3,622.4 Mixed LLW solid (yd^3): 72.3 Mixed TRU solid (yd^3): 310 Hazardous solid ((yd^3): 1,368.6 Hazardous liquid (gal): 8,850.5 Non-hazardous solid (yd^3): 29,900 Non-hazardous liquid (gal): 165,500	Same a No Action Alternative.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
NTS	Current and planned activities would continue as required resulting in no additional impacts. Wastes from 2001 LLW (yd^3): 0 Hazardous (tons): 4.86 Sanitary (tons): 4,550 Existing waste management facilities are sufficient to manage these levels and maintain compliance with all regulatory requirements.	**Construction** TRU solid (yd^3): 0 LLW solid (yd^3): 0 Mixed TRU solid (yd^3): 0 Hazardous (tons): 7 Non-hazardous solid (yd^3): 10,900 Non-hazardous liquid (gal): 56,000 **Operation** TRU solid (yd^3): 950 LLW liquid (yd^3): 0 LLW solid (yd^3): 3,900 Mixed LLW liquid (yd^3): 0.4 Mixed LLW solid (yd^3): 2.5 Mixed TRU solid (yd^3): 340 Hazardous solid (tons): 4.0 Hazardous liquid (tons): 0.6 Non-hazardous solid (yd^3): 8,100 Non-hazardous liquid (gal): 75,000	**Construction** TRU solid (yd^3): 0 LLW solid (yd^3): 70 Mixed TRU solid (yd^3): 0 Hazardous (tons): 6 Non-hazardous solid (tons): 1,000 **Operation** TRU solid (yd^3): 0 LLW liquid (gal):3,515 LLW solid (yd^3): 8,100 Mixed LLW liquid (yd^3): 3,616 Mixed LLW solid (yd^3): 70 Mixed TRU solid (yd^3): 0 Hazardous solid (tons): 15 Hazardous liquid (tons): 0 Non-hazardous solid (yd^3): 7,500 Non-hazardous liquid (gal): 50,000	**Construction** TRU solid (yd^3): 0 LLW solid (yd^3): 9,000 Mixed TRU solid (yd^3): 0 Hazardous (tons): 0 Non-hazardous solid (yd^3): 6,400 Non-hazardous liquid (gal): 40,000 **Operation** Low Level Liquid Waste (gal): 5,410 Low Level Solid Waste (yd^3): 40 Mixed Low Level Liquid Waste (gal): 6 Hazardous waste solid (tons): .90 Hazardous waste liquid (tons): 5.9 Non-hazardous Solid Waste (yd^3): 12,000 Non-hazardous Liquid Waste (gal):46,000	TRU solid (yd^3): 950 LLW liquid (gal):3,515 LLW solid (yd^3): 12,000 Mixed LLW liquid (yd^3): 3,616.4 Mixed LLW solid (yd^3): 72.5 Mixed TRU solid (yd^3): 340 Hazardous solid (tons): 19 Hazardous liquid (tons): 0.6 Non-hazardous solid (tons): 15,600 Non-hazardous liquid (gal): 125,000	TRU solid (yd^3): 950 LLW liquid (gal):8,925 LLW solid (yd^3): 12,640 Mixed LLW liquid (yd^3): 3,622.4 Mixed LLW solid (yd^3): 782.5 Mixed TRU solid (yd^3): 340 Hazardous solid (tons): 19.9 Hazardous liquid (ton): 6.5 Non-hazardous solid (yd^3): 27,600 Non-hazardous liquid (gal): 171,000	NTS would be unaffected by the Capability Based Alternative.
Pantex	The following existing levels of waste generation would be expected to continue: Wastes from 2005 LLW (yd^3): 96.8 Mixed LLW (yd^3): 1.8 Hazardous (yd^3): 711 Non-hazardous (yd^3): 6,375 Sanitary (yd^3): 944.9 TSCA (yd^3): 2,036 Universal (yd^3): 31 Existing waste management facilities are sufficient to manage these levels and maintain compliance with all regulatory requirements.	**Construction** TRU solid (yd^3): 0 LLW solid (yd^3): 0 Mixed TRU solid (yd^3): 0 Hazardous waste (tons): 7 Non-hazardous solid (yd^3): 10,900 Non-hazardous liquid (gal): 56,000 **Operation** TRU solid (yd^3): 950 LLW liquid (yd^3): 0 LLW solid (yd^3): 3,900 Mixed LLW liquid (yd^3): 0.4 Mixed LLW solid (yd^3): 2.5 Mixed TRU solid (yd^3): 340 Hazardous solid (tons): 4.0 Hazardous liquid (tons): 0.6 Non-hazardous solid (yd^3): 8,100	**Construction** TRU solid (yd^3): 0 LLW solid (yd^3): 70 Mixed TRU solid (yd^3): 0 Hazardous (tons): 6 Non-hazardous solid (tons): 1,000 **Operation** TRU solid (yd^3): 0 LLW liquid (yd^3):3,615 LLW solid (yd^3): 8,100 Mixed LLW liquid (yd^3): 3,620 Mixed LLW solid (yd^3): 70 Mixed TRU solid (yd^3): 0 Hazardous solid (tons): 15 Hazardous liquid (tons): 0 Non-hazardous solid (yd^3): 7,500	No A/D/HE Center is proposed at Pantex because the A/D/HE mission is part of the No Action Alternative.	Pantex performs the A/D/HE mission; therefore the impact of a CNC at this site is identical to the CNPC impact. See CNPC Operation in next column.	TRU solid (yd^3): 950 LLW liquid (yd^3):3,615 LLW solid (yd^3): 12,000 Mixed LLW liquid (yd^3): 3,620 Mixed LLW solid (yd^3): 72.5 Mixed TRU solid (yd^3): 340 Hazardous solid (tons): 19 Hazardous liquid (tons): 0.6 Nonhazardous solid (yd^3): 15,600 Nonhazardous liquid (yd^3): 125,000	Current and planned activities would continue as required to support smaller stockpile requirements. LLW (yd^3): 73 Mixed LLW (yd^3): 1.4 Hazardous (yd^3): 530 Non-hazardous (yd^3): 4,800 No major impacts are expected.

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
		Non-hazardous liquid (yd^3): 75,000	Non-hazardous liquid (gal): 50,000				
SRS	Existing levels of waste generation of: Wastes from 2001 TRU (yd^3): 64.1 LLW (yd^3): 4,610 Mixed TRU (yd^3): 380 Hazardous (yd^3): 45.3 Sanitary (yd^3): 1,560 And are expected to be increased by the construction of t he MOX/PDCF facilities which are expected to add: TRU (yd^3): 500 LLW (yd^3): 270 Mixed (yd^3): 6.5 Existing waste management facilities are more than adequate to manage these wastes in compliance with all regulatory requirements.	**Construction** TRU solid (yd^3): 0 LLW solid (yd^3): 0 Mixed TRU solid (yd^3): 0 Hazardous (tons): 7 Non-hazardous solid (yd^3): 10,900 Non-hazardous liquid (gal): 56,000 **Operation** TRU solid (yd^3): 950 LLW liquid (yd^3): 0 LLW solid (yd^3): 3,900 Mixed LLW liquid (yd^3): 0.4 Mixed LLW solid (yd^3): 2.5 Mixed TRU solid (yd^3): 340 Hazardous solid (tons): 4.0 Hazardous liquid (tons): 0.6 Non-hazardous solid (yd^3): 8,100 Non-hazardous liquid (gal): 75,000	**Construction** TRU solid (yd^3): 0 LLW solid (yd^3): 70 Mixed TRU solid (yd^3): 0 Hazardous (tons): 6 Non-hazardous solid (tons): 1,000 **Operation** TRU Solid Waste (yd^3): 0 Low Level Liquid Waste (yd^3): 3,515 Low Level Solid Waste (yd^3): 8,100 Mixed Low Level Liquid Waste (yd^3): 3,616 Mixed Low Level Solid Waste (yd^3): 70 Mixed TRU Solid Waste (yd^3): 0 Hazardous waste solid (tons): 15 Hazardous waste liquid (tons): 0 Non-Hazardous Solid Waste (tons): 7,500 Non-Hazardous Liquid Waste (gal) : 50,000	**Construction** TRU solid (yd^3):0 LLW solid (yd^3): 9,900 Mixed TRU solid (yd^3): 0 Hazardous (tons): 0 Non-hazardous solid (tons): 7,1000 Non-hazardous liquid (gal): 45,000 **Operation** Low Level Liquid Waste (gal): 5,410 Low Level Solid Waste (yd^3): 40 Mixed Low Level Liquid Waste (gal): 6 Hazardous waste solid (tons): .90 Hazardous waste liquid (tons): 5.9 Non-hazardous Solid Waste (yd^3): 12,000 Non-hazardous Liquid Waste (gal):46,000	TRU solid (yd^3): 950 LLW liquid (gal):3,515 LLW solid (yd^3): 12,000 Mixed LLW liquid (yd^3): 3,616.4 Mixed LLW solid (yd^3): 72.5 Mixed TRU solid (yd^3): 340 Hazardous solid (tons): 19 Hazardous liquid (tons): 0.6 Nonhazardous solid (tons): 15,600 Nonhazardous liquid (gal): 125,000	TRU solid (yd^3): 950 LLW liquid (gal):8,925 LLW solid (yd^3): 12,040 Mixed LLW liquid (yd^3): 3,622.4 Mixed LLW solid (yd^3): 782.5 Mixed TRU solid (yd^3): 340 Hazardous solid (tons): 19.9 Hazardous liquid (tons): 6,5 Nonhazardous solid (yd^3): 27,600 Nonhazardous liquid (gal): 171,000	Reduced tritium operations would reduce LLW by approximately 50%, from 138 yd^3 to approximately 69 yd^3. No other waste streams would be affected.
Y-12	Wastes generated in 2003: LLW liquid (yd^3): 17.4 LLW solid (yd^3): 7,800 Mixed LLW liquid (yd^3): 17.9 Mixed LLW solid (yd^3): 21.1 Existing waste management facilities are more than	**Construction** TRU solid (yd^3): 0 LLW solid (yd^3): 0 Mixed TRU solid (yd^3): 0 Hazardous (tons): 7 Non-hazardous solid (tons): 10,900 Non-hazardous liquid (gal): 56,000 **Operations** TRU solid (yd^3): 950 LLW liquid (yd^3):0 LLW solid (yd^3): 3,900 Mixed LLW liquid (gal): 0.4 Mixed LLW solid (yd^3): 2.5	**Construction** TRU solid (yd^3): 0 LLW solid (yd^3): 70 Mixed LLW solid (yd^3): 4 Hazardous (tons): 4 Non-hazardous solid (tons): 800 Non-hazardous liquid (gal): 0 **Operations** TRU solid (yd^3): 0 LLW liquid (gal):3,515 LLW solid (yd^3): 7,800 Mixed LLW liquid (gal): 3,616	**Construction** TRU solid (yd^3): 0 LLW solid (yd^3): 9,900 Mixed TRU solid (yd^3): 0 Hazardous (tons): 0 Non-hazardous solid (yd^3): 7,100 Non-hazardous liquid (gal): 45,000 **Operation** Low Level Liquid Waste (gal): 5,410 Low Level Solid Waste (yd^3): 40 Mixed Low Level Liquid	TRU solid (yd^3): 950 LLW liquid (gal): 3,515 LLW solid (yd^3): 11,700 Mixed LLW liquid (gal): 3,616.4 Mixed LLW solid (yd^3): 72.5 Mixed TRU solid (yd^3): 340 Hazardous solid (tons): 19 Hazardous liquid (yd^3): 0.6 Non-hazardous solid (tons): 15,600 Non-hazardous liquid (gal): 125,000	TRU solid (yd^3): 950 LLW liquid (gal): 8,925 LLW solid (yd^3): 11,740 Mixed LLW liquid (gal): 3,622.4 Mixed LLW solid (yd^3): 23.5 Mixed TRU solid (yd^3): 340 Hazardous solid (tons): 18.9 Hazardous liquid (tons): 6.5 Non-hazardous solid (yd^3): 27,225 Non-hazardous liquid	LLW liquid (yd^3): 10.4 LLW solid (yd^3): 4,700 Mixed LLW liquid (yd^3): 10.7 Mixed LLW solid (yd^3): 12.7

Table 3.16-1—Comparison of Environmental Impacts Among Programmatic Alternatives (continued)

SITE	NO ACTION ALTERNATIVE	Major New Restructured SNM Facilities in the DCE and CCE Alternatives					CAPABILITY BASED ALTERNATIVE*
		CPC	CUC (or UPF at Y-12)	A/D/HE	CNC Operation	CNPC Operation	
	adequate to manage these wastes in compliance with all regulatory requirements	Mixed TRU solid (yd^3): 340 Hazardous solid (tons): 4.0 Hazardous liquid (yd^3): 0.6 Non-hazardous solid (tons): 8,100 Non-hazardous liquid (gal): 75,000	Mixed LLW solid (yd^3): 70 Mixed TRU solid (yd^3):0 Hazardous solid (tons): 15 Hazardous liquid (yd^3): 0 Non-hazardous solid (tons): 7,500 Non-hazardous liquid (gal): 50,000	Waste (gal): 6 Hazardous waste solid (tons): .90 Hazardous waste liquid (tons): 5.9 Non-hazardous Solid Waste (yd^3): 12,000 Non-hazardous Liquid Waste (gal):46,000		(gal): 171,000	

*****Data is presented for Capability-Based Alternative. The No Net Production/Capability-Based Alternative is discussed in Chapter 5, as appropriate for any potentially-affected site. The No Net Production Capability-Based Alternative would result in less weapons-related activities at NNSA sites. This would translate into smaller infrastructure demands, less waste generation, less dose to workers, and reductions in employment. Although these changes would vary differently at the NNSA sites (see Section 3.6.2), most reductions would be on the order of approximately 10 percent compared to the Capability-Based Alternative.

Table 3.16-2—Summary of Impact Comparison of SNM Consolidation: Transfer SNM from LLNL

Resource	No Action Alternative	Remove Category I/II SNM from LLNL (Includes the impacts of phasing out Category I/II SNM operations from LLNL Superblock)—Preferred Alternative
Land	No land issues	No land impacts or issues
Noise	No noise impacts	No change
Air Quality	No changes to air quality	• no emissions of radionuclides to air from Superblock; therefore, phasing out this facility would have no effect on radiological air quality • no nonradiological changes expected
Socioeconomic	No change	• if Superblock operated as Category III SNM facility: minor impacts to facility employment associated with security force reductions • if Superblock closed and undergoes D&D: employment would be expected to increase because of the D&D work, but would likely not be significant, and would be offset by the transfer of some personnel to LANL.
Transportation	No change. LLNL is authorized to transport approximately 584 shipments annually.	• less than 19 shipments of radiological material expected • population dose for all shipments: < 3 person-rem • LCF risk: <0.01
Human Health	There are no emissions of radionuclides from Superblock.	• phasing out Category I/II SNM operations from Superblock would have no effect on population doses to the surrounding population. • material-at-risk limit for Superblock reduced by 60%; • bounding accident source term for Superblock reduced by 60% • Superblock accident consequences reduced from 1.3 LCFs to 0.52 LCFs.
Waste Management	Small quantities of hazardous, and liquid and solid non-hazardous wastes	• if Superblock operated as Category III SNM facility: wastes would drop to 10% of current quantities (to 10 TRU waste drums per year and 40 LLW drums per year) • if Superblock closed and undergoes D&D: waste would increase in short-term; for bounding case, wastes could double to 200 TRU waste drums and 800 LLW drums per year for several years

Table 3.16-3—Summary of Impact Comparison of SNM Consolidation: Transfer SNM from Pantex Zone 4 to Zone 12

Resource	No Action Alternative	Move Category I/II SNM Storage from Zone 4 to Newly Constructed Underground Storage Facility in Zone 12 at Pantex—Preferred Alternative
Land	No land issues	Would disturb 42-57 acres of brownfield land for construction; A maximum of 11 acres would be utilized once operational
Noise	No noise impacts	Minor increase in noise during construction of new 95,900-142,800 sq. ft. underground storage facility.
Water	Water use limited to personal consumption of employees	Would require an additional 1,500,000-2,950,000 gallons of water for 5-year construction period
Air Quality	No impacts to air from SNM storage	Minor fugitive dust emissions during construction of new underground storage facility
Socioeconomics	Currently employs 40 workers	No change
Transportation	No impacts	No impacts off site; all transportation on-site Human health impacts from transportation included under “Human Health”
Human Health	Average dose of 12 mrem to 10 radiological workers	Movement of material would entail an additional total dose of 1,100 person-rem, which would statistically translate into a maximum of approximately 0.657 LCFs
Waste Management	No waste generation	Once material moved D&D of old facility would be expected to generate: • 12,000 yd^3 of solid waste • 700 yd^3 of LLW

Table 3.16-4—Summary of Impact Comparison of Tritium R&D Alternatives

Resource	No Action	SRS Consolidation—Preferred Alternative	LANL Consolidation	Downsize-in-Place
Land	Continue operations at LLNL, LANL, and SRS	No new land disturbed	No new land disturbed	No new land disturbed
Noise	Continue operations at LLNL, LANL, and SRS	No change	No change*	No change
Air Quality	Continue operations at LLNL, LANL, and SRS No change	• SRS tritium emissions increase by 1,000 Curies (2.4% increase over current tritium emissions) • LANL tritium emissions decrease by 1,000 Curies (42% decrease compared to current tritium emissions) • No change to nonradiological emissions	No change*	No change
Socioeconomic	Continue operations at LLNL, LANL, and SRS No change	• 25 jobs restructured at LANL • 25 new jobs would be created at SRS	No change*	No change
Human Health	Continue operations at LLNL, LANL, and SRS	• Average exposure to worker from tritium R&D would be approximately 4.3 mrem • Total worker dose: 0.11 person-rem • Worker LCF risk: 6.6×10^{-5} • MEI dose at SRS: increase by 0.0008 mrem/year; • 50-mile population dose: increase 0.041 person-rem. • LANL decreases would be similarly small	No change*	No change
Waste Management	Continue operations at LLNL, LANL, and SRS	Wastes would change by less than 1%	No change*	No change

* Consolidation to LANL includes LLNL tritium R&D activities, which amount to one glovebox system.

Table 3.16-5—Summary of Impact Comparison of HE R&D Alternatives*

Resource	No Action	Consolidate HE R&D to LANL	Consolidate HE R&D to LLNL	Consolidate HE R&D to Pantex	Consolidate HE R&D to SNL/NM	Consolidate HE R&D to NTS
Donor Sites	Not Applicable	SNL/NM, LLNL, Pantex	SNL/NM, LANL, Pantex	SNL/NM, LLNL, LANL	Pantex, LLNL, LANL	SNL/NM, LLNL, Pantex, LANL
Land	Continue operations at LANL, LLNL, SNL/NM, Pantex	5 acres disturbed at LANL in vicinity of the Two-Mile Mesa Complex (includes portions of TA-6, TA-22, and TA-40)	8-10 acres disturbed on main LLNL site near the HEAF	5.7 acres disturbed in vicinity of Zone 11 and Zone 12	13.5 acres disturbed in Technical Areas 2 or 3	15 acres disturbed in vicinity of the BEEF
Noise	Continue operations at LANL, LLNL, SNL/NM, Pantex	"thunder-like" explosives testing; noise occasional, not continuous; public, and sensitive wildlife receptors unlikely to be adversely impacted	None detectable outside of HEAF.	"thunder-like" explosives testing; noise occasional, not continuous; public, and sensitive wildlife receptors unlikely to be adversely impacted	"thunder-like" explosives testing; noise occasional, not continuous; public, and sensitive wildlife receptors unlikely to be adversely impacted	"thunder-like" explosives testing; noise occasional, not continuous; public, and sensitive wildlife receptors unlikely to be adversely impacted
Air Quality	Continue operations at LANL, LLNL, SNL/NM, Pantex	Short-term impacts from construction; Operation increases in pollutants would be less than 1% of site emissions. No radiological emissions.	Short-term impacts from construction; Operation increases in pollutants would be less than 1% of site emissions. No radiological emissions.	Short-term impacts from construction; Operation increases in pollutants would be less than 1% of site emissions. No radiological emissions.	Short-term impacts from construction; Operation increases in pollutants would be less than 1% of site emissions. No radiological emissions.	Short-term impacts from construction; Operation increases in pollutants would be less than 1% of site emissions. No radiological emissions.
Socioeconomic	Continue operations at LANL, LLNL, SNL/NM, Pantex	• 125 peak construction jobs; • LANL: +300 jobs • LLNL: -175 jobs • SNL/NM: -45 jobs • Pantex: -10 jobs	• 150 peak construction jobs; • LLNL: +300 jobs • LANL: -150 jobs • SNL/NM: -45 jobs • Pantex: -10 jobs	• 210 peak construction jobs; • Pantex: +160 jobs • LANL: -150 jobs • SNL/NM: -45 jobs • LLNL: -175 jobs	• 220 peak construction jobs; • SNL/NM: +325 jobs • LANL: -150 jobs • LLNL: -175 jobs • Pantex: -10 jobs	• 250-300 peak construction jobs; • NTS: +250 jobs • LLNL: -175 jobs • LANL: -150 jobs • SNL/NM: -45 jobs • Pantex: -10 jobs

Table 3.16-5—Summary of Impact Comparison of HE R&D Alternatives* (continued)

Resource	No Action	Consolidate HE R&D to LANL	Consolidate HE R&D to LLNL	Consolidate HE R&D to Pantex	Consolidate HE R&D to SNL/NM	Consolidate HE R&D to NTS
Human Health	Continue operations at LANL, LLNL, SNL/NM, Pantex	No change	No change	No change	No change	No change
Waste Management	Continue operations at LANL, LLNL, SNL/NM, Pantex	Construction solid waste: 4,930 cubic yards. Operational wastes minimal.	Construction solid waste: 6,200 cubic yards. Operational wastes minimal.	Construction solid waste: 1,550 cubic yards. Operational wastes minimal.	Construction solid waste: 2,650 cubic yards. Operational wastes minimal.	Construction solid waste: 4,650 cubic yards. Operational wastes minimal.

*Impacts of minor downsizing/consolidation alternatives are presented in Section 5.13.1. Preferred alternative is presented in Section 5.20.

Table 3.16-6—Summary of Impact Comparison of Flight Testing Alternatives

Resource	No Action Alternative	Mobile Upgrade Alternative	Campaign Mode at TTR Alternative			Move to NTS Alternative	Move to WSMR Alternative
			OPTION 1	OPTION 2	OPTION 3 Preferred Alternative		
Impacts to Land	No land disturbance issues. Requires Agreement extension	No land disturbance issues. Requires Agreement extension	No land disturbance issues. Requires Agreement extension	No land disturbance issues. Requires Agreement renegotiation with USAF	No land disturbance issues. Requires Agreement renegotiation with USAF. Free up 178,560 acres at Tonopah	Disturb less than 2 acres at NTS Free up 179,200 acres at Tonopah	Disturb less than 2 acres as WSMR Free up 179,200 acres at Tonopah
Noise Impacts	No noise impacts to public	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Impact on Air Quality	No impacts to air	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Temporary PM-10 emissions during construction	Temporary PM-10 emissions during construction
Socioeconomic Impacts	Currently employs 135 at Tonopah	No impact to jobs	Loss of 92 jobs at Tonopah with secondary impacts on community	Loss of 57 jobs at Tonopah with secondary impacts on community	Loss of 70 jobs at Tonopah with secondary impacts on community	Loss of 135 jobs at Tonopah with impacts to community and gain of 135 jobs at NTS	Loss of 135 jobs at Tonopah and gain of 135 jobs at WSMR
Human Health Impacts	No radiological emissions (note 1)	No radiological emissions (note 1)	No radiological emissions (note 1)	No radiological emissions (note 1)	No radiological emissions (note 1)	No radiological emissions (note 1)	No radiological emissions (note 1)
Waste Management Impacts	Small quantities of hazardous and liquid and solid non-hazardous	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action

Note 1: Some Flight Test operations utilize depleted uranium in the Joint Test Assembly. There is no explosive event and the depleted uranium is contained within the weapon case. Following each flight test, the depleted uranium is removed.

Table 3.16-7—Summary of Impact Comparison of Hydrodynamic Testing Alternatives

Resource	No Action Alternative	Downsize in Place Alternative—Preferred Alternative*	Consolidate at LANL Alternative—Preferred Alternative*	Consolidate at NTS Alternative—Preferred Alternative*
Impacts to Land	No land issues	Would not require additional land	Require 5-7 acres additional land	Require 17 acres additional land
Noise Impacts	Limited to workers at facilities	Limited to workers at closure and facility sites	Limited to workers at closure construction and work sites	Limited to workers at closure construction and work sites
Impact on Air Quality	Less than 100 pounds of NOX and CO emissions/year from DARHT & CFF	Same as No Action	Construction PM-10 Emissions	Construction PM-10 Emissions
Socioeconomic Impacts	None as facilities do not employ but are used and managed by other programs	Loss of 26 jobs at LLNL Loss of 5 jobs at LANL	Loss of 56 jobs at LLNL Gain of 5 jobs at LANL	Loss of 56 jobs at LLNL Gain of 5 jobs at LANL
Human Health Impacts	No human health issues	No impacts	No impacts	No impacts
Waste Management Impacts	Small quantities of hazardous waste generated by DARHT and CFF	Additional waste from facility closures	Additional waste from facility closures	Additional waste from facility closures

***** Preferred alternative contains elements of the Downsize in-Place Alternative, the Consolidate at LANL Alternative, and the Consolidate at NTS Alternative.

Table 3.16-8—Summary of Impact Comparison of Major Environmental Test Facilities Alternatives

Resource	No Action Alternative	Downsize-in-Place Alternative	Move All ETF to NTS	Move all ETF to SNL/NM—Preferred Alternative*
Impacts to Land	Currently has 558,311 sq ft of floor space at four sites	Reduce building floor space by 62,777 sq ft	Reduce building floor space by 537,385 sq ft but require 23.5 acres of land at NTS	Reduce building floor space by 159,268 sq ft but require 2.5 acres of land at SNL/NM
Noise Impacts	Limited to workers at work sites	Limited to workers at closure and work sites	Limited to workers at closure construction and work sites	Limited to workers at closure construction and work sites
Transportation	No transportation issues	No transportation issues	Closure D&D could cause traffic congest at LANL and Sandia	Closure D&D could cause traffic congestion at LANL
Impact on Air Quality	Small emissions from Bldg 836 at LLNL	Same as no action alternative	PM-10 issues during Construction	PM-10 issues during Construction
Socioeconomic Impacts	Currently employs 29 at LANL 6 at LLNL 224 at SNL/NM	Jobs Lost: 6 at LLNL 16 at SNL/NM	Jobs Lost: 29 at LANL 6 at LLNL 224 at SNL/NM	Jobs Lost: 29 at LANL 6 at LLNL 16 at SNL/NM
Human Health Impacts	No human health issues	Same as no action alternative	Same as no action alternative	Same as no action alternative
Waste Management Impacts	Small waste generation from DAF and SNL/NM	Additional waste from facility closures	Additional waste from facility closures	Additional waste from facility closures

*Preferred alternative includes the option of moving environmental testing of nuclear explosive packages currently performed in LLNL Building 334 and the Building 834 environmental conditioning functions to Pantex by 2012.

Chapter 4
AFFECTED ENVIRONMENT

Chapter 4
AFFECTED ENVIRONMENT

In Chapter 4, the affected environment descriptions provide the context for understanding the environmental impacts described in Chapter 5. They serve as a baseline—or description of current environmental conditions—from which any environmental changes brought by implementing the alternatives can be evaluated. The affected environment at Los Alamos National Laboratory (LANL), Nevada Test Site (NTS), Pantex Plant (Pantex), Savannah River Site (SRS), Y-12 National Security Complex (Y-12), Sandia National Laboratories/New Mexico (SNL/NM), Lawrence Livermore National Laboratory (LLNL), (including SNL/California), Tonopah Test Range (TTR), and the White Sands Missile Range (WSMR) are described for the following impact areas: land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, radiation and hazardous chemical environment, transportation, and waste management.

4.0 INTRODUCTION

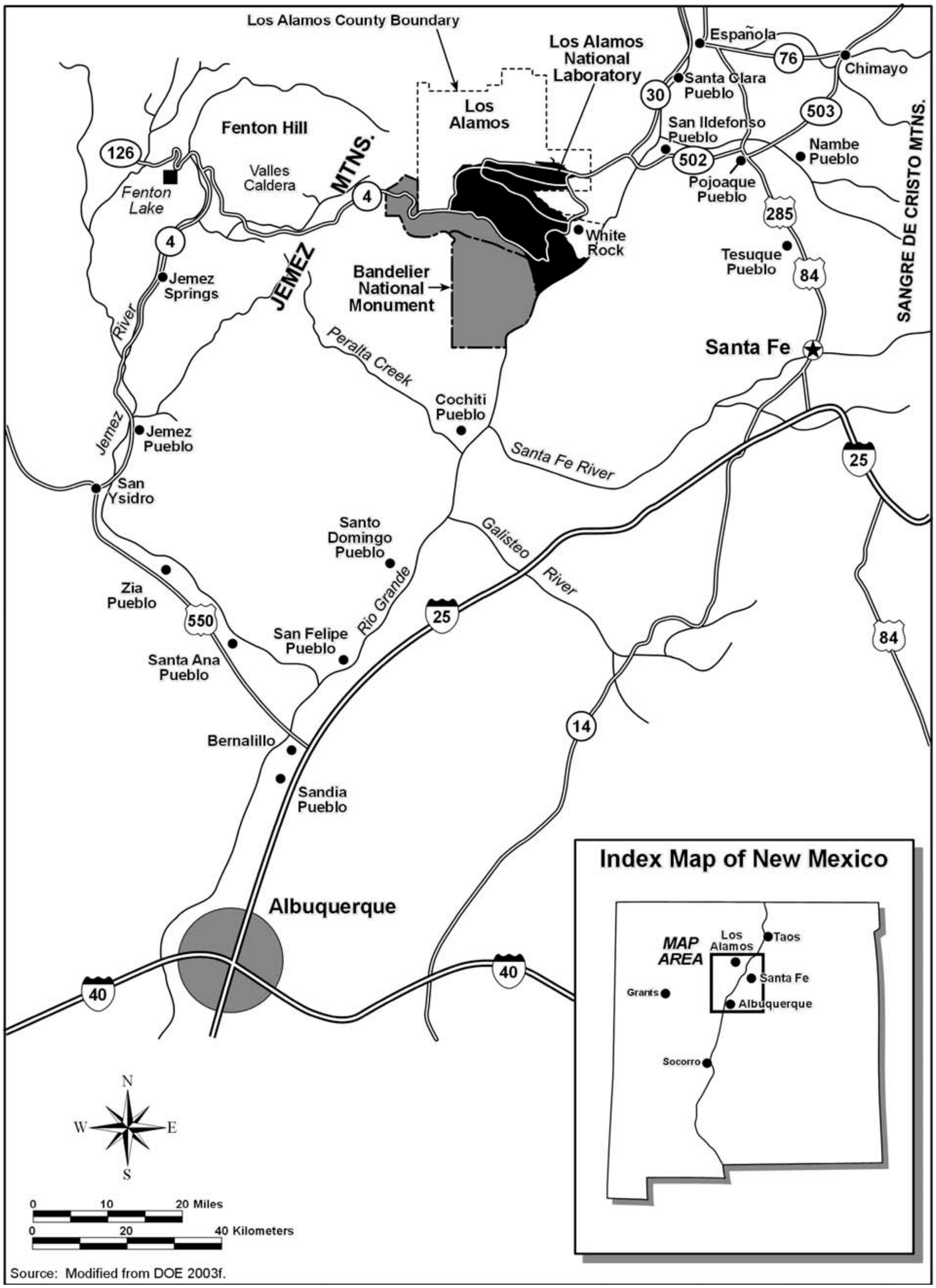
In accordance with the Council on Environmental Quality (CEQ) *National Environmental Policy Act* (NEPA) regulations (40 *Code of Federal Regulations* [CFR] 1500-1508) for preparing an environmental impact statement (EIS), the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with the environment."

The candidate sites for the various Complex Transformation Supplemental Programmatic Environmental Impact Statement (SPEIS) alternatives are LANL, NTS, Pantex, SRS, Y-12, SNL/NM, SNL/CA, LLNL, TTR, and the WSMR. The level of detail presented for the affected environment varies depending on the potential for impacts on a particular resource as result of implementation of the various Complex Transformation SPEIS alternatives.

Recent environmental documents (e.g., site environmental reports) and relevant laws and regulations were used in describing the existing environment at each of the candidate sites. These documents are cited as appropriate. A listing of the information and references used to develop this chapter and the SPEIS is included in Chapter 12, References.

4.1 LOS ALAMOS NATIONAL LABORATORY

The LANL was established as a nuclear weapons design laboratory in 1943 and was formerly known as the Los Alamos Scientific Laboratory. Its facilities are located on approximately 25,600 acres in north-central New Mexico. It is 60 miles north-northeast of Albuquerque, 25 miles northwest of Santa Fe, and 20 miles southwest of Española in Los Alamos and Santa Fe Counties. The location of the facility is shown in Figure 4.1-1.



Source: LANL 2008.

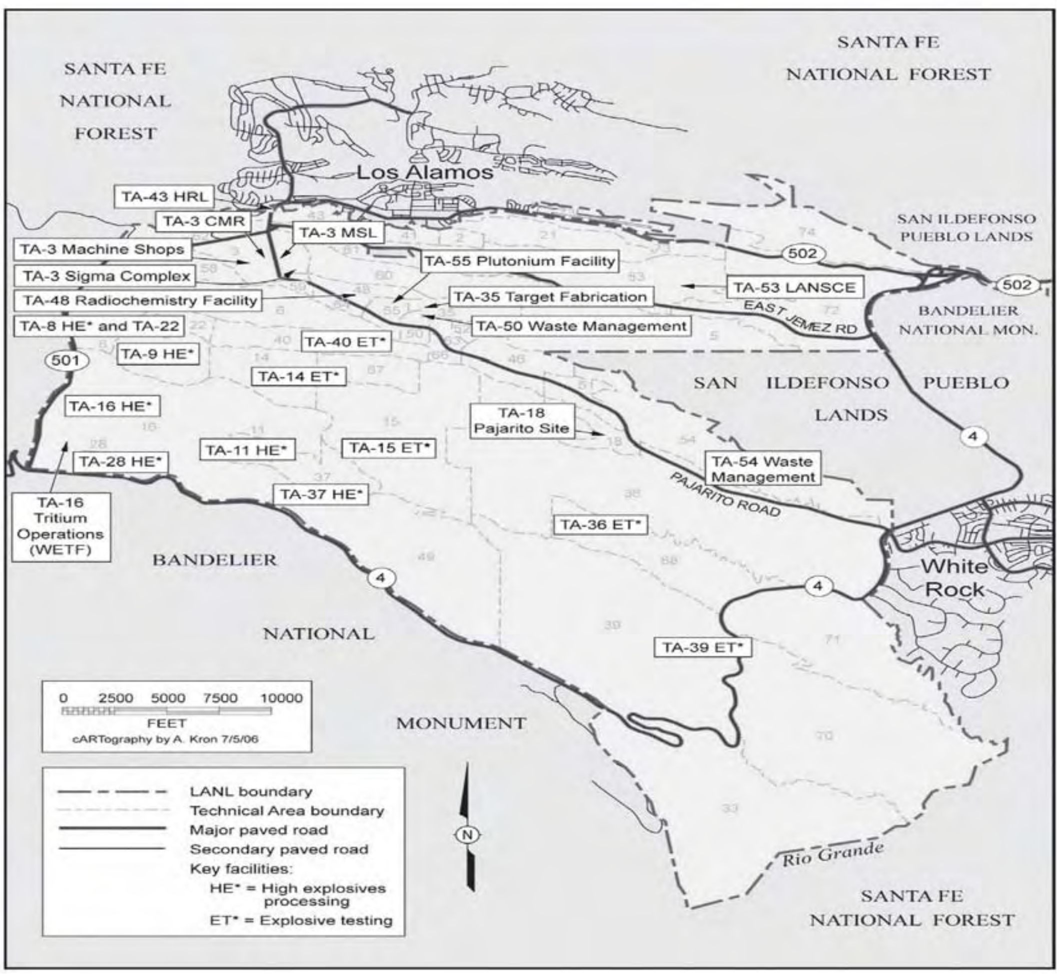
Figure 4.1-1—Location of LANL

LANL's principal NNSA missions are to conduct research and development of nuclear weapons; design and test advanced technology concepts; design weapons; provide safety and reliability assessments of the stockpile; maintain interim production capabilities for limited quantities of plutonium components (e.g., pits); and manufacture nuclear weapon detonators for the stockpile. LANL maintains Category I/II quantities of special nuclear materials (SNM) associated with the nuclear weapons program and material no longer needed by the weapons program.

4.1.1 Land Use

4.1.1.1 *Onsite Land Uses*

LANL is divided into technical areas (TAs) that are used for building sites, experimental areas, support facilities, roads, and utility rights-of-way (see Figure 4.1.1-1). However, these uses account for only a small part of the total land area; much of the LANL land provides buffer areas for security and safety or is held in reserve for future use. LANL has approximately 2,000 structures with approximately 8.6 million square feet under roof, spread over an area of approximately 25,600 acres. Approximately 826 acres of land are available for development or redevelopment (LANL 2008).



Source: LANL 2008.

Figure 4.1.1-1—TAs and Key Facilities at LANL

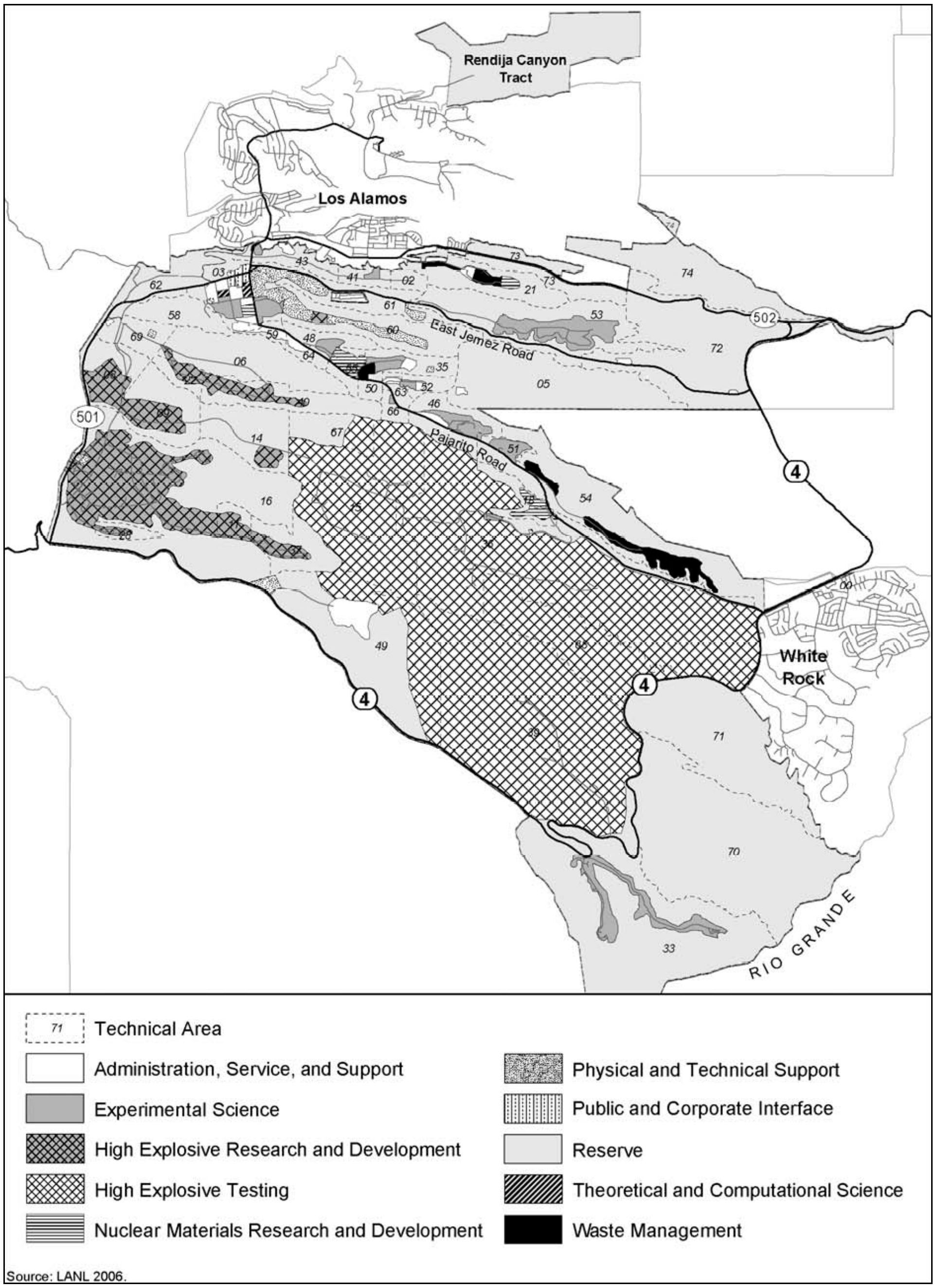
As shown in Figure 4.1.1-1, the facilities identified as "Key" are those that house activities critical to meeting work assignments assigned to LANL (LANL 2008). The remaining facilities at LANL are identified as "Non-Key" Facilities and comprise all or the majority of 30 of LANL's 48 TAs and approximately 14,224 acres. Non-Key Facilities include the Nonproliferation and International Security Center and the TA-46 sewage treatment facility (LANL 2008).

Although developed areas play a vital role at LANL, they make up only a small part of the site. Most of the site is undeveloped to provide security, safety, and expansion possibilities for future mission-support requirements. There are no agricultural activities present at LANL, nor are there any prime farmlands in the vicinity (LLNL 2008).

In 1977, DOE designated LANL as a National Environmental Research Park; and, in 1999, the White Rock Canyon Reserve was dedicated. The Reserve is about 1,000 acres in size and is located on the southeast perimeter of LANL. It is managed jointly by DOE and the National Park Service for its significant ecological and cultural resources and research potential (DOE 2003f). LANL is separated into the following internal land use categories: service and support, experimental science, high explosives research and development, high explosives testing, nuclear materials research and development, physical and technical support, public and corporate interface, reserve, theoretical and computational science, and waste management (see Figure 4.1.1-2) (LANL 2003g). The 10 land use categories and activities at LANL are defined below (LANL 2008).

- **Administration, service, and support.** Administrative functions, nonprogrammatic technical expertise, support, and services for LANL management and employees.
- **Experimental science.** Applied research and development activities tied to major programs.
- **High-explosives research and development.** Research and development of new explosive materials. This land is isolated for security and safety.
- **High-explosives testing.** Large, isolated, exclusive-use areas required to maintain safety and environmental compliance during testing of newly developed explosive materials and new uses for existing materials. This land also includes exclusion and buffer areas.
- **Nuclear materials research and development.** Isolated, secured areas for conducting research and development involving nuclear materials. This land use includes security and radiation hazard buffer zones. It does not include waste disposal sites.
- **Physical and technical support.** Includes roads, parking lots, and associated maintenance facilities; infrastructure such as communications and utilities; facility maintenance shops; and maintenance equipment storage. This land use is generally free from chemical, radiological, or explosives hazards.
- **Public and corporate interface.** Provides link with the general public and other outside entities conducting business at LANL, including technology transfer activities.
- **Reserve.** Areas that are not otherwise included in one of the previous categories. It may include environmental core and buffer areas, vacant land, and proposed land transfer areas.
- **Theoretical and computational science.** Interdisciplinary activities involving mathematical and computational research and related support activities.

- **Waste management.** Provides for activities related to the handling, treatment, and disposal of all generated waste products, including solid, liquid, and hazardous materials (chemical, radiological, and explosive).



Source: LANL 2008.

Figure 4.1.1-2—Generalized Land Use at LANL

4.1.1.2 *Surrounding Land Uses*

LANL is located in Los Alamos County approximately 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe (LANL 2006b). The land surrounding LANL is largely undeveloped, and large tracts of land north, west, and south of the LANL site are held by the Santa Fe National Forest, the U.S. Bureau of Land Management (BLM), the Bandelier National Monument, private land owners, State of New Mexico, and the Los Alamos County. Pueblo de San Ildefonso borders the LANL to the east (LANL 2008). The closest residential town from LANL is White Rock which is approximately a mile away. Residents of San Ildefonso are approximately 4.5 miles from the eastern-most LANL boundary to the closest residents on San Ildefonso Pueblo lands both along State Road 30 or State Road 502.

There are no designated prime farmlands within either Los Alamos or Santa Fe Counties. The closest designated prime farmland in the vicinity to LANL is in Rio Arriba County in the vicinity of the town of Española. Prime farmland is defined as land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion. (7U.S.C. 4201(c)(1)(A)).

Most developments within Los Alamos County are confined to mesa tops. The U.S. Forest Service (USFS) is responsible for the Santa Fe National Forest, which encompasses 1,567,181 acres in the Sangre De Cristo Mountains to the east and Jemez Mountains to the west of LANL.

Los Alamos County consists of approximately 69,860 acres, most of which is federally owned. Approximately 8,751 acres, including land that has been conveyed from DOE, are under county jurisdiction (LANL 2008).

The lands of the Pueblo of San Ildefonso are located immediately east of LANL. The Pueblo owns or has use of 30,242 acres of land, including approximately 2,106 acres recently transferred from DOE. Land use of the Pueblo is a mixture of residential use, gardening and farming, cattle grazing, hunting, fishing, food and medicinal plant gathering, and firewood production, along with general cultural and resource preservation (LANL 2008).

The National Park Service (NPS) is responsible for the Bandelier National Monument. The area consists of two units, the Main Unit (32,937 acres), located immediately south of LANL, and the Tsankawi Unit (790 acres) located to the northeast of LANL. The Tsankawi Unit is undeveloped, and only a small portion of the Main Unit has been developed for visitors (approximately 70 percent has been designated as a Wilderness Area) (LANL 2008).

The Santa Fe National Forest is managed for multiple-use activities, such as logging, cattle grazing, and recreation. The Dome Wilderness Area is located within the National Forest near Bandelier National Monument and provides habitat for a number of Federal and state protected species (LANL 2008).

4.1.2 Visual Resources

LANL and the surrounding region are characterized by forested areas with mountains, canyons, and valleys, as well as diverse cultures and ecosystems. The area is dominated by the Jemez Mountains to the west and the Sangre de Cristo Mountains to the east. These two mountain ranges are divided north to south by the Rio Grande. LANL is located on the Pajarito Plateau, which is cut by steeply-sloped and deeply-eroded canyons that have formed isolated finger-like mesas running west to east. Mesa tops at LANL range in elevation from approximately 7,800 feet on the west to about 6,200 feet on the east (LANL 2008).

The topography of northern New Mexico is rugged, especially in the vicinity of LANL. Mesa tops are cut by deep canyons, creating sharp angles in the land form. Often, little vegetation grows on these steep slopes, exposing the geology, with contrasting horizontal planes varying from fairly bright reddish orange to almost white in color. A variety of vegetation occurs in the region, the density and height of which may change over time and can affect the visibility of an area within the LANL viewshed. Generally, portions of LANL located along mesa tops at lower elevations toward the eastern site boundary are covered with grasslands, mixed shrubs, or short trees, with sparsely distributed taller trees, allowing greater visibility from within the viewshed. In contrast, portions of LANL located at upper elevations toward the western boundary are more densely covered by tall mixed conifer forests that reduce the visibility of these areas (LANL 2008).

Undeveloped lands within LANL have a BLM Visual Resource Contrast rating of Classes II and III, which are described in Table 4.1.2-1. Changes to the landscape within these classes may be seen but should not dominate the view.

Table 4.1.2-1—BLM Visual Resource Management Rating System

Class	Objective
Class I	To preserve the existing character of the landscape, the level of change to the characteristic landscape should be very low and must not attract attention.
Class II	To retain the existing character of the landscape, the level of change to the characteristic landscape should be low.
Class III	To partially retain the existing character of the landscape, the level of change to the characteristic landscape should be moderate.
Class IV	To provide for management activities which require major modification of the existing character of the landscape, the level of change to the characteristic landscape can be high.

Source: BLM 1980.

As viewed from a distance at lower elevations, LANL is primarily distinguishable among the trees in the daytime by views of its water storage towers, emission stacks, the domes at TA-54, and occasional glimpses of older buildings. The new National Security Sciences Building is eight stories in height and is highly visible. The Los Alamos townsite appears mostly residential in character, with the water storage towers being visible against the forested backdrop of the Jemez Mountains. At elevations above LANL, along the upper reaches of the Pajarito Plateau rim, the view of LANL is primarily of scattered buildings among heavily forested areas and the multi-storied buildings within TA-3. Similarly, the residential character of the Los Alamos townsite is predominately visible from higher elevation viewpoints (LANL 2008, LANL 2004f).

At night, the lights of LANL, the Los Alamos townsite, and White Rock are directly visible from various locations across the viewshed as far away as the towns of Española and Santa Fe. Because there is little nighttime activity at LANL, there are relatively few security light sources compared to the nearby communities; thus, at a distance, the distinction between LANL and the two communities is lost to the casual observer (LANL 2008).

An important viewpoint of LANL is the Bandelier National Monument. Views from the Main Unit are generally of natural landscapes, although, there are instances where LANL structures are visible. LANL structures are also visible from the Tsankawi Unit (LANL 2008).

The Cerro Grande Fire of 2000 altered views of LANL from various locations in Los Alamos County. While many LANL facilities are still generally screened from view, some developed areas that were previously screened by vegetation are now more visible to passing traffic (LANL 2008).

Following September 11, 2001, a number of changes that limited or redirected public access to facilities at LANL were initiated resulting in fewer opportunities for the public to view LANL facilities (LANL 2008).

4.1.3 Site Infrastructure

Site infrastructure includes the physical resources required to support the construction and operation of LANL facilities. Utility infrastructure at LANL encompasses the electrical power, natural gas, and, water supply systems. These systems are described in Table 4.1.3-1.

Table 4.1.3-1—LANL Site Infrastructure

Characteristics	Current Value
Land Use	
Area (acres)	25,600
Roads (miles)	80[a]
Electricity[b]	
Energy (MWh/yr)[c]	1,138,800
Peak load (MWe)[d]	130
Fuel[e]	
Natural Gas (million yd^3)	44
Water	
Usage (million gal/year)	380

Source: LANL 2008.
[a] Includes paved roads and paved parking areas only.
[b] Usage and capacity values are for the entire Los Alamos Power Pool.
[c] Energy—Energy use during normal operations
[d] Peak load—Maximum demand of electricity
[e] Contractually-limited capacity for the natural gas delivery system servicing the Los Alamos area.

4.1.3.1 *Ground Transportation*

Motor vehicles are the primary means of transportation to LANL. The nearest commercial bus terminal is located in Santa Fe, New Mexico, about 25 miles. The nearest commercial rail connection is at Lamy, New Mexico, 52 miles southeast of LANL. There is a spur into central Santa Fe used by the Santa Fe Southern Railway. However, LANL does not currently use rail for commercial transport (LANL 2008).

Park-and-ride services are provided by a commercial corporation in conjunction with the New Mexico State Highway and Transportation Department. Over 80 daily departures between Santa Fe and Española; Santa Fe and Los Alamos; Española and Los Alamos; and Albuquerque, Santa Fe, and Los Alamos are provided for commuters. Monthly passes are available for unlimited use of most park-and-ride services (LANL 2008).

Hazardous, radioactive, industrial, commercial, and recyclable materials, including wastes, are routinely transported to, from, and on the LANL site. Hazardous materials include commercial chemical products that are nonradioactive and are regulated and controlled based on whether they are listed materials, or if they exhibit the hazardous characteristics of ignitability, toxicity, corrosivity, or reactivity. Radioactive materials include special nuclear material (plutonium, enriched uranium), medical radioisotopes, and other miscellaneous radioactive materials. Offsite transport, both to and from LANL, is performed by commercial carriers and by DOE safe secure transport trailers (LANL 2008).

The primary route designated by the State of New Mexico to be used for radioactive and other hazardous material transport to and from LANL is the 40-mile corridor between LANL and Interstate 25 at Santa Fe. This route passes through the Pueblos of San Ildefonso, Pojoaque, Nambe, and Tesuque, and is adjacent to the northern segment of Bandelier National Monument. This primary transportation route bypasses the city of Santa Fe on NM 599 to Interstate 25 (LANL 2008).

Numerous regulations and requirements govern the transportation of hazardous and radioactive materials, including those of the U.S. Department of Transportation, U.S. Nuclear Regulatory Commission, DOE, and LANL. Additional transportation information is presented in 4.5.3.12 (LANL 2008).

4.1.3.2 *Electricity*

Electrical service to LANL is supplied through a cooperative arrangement with Los Alamos County, known as the Los Alamos Power Pool, which was established in 1985. Electric power is supplied to the pool through two existing regional 115-kilovolt electric power lines. The first line (the Norton-Los Alamos line) is administered by DOE and originates from the Norton Substation east of White Rock, and the second line (the Reeves Line) is owned by the Public Service Company of New Mexico and originates from the Bernalillo-Algodones Substation south of LANL. Both substations are owned by the Public Service Company of New Mexico (LANL 2008).

Import capacity is now limited only by the physical capability (thermal rating) of the transmission lines based on transmission agreements made in 2002 with the Public Service Company of New Mexico. The import capacity is about 110 to 120 megawatts from a number of hydroelectric, coal, and natural gas-powered generators throughout the western United States (LANL 2008).

Within LANL, DOE also operates a natural gas-fired steam and electrical power generation plant at the TA-3 Co-Generation Complex, which can produce as much as 20 megawatts of electric power that is shared by the Power Pool under contractual arrangement. Generally, onsite electricity production is used to fill the difference between peak loads and the electric power import capability. The DOE-maintained electric distribution system at LANL consists of various low-voltage transformers at LANL facilities and about 34 miles of 13.8-kilovolt distribution lines. It also consists of two older power distribution substations: the Eastern TA Substation and the TA-3 Substation. Construction of the new Western TA Substation was completed in 2002. This 115-kilovolt (13.8-kilovolt distribution) substation has a main transformer rated at 56-megavolt-amperes or about 45 megawatts. The substation provides redundant capacity for LANL and the Los Alamos Townsite in the event of an outage at either of the two existing LANL substations (LANL 2008).

To address the potential for an electrical brownout or blackout, plans have been proposed to construct new transmission line segments, one from the Norton Substation to the Southern TA Substation, a new substation under construction near White Rock, and from the new Southern TA Substation to the Western TA Substation as well. The first segment would be constructed at 345 kilovolts but operated in the short term at 115 kilovolts, as large pulse power loads at LANL would need the higher voltage in the future. The second segment would be constructed and operated at 115 kilovolts. Construction of the portion of the new transmission line from the Southern TA Substation to the Western TA Substation is now complete. The construction of the portion of the line from the Norton Substation to the Southern TA Substation is under negotiation. Other electrical system upgrades at the site are planned or already underway (LANL2008).

4.1.3.3 *Fuel*

Natural gas is the primary heating fuel used at LANL. Natural gas is delivered to the site by a high-pressure main and distribution system with pressure-reduction stations at LANL buildings. The main gas supply line and associated meter stations are owned by the Public Service Company of New Mexico (LANL 2008).

About 98 percent of the gas consumed at LANL is used to heat air and generate steam. The TA-3 Co-Generation Complex is the principal consumer of natural gas at LANL. The remainder is used for steam-generated electrical power production at the TA-3 Co-Generation Complex. The TA-3 Co-Generation Complex currently has three dual fuel boilers with associated steam turbine-generator sets, which use natural gas as the primary fuel and Number-2 fuel oil available for use as a standby fuel. Low-pressure steam is supplied to the TA-3 district heat system and some of the process needs. The electricity is then routed into the power grid. The TA-3 steam distribution system has about 5.3 miles of steam supply and condensate return lines. Steam used to heat facilities is also currently generated at the TA-21 steam plant. This facility has three relatively small boilers, each with only about 5 percent of the capacity of the units at the TA-3 Co-Generation Complex. They are primarily natural gas-fired but can also burn Number-2 fuel oil. Steam produced in the TA-21 steam plant is used to provide space heat for the buildings in TA-21. LANL also maintains about 200 other smaller boilers, which are primarily natural gas fired. As mentioned above, relatively small quantities of fuel oil are also stored at LANL as a backup fuel source for emergency generators, and use is therefore negligible (LANL 2008).

4.1.3.4 *Water*

The Los Alamos County water production system consists of 14 deep wells, 153 miles of main distribution lines, pump stations, and storage tanks. The system supplies potable water to all of the County, LANL, and Bandelier National Monument. The deep wells are located in three well fields (Guaje, Otowi, and Pajarito). Water is pumped into production lines, and then booster pump stations lift this water to reservoir tanks for distribution. Prior to distribution, the entire water supply is disinfected (LANL 2008).

DOE transferred operation of the system to Los Alamos County under a lease agreement. Under the agreement, DOE retained responsibility for operation of the distribution system within LANL boundaries, whereas the county assumed full responsibility to ensure compliance with Federal and state potable water regulations. DOE retains the right to withdraw an equivalent of about 5,541 acre-feet of water per year from the main aquifer and to purchase a water allocation of some 1,200 acre-feet per year from the San Juan-Chama Transmountain Diversion Project. LANL is now considered a Los Alamos County water customer, and the County issues an invoice for water consumed by LANL (LANL 2008).

LANL does not have a ceiling on its water rights. However, DOE has implemented a target ceiling of 1,662 acre-feet (542 million gallons [2,050 million liters] per year), as that is the amount of water rights it owns and leases to Los Alamos County. With proposed changes to the management of LANL facilities, at a maximum LANL could use up to 522 million gallons (1,980 million liters) of water per year. This represents a 45 percent increase in total water use at LANL, but remains within the historical consumption of LANL and within the ceiling limit of water as defined by the contract with the water utility. The annual water use ceiling for LANL is 542 million gallons (2,050 million liters) (LANL 2008)The firm rated capacity is the maximum amount of water that can be pumped immediately to meet peak demand (LANL 2008).

The onsite water distribution system is more than 50 years old. Portions of the system are replaced as problems arise. The condition of the water distribution system was identified as a concern in the *1999 LANL SWEIS*. An initiative is underway to install additional water meters and a Supervisory Control and Data Acquisition and Equipment Surveillance System on the water distribution system to track water usage and determine specific water use for various applications. Accumulated data will establish a baseline for future conservation efforts. DOE has also initiated efforts to automate monitoring to improve system response for emergency situations. DOE has instituted a number of conservation and gray-water-reuse projects, including a cooling tower conservation project to reduce water usage further and ensure that future LANL initiatives are not limited by water availability (LANL 2008).

4.1.4 Air Quality and Noise

4.1.4.1 *Air Quality*

LANL provides regulatory and environmental surveillance leadership and services to meet air quality obligations and public assurance needs by developing and implementing programs to ensure institutional compliance with State and Federal Laws related to air quality regulations, and DOE Orders for emergency management, air quality surveillance, and dose assessment activities, as well as to address community concerns related to air quality issues (LANL 2006b).

4.1.4.1.1 Meteorology and Climatology

Los Alamos has a semiarid, temperate mountain climate. This climate is characterized by seasonable, variable rainfall with precipitation ranging from 10 to 20 inches per year. The climate of the Los Alamos townsite is not as arid (dry) as that part near the Rio Grande, which is arid continental. Meteorological conditions within Los Alamos are influenced by the elevation of the Pajarito Plateau (DOE 2002). Normal (30-year mean) precipitation for the communities of Los Alamos and White Rock and the extremes of precipitation are unchanged for the expanded period 1971 through 2000 (LANL 2008, LANL 2004e).

There are four distinct seasons in Los Alamos County, winters are generally mild, with occasional winter storms; spring is the windiest season; summer is the rainy season, with occasional afternoon thunderstorms; and fall is typically dry, cool, and calm (LANL 2006).

Normal (30-year mean) minimum and maximum temperatures for the community of Los Alamos range from a mean low of 17.4 °F in January to a mean high of 80.6 °F in July. Los Alamos townsite temperatures have dropped as low as -18 °F and have reached as high as 95 °F. The normal annual precipitation for Los Alamos is approximately 19 inches. The lowest recorded annual precipitation in Los Alamos townsite was 7 inches and the highest was 39 inches (DOE 2002).

Since 1999, the most widespread and pervasive climatological change in the region has been drought. LANL precipitation records show that between 1995 and 2005 there were two years (1997 and 2005) with above average precipitation. Precipitation patterns leading into the recent drought are strikingly similar, but of greater duration, to the period from 1953 to 1956, commonly referred to as the 1950s drought. The 1950s drought consisted of 4 years of progressively declining rainfall, with a sharp increase in precipitation in 1957 that ended the drought. The recent drought has been partially responsible for several disturbances that have greatly affected the regional environment. Dry weather facilitated the Cerro Grande Fire in May 2000, and set the stage for the bark beetle infestation that started around the summer of 2002 (LANL 2008). Precipitation in 2004 was close to average (LANL 2005g).

4.1.4.1.2 Ambient Air Quality

Only a limited amount of ambient air monitoring has been performed for nonradiological air pollutants within the LANL region. New Mexico Environment Department (NMED) operated a DOE-owned ambient air quality monitoring station adjacent to Bandelier National Monument between 1990 and 1994 to record sulfur dioxide, nitrogen dioxide, ozone, and PM_{10} levels. DOE and NMED discontinued operation of this station in fiscal year 1995 because recorded values were well below applicable standards.

New Mexico State had ambient air quality control standards for beryllium, which were repealed in 1995. To ensure that LANL beryllium emissions did not exceed those standards, ambient air monitoring of beryllium was performed at LANL from 1988 to December 1995. The recorded beryllium levels were low, and as a result, beryllium monitoring was discontinued after December 1995. Beryllium monitoring resumed in 1998 through the present at over 20 sites located near potential beryllium sources at LANL or in nearby communities. Air concentrations remain very similar to those measured previously.

After the Cerro Grande Fire in the spring of 2000, there was concern that an adequate baseline of nonradiological ambient air sampling was not in place at LANL. Therefore, in 2001, DOE designed and implemented a new air monitoring program, entitled NonRadNET, to provide nonradiological background ambient data under normal conditions. The NonRadNET program includes real-time ambient sampling for PM_{10} and $PM_{2.5}$. Additionally, air samples were collected in the first year of this program and analyzed for up to 20 inorganic elements and up to 160 volatile organic compounds. The results for PM_{10} and $PM_{2.5}$ for 2005 are presented in Table 4.1.4-1. Results for the inorganic elements and the volatile organic compounds were all below any published ambient or occupational exposure limits. More information about this ambient monitoring program can be found in the report entitled *Nonradioactive Ambient Air Monitoring at Los Alamos National Laboratory 2001–2002* (LANL 2008).

Table 4.1.4-1—Ambient Air Monitoring for Particulate Matter

Station Location	Constituent	Annual Mean Monitored Value (micrograms per cubic meter)	NAAQS Primary Annual Standard (micrograms per cubic meter)	Maximum 24-Hour Monitored Valve (micrograms per cubic meter)	NAAQS 24-Hour Standard (micrograms per cubic meter)
48thStreet, Los Alamos	PM_{10}	12	50	34	150
	$PM_{2.5}$	7	15	20	65
Los Alamos Medical Center	PM_{10}	15	50	55	150
	$PM_{2.5}$	8	15	27	65
White Rock Fire Station	PM_{10}	13	50	34	150
	$PM_{2.5}$	7	15	20	65

Source: LANL 2008.
Note: NAAQS = National Ambient Air Quality Standards, PMn=Particulate matter less than n microns in aerodynamic diameter.

Criteria pollutants released from LANL operations are emitted primarily from combustion sources such as boilers and emergency generators. Estimated emissions from operations at LANL for the years 1999 through 2005 are shown in Table 4.1.4-2. Data includes emissions from the operation of facilities at LANL (LANL 2008).

Table 4.1.4-2—Emissions of Criteria Pollutants

Pollutant[a]	Emissions per year[b]						
	1999	2000	2001	2002	2003	2004[b]	2005
Carbon Monoxide	32	26	29.08	28.1	31.9	35.4	35.1
Nitrogen Oxides	88	80	93.8	64.7	49.6	50.5	50.5
Particulate Matter	4.5	3.8	5.5	15.5[c]	22.1[c]	4.8	5.0
Sulfur Oxides	0.55	4.0 d	0.82	1.3[e]	1.6[e]	1.5	1.0

Source: LANL 2008.
[a] Tons per year.
[b] Values include emissions from small boilers and heaters not included in previous years' emissions inventories.
[c] Increased emissions of particulate matter were primarily due to operation of three air curtain destructors used to burn wood and slash from the fire mitigation activities.
[d] The higher emissions of sulfur oxides were due to the main steam plant burning fuel oil during the Cerro Grande Fire.
[e] The increased emissions of sulfur oxides were due to operation of the three air curtain destructors used to burn wood and slash from fire mitigation activities.

Approximately two-thirds of the most significant criteria pollutants, nitrogen oxides, result from the TA-3 steam plant. In late 2000, DOE received a permit from the NMED to install flue gas recirculation equipment on the steam plant boilers to reduce emissions of nitrogen oxide. This equipment became operational in 2002, and initial source tests indicated a reduction in emissions, of approximately 64 percent. The water pump, which was a large source of nitrogen oxide emissions, was transferred to Los Alamos County in November 2001 (LANL 2003g, 2004h).

Under the Title V Operating Permit program, LANL is a major source, based on the potential to emit, for nitrogen oxides (NOX), carbon monoxide (CO), and volatile organic compounds VOCs). In 2005, the TA-3 steam plant and boilers located across the LANL were the major contributors of NOX, CO, and particulate matter (PM). Research and Development (R&D) activities were responsible for most of the VOC and hazardous air pollutants emissions. A summary of the data is presented in Table 4.1.4-3.

Table 4.1.4-3—Operation Permit Emission Limits

Facility	Emissions (tons per year unless stated)					
	Nitrogen Oxides	Carbon Monoxide	Volatile Organic Compounds	Sulfur Dioxide	Particulate Matter	Hazardous Air Pollutants
LANL – Entire Facility	245	225	200	150	120	24 combined/ 8 individual
Asphalt Production (TA-60-BDM)	1.0	2.6	1.0	1.0	0.04 grams per dry standard cubic foot, 35.4 pounds per hour	NA
Beryllium Activities						
CMR Facility (TA-3-29)	NA	NA	NA	NA	Beryllium 10 grams per 24 hours	NA
Sigma Facility (TA-3-66)	NA	NA	NA	NA	Beryllium 10 grams per 24 hours	NA
Beryllium Technology Facility (TA-3-141)	NA	NA	NA	NA	Beryllium 0.35 grams per 24 hours 3.5 grams per year	NA
TA-16-207	NA	NA	NA	NA	Beryllium 10 grams per 24 hours	NA
TA-35-87	NA	NA	NA	NA	Beryllium 10 grams per 24 hours	NA
Target Fabrication Facility (TA-35-213)	NA	NA	NA	NA	Beryllium 1.8×10^{-4} grams per year, 0.36 grams per year	NA

Table 4.1.4-3—Operation Permit Emission Limits (continued)

Facility	Emissions (tons per year unless stated)					
	Nitrogen Oxides	Carbon Monoxide	Volatile Organic Compounds	Sulfur Dioxide	Particulate Matter	Hazardous Air Pollutants
Plutonium Facility (TA-55-PF4)						
Machining Operation	NA	NA	NA	NA	Beryllium - 0.12 grams per 24 hours, 2.99 grams per year Aluminum - 0.12 grams per 24 hours, 2.99 grams per year	NA
Foundry Operation	NA	NA	NA	NA	Beryllium - 3.49×10^{-5} grams per 24 hours, 8.73×10^{-4} grams per year Aluminum - 3.49×10^{-5} grams per 24 hours, 8.73×10^{-4} grams per year	NA
Boilers and Heaters[a]	80	80	50	50	50	NA
Carpenter Shops						
TA-15-563	NA	NA	NA	NA	2.81	NA
TA-3-38	NA	NA	NA	NA	3.07	NA
Chemical Usage (facility wide)	NA	NA	200	NA	NA	8 individual chemical 24 total
Plutonium Facility (TA-55-PF4)						
Degreasers – TA-55-DG-1, TA-55-DG-2, and TA-55-DG-3	NA	NA	200 facility wide	NA	NA	8 individual 24 total
Internal Combustion Sources						
TA-33-G-1 (diesel generator)	18.1 tons per year, 40.3 pounds per hour	15.2 tons per year, 33.7 pounds per hour	0.3 tons per year, 0.7 pounds per hour	2.5 tons per year, 5.5 pounds per hour	TSP 0.6 tons per year, 1.4 pounds per hour PM_{10} 0.6 tons per year, 1.4 pounds per hour	NA
Various StandbyGenerators[b]	NA	NA	NA	NA	NA	NA
Data Disintegrator/ Industrial Shredder	NA	NA	NA	NA	TSP 9.9 tons per year, 2.3 pounds per hour PM_{10}9.9 tons per year, 2.3 pounds per hour	NA
Power Plant at TA-3-22						
TA-3-22-1	10.2 pounds per hour gas 11.3 pounds per hour oil	7.0 pounds per hour gas 6.5 pounds per hour oil	1.0 pounds per hour gas 0.3 pounds per hour oil	1.1 pounds per hour gas 9.6 pounds per hour oil	TSP 1.3 pounds per hour gas 4.3 pounds per hour oil PM_{10} 1.3 pounds per hour gas 3.0 pounds per hour oil	NA
TA-3-22-2	10.2 pounds per hour gas 11.3 pounds per hour oil	7.0 pounds per hour gas 6.5 pounds per hour oil	1.0 pounds hour gas 0.3 pounds per hour oil	1.1 pounds per hour gas 9.6 pounds per hour oil	TSP 1.3 pounds per hour gas 4.3 pounds per hour oil PM_{10} 1.3 pounds per hour gas 3.0 pounds per hour oil	NA
TA-3-22-3	10.2 pounds per hour gas 11.3 pounds per hour oil	7.0 pounds per hour gas 6.5 pounds per hour oil	1.0 pounds hour gas 0.3 pounds per hour oil	1.1 pounds per hour gas 9.6 pounds per hour oil	TSP 1.3 pounds per hour gas 4.3 pounds per hour oil PM_{10} 1.3 pounds per hour gas 3.0 pounds per hour oil	NA

Table 4.1.4-3—Operation Permit Emission Limits (continued)

Facility	Emissions (tons per year unless stated)					
	Nitrogen Oxides	Carbon Monoxide	Volatile Organic Compounds	Sulfur Dioxide	Particulate Matter	Hazardous Air Pollutants
Power Plant at TA-3-22 *(continued)*						
Boilers Combined	60.2 tons per	41.3 tons per year	5.6 tons per year	7.9 tons per year	TSP 8.4 tons per year PM_{10}8.2 tons per year	NA
TA-3-22 CT-1	23.8 pounds per hour 33.2 tons per year	170.9 pounds per hour 19.8 tons per year	1.0 pounds per hour	1.4 pounds per hour 1.9 tons per year	TSP 1.6 pounds per hour 2.3 tons per year PM_{10}1.6 pounds per hour 2.3 tons per year	NA

Source: LANL 2008.
NA = not available, CMR=Chemistry and Metallurgy Research, TSP=total suspended particulate, PM_{10}=particulate matter less than 10 microns in aerodynamic diameter, TA=technical area.
[a] Including TA-16-1484-BS-1, TA-16-1484-BS-2, TA-21-357-1, TA-21-357-2, and TA-21-357-3, TA-48-1-BS-1, TA-48-1-BS-2, TA-48-1-BS-6, TA-50-2, TA-53-365-BHW-1, TA-53-365-BHW-2, TA-55-6-BHW-1, TA-55-6-BHW-2, TA-59-BHW-1, TA-59-BHW-2.
[b] Standby generators are limited to an average of 168 hours per year; tons per year to metric tons per year, multiply by 0.9072.
Note: To convert pounds per hour to kilograms per hour, multiply by 0.45359; tons per year to metric tons per year, multiply by 0.90718.

4.1.4.1.3 Radiological Air Emissions

The LANL radiological air-sampling network, referred to as AIRNET, measures the environmental levels of airborne radionuclides, such as plutonium, americium, uranium, tritium, and activation products that could be released from LANL operations. Most regional airborne radioactivity comes from the following sources: (1) natural radioactive constituents in particulate matter (such as uranium and thorium), (2) terrestrial radon diffusion out of the Earth and its subsequent decay products, (3) material formation from interaction with cosmic radiation, and (4) fallout from past atmospheric nuclear weapons tests conducted by several countries. Table 4.5.4.1-4 summarizes regional levels of radioactivity in the atmosphere over the period 1999 – 2005 (LANL 2008).

Table 4.1.4-4—Annual Average Background Concentration of Radioactivity in the Regional Atmosphere

	Units[a]	EPA Concentration Limit[b]	1999	2000	2001	2002	2003	2004	2005
Gross Alpha	fCi/m^3	NA	1	1	0.8	0.8	0.8	1.1	0.9
Gross Beta	fCi/m^3	NA	13.4	13	13.9	13.3	13.7	18.3	16.3
Tritium	pCi/m^3	1,500	0.5	0.8	NM	NM	NM	0.1	0.1
Strontium-90	aCi/m^3	19,000	NA	NA	NA	4	11	NA	NA
Plutonium-238	aCi/m^3	2,100	NM	0	0	0	NM	0.09	0
Plutonium-239 and Plutonium-240	aCi/m^3	2,000	0.1	0	0.1	0.3	NM	NM	0.1
Americium-241	aCi/m^3	1,900	NM	0.3	NM	0.3	NM	NM	0.1
Uranium-234	aCi/m^3	7,700	16.1	17.1	17.9	21.7	20.9	17.4	12.4
Uranium-235	aCi/m^3	7,100	1.2	0.9	1.3	2.4	1.8	1.17	1.2
Uranium-238	aCi/m^3	8,300	15.2	15.9	17.7	21.8	20.1	17.0	13.2

Source: LANL 2008.
EPA = U.S. Environmental Protection Agency, NA = not available, NM = not measurable, m^3 = cubic meters, pCi = picocurie = 10^{-12} curie, fCi = femtocurie = 10^{-15} curie, aCi = attocurie = 10^{-18} curie.

In 2005, 28 stacks were continuously monitored for the emission of radioactive material to the ambient air. A total of 19,100 curies of stack emissions were measured for year 2005. This included 704 curies of tritium emissions and 18,400 curies of activation products from the Los Alamos Neutron Science Center (LANSCE). Airborne emissions of plutonium, uranium, americium, and thorium were less than 0.00002 curies. Overall, radiological air emissions at LANL tend to be dominated by emissions from LANSCE stacks and tritium (LANL 2008). Table 4.1.4-5 provides further detailed emissions data for buildings with sampled stacks in the years 1999 through 2005. Overall, radiological air emissions at LANL tend to be dominated by emissions from LANSCE stacks and tritium.

Table 4.1.4-5—Range of Annual Airborne Radioactive Emissions from LANL with Sampled Stacks from 1999 through 2005 (curies)

TA Building	Tritium [a]	Americium-241	Plutonium [b]	Uranium [c]	Thorium [d]	P/VAP [e]	G-MAP [f]	Strontium-90
TA-3-029	–	1.3×10^{-7} – 2.6×10^{-6}	2.1×10^{-6} – 2.1×10^{-5}	2.8×10^{-6} – 9.8×10^{-6}	1.3×10^{-7} – 1.3×10^{-6}	2.2×10^{-5} [g]	–	2.1×10^{-7} – 3.9×10^{-7}
TA-3-102	–	1.0×10^{-10} [h]	3.9×10^{-10} [i]	4.4×10^{-9} – 3.3×10^{-7}	8.0×10^{-10} – 7.2×10^{-9}	–	–	–
TA-16-205	140–7900 [j]	–	–	–	–	–	–	–
TA-21-155	66–520	–	–	–	–	–	–	–
TA-21-209	61–760	–	–	–	–	–	–	–
TA-48-001	–	–	1.7×10^{-9} [i]	6.1×10^{-10} – 6.5×10^{-9}	1.1×10^{-9} [h]	0.00023 – 0.017	–	–
TA-50-001	–	6.9×10^{-9} – 1.3×10^{-7}	7.4×10^{-9} – 5.1×10^{-8}	2.5×10^{-8} [i]	3.7×10^{-8} – 7.0×10^{-8}	–	–	–
TA-50-037	–	5.8×10^{-10} [i]	8.9×10^{-10} [i]	1.9×10^{-8} [k]	3.4×10^{-9} [h]	–	–	3.4×10^{-9} [h]
TA-50-069	–	5.8×10^{-11} – 7.6×10^{-10}	9.9×10^{-11} – 5.3×10^{-9}	–	1.2×10^{-10} -1.2×10^{-9}	–	–	–
TA-53-003	0.57–1.8	–	–	–	–	3.5×10^{-10} [h]	1.7 – 8.4	–
TA-53-007	0.45–7.2	–	–	–	–	0.016 – 60	300 – 18,400	–
TA-55-004	1.8–61	6.2×10^{-9} – 5.9×10^{-7}	4.3×10^{-8} – 2.5×10^{-6}	7.1×10^{-8} – 2.3×10^{-7}	3.4×10^{-8} – 1.5×10^{-7}	–	–	5.6×10^{-8} [h]

Source: LANL 2008.
TA=technical area.
[a] Includes both gaseous and oxide forms of tritium.
[b] Includes plutonium-238, plutonium-239, and plutonium-240.
[c] Includes uranium-234, uranium-235, and uranium-238.
[d] Includes thorium-228, thorium-230, and thorium-232.
[e] P/VAP—Particulate and vapor activation products.
[f] G-MAP—Gaseous mixed activation products.
[g] Only emitted during 2005.
[h] Only emitted during 2003.
[i] Only emitted during 2002.
[j] The 7,900 curies were an unanticipated one-time release in 2001.
[k] Only emitted during 1999.

4.1.4.2 *Noise*

Noise, air blasts, and ground vibrations are intermittent aspects of the LANL area environment. Although the receptor most often considered for these environmental conditions is human, sound and vibrations may also be perceived by animals in the area. Little is known about how different wildlife species may react to these noises and vibrations; however, the observed vigor and wellness of area wildlife and federally-protected bird populations suggests that LANL noise and vibration conditions do not pose problems for wildlife in the area (LANL 2008).

Public noise is the noise that is present outside LANL site boundaries. Public noise originates from the combined effect of existing LANL traffic and site activities and the noise generated by activities around the Los Alamos and White Rock communities. Worker noise is the noise generated by DOE activities within LANL boundaries. Air blasts consist of a higher frequency portion of audible air pressure waves that accompany an explosives detonation. This noise can be heard by both LANL workers and the area public. The lower frequency portion of air pressure waves is not audible, but may cause a secondary and audible noise within a test structure that may be heard by workers. Air blasts and most ground vibrations generated at LANL result from test activities that involve aboveground explosives research (LANL 2008).

The forested condition of much of LANL (especially where the explosives test areas are located), atmospheric conditions in the area, and the regional topography that consists of widely varied elevations and rock formations, all influence how noise and vibrations can be both attenuated and channeled away from receptors. Together these regional features minimize the noise pollution and ground vibration concerns in the area due to LANL site operations. Loud sudden blast noises associated with explosive tests are similar to the sound of thunder and may occasionally startle members of the public and LANL workers alike. Although these noises are sporadic or episodic in nature, they contribute to noise pollution in the area (LANL 2008).

Loss of large forest areas from the Cerro Grande Fire in 2000 compromised the ability of the natural environment to absorb noise. However, types of noise and noise levels associated with LANL and from activities in nearby communities have not changed significantly as a result of the fire (LANL 2008).

The standard unit used to report sound level is the decibel (dB) which is a measure of the sound pressure independent of frequency. Noise, however, is generally a combination of many sound frequencies, some of which are more readily detected by the human ear. The A-weighted decibel (dBA) is a modification of the decibel unit that accounts for the perceived loudness of noise by human ears (LANL 2008).

Existing LANL-related publicly detectable noise levels are generated by a variety of sources, including onsite transport via truck and automobile, high explosive tests, and firearms practice activities. Noise levels within Los Alamos County unrelated to LANL are generated predominantly by traffic and to a much lesser degree by residential, commercial, and industrial-related activities within the nearby areas (LANL 2008).

Construction activities at LANL have produced a steady increase in temporary construction noise since 1999; however, these noise level increases have not resulted in increased annoyance to the public. Operation of new and modified facilities has not been reported to result in increased annoyance to the public from offsite noise impacts (LANL 2008).

Los Alamos County has promulgated a local noise ordinance that establishes noise level limits for residential land uses. Noise levels that affect residential receptors are limited to a maximum of 65 dBA in the daytime and 53 dBA at night (that is between 9 p.m. and 7 a.m.). Permissible daytime noise levels can reach 75 dBA in residential areas for no more than 10 minutes each hour. A permit is required for activities that fail to satisfy the noise ordinance limits (LANL 2008).

Traffic noise generated by traffic at the LANL site is exempt from Los Alamos County noise regulations, but not state and federal noise standards. Traffic noise constitutes the majority of background noise in the county. Sound measurements have been collected to target traffic noise at various places in the county; however, the sound levels are found to be highly dependent upon the exact measurement location, time of day, and meteorological conditions. For this reason, there is no single representative measurement for ambient traffic noise for the LANL site (LANL 2008).

Noise generated by traffic has been computer modeled to estimate the impact of incremental traffic for various studies, including recent NEPA analyses. The results indicate that planned new activities would impose a very minor change from current levels. While very few measurements of nonspecific background ambient noise in the LANL area have been made, two such measurements have been sampled at locations near the LANL boundaries near public roadways (LANL 2008).

Background noise levels were found to range from 31 to 35 dBA at the vicinity of the entrance to Bandelier National Monument and New Mexico State Rout 4. At White Rock, background noise levels range from 38 to 51 dBA; this is slightly higher than was found near Bandelier National Monument, probably due to higher levels of traffic, the presence of a residential neighborhood, and the different physical setting (LANL 2008).

The detonation of high explosives represents the peak noise levels generated by LANL operations. High explosives detonations produce air blasts and ground vibrations.

4.1.5 Water Resources

4.1.5.1 *Surface Water*

Watersheds that drain LANL property are dry for most of the year. No perennial surface water extends completely across LANL land in any canyon. The canyons consist of over 85 miles of watercourses located within LANL and immediately upstream of LANL within Los Alamos Canyon. Of the 85 miles of watercourse, approximately two miles are naturally perennial, and approximately three miles are perennial waters created by effluent (LANL 2008).

The remaining 80 or more miles of watercourse are dry for varying lengths of time. Streams that drain LANL area are dry for most of the year, and the area's surface water flows primarily in intermittent streams in response to local precipitation or snowmelt. The flow in these streams is ephemeral. Other streams may sometimes have the water table higher than the streambed and/or extensive snowmelt in the watershed and are said to be intermittent. Intermittent streams may flow for several weeks to a year or longer (LANL 2008).

Some of the surface water at LANL comes from groundwater discharging as springs into canyons. Surface water at LANL is not a source of municipal, industrial, irrigation, or recreational water, though it is used by wildlife. Although there is minimal direct use of surface water within LANL boundaries, flows may extend beyond site boundaries where there is more potential for use. Surface waters that flow off LANL may reach the Rio Grande, where contaminants could flow downstream (LANL 2008, LANL 2006b).

4.1.5.1.1 Surface Water Quality

Surface water quality has been affected by LANL operations, with the greatest effects caused by past discharges into Acid, Pueblo, Los Alamos, and Mortandad Canyons. TA-55 contains no permanent, natural surface water bodies and the developed areas are not located within a delineated floodplain (DOE 2002).

In accordance with DOE Order 450.1, Environmental Protection Program, and other statutory requirements, LANL personnel routinely monitor surface water, stormwater, and sediments as part of their ongoing environmental monitoring and surveillance program. The monitoring results are published annually in Environmental Surveillance Reports. Since 1999 LANL personnel expanded the water monitoring to a site-wide monitoring program that integrates groundwater, surface water, stormwater, and sediment monitoring, on a watershed basis.

Effluent quality from the TA-50 Radioactive Liquid Waste Treatment Facility has improved since 1999. New treatment processes have been installed to improve effluent quality. The 2005 calendar year marked the sixth consecutive year that the Radioactive Liquid Waste Treatment Facility effluent had no National Pollutant Discharge Elimination System (NDPES) violations or exceedances of the DOE Derived Concentration Guides for radioactive liquid wastes (LANL 2008). Annual average alpha activities in the Radioactive Liquid Waste Treatment Facility effluent was reduced to 5.2 picocuries per liter in 2005, compared to the DOE Derived Concentration Guide of 30 picocuries per liter (LANL 2008). Table 4.1.5-1 summarizes the water quality in the Radioactive Liquid Waste Treatment Facility effluent for 2005 for certain contaminants.

Table 4.1.5-1—Selected Water Quality Data for Radioactive Liquid Waste Treatment Facility Effluent in 2005

Contaminant	Effluent Concentration in 2004	Standard Concentration Limit	Water Quality Standard
Sum of 39 radionuclide ratios, including tritium	Less than 0.18	1.0 Sum of Ratios	DOE Derived Concentration Guideline
Nitrogen as nitrate	3.7 milligrams per liter	10 milligrams per liter	NMED Groundwater Standard for Human Health

Table 4.1.5-1—Selected Water Quality Data for Radioactive Liquid Waste Treatment Facility Effluent in 2005 (continued)

Contaminant	Effluent Concentration in 2004	Standard Concentration Limit	Water Quality Standard
Fluoride	0.24 milligrams per liter	1.6 milligrams per liter	NMED Groundwater Standard for Human Health
Total dissolved solids	182 milligrams per liter	1,000 milligrams per liter	NMED Groundwater Standard for Domestic Water Supply
Perchlorate	Not detected	(a)	No current standard
Tritium	3,200 picocuries per liter	2,000,000 picocuries per liter	DOE Derived Concentration Guideline
		20,000 picocuries per liter	EPA Primary Drinking Water Standard

Source: LANL 2008.
NMED=New Mexico Environment Department, EPA=U.S. Environmental Protection Agency.
[a] The EPA has proposed a drinking water standard for perchlorate of 4 micrograms per liter, but it has not been issued yet.

Table 4.1.5-2 summarizes the locations of LANL impacted surface water and sediments. The following are potential sources of contamination to local surface water resources (LANL 2008):

- Industrial effluents discharged through National Pollutant Discharge Elimination System (NPDES) permitted outfalls. This source is referred to as “NPDES-permitted outfalls” and includes point-source discharges from LANL wastewater treatment plants and cooling towers;
- Stormwater runoff, including stormwater runoff from certain industrial activities, construction activities, and solid waste management units ;
- Dredge and fill activities or other work within perennial, intermittent, or ephemeral water courses; and
- Sediment transport.

Recent data from stormwater runoff monitoring detected some contaminants onsite and offsite, but the exposure potential for these contaminants is limited. Radionuclides have been detected in runoff at higher than background levels in Pueblo, DP, Los Alamos, and Mortandad Canyons, with sporadic detections extending offsite in Pueblo and Los Alamos Canyons. Stormwater runoff exceeded the wildlife habitat standard for gross alpha activity of 15 picocuries per liter since the Cerro Grande Fire in nearly all canyons. Los Alamos Canyon and Sandia Canyon runoff and base flows contain polychlorinated biphenyls at levels above New Mexico human health stream standards.

Table 4.1.5-2—Surface Water and Sediment Contamination Affected by LANL Operations

Contaminant	Onsite	Offsite	Significance	Trends
Radionuclides in Sediments	Higher than background in sediments because of LANL contributions in Pueblo, DP, Los Alamos, Pajarito, and Mortandad Canyons.	Yes, in Los Alamos, Acid, and Pueblo Canyons; and slightly elevated in the Rio Grande and Cochiti Reservoir.	Sediments below health concern, except onsite along a short distance of Mortandad Canyon; exposure potential is limited.	Plutonium-239 and -240 and cesium-137 concentrations temporarily increased after the Cerro Grande Fire, but fell back to pre-fire levels in Pueblo and Los Alamos Canyons.
Radionuclides in Surface Water	Higher than background in runoff in Pueblo, DP, Los Alamos, and Mortandad Canyons.	Yes, Los Alamos and Pueblo Canyons.	Minimal exposure potential because storm events are sporadic. Mortandad Canyon surface water is 7 percent of Biota Concentration Guide.	Flows in Pueblo Canyon occurring more often after the Cerro Grande Fire. Flows in other LANL canyons recovered to near pre-fire levels.
Polychlorinated Biphenyls in Sediment	Detected in sediment in nearly every canyon	Yes, particularly in Los Alamos and Pueblo Canyons	Wildlife exposure in Sandia Canyons. Elsewhere, finding include non-LANL and LANL sources.	None.
Polychlorinated Biphenyls in Surface Water	Detected in Los Alamos and Sandia Canyon runoff and base flow above New Mexico Stream Standards.	No.	Wildlife exposure potential in Sandia Canyon. Elsewhere, findings include non-LANL and LANL sources.	Polychlorinated biphenyls are found everywhere in the Rio Grande, both upstream and downstream of LANL.
Dissolved Copper, Lead, and Zinc in Surface Water	Detected in many canyons above NM acute aquatic life standards.	Yes, in Los Alamos Canyon.	Origins uncertain; probably multiple sources.	None.
High Explosive Residues and Barium in Surface Water	Detections near or above screening values in Cañon de Valle base flow and runoff.	No.	Minimal potential for exposure.	None.
Benzo(a)pyrene	Detections near or above industrial screening levels in Los Alamos Canyon.	Yes, in Los Alamos and Acid Canyons.	Origins uncertain; probably multiple sources.	None.

Source: LANL 2008.

Dissolved copper, lead and zinc have been detected in many canyons above the New Mexico acute aquatic life stream standards, and these metals were detected offsite in Los Alamos Canyon. Some of this polychlorinated biphenyl (PCB) and metals' detections were upstream of LANL facilities, which indicate that non-LANL urban runoff was one source of the contamination. Mercury was detected slightly above wildlife habitat stream standards in Los Alamos and Sandia Canyons. The installation of erosion controls near the polychlorinated biphenyl and mercury sources to minimize further migration of these contaminants is an example of the watershed-based approach to surface water quality protection. Surface water in Cañon de Valle, a tributary of Water Canyon, occasionally has explosive residue levels greater than the 6.1 parts per billion EPA Tap Water Health Advisory level, but the barium levels have dropped below the New Mexico Groundwater Standard (LANL 2005j).

Los Alamos County, as owner and operator of the Los Alamos water supply system, is responsible for compliance with the requirements of the *Safe Drinking Water Act* (SDWA) and the New Mexico Drinking Water Regulations (NMAC 20.7.10). The SDWA requires Los

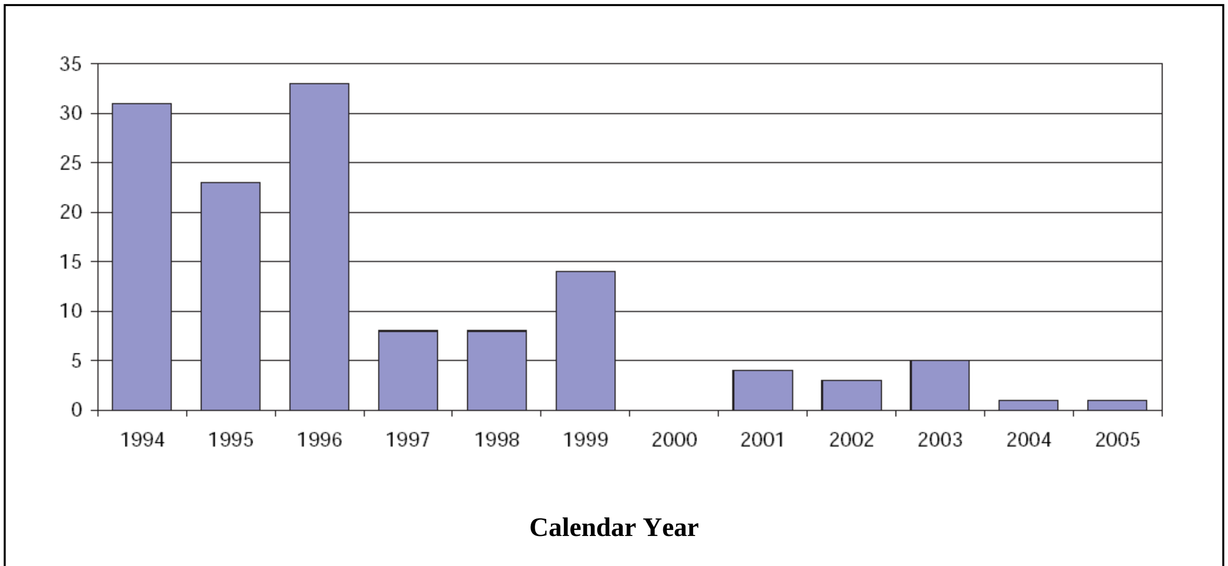
Alamos County to collect samples from various points in the water distribution systems at the LANL, Los Alamos County, and Bandelier National Monument to demonstrate compliance with SDWA maximum contaminant levels (MCLs). EPA has established MCLs for microbiological organisms, organic and inorganic constituents, and radioactivity in drinking water. The state has adopted these standards in the New Mexico Drinking Water Regulations. EPA has authorized NMED to administer and enforce Federal drinking water regulations and standards in New Mexico. In 2005, the LANL conducted additional confirmation monitoring of the Los Alamos water supply system for quality assurance purposes (LANL 2005j).

In 2005, Los Alamos County and NMED conducted sampling for microbiological organisms, nitrate+nitrite (asN), radionuclides, total trihalomethanes, total haloacetic acids, volatile and semi-volatile organic compounds, and heavy metals in drinking water for SDWA compliance purposes. In addition, lead and copper samples were collected from 34 residential taps. Results showed that all samples were compliant with SDWA MCLs (LANL 2006b).

4.1.5.1.2 Surface Water Rights and Permits

In 2005, University of California (UC) and DOE/NNSA were co-permittees of the NPDES permit covering LANL operations. LANL's current industrial point-source NPDES permit contains 21 permitted outfalls that include one sanitary outfall and 20 industrial outfalls. LANL eliminated four outfalls for the NPDES Permit re-applications submitted on July 30, 2004 (LANL 2008). LANL's new NPDES point-source permit was issued on June 2007 and became effective on August 1, 2007 and includes one sanitary outfall and 16 industrial outfalls for a total of 17 permitted outfalls (LANL 2008, EPA 2007).

LANL personnel collect weekly, monthly and quarterly samples to analyze effluents for compliance with NPDES permit levels. Since 2000, LANL has maintained an average compliance rate with permit conditions of 99.75 percent. Generally, exceedances of permit standards in the 5 years since 2000 were of excess total residual chlorine. Figure 4.1.5-1 shows the number of effluent exceedances over the past 12 years at LANL.



Source: LANL 2008.

Figure 4.1.5-1—Number of Exceedances of NPDES Outfall Effluent Limits Over the Past 12 Years

4.1.5.2 *Groundwater*

The three modes of groundwater occurrence are; 1) perched alluvial groundwater in canyon bottom sediments, 2) zones of intermediate-depth perched groundwater whose location is controlled by availability of recharge and by changes in rock permeability, and 3) the regional aquifer beneath the Pajarito Plateau.

4.1.5.2.1 Groundwater Quality

The drinking water in the Los Alamos area has not been adversely impacted by DOE actions. Low levels (below drinking water standards or proposed standards) of tritium, perchlorate and dioxane [1,4-] have been detected since 2000 in one water supply well (Otowi-1) that is not currently used in the County drinking water system. Perchlorate was detected in all groundwater zones in Mortandad Canyon, in the regional aquifer, and in Pueblo Canyon, off the LANL site, with an average concentration of 2.45 micrograms per liter, approximately 1/10th of the EPA Drinking Water Equivalent Value of 24.5 micrograms per liter (LANL 2008). There is no Federal or state standard for dioxane [1,4-] and LANL and NMED are currently working to determine the extent and impact of this contaminant. All drinking water produced by the Los Alamos County water supply system meets Federal and state drinking water requirements (LANL 2008)

Strontium-90 has been consistently found in trace amounts, as have plutonium-238, plutonium-239, plutonium-240 and americium-241. Regional groundwater sampling data from monitoring wells and production wells show that some wells have a high concentration of hexavalent chromium as a result of past laboratory activities and effluent from cooling-water systems (LANL 2008). Mortandad Canyon is the only location where in the mid 1990s, tritium was detected above the 20,000 picocuries per liter EPA drinking water MCL; levels dropped below the standard in 2001, and have been dropping steadily since then. None of the radionuclide levels exceeded the 100-millirem-per-year DOE Derived Concentration Guide (DCG) for public dose (LANL 2004f, LANL 2005j).

Discharges from the Radioactive Liquid Waste Treatment Facility caused high levels of nitrate and perchlorate in both alluvial and intermediate perched groundwater in Mortandad Canyon until new treatment methods were installed to remove nitrate in 1999 and perchlorate in 2002. Nitrate levels were below the 10-milligram-per-liter EPA MCL in Mortandad Canyon in 2003 and 2004 (for alluvial groundwater), but were close to or exceeded that level in previous years. Nitrate concentrations in Pueblo Canyon have been around the MCLl in recent years. Maximum perchlorate levels have been below 200 parts per billion in alluvial and intermediate perched groundwater in Mortandad Canyon (LANL 2004f, 2005j). EPA has not established a drinking water standard for perchlorate.

Molybdenum is found in Los Alamos Canyon alluvial groundwater as a result of treatment chemicals no longer used in the TA-53 cooling towers. Levels in the alluvial groundwater have been quite variable in recent years and are often above the 1 milligram per liter New Mexico groundwater standard for irrigation use. Barium exceeds New Mexico groundwater standard by 10 times in alluvial groundwater, now used as a drinking water supply and RDX (an explosive) exceeds U.S. Environmental Protection Agency (EPA) drinking water risk levels by 20 to 40 times in intermediate and alluvial groundwater. The value for barium and RDX in the monitoring wells vary seasonally, but remain high. Neither barium nor RDX are present in drinking water, but are present in alluvial groundwater of Cañon de Valle (LANL 2006b).

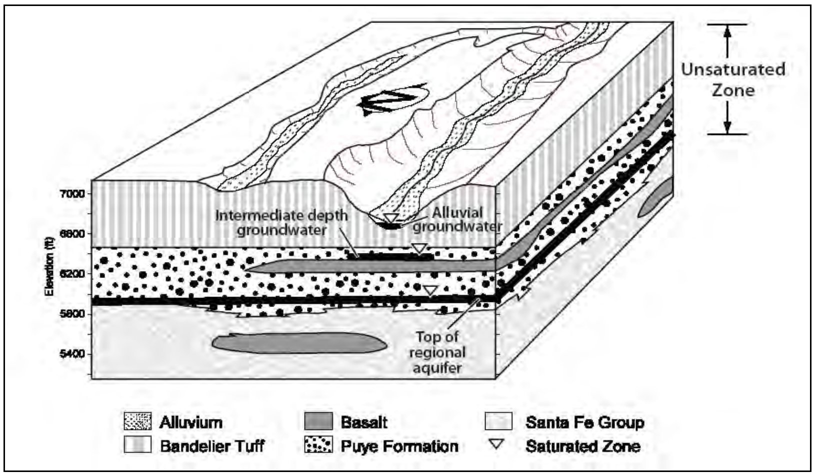
Chromium has also been detected in the regional aquifer in concentrations ranging from 375 to 404 parts per billion. This exceeds the New Mexico Water Quality Control Commission standard of 50 parts per billion and the EPA maximum standard of 100 parts per billion. The cause of the high concentration of chromium has yet to be determined, but DOE is providing an Interim Measures Work Plan to the NMED detailing information on historical pumping, causes of the high concentration of chromium and methods to ensure protection of this drinking water. Chromium may be a localized occurrence, limited to the well itself, and not due to past or present LANL activities. Chromium could be attributable to corrosion of stainless steel well screens (LANL 2008). LANL is monitoring the quality of its groundwater in accordance with the New Mexico Environment Department Consent Order. Under this Order, actions are being taken to ensure quality drinking water for Los Alamos County by implementing Interim Work Plans to research sources of contamination, history of the site and methods to reduce contamination to a level that complies with state and Federal regulations.

4.1.5.2.2 Groundwater Availability

The regional aquifer of the Los Alamos area occurs at a depth of approximately 1,200 feet along the western edge of the plateau and about 600 feet along the eastern edge. The regional aquifer lies about 1,000 feet beneath the mesa tops in the central part of the plateau. Water in the aquifer flows generally east or southeast toward the Rio Grande, and groundwater model studies indicate that underflow of groundwater from the Sierra de los Valles in the Jemez Mountains is the main source of recharge for the regional aquifer (Nylander et al. 2003).
About 350 to 620 feet of unsaturated tuff, basalt, and low moisture content sediments separate

the alluvial and perched groundwater zones and the regional aquifer (Figure 4.1.5-2) (LANL 2005j). Groundwater flow from the Sierra de los Valles to the Pajarito Plateau may be affected by the Pajarito Fault.

Deep below the ground surface, there is an area of saturation that forms the regional groundwater aquifer. The regional aquifer is the only aquifer in the area capable of serving as a municipal water supply; the regional aquifer supplies various customers including LANL, Los Alamos County, and others located in parts of Santa Fe and Rio Arriba Counties (LANL 2005j). Regional aquifer models have been developed that have focused on the amount of drawdown in the aquifer and the effects of pumping near the water supply wells for Los Alamos County and LANL. The recent regional drought would only affect water levels through increased withdrawals through water supply use, because recharge from the surface occurs at a slow rate, changing only over a period of decades.



Source: LANL 2008.

Figure 4.1.5-2—Illustration of Geologic and Hydrologic *Relationships in the Los Alamos Area, Showing the Three Modes of Groundwater Occurrence*

The Los Alamos potable water production system consists of 14 deep wells, 153 miles of main distribution lines, pump stations, storage tanks, and nine chlorination stations. On September 8, 1998, DOE transferred operation of the system from the LANL to Los Alamos County under a lease agreement. Under this agreement, LANL retained responsibility for operating the distribution system within its boundaries, whereas the county assumed full responsibility for operating the water system, including ensuring compliance with Federal and state drinking water regulations. The system supplies potable water to the county, LANL, and Bandelier National Monument. DOE's rights to withdraw an equivalent of about 1,806 million gallons of water per year from the main aquifer and its right to purchase a water allocation from the San Juan-Chama Transmountain Diversion Project were included in the lease agreement (LANL 2000).

The recent drop in the water table remains 1 to 2 feet per year as projected in the 1999 LANL SWEIS. Water demand at LANL continues to be well within DOE's water rights that DOE owns and leases to Los Alamos County. In 2005, approximately 380 million gallons of water were used at LANL. While LANL total and consumptive water use has generally decreased from 1999 to 2005, water usage by other Los Alamos County users has exhibited a generally upward trend over the period.

Los Alamos County recently completed a conversion of its water contract with the Bureau of Reclamation to access San Juan-Chama project water, which will enable the county to move forward with this water diversion project. This project, coupled with the implementation of the measures outlined in the Los Alamos County August 2006 Long-Range Water Supply Plan, should enable it to meet regional water demands for the next 40 years (LANL 2008)

4.1.6 Geology and Soils

LANL is located on the Pajarito Plateau within the Southern Rocky Mountains Physiographic Province. The Pajarito Plateau lies between the Sierra de Los Valles and the Jemez Mountains to the west and the Rio Grande to the east. It is formed of volcanic tuffs (welded volcanic ash) deposited by past volcanic eruptions from the Jemez Mountains to the west. The geology of the LANL region is the result of complex faulting, sedimentation, volcanism, and erosion over the past 20 to 25 million years (LANL 2008).

4.1.6.1 *Geology*

A primary geologic feature in the region is the Rio Grande Rift, which begins in northern Mexico, trends northward across central New Mexico, and ends in central Colorado. The rift is a complex system of north-trending basins that have formed by down faulting of large blocks of the Earth's crust. In the Los Alamos area, the Rio Grande Rift is about 35 miles wide and encompasses the Española Basin. The Sangre de Cristo Mountains border the Rio Grande Rift on the east, and the Jemez Mountains lie over the western fault margin of the rift. The north-trending Pajarito Fault system is part of the Rio Grande Rift and consists of a group of interconnecting faults that are nearly parallel.

The Jemez Mountains are a broad highland built up over the last 13 million years through volcanic activity. Most of the bedrock on LANL property is composed of the salmon-colored Bandelier Tuff (DOE 2004e). The surface of the Pajarito Plateau is divided into numerous narrow, fingerlike mesas separated by deep east-to-west-oriented canyons that drain to the Rio Grande. The canyons were formed by streams flowing eastward across the plateau from the Jemez Mountains to the Rio Grande.

The Cerro Toledo "Interval" of the Bandelier Tuff unit consists of volcaniclastic sediments and tephras reaching a thickness of 400 feet (LANL 2004e), an increase from the previously reported maximum thickness of 130 feet (LANL 2008).

In summary, the rocks present in the LANL region were predominantly produced by volcanic and sedimentary processes. The Pajarito Plateau is capped by the Bandelier Tuff. This unit attains a thickness of more than 700 feet in the LANL region and consists of ash-flow deposits of rhyolitic tuff and pumice, erupted between about 1.2 and 1.6 million years ago during the early to middle Quaternary period (i.e., Pleistocene) from the Valles and Toledo calderas located in the Jemez Mountains volcanic field (located west of LANL). Older, underlying units include the

Puye Formation, which is a sedimentary unit comprised from materials derived from the Jemez Mountains and the ancestral Rio Grande and intruded in places by Cerros del Rio basalt flows. Underlying the Puye Formation is the Tschicoma Formation which consists of volcanic vent deposits. The Santa Fe Group is the most extensive unit in the Rio Grande Rift and largely consists of sedimentary materials and rocks' including evaporites derived from stream or deltaic deposits, but also contains volcanic tuff deposits and basalts. The Santa Fe Group sits atop Precambrian age (greater than 570 million years old) crystalline basement rock (LANL 2008).

Overall, the complex interfingering and interlayering of strata beneath LANL results in variable properties that affect canyon wall formation, slope stability, subsurface fluid flow, seismic stability, and engineering properties of the rocks. In general, poorly indurated and densely fractured layers tend to form canyon slopes susceptible to failure during erosion or seismic events and require remediation prior to installing engineered structures on the mesa surfaces, in the canyons, or crossing canyon walls. In such cases, the direction and density of fractures is a critical engineering parameter. Beneath the Pajarito Plateau, the complex stratigraphy is reflected in the presence of perched groundwater zones. Perched groundwater occurs above welded tuffs in the Bandelier Tuff and other volcanic strata, above tuffs that have been altered to clays, above non-fractured basalt flows of the Cerro del Rio Basalts, and above fine-grained sedimentary deposits (such as lacustrine clays) in the Puye Formation (LANL 2008). The upper surface of the regional aquifer (the water table) lies within the lower portion of the Puye Formation. The aquifer includes the full thickness of the Santa Fe Group except along the Rio Grande River, where the water table drops below the overlying Puye Formation. Interbedded basalt flows may account for localized confining conditions observed in the aquifer (NPS 2005). The paleotopography and general dip to the southeast of the pre-Tshirege surface may strongly influence the direction of possible groundwater flow and contaminant migration in subsurface units. The paleotopography of the surface underlying the Bandelier Tuff may influence the flow direction of potential perched water zones (LANL 1999a).

In addition, the direction and rate of subsurface flow may be affected by the presence and orientation of fractures in some rock layers. As discussed above, these fractures may be related to cooling and formation of the individual strata. In some areas, faults related to seismic activity may also influence groundwater flow.

4.1.6.2 *Soils*

Most of the LANL facilities are located on mesa tops, where the soils are generally well-drained and thin (0 to 40 inches). TA-55 is located just to the southwest of the southern terminus of Rendija Canyon Fault, which is located about 0.8 miles northwest of the facility. Site stratigraphy is generally expected to be similar to that described above for TA-18, except that the thickness of overlying alluvium is thinner.

In May 2000, the Cerro Grande Fire burned approximately 43,000 acres, including about 7,700 acres on LANL (Balice, Bennett, and Wright 2004). The fire severely burned much of the mountainside that drains onto LANL (Gallaher and Koch 2004). The effects of the fire included increased soil erosion due to loss of vegetative cover, formation of hydrophobic soils, and soil disturbance during construction of fire breaks, access roads, and staging areas (DOE 2000f). The increased potential for flooding and erosion led to construction of mitigation structures to retain floodwaters and reinforce road crossings (DOE 2002i).

Combined with loss of vegetation, hydrophobic soil formation enhances the potential for increased runoff, soil erosion, downslope flooding, and degradation of water quality (Gallaher and Koch 2004). Approximately 9,310 acres of hydrophobic soils were formed in the Jemez Mountains from the Cerro Grande Fire (DOE 2000f).

Typical subsurface stratigraphy at LANL and TA-18 consists of welded and poorly welded volcanic tuffs that comprise the Tshirege Member of the Bandelier Tuff Formation. Site-specific investigations in Pajarito Canyon near TA-18 have found the tuff to be highly weathered and unwelded, with the upper 10 to 15 feet of the material classified as clayey sand or sandy clay. However, surrounding cliff faces consist of welded tuff exhibiting vertical jointing. The canyon tuff is overlain by up to 15 feet of sandy and silty alluvium. Soils derived from these deposits are typically sandy loams ((DOE 2002i).

4.1.6.3 *Seismology*

A comprehensive update to the LANL seismic hazards analysis was completed in 2007 (LANL 2007); the analysis presents estimated ground-shaking hazards and the ground motions that may result. The geological and geotechnical aspects of the study, along with a summary of the seismic setting, are incorporated in the following description. The relevance of the revised understanding of seismic hazards to LANL facilities is discussed in Chapter 5. The 2007 seismic hazard study updates the 1995 LANL study that was used for the *1999 LANL SWEIS*. The studies consider all earthquake faults within 10 mi (16 km) that meet the definition of the term "capable fault" as used by the U.S. Nuclear Regulatory Commission to assess the seismic safety of nuclear power reactors (Title 10 *Code of Federal Regulations* [CFR] Part 100, Appendix A). New characterization data regarding the dynamic properties of the subsurface beneath LANL are those from investigations performed at the Chemistry and Metallurgy Research Replacement Facility. Recent geological studies have refined the understanding of fault geometry, slip characteristics, and the relationship of the faults in the LANL area. The methods used in the updated 2007 analysis follow the Senior Seismic Hazard Advisory Committee's guidelines for a Level 2 analysis in *Recommendations for Probabilistic Seismic Hazard Analysis—Guidance on Uncertainty and Use of Experts*. The study was designed and performed under the following DOE standards (LANL 2008):

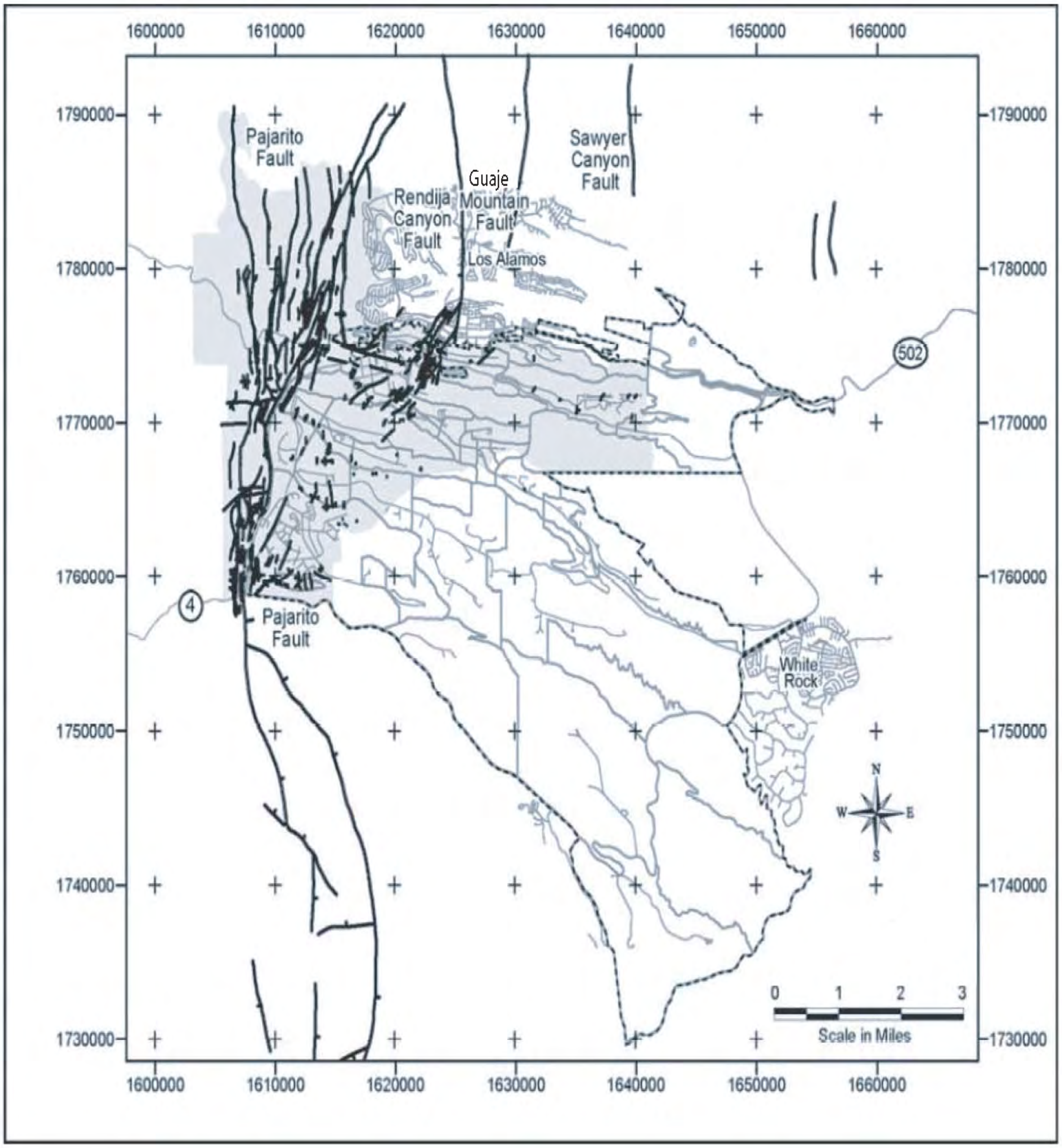
- DOE Standard 1020-2002, Natural Phenomena Hazards Design and Evaluation Criteria for DOE Facilities;
- DOE Standard 1022-94, Natural Phenomena Hazards Site Characterization Criteria; and
- DOE Standard 1023-95, Natural Phenomena Hazard Assessment Criteria. The seismic hazards analysis report (LANL 2007) includes details on refinement of the seismic source model, ground motion attenuation relationships, dynamic properties of the subsurface (particularly the Bandelier Tuff) beneath LANL, as well as the probabilistic seismic hazard, horizontal and vertical hazards, and design basis earthquake for LANL.

The dominant contributor to seismic risk at LANL is the Pajarito Fault System. The main element of the system is the Pajarito Fault. Secondary elements include the Santa Clara Canyon

Fault, the Rendija Canyon Fault, the Guaje Mountain Faults, and the Sawyer Canyon Fault. The general fault geometry in the system is reflected in Figure 4.1.6-1 (LANL 2008).

4.1.6.3.1 Pajarito Fault

The geometry of the Pajarito Fault varies appreciably along its north-south extent. Its surface expression varies from a simple normal fault to broad zones of small faults to largely unfaulted monoclines. These features are all considered surface expressions of deep-seated normal faulting (LANL 2008).



Source: LANL 2008.

Figure 4.1.6-1—Mapped Faults in the LANL Area

In the latest studies, including trench excavations and borehole stratigraphy and structure, indicated more recent movement (Table 4.1.6-1). Recent studies also indicated that movement on the Pajarito Fault may be linked to movement on the other fault segments in the Pajarito Fault System. Five small earthquakes (magnitudes of 2 or less on the Richter scale) have been recorded in the Pajarito Fault since 1991. These small events, which produced effects felt at the surface, are thought to be associated with ongoing tectonic activity within the Pajarito Fault zone (LANL 2008).

Table 4.1.6-1—Summary of Movement on Faults of the Pajarito Fault System

Name	Approximate Length	Type	Most Recent Faulting Event	Maximum Earthquake Potential[a]
Pajarito	26 miles	Normal, down-to-the-east[b]	1,400 to 2,200 years ago	7
Rendija Canyon	8 miles	Normal, down-to-the-west	Less than 8,000 years ago	6.5
Guaje Mountain	8 miles	Normal, down-to-the-west	3,400 to 6,500 years ago	6.5

Source: LANL 2007.
[a] Richter magnitude.
[b] The fault plane dips to the east and the crustal block on the east side of the fault slips downward to the east when fault movement occurs. Down-to-the-west reverses this fault plane angle and sense of movement.
Note: To convert miles to kilometers, multiply by 1.6093.

4.1.6.3.2 Rendija Canyon Fault

Studies of the Rendija Canyon Fault (LANL 2008) indicate that it is a dominantly down-to-the west normal fault located approximately 2 miles east of the Pajarito Fault. Trench exposures across the Rendija Canyon Fault indicate that the most recent surface rupture occurred about 8,600 or 23,000 years ago. The probabilistic displacement hazard for the worst-case scenario was determined to be less than 0.67 inches of displacement in 10,000 years. The low hazard resulted from the long recurrence interval (33,000 to 68,000 years), and related low slip rates on the Rendija Canyon Fault. Geologic mapping shows that there is no faulting in the near-surface directly beneath TA-55. The closest fault is about 1,500 feet west of the TA-55 Plutonium Facility. The Rendija Canyon Fault, therefore, does not continue from the Los Alamos town site directly south to TA-55 (LANL 2008).

4.1.6.3.3 Guaje Mountain Fault

The Guaje Mountain Fault is subparallel to the Pajarito Fault and Rendija Canyon Fault and is located approximately 1.2 miles east of the Rendija Canyon Fault. It is somewhat shorter than the Rendija Canyon Fault and the southern extent is not well documented. Geologic surface mapping and trenching at Pajarito Mesa demonstrated the absence of faulting in that area for at least the last 50,000 to 60,000 years. Based on available data, a series of seismic events have been identified on the Guaje Mountain Fault. These range in age from 4,200 to 300,000 years ago and have up to approximately 7 feet of displacement (LANL 2008).

4.1.6.3.4 Sawyer Canyon Fault

The Sawyer Canyon Fault is a short, west-dipping fault that is subparallel to and located east of the Rendija Canyon and Guaje Mountain Faults. Its effect on seismicity at LANL is relatively small because the surface trace is located at a distance from the site and the structure migrates away from LANL at depth. This fault is included in the 2007 seismic update to simplify modeling (LANL 2008).

4.1.6.3.5 Other Areas of LANL

Surveying of Bandelier Tuff contacts at Mesita del Buey (TA-54) revealed 37 faults with vertical displacements of 2 to 26 inches (5 to 65 centimeters). These small faults appear to be secondary effects associated with large earthquakes in the main Pajarito Fault zone, or perhaps earthquakes on other faults in the region. Geologic mapping and related field and laboratory investigations in the north-central to northeastern portion of LANL (TAs 53, 5, 21, 72, and 73) revealed only small faults that have little potential for seismic surface rupture. The study identified six small-displacement (less than 5 feet vertical displacement) faults or fault zones. These faults are considered subsidiary to the principal faults of the Pajarito Fault system (that is, the Pajarito, Rendija Canyon, and Guaje Mountain Faults) and likely experienced small amounts of movement during earthquakes on the principal faults.

4.1.6.3.6 Pajarito Fault System Event Chronology

Recent work has shown that the Pajarito Fault system is a broad zone of distributed deformation, and that the master Pajarito Fault itself probably breaks the surface along only part of its length in the vicinity of LANL (LANL 2004e). Most of the geologic structures that have been the targets of seismic studies are, in fact, faults subsidiary to the three main faults (that is, the Pajarito, Rendija Canyon, and Guaje Mountain Faults). As such, the individual faults do not provide a complete record of paleoseismic events for the entire system.

The potential seismic hazard at LANL is dominated by seismic ground motion associated with earthquakes on nearby faults. It also includes surface rupture along faults within the boundaries of LANL. New data obtained by the LANL Seismic Hazards Program over the last 5 years, combined with previous work, suggest that there may have been three Holocene surface-rupturing events within the Pajarito Fault system. A report in preparation by the LANL Seismic Hazards Geology Team will document a comprehensive review and re-evaluation of geochronological constraints on paleoseismic activity in the Pajarito Fault system. This study is being prepared to recalculate the probabilistic seismic hazard at LANL. The reanalysis of the seismic hazard will incorporate data from studies completed since the *1999 LANL SWEIS* (LANL 2008). The *Update of the Probabilistic Seismic Hazard Analysis and Development of Seismic Design Ground Motions at the Los Alamos National Laboratory* was completed in 2007 (LANL 2007).

4.1.7 Biological Resources

This section describes ecological resources at LANL including terrestrial and aquatic resources, threatened and endangered (T&E) species, and floodplains and wetlands.

4.1.7.1 *Terrestrial Resources*

Five vegetation zones have been identified within LANL. In general these zones result from changes in elevation, temperature, and moisture along the approximately 12-mile wide, 5,000-foot elevational gradient from the Rio Grande to the western edge of the site. The five zones include: Juniper (*Juniperus monosperma* [Engelm.] Sarg.) Savannas; Piñon (*Pinus edulis* Engelm.)-Juniper Woodlands; Grasslands; Ponderosa Pine (*Pinus ponderosa* P. & C. Lawson) Forests; and Mixed Conifer Forests (Douglas fir [*Pseudotsuga menziesii* (Mimel) Franco], ponderosa pine, and white fir [*Abies concolor* (Gord. & Glend.) Lindl. Ex Hildebr.]). While Mixed Conifer Forests are prevalent at higher elevations to the west of LANL, within the site this vegetation zone is restricted to cooler north-facing canyons walls. This diversity in vegetative communities has resulted in the presence of over 900 species of vascular plants. There is a comparable diversity in regional wildlife with 57 species of mammals, 200 species of birds, 28 species of reptiles, 9 species of amphibians, and over 1,200 species of arthropods having been identified (LANL 2008, LANL 2004e).

Approximately 2,259 acres of land have been conveyed to Los Alamos County or transferred to the Department of the Interior to be held in trust for the Pueblo of San Ildefonso (LANL 2008). This resulted in a reduction in the size of LANL to its present size of 25,600 acres. Much of the transferred land is in a natural state and falls within the Piñon-Juniper Woodland and Ponderosa Pine Forest Vegetation Zones.

4.1.7.2 *Wetlands and Floodplains*

4.1.7.2.1 Wetlands

Approximately 34 acres of wetlands have been identified within LANL boundaries during a survey in 2005 with 45 percent of these located in Pajarito Canyon. Wetlands in the LANL region are primarily associated with canyon stream channels or are present on mesas, often in association with springs, seeps, or effluent outfalls. Cochiti Lake and the area near the LANL Fenton Hill site (TA-57) support lake-associated wetlands. There are also some springs within White Rock Canyon that support wetlands. Wetlands in the general LANL region provide habitat for reptiles, amphibians, and invertebrates, and potentially contribute to the overall habitat requirements of a number of species, including sensitive species (LANL 2004e, LANL 2008).

4.1.7.2.2 Floodplains

Floodplains are areas adjacent to watercourses that can become inundated with surface waters during high flows from runoff due to precipitation or snowmelt. At LANL, the floodplains are generally located in the canyons that lie between the mesa fingers (DOE 2002i). DOE regulations [10 CFR 1022.4] consider the critical action floodplain to be those areas affected during a 500-year flood (has a 0.2 percent chance of occurrence in any given year). The base floodplain, which is the floodplain considered by DOE’s Resource Conservation and Recovery Act (RCRA) Permit, is the 100-year flood (has a 1.0 percent chance of occurrence in any given year) [40 CFR 270.14(b)(11)(iii)]. To meet the requirements of its RCRA permit, DOE delineated the 100-year floodplain boundaries within the facility in 1992 (McLin 1992). DOE considered the 100-year flood at LANL to be created by the 100-year, 6-hour storm (McLin, Van Eeckhout, and Earles 2001).

4.1.7.3 *Aquatic Resources*

The Rio Grande is a designated Wild and Scenic Rivers. Twelve species of fish (found in the Rio Grande, Cochiti Lake, and the Rito de los Frijoles) have been identified in the LANL region (LANL 2008, LANL 2004e). No fish species have been found within LANL boundaries (LANL 2008, LANL 2004e).

4.1.7.4 *Threatened and Endangered Species*

Federally-listed wildlife includes 2 endangered species, 2 threatened species, 1 candidate, and 8 species of concern. New Mexico protected and sensitive plants and animals include 3 endangered species, 7 threatened species, 2 species of concern, and 14 sensitive species. Additionally, 18 species of birds are listed as birds of conservation concern. Information related to the occurrence of these species within the LANL region is included in the Table 4.1.7-1.

4.1.7.5 *Biological Monitoring and Abatement Programs*

A wide variety of wild and domestic edible vegetables, fruit, grain, and animal products are harvested in the area surrounding LANL. Ingestion constitutes an important exposure pathway by which radionuclides and nonradionuclides can be transferred to humans. The objective of LANL's biota monitoring program is to:

- Measure radioactive and nonradioactive concentrations in foodstuffs from LANL and perimeters areas, and compare results to regional areas;
- Determine trends over time; and
- Provide data used to estimate dose from the consumption of foodstuffs.

To evaluate LANL impacts from radionuclides, the analytical results of biota samples collected from on-site and perimeter areas are compared with regional or baseline statistical reference levels (LANL 2008).

Foodstuffs samples that were collected in 2005 included fish from Cochiti Reservoir and purslane, an edible plant, from the Pueblo de San Ildefonso. Samples were also collected Area G and at the Dual Axis Radiographic Hydrodynamic Test (DARHT) facility.

Table 4.1.7-1—Protected and Sensitive Species

Common Name	Scientific Name	Status		Notes
		Federal	State	
Plants				
Sapello Canyon larkspur	*Delphinium sapellonis (Tidestrom)*		Species of Concern	
Springer's blazing star	*Mentzelia springeri (Standley) Tidestrom*		Species of Concern	
Wood lily (Mountain lily)	*Lilium philadelphicum* L. var.*anadinum* (Nutt.) Ker		Endangered	Observed on Los Alamos County, Bandelier National Monument, and Santa Fe National Forest lands
Yellow lady's slipper orchid	*Cyprepedium calceolus* L. var.*pubescens* (Willd.) Correll		Endangered	Observed on Bandelier National Monument lands
Insects				
New Mexico silverspot butterfly	*Speyeria nokomis nitocris*	Species of Concern		
Fish				
Rio Grande chub	*Gila pandora*		Sensitive	
Amphibians				
Jemez Mountain salamander	*Plethodon neomexicanus*	Species of Concern	Threatened	Permanent resident, Los Alamos County, Bandelier National Monument, and Santa Fe National Forest lands
Birds				
American peregrine falcon	*Falco peregrinus anatum*	Species of Concern, Conservation Concern	Threatened	Forages on LANL, nests and forages on adjacent lands
Arctic peregrine falcon	*Falco peregrinus tundrius*	Species of Concern, Conservation Concern	Threatened	
Bendire's thrasher	*Toxostoma bendirei*	Conservation Concern		
Black-throated gray warbler	*Dendroica nigrescens*	Conservation Concern		
Crissal thrasher	*Toxostoma crissal*	Conservation Concern		
Feruginous hawk	*Buteo regalis*	Conservation Concern		Considered accidental or transient on Bandelier National Monument
Flammulated owl	*Otus flammeolus*	Conservation Concern		Permanent resident on LANL
Graces's warbler	*Dendroica graciae*	Conservation Concern		
Golden eagle	*Aquila chrysaetos*	Conservation Concern		Has been known to nest in the Los Alamos area, but not found every year

Table 4.1.7-1—Protected and Sensitive Species (continued)

Common Name	Scientific Name	Status		Notes
		Federal	State	
Birds *(continued)*				
Gray vireo	*Vireo vicinior*	Conservation Concern	Threatened	Considered accidental or transient to Bandelier National Monument
Lewis's woodpecker	*Melanerpes lewis*	Conservation Concern		Breeding resident on LANL
Loggerhead shrike	*Lanius ludovicianus*	Sensitive		Considered accidental or transient on Bandelier National Monument
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Sensitive	Breeding resident on LANL, Los Alamos County, Bandelier National Monument, Santa Fe lands; critical habitat designated on Santa Fe National Forest Lands
Northern goshawk	*Accipiter gentilis*	Species of Concern	Sensitive	Observed as a breeding resident on Los Alamos County, LANL, Bandelier National Monument, and Santa Fe National Forest lands
Northern harrier	*Circus cyaneus*	Conservation Concern		Considered rare or occasional on Bandelier National Monument
Pinyon jay	*Gymnorhinus cyanocephalus*	Conservation Concern		Breeding resident on LANL
Prairie falcon	*Falco mexicanus*	Conservation Concern		
Sage sparrow	*Amphispiza belli*	Conservation Concern		Breeding resident on LANL
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Endangered	Present on LANL and White Rock Canyons, Jemez Mountains, and near Española; potential nesting area on LANL
Virginia's Warbler	*Vermivora virginiae*	Conservation Concern		Breeding resident on LANL
Williamson's sapsucker	*Sphyrapicus thyroideus*	Conservation Concern		Breeding resident on LANL
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate, Conservation Concern	Sensitive	Has been recorded along Rio Grande, adjacent to LANL
Mammals				
Big free-tailed bat	*Nycinomops macrotis*		Sensitive	Migratory visitor on Bandelier National Monument and Santa Fe National Forest lands; breeding resident on Los Alamos County
Black-footed ferret	*Mustella nigripes*	Endangered		
Fringed myotis	*Myotis thysanodes*		Sensitive	Breeding resident on LANL
New Mexico meadow mouse	*Zapus hudsonius luteus*	Species of Concern	Threatened	Permanent resident on Bandelier National Monument and Santa Fe National Forest lands; overwinters by hibernating
Goat Peak pika	*Ochotona princeps nigrescens*	Species of Concern	Sensitive	Observed on Los Alamos County and Bandelier National Monument lands

Table 4.1.7-1—Protected and Sensitive Species (continued)

Common Name	Scientific Name	Status		Notes
		Federal	State	
Mammals *(continued)*				
Long-eared myotis	*Myotis evotis*		Sensitive	Breeding resident on LANL
Long-legged myotis	*Myotis volans*		Sensitive	Breeding resident on LANL
New Mexico meadow jumping mouse	*Zapus hudsonius luteus*	Species of Concern	Threatened	Permanent resident on Bandelier National Monument and Santa Fe National Forest lands; overwinters by hibernating
Ringtail	*Bassariscus astutus*		Sensitive	Observed in Los Alamos County
Spotted bat	*Euderma maculatum*		Threatened	Seasonal resident on LANL, Bandelier National Monument, and Santa Fe National Forest lands
Townsend's big-eared bat	*Plecotus townsendii*	Species of Concern	Sensitive	Seasonal resident on LANL
Western small-footed myotis	*Myotis ciliolabrum*		Sensitive	Seasonal resident on LANL
Yuma myotis	*Myotis yumanensis*		Sensitive	Summer resident on LANL, Los Alamos County, and Santa Fe National Forest lands

Source: LANL 2008.

Levels of radionuclides, non-radionuclide inorganic metals, and PCBs in fish upstream and downstream of LANL were similar to each other and support previous studies that imply LANL is not the source of significant contaminants. Radionuclides in the fish from upstream and downstream sources are near detection limits or nondetectable (the result is less than three times the analytical uncertainty), except for one sample from Cochiti Reservoir that contained uranium-234 and uranium-238 just above the regional statistical reference levels (three standard deviations above background averages); however, the isotopic distribution indicates a natural origin of the uranium. Mercury levels in the fish upstream and downstream were similar but are at levels that have triggered fish consumption advisories on the Rio Grande. Similarly, PCB levels in bottom-feeding fish from both upstream and downstream sources exceed safe levels for regular consumption (LANL 2008).

Wild edible plants (oak acorns, wild spinach, and purslane) were sampled in past years from Pueblo de San Ildefonso lands near the LANL boundary. Some radionuclides in these plants were at higher levels than natural or fallout levels; however, all were below levels that would result in a dose of 0.01 millirem for each pound of each consumed, which is 0.1 percent of the DOE dose limit of 100 millirem per year. In 2005, additional purslane samples and soil samples were collected to investigate the slightly elevated strontium-90 levels. The results confirmed suspicions that lower calcium levels in the soil results in increased uptake of fallout strontium-90 by the plants (LANL 2008).

All non-radionuclide contaminant concentrations, with the exception of barium, in these wild edible plants were either undetected or within the regional statistical reference levels. The additional samples of purslane from background locations confirmed elevated barium concentrations in these plants that are most likely due to bioaccumulation of barium by purslane plants (LANL 2008).

Honeybees sampled from hives on LANL property near a testing area where depleted uranium is used found only uranium-238 above regional statistical reference levels but at levels far below terrestrial animal dose screening levels (<0.01 radiation per day). All other radionuclides and all non-radionuclides were below regional statistical reference levels (LANL 2008).

Samples of soil, vegetation, and small mammals (e.g., deer mice) at the Los Alamos Canyon Weir, a low rock dam designed to trap sediment being transported off LANL property in Los Alamos Canyon were collected. The levels of radionuclides and metals in these media were mostly below regional statistical reference levels and indicate that there is no measurable impact to the biota (LANL 2008).

A special study of uranium uptake by ponderosa pine trees growing near firing sites at TA-15 was conducted to determine if variations in environmental uranium concentrations from open-air dynamic tests were similar to variations in uranium concentrations in trees. Results indicate that uranium concentrations were statistically similar in off-site and on-site ponderosa pine trees, indicating that dynamic tests conducted at LANL have not significantly impacted uranium concentrations in ponderosa pine pulp (LANL 2008).

Moss samples were collected from several springs around northern New Mexico and analyzed for cesium-137 as part of another special study. Levels at two of the sampled springs were similar to those measured by other organizations at those springs. The varying levels of cesium-137 may be attributable to the exposure of the moss to dust or soil that contains fallout levels of cesium-137; the lowest levels were generally found on moss from springs that are relatively sheltered (LANL 2008).

4.1.8 Cultural Resources

As of 2005, cultural and archaeological surveys have been conducted on approximately 90 percent of the land within LANL boundaries with 86 percent having been intensively surveyed. The majority of these surveys emphasized American Indian cultural resources. Information on these resources was obtained from the LANL cultural resources database, which is organized primarily by site type. Although about 400 cultural and archaeological resource sites have been determined to be NRHP eligible, most of the remaining sites have yet to be formally assessed and are therefore assumed to be eligible until assessed (LANL 2005h).

4.1.8.1 *Archaeological Resources*

Occupation and use of the Pajarito Plateau began as early as 10,000 BC as foraging groups used the area for gathering and hunting large game animals. Since 10,000 BC a succession of peoples has populated the LANL area as evident in its rich archaeological resources (LANL 2008). Recent surveys have showed that a total of 1,915 archaeological resource sites have been identified at LANL. Of these, 1,776 are prehistoric sites related to the Paleoindian, Archaic, and

Ancestral Pueblo Cultures, and 139 are related to early American Indian, Hispanic, and Euro-American Cultures.

4.1.8.2 *Historic Resources*

Two potential National Historic Landmarks and one potential National Register Historic District have been proposed at LANL. The former includes the "Project Y" Manhattan Project and Los Alamos National Laboratory Ancestral Pueblo National Historic Landmarks. "Project Y" of the Manhattan Project lasted only four years (1942 through 1946), but represented one of the defining moments of recent world history. The main goal of "Project Y" was the immediate development and possible deployment of the world's first atomic weapon. The potential Los Alamos National Laboratory Ancestral Pueblo National Historic Landmark would consist of four discrete units totaling 132 acres and would recognize a number of the Ancestral Pueblo archaeological sites that are especially important due to integrity of location and the nature of the resource (LANL 2005h).

The potential Los Alamos Archaeology National Register Historic District would consist of a number of sites and clusters of sites that, while not deemed of sufficient significance to be considered for inclusion in the two potential National Historic Landmarks, nevertheless are important to the State of New Mexico and to the Nation. The proposed National Register Historic District would contain a total of 10 discrete components with a combined size of 1,496 acres. Included are six complexes rich in resources dating from the Archaic Period through the Ancestral Pueblo Classic Period and four components relating to the Homestead Period (LANL 2005h).

4.1.8.3 *Native American Resources*

Within LANL's boundaries there are ancestral villages, shrines, petroglyphs (carvings or line drawings on rocks), sacred springs, trails, and traditional use areas that could be identified by Pueblo and Hispanic communities as traditional cultural properties. According to the DOE compliance procedure, American Indian tribes may request permission for visits to sacred sites within LANL boundaries for ceremonies (LANL 2008).

Previous consultations were conducted with 19 American Indian tribes and two Hispanic communities to identify cultural properties important to them in the LANL region. All of the consulting groups stated that they had at least some traditional cultural properties present on or near LANL. Categories and numbers of traditional cultural properties identified included 15 ceremonial and archaeological sites, 14 natural features, 10 ethonobotanical sites, 7 artisan material sites, and 8 subsistence features. Although these resources were stated as being present throughout LANL and adjacent lands; no specific features or locations were identified that would permit formal evaluation and recognition as traditional cultural properties. In addition to physical cultural entities, concern has been expressed that "spiritual," "unseen," "undocumentable," or "beingness" aspects can be present at LANL that are an important part of American Indian culture (LANL 2008).

A "Comprehensive Plan for the Consideration of Traditional Cultural Properties and Sacred Sites at Los Alamos National Laboratory, New Mexico" was sent by DOE to 26 different tribes to help complete the traditional cultural properties identification and evaluation process begun in 1999. As of September 30, 2005, this process had narrowed the number of tribes with active traditional cultural properties concerns on LANL to the Pueblo of San Ildefonso, the Pueblo of Santa Clara (Rendija Canyon), and possibly the Pueblo of Cochiti. DOE maintains ongoing discussions with these pueblos. Such discussions with the Pueblo of San Ildefonso have identified one traditional cultural property, which is in the process being forwarded to the New Mexico State Historic Preservation Office (SHPO) for review and concurrence. In addition, several other locations have been identified by the Pueblo of San Ildefonso for consideration as traditional cultural properties. None of these are locations that would have a significant impact on current mission activities at LANL.

A number of traditional cultural properties were identified in the Rendija Canyon Tract in 1993 in response to the then proposed Bason Land Exchange; another traditional cultural property was identified during the Land Conveyance and Transfer Project. Although not directly disturbed, seven traditional cultural properties within the tract were threatened by persons driving through a traditional cultural properties-dense area and by disturbance through the removal of stones to use in the apparent burial of a pet. Corrective actions have been taken in order to prevent further damage to these sites including placing fencing around all traditional cultural properties in the Rendija Canyon Tract, posting areas as environmentally sensitive, documenting damage, strengthening gates, and installing surveillance cameras. Additionally, discussion have been held with Santa Fe National Forest archaeologists and recreation specialists to formulate a shared strategy for helping to prevent or limit future vandalism in Rendija Canyon (LANL 2008).

4.1.9 Socioeconomic Resources

Socioeconomic characteristics addressed at LANL include employment, regional economy, and population, housing, and community services. Socioeconomic characteristics are presented for a ROI.

LANL is located in Los Alamos County, New Mexico. Statistics for employment and regional economy, population, housing, and community services are presented for the ROI, a tri-county region consisting of Los Alamos, Rio Arriba, and Santa Fe Counties. Figure 4.1.9-1 presents a map of the counties composing the LANL ROI.

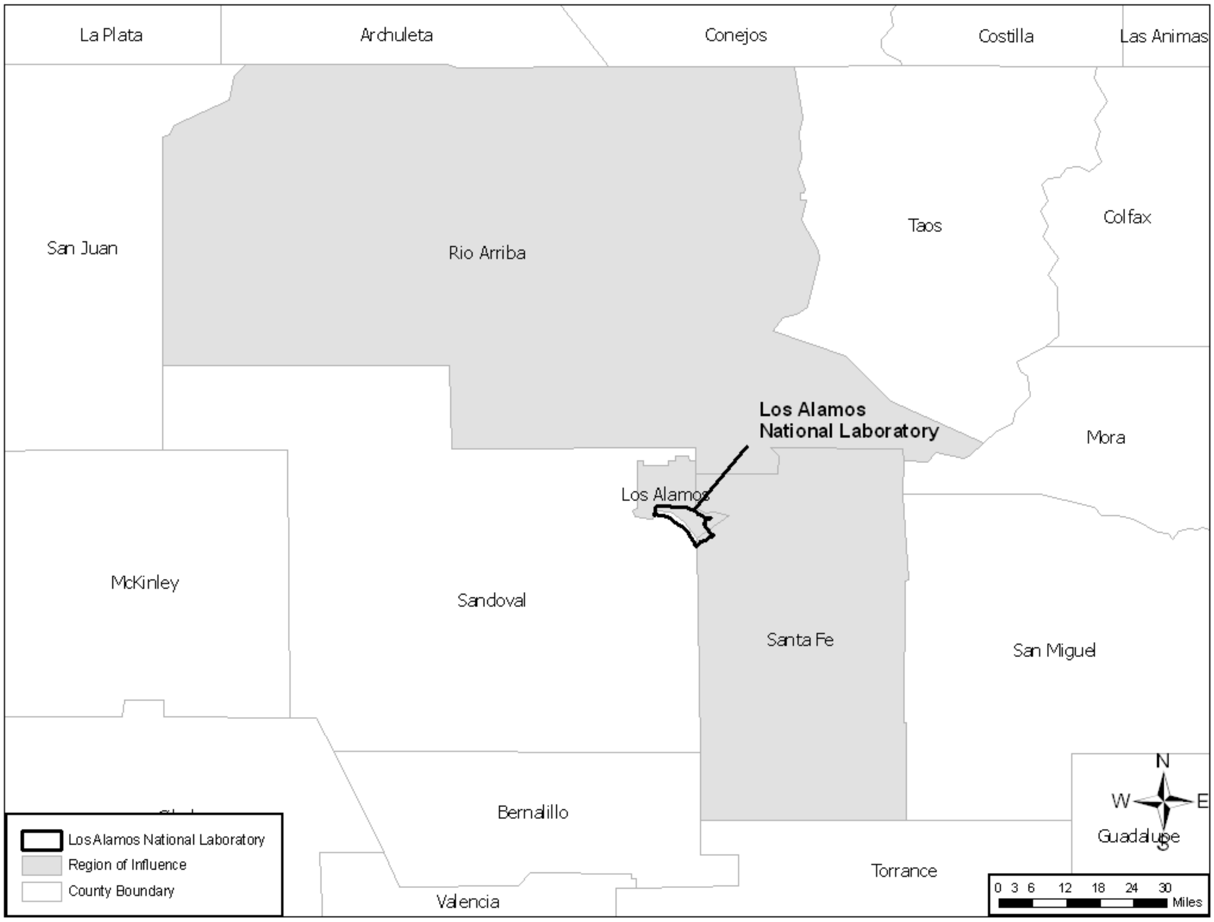


Figure 4.1.9-1—Region of Influence for Socioeconomic Impacts at LANL

4.1.9.1 *Employment and Income*

In 2005, a total of 13,504 persons were employed by LANL contractors of which approximately 12,650 resided in New Mexico (LANL 2008). Labor force statistics are summarized in Table 4.1.9-1. The civilian labor force of the ROI grew by approximately 8.3 percent from 100,492 in 2000 to 109,535 in 2005. The overall ROI employment experienced a growth rate of 7.9 percent with 196,434 in 2000 to 104,024 in 2005 (BLS 2007).

The ROI unemployment rate was 4.4 percent in 2005 and 4.0 percent in 2000. In 2005, unemployment rates within the ROI ranged from a low of 2.8 percent in Los Alamos County to a high of 5.9 percent in Rio Arriba County. The unemployment rate in New Mexico in 2005 was 5.3 percent (State of New Mexico 2006).

Table 4.1.9-1—Labor Force Statistics for the ROI and New Mexico

	ROI		New Mexico	
	2000	2005	2000	2005
Civilian Labor Force	100,492	109,535	852,293	915,489
Employment	96,434	104,695	810,024	867,317
Unemployment	4,058	4,840	42,269	48,172
Unemployment Rate (percent)	4.0	4.4	5.0	5.3

Source: BLS 2007.

Income information for the LANL ROI is provided in Table 4.1.9-2. There are major differences in the income levels among the counties making up the ROI, especially between Rio Arriba County at the low end with a median household income in 2004 of $32,935 and a per capita income of $22,194 and Los Alamos County at the upper end with a median household income of $94,640 and a per capita income of $52,524 (BEA 2007).

Table 4.1.9-2—Income Information for the LANL ROI, 2004

	Per capita income (dollars)	Median household income (dollars)	Average earnings per job (dollars)
Los Alamos	52,524	94,640	71,641
Rio Arriba	22,194	32,935	24,511
Santa Fe	36,095	43,727	40,015
New Mexico	26,679	37,838	36,131

Source: BEA 2007.

4.1.9.2 *Population and Housing*

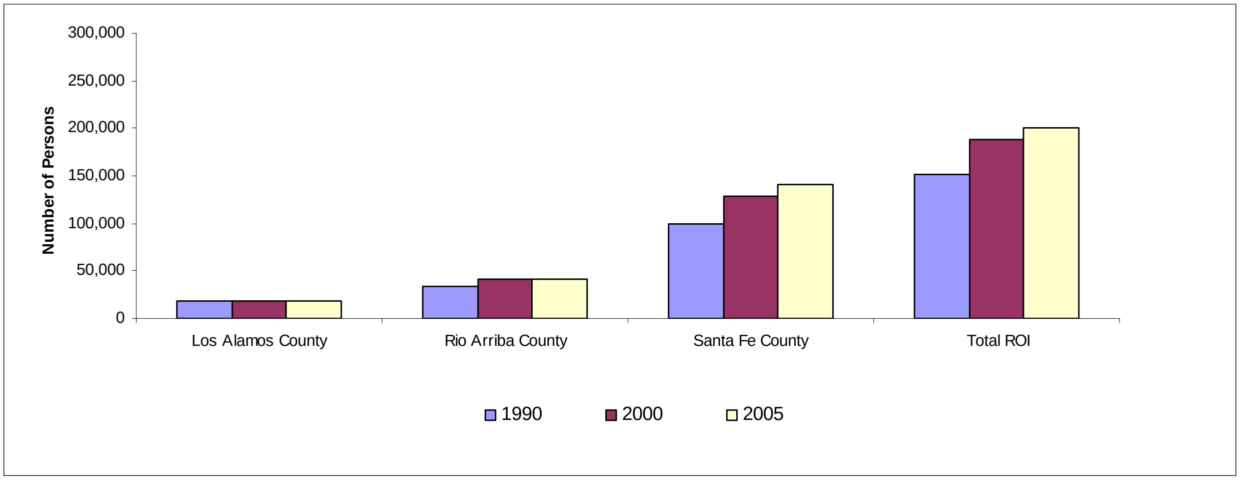
The ROI is used to analyze the primary economic impacts on population and housing. From 1990 to 2000, population within the LANL ROI has grown at approximately the same rate compared to the State of New Mexico. Table 4.1.9-3 presents historic and projected population in the ROI and the state.

Table 4.1.9-3—Historic and Projected Population

Region	1990	2000	2005	2010	2020
Los Alamos	18,115	18,343	18,858	19,114	20,060
Rio Arriba	34,365	41,190	40,633	45,058	48,630
Santa Fe	98,928	129,292	140,801	158,624	191,403
ROI	151,408	188,825	200,292	222,796	260,093
New Mexico	1,515,069	1,819,046	1,925,985	2,112,986	2,383,116

Source: BBER 2004.

Between 1990 and 2000, the ROI population increased 25 percent from 151,408 in 1990 to 188,825 in 2000. From 2000 to 2005, the population of the ROI increased 6 percent to 200,292 in 2005. Santa Fe County experienced the largest population growth within the ROI between 2000 and 2005 with an increase of 10 percent. Los Alamos County had a 3.7 percent increase from 18,343 in 2000 to 18,858 in 2005 (USCB 2007). Figure 4.1.9-2 presents the trends in population within the LANL ROI.



Source: USCB 2007.

Figure 4.1.9-2—Trends in Population for LANL ROI, 1990–2005

Table 4.1.9-4 lists the total number of housing units and vacancy rates in the ROI. In 2000, the total number of housing units in the ROI was 86,417 with 75,023 occupied (89.6 percent). There were 56,923 owner-occupied housing units and 20,863 rental units. The median value of owner-occupied units in Los Alamos County was the greatest of the counties in the LANL ROI. The vacancy rate was the smallest in Los Alamos County (5.5 percent) with the highest in Rio Arriba County (16.5 percent).

4.1.9.3 *Community Services*

New Mexico is divided into 89 school districts, 7 of which are in the LANL ROI. Total public school enrollment in these districts was 25,416 students for the 2005 to 2006 school year (IES 2006a). Community services in the ROI include public schools, public safety, and medical services. The student-to-teacher ratio in these school districts ranges from a high of 15:1 in the Española Municipal School District in Rio Arriba County to a low of 11:1 in Chama Valley Independent Schools in Rio Arriba County. The student-to-teacher ratio in the ROI was 15:1 (IES 2006a).

Table 4.1.9-4—Housing in the LANL ROI, 2000

	Total Units	Occupied housing Units	Owner Occupied Units	Renter Occupied Units	Vacant units	Vacancy Rate (percent)	Median value of Owner Occupied Units (dollars)
Los Alamos County	7,937	7,497	5,894	1,603	440	5.5	228,300
Rio Arriba County	18,016	15,044	15,044	2,763	2,972	16.5	107,500
Santa Fe County	57,701	52,482	35,985	16,497	5,219	9.0	189,400
Total ROI	83,654	75,023	56,923	20,863	8,631	10.3	175,067

Source: USCB 2007.

The Los Alamos County Police Department has 31 officers and 10 detention staff. The Santa Fe Police Department has a total of 207 full time employees, 133 sworn employees and 74 civilian

(DOJ 2004). The Rio Arriba County Sheriff's department has 25 full time employees and 25 sworn employees (Rio Arriba 2007a).

The Los Alamos County fire Department provides fire suppression, medical, rescue, wildland fire suppression and fire prevention services to both LANL and the Los Alamos County community. There are six manned fire stations with 141 budgeted positions including 123 uniformed personnel (LANL 2008). The Los Alamos County Fire Department has 31 officers and 10 detention staff. There are 15 fire districts serving Santa Fe (Santa Fe 2007) and 19 manned fire stations serving Rio Arriba (Rio Arriba 2007b).

Four hospitals serve the LANL ROI: Española, Los Alamos Medical Center, St. Vincent Hospital, and PHS Santa Fe Indian Hospital. These hospitals have a total bed capacity of 375 (ESRI 2007).

4.1.10 Environmental Justice

The potentially affected area considered for environmental justice analysis is the area within a 50-mile radius of LANL. Figure 4.1.10-1 shows eight counties potentially affected by the current missions performed at LANL. These counties include Bernalillo, Los Alamos, Mora, Rio Arriba, Sandoval, San Miguel, Santa Fe, and Taos. Table 4.1.10-1 provides the demographic profile of the potentially affected area using data obtained from the 2000 Census.

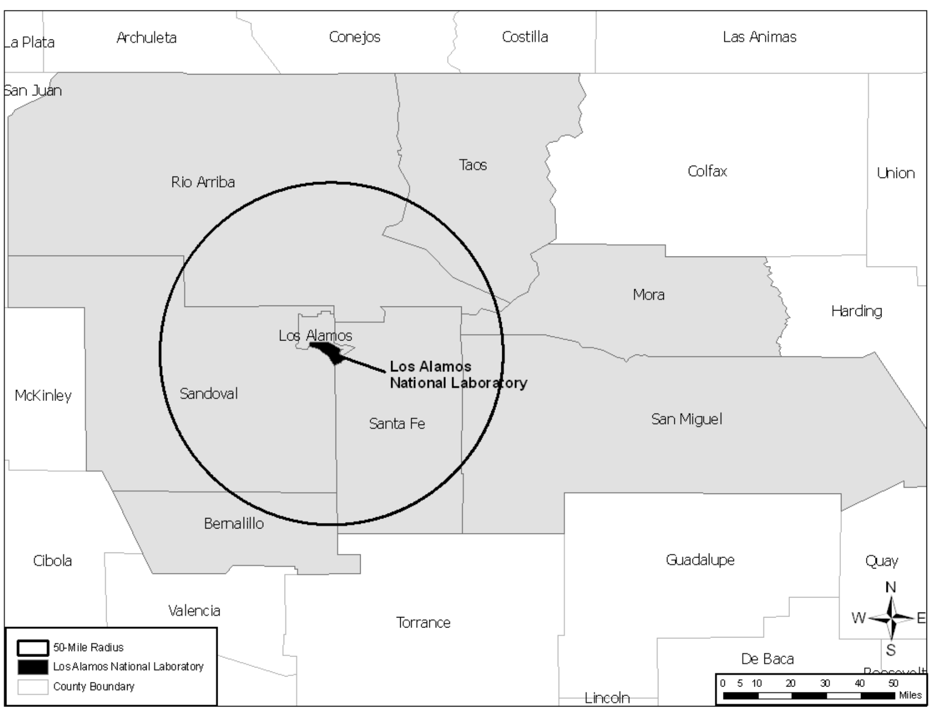


Figure 4.1.10-1—Potentially Affected Counties Surrounding LANL Environmental Justice ROI

Table 4.1.10-1—Demographic Profile of the Potentially Affected Counties Surrounding LANL, 2000

Population Group	Population	Percent
Minority	**490,172**	**54.4**
Hispanic alone	400,725	44.5
Black or African American	15,945	1.8
American Indian and Alaska Native	44,468	4.9
Asian	12,188	1.4
Native Hawaiian and Other Pacific Islander	527	0.1
Some other race	1,460	0.2
Two or more races	14,859	1.6
White alone	**410,524**	**45.6**
Total	**900,696**	**100.0**

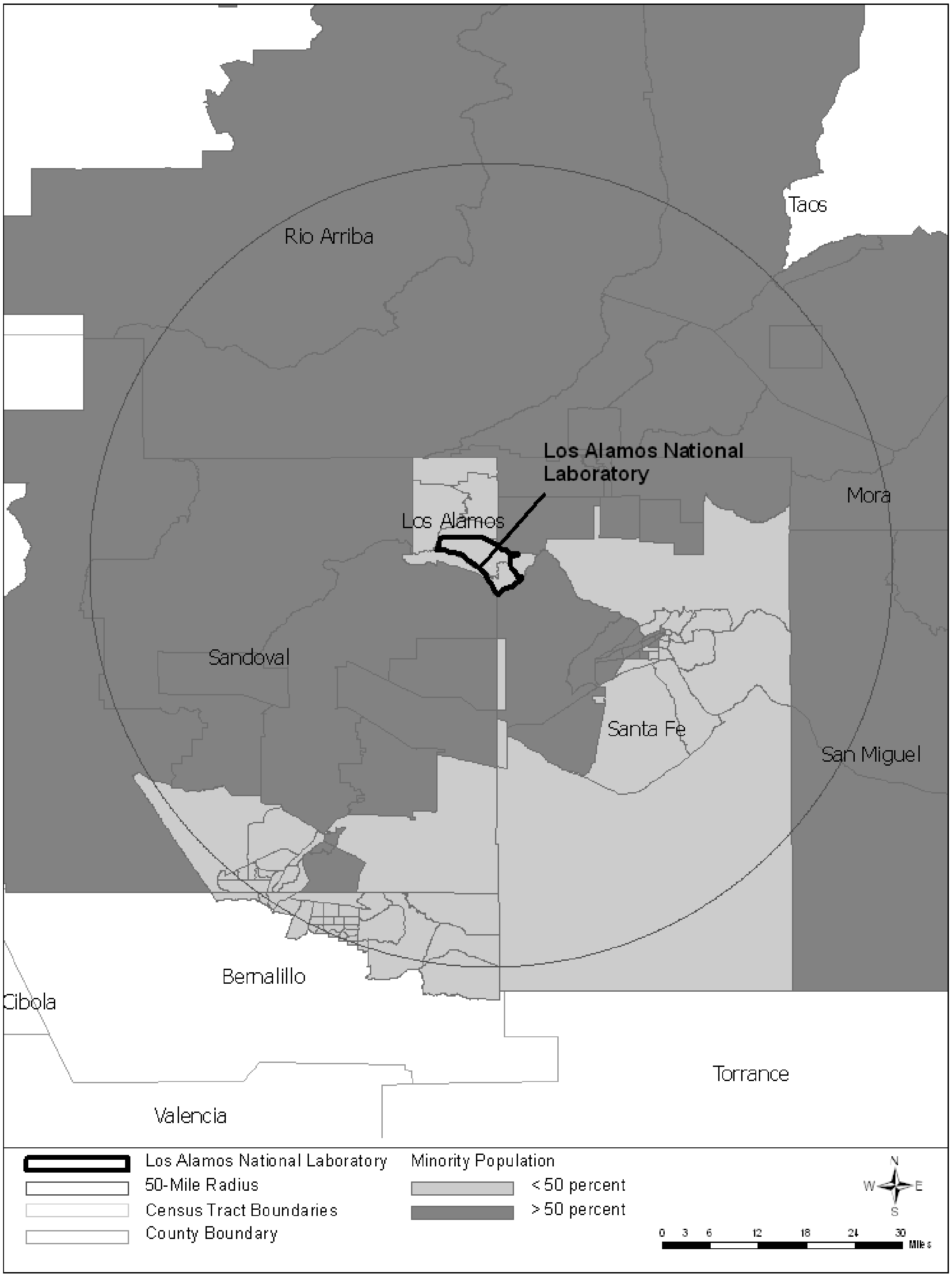
Source: USCB 2007, LANL 2008.
Note: Analysis is based on all counties (eight counties) whose boundaries are within a 50-mile radius. LANL SWEIS is based on a three county ROI.

In 2000, persons self-designated as minority individuals in the potentially affected area comprised 54.4 percent of the total population. This minority population is composed largely of Hispanic or Latino residents. As a percentage of the total resident population in 2000, New Mexico had a minority population of 55 percent and the U.S. had a minority population of 30.9 percent (USCB 2007).

Census tracts with minority populations exceeding 50 percent were considered minority census tracts. Based on 2000 census data, Figure 4.1.10-2 shows minority census tracts within the 50-mile radius where more than 50 percent of the census tract population is minority.

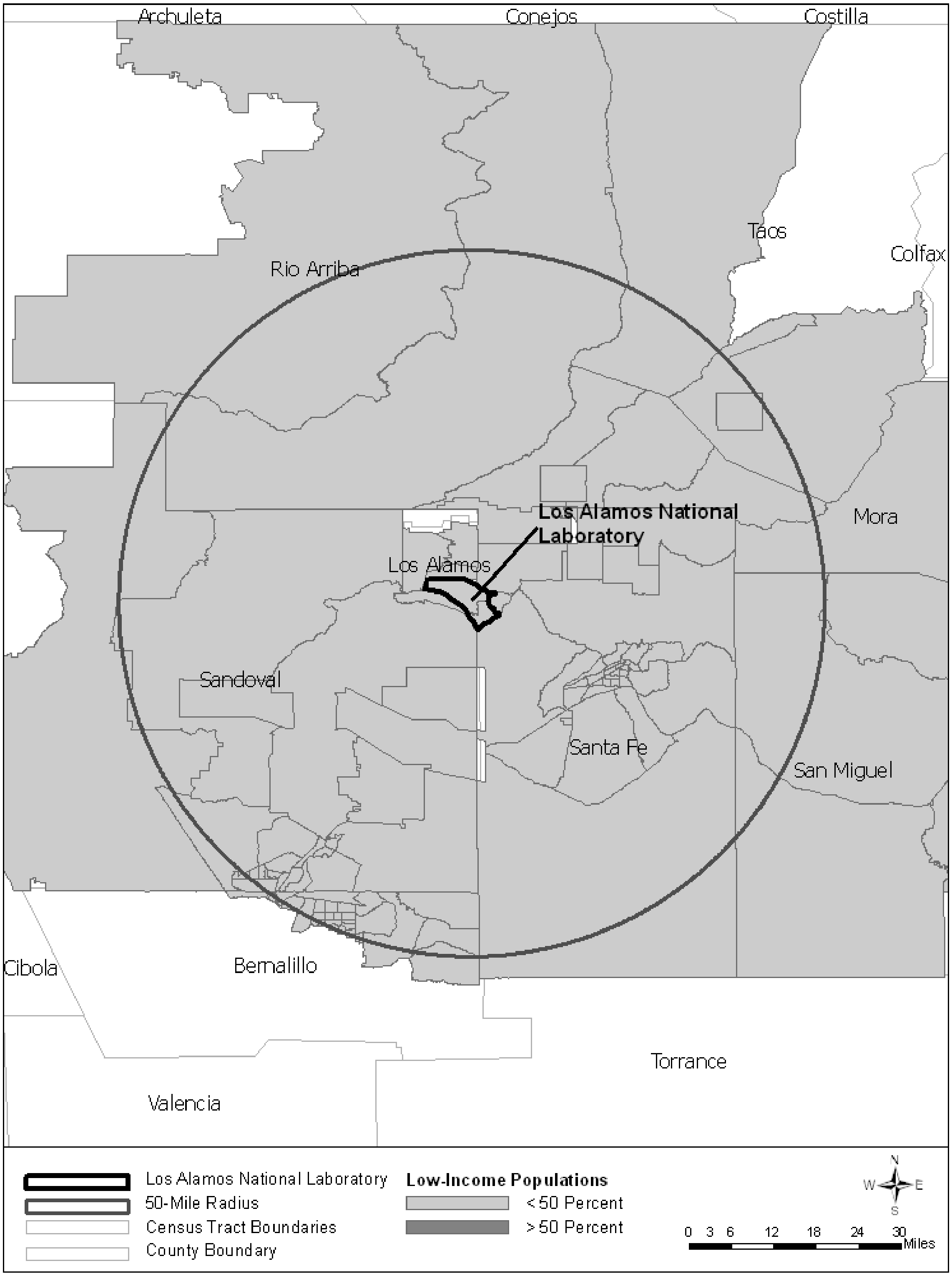
Census tracts were considered low-income census tracts if the percentage of the populations living below the poverty threshold exceeded 50 percent. Based on 2000 Census data, Figure 4.1.10-3 shows low-income census tracts within the 50-mile radius where more than 50 percent of the census tract population is living below the Federal poverty threshold.

According to 2000 census data, there were no census tracts within the 50-mile radius of LANL where more than 50 percent of the census tract population was identified as living below the Federal poverty threshold. In 2000, 18.4 percent of individuals for whom poverty status is determined were below the poverty level in New Mexico and 12.4 percent in the U.S. (USCB 2007).



Source: USCB 2007.

Figure 4.1.10-2—Minority Population—Census Tracts with More than 50 Percent Minority Population in a 50-Mile Radius of LANL



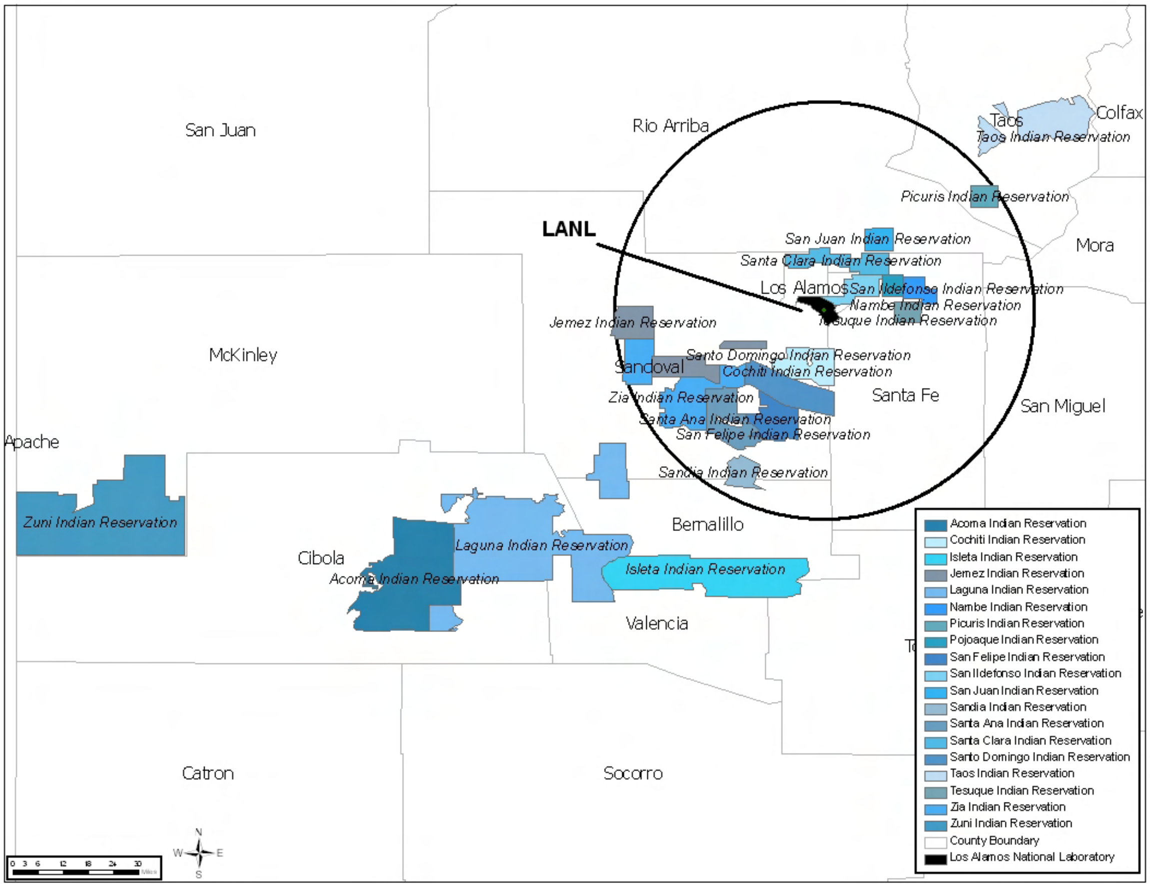
Source: USCB 2007.

Figure 4.1.10-3—Low-Income Population—Census Tracts with More than 50 Percent Low-Income Population in a 50-Mile Radius of LANL

4.1.10.1 *Characteristics of Native American Populations within the Vicinity of or with Interest in LANL Activities/Operations*

As discussed in Sections 4.1.8.3, Native American groups which are known to have used or have interest in the lands surrounding LANL are the New Mexican Pueblo Indians which are shown in Figure 4.1.10-4 and listed below:

- Acoma
- Cochiti
- Jemez
- Laguna
- Nambe
- Picuris
- Pojoaque
- San Felipe
- San Ildefonso
- San Juan Pueblo
- Sandia
- Santa Ana
- Santa Clara
- Santo Domingo
- Taos
- Tesuque
- Zia
- Zuni



Source: ESRI 2007.

Figure 4.1.10-4—Location of New Mexico Indian Pueblo Reservations

The 2000 U.S. Census Bureau was used to obtain characteristics, including population, employment, educational attainment, income, poverty level, average family size, and housing

characteristics for all population subcategories associated with the ones mentioned above. The results of this analysis are provided in the following section.

As shown in Table 4.1.10-2, the Zuni had the highest of the Native American populations with 9,311 and Pojoaque with the least at 209. The Picuris have the largest percentage of their population as members of the civilian labor force at 74.8 percent and the San Felipe with the smallest percentage of their population as members of the civilian labor force with 31.5 percent. The Zuni had the highest unemployment rate at 11.8 percent and the Santa Clara with the lowest unemployment rate at 3.2 percent (USCB 2007).

Of those individuals over 25 with some form of education, the largest constituency of all the New Mexico Pueblo populations had received a high school diploma as shown in Table 4.1.10-3. A comparable percentage of individuals had attended some college and slightly lesser percentages of these populations had received degrees from institutions of higher learning (Associate, Bachelor, or Graduate/Professional) (USCB 2007).

Table 4.1.10-2—Population and Employment Estimates for Native American Populations within the Vicinity of or With Interest in LANL, 2000

LANL	Population	Civilian Labor Force	Civilian Labor Force (percent)	Employed	Employed (percent)	Unemployed	Unemployed (percent)
Pueblo	59,621	24,527	58.1	21,130	50.1	3,397	8
Acoma	4,298	1,792	60.1	1,548	51.9	244	8.2
Cochiti	913	409	60.9	357	53.1	52	7.7
Isleta	3,685	1,602	58.8	1,474	54.1	128	4.7
Jemez	2,705	1,057	56.8	875	47	182	9.8
Laguna	6,346	2,682	59.4	2,375	52.6	307	6.8
Nambe	558	200	56.3	184	51.8	16	4.5
Picuris	338	178	74.8	168	70.6	10	4.2
Pojoaque	209	53	48.6	53	48.6	0	0
San Felipe	2,756	579	31.5	428	23.2	151	8.2
San Ildefonso	539	269	70.1	234	60.9	35	9.1
San Juan Pueblo	1,438	639	64.7	579	58.7	60	6.1
Sandia	353	186	70.7	176	66.9	10	3.8
Santa Ana	623	276	62	257	57.8	19	4.3
Santa Clara	1,057	437	55.8	412	52.6	25	3.2
Santo Domingo	4,216	1,363	49	1,117	40.2	246	8.8
Taos	1,877	993	66.9	875	58.9	118	7.9
Tesuque	511	214	62.2	197	57.3	17	4.9
Zia	900	398	61.3	353	54.4	45	6.9
Zuni	9,311	3,571	54.9	2,802	43.1	769	11.8

Source: USCB 2007.

Table 4.1.10-3—Level of Educational Attainment by Native American Populations within the Vicinity of or With Interest in LANL, 2000

LANL	High School Graduate	High School Graduate (percent)	Some College	Some College (percent)	Associate Degree	Associate Degree (percent)	Bachelor Degree	Bachelor Degree (percent)	Graduate/ Professional Degree	Graduate/ Professional Degree (percent)
Pueblo	11,039	33.4	8,628	26.1	2,362	7.1	2,279	6.9	909	2.8
Acoma	943	40.9	540	23.4	161	7	116	5	52	2.3
Cochiti	161	30.3	186	35	54	10.2	27	5.1	27	5.1
Isleta	848	38	559	25.1	115	5.2	170	7.6	63	2.8
Jemez	525	37.7	340	24.4	77	5.5	108	7.8	19	1.4
Laguna	1,124	31.9	1,004	28.5	385	10.9	343	9.7	96	2.7
Nambe	76	29	75	28.6	33	12.6	23	8.8	2	0.8
Picuris	38	19.2	110	55.6	2	1	26	13.1	4	2
Pojoaque	27	34.6	24	30.8	4	5.1	3	3.8	3	3.8
San Felipe	661	46.4	169	11.9	44	3.1	39	2.7	22	1.5
San Ildefonso	117	37.9	100	32.4	23	7.4	40	12.9	3	1
San Juan Pueblo	223	27.4	272	33.5	82	10.1	61	7.5	6	0.7
Sandia	44	21.4	41	19.9	64	31.1	15	7.3	26	12.6
Santa Ana	147	41.8	98	27.8	26	7.4	19	5.4	8	2.3
Santa Clara	235	36	171	26.2	50	7.7	69	10.6	21	3.2
Santo Domingo	897	42	377	17.6	48	2.2	64	3	67	3.1
Taos	378	31.6	367	30.6	100	8.3	112	9.3	39	3.3
Tesuque	104	37.3	89	31.9	5	1.8	22	7.9	8	2.9
Zia	174	34.7	125	24.9	37	7.4	23	4.6	7	1.4
Zuni	1,547	31.5	1,189	24.2	346	7	198	4	52	1.1

Source: USCB 2007.

In 2000, the mean household earnings and per capita income were comparable for all New Mexico Pueblo populations. The San Felipe Pueblo had the highest mean household earnings with $45,444 as shown in Table 4.1.10-4. The Isleta Pueblo had the highest per capita income with $17,030. The Zuni population had the lowest mean household earnings with $30,258 and the lowest per capita income with $7,837 (USCB 2007).

Of all the New Mexico pueblo populations, the Santo Domingo had the largest percentage of individuals below the poverty level in 2000 with 36.8 percent as compared to the Santa Ana population which had 7.4 percent of the total population living below the poverty level as shown in Table 4.1.10-5 (USCB 2007).

Table 4.1.10-4—Income and Poverty Level Estimates for Native American Populations within the Vicinity of or With Interest in LANL, 2000

LANL	Mean Household Earnings	Per Capita Income	Individuals Below the Poverty Level	Individuals Below the Poverty Level (percent)
Pueblo	$35,886	$10,798	17,030	29.1
Acoma	$37,498	$9,584	1,067	25.3
Cochiti	$32,245	$10,095	227	25.2
Isleta	$39,314	$17,106	743	20.5
Jemez	$31,431	$8,897	727	27.2
Laguna	$35,535	$11,099	1,476	24
Nambe	$31,319	$8,718	127	23
Picuris	$45,403	$14,370	57	16.9
Pojoaque	$33,720	$8,719	68	32.5
San Felipe	$45,444	$8,514	952	34.7
San Ildefonso	$31,154	$11,095	129	23.9
San Juan Pueblo	$35,950	$11,519	365	25.8
Sandia	$41,347	$14,414	53	15
Santa Ana	$39,011	$10,527	46	7.4
Santa Clara	$32,255	$10,483	288	27.4
Santo Domingo	$33,080	$8,228	1,537	36.8
Taos	$34,456	$12,022	492	26.9
Tesuque	$35,240	$12,001	93	18.2
Zia	$35,999	$9,693	125	14.7
Zuni	$30,258	$7,837	4,041	44

Source: USCB 2007.

In 2000, the Santo Domingo had the largest average family size with 5.22 persons compared to the Tesuque who had the smallest average family size with 2.96 persons per family. The Zuni had the greater number of occupied housing units which is consistent with their larger population Table 4.1.10-5 (USCB 2007).

Table 4.1.10-5—Housing Characteristics for Native American Populations within the Vicinity of or With Interest in LANL, 2000

LANL	Average Family Size	Housing Units	Occupied Housing Units	Owner Occupied Housing Units	Owner Occupied Housing Units (percent)	Renter Occupied Housing Units	Renter Occupied Housing Units (percent)
Pueblo	3.89	17,328	17,084	11,578	67.8	5,506	32.2
Acoma	4.18	1,089	1,076	783	72.8	293	27.2
Cochiti	4.38	267	284	170	59.9	114	40.1
Isleta	3.37	1,361	1,355	1,045	77.1	310	22.9
Jemez	4.05	699	701	538	76.7	163	23.3
Laguna	3.6	1,953	1,894	1,171	61.8	723	38.2
Nambe	3.22	202	194	165	85.1	29	14.9
Picuris	3.39	117	108	84	77.8	24	22.2
Pojoaque	3.31	83	85	50	58.8	35	41.2
San Felipe	5.44	517	521	470	90.2	51	9.8
San Ildefonso	3.05	218	205	156	76.1	49	23.9
San Juan Pueblo	3.39	472	468	289	61.8	179	38.2
Sandia	3.31	138	128	108	84.4	20	15.6
Santa Ana	5.1	150	162	144	88.9	18	11.1
Santa Clara	3.29	409	404	357	88.4	47	11.6
Santo Domingo	5.22	859	889	575	64.7	314	35.3
Taos	3.17	752	733	563	76.8	170	23.2
Tesuque	2.96	171	161	139	86.3	22	13.7
Zia	3.64	255	234	181	77.4	53	22.6
Zuni	4.22	2,334	2,293	1,558	67.9	735	32.1

Source: USCB 2007.

The Final 2008 LANL SWEIS analyzed several additional diet items ("Special Pathways") in its human health impacts section to include potential impacts to Native American, Hispanic, and other residents with traditional living habits and diets. The results of these analyses were not much different from the initial analyses presented in the 1999 LANL SWEIS as shown in Table 4.1.10-6. As represented by the sum of all the analyzed pathway components, the worst-case individual (an "Offsite Resident" who is also a "Recreational User" and consumes the "Special Pathways" diet items) would receive a radiation dose of 11 millirem per year and the associated excess latent cancer fatality risk would be 6.6 in one million (LANL 2008).

Table 4.1.10-6—Comparison of Human Health Analyses of Radioactive Contamination Including Special Pathway Analysis from 1999 and 2008 LANL SWEIS

	1999 SWEIS	2008 SWEIS
Individual dose (millirem per year)	15 – 21	11
Latent cancer fatality (per year)	$9 \times 10^{-6} – 13 \times 10^{-6}$	6.6×10^{-6}

Source: LANL 2008.

With the exception of several naturally-occurring metals, the hazard indices and latent cancer fatality risks for all nonradioactive contaminants were similar for both the 1999 and 2008 LANL SWEIS. The hazard indices were generally found to be less than 1 and the latent cancer fatality risk was less than 1 in one million per year (LANL 2008).

Of those naturally-occurring metals, arsenic and vanadium were identified as having a hazard index above 1 in groundwater that supplies Los Alamos County and San Ildefonso Pueblo. Excess latent cancer fatality risk from arsenic greater than 1 in one million per year was also estimated for consumption of soils, sediments, and surface water, but was not associated with discharges from LANL (LANL 2008).

Beryllium has no hazard index for ingestion exceeding 1. However, excess latent cancer fatality rates greater than 1 in one million are estimated in several pathways. Berrylium concentrations in waters, soils, and sediments are typical of those in background readings in the northern New Mexico region. Based on the environmental surveillance data from LANL, the portion of beryllium associated with LANL operations is not a significant contributor to beryllium concentrations in the immediate area of LANL (LANL 2008). Table 4.1.10-7 provides a baseline for the population and average individual annual doses to total minority, Hispanic, American Indian, and Low-Income populations as presented in the 2008 LANL SWEIS. The annual population and average individual dose is highest for the white (non-Hispanic) population. Similarly, the projected annual population and average individual dose for persons living above the poverty level (non-low-income populations) is higher than for those living below the poverty threshold (LANL 2008).

Table 4.1.10-7—Comparison of Total Minority, Hispanic, American Indian, and Low-Income Population and Average Individual Annual Doses

	Current Operations[a]
Collective Population Dose (person-rem)	29.2
Average Individual Dose (millirem)	0.10
White (non-Hispanic) Population Dose (person-rem)	15.0
Non-Minority Average Individual Dose (millirem)	0.11
Minority Population Dose (person-rem)	14.1
Minority Average Individual Dose (millirem)	0.088
Hispanic Population Dose (person-rem)[b]	11.3
Hispanic Average Individual Dose (millirem)	0.086
American Indian Population Dose (person-rem)[c]	1.8
American Indian Average Individual Dose (millirem)	0.092
Non-low-income Population Dose (person-rem)	25.9
Non-low-income Average Individual Dose (millirem)	0.10
Low-Income Population Dose (person-rem)	3.0
Low-Income Average Individual Dose (millirem)	0.082

Source: LANL 2008.
[a]The collective population dose displayed in this table, accounts for the estimated dose from LANSCE at TA-53 and the HE Testing firing sites at TA-36.
[b]The total Hispanic population includes all Hispanic persons regardless of race.
[c]The American Indian population may include persons who indicated that they were of Hispanic ethnicity in the 2000 Census.

Table 4.1.10-8 shows a comparison between the doses to different receptors (offsite resident, recreational user, and special pathway receptor) as presented in the 2008 LANL SWEIS. Using a conservative estimate of higher consumption rates of each exposure pathway, the lifetime probability of developing a fatal cancer would be about 4.3 x 10-6 for the offsite resident total dose of 0.0072 rem; 5.5 x 10-6 for the recreational user total dose of 0.0091 rem; and 6.4 x 10-6 for the special pathways receptor total dose of 0.0107 rem per year of exposure (LANL 2008).

Table 4.1.10-8—Summary of Ingestion Pathway Doses for Offsite Resident, Recreational User, and Special Pathway Receptors

Exposure Pathway	Dose to Receptor		
	Offsite Resident	Recreational User	Special Pathways
Produce	1.05 x 10-3	1.05 x 10-3	1.05 x 10-3
Meat (free-range beef)	2.56 x 10-4	2.56 x 10-4	2.56 x 10-4
Milk	2.84 x 10-4	2.84 x 10-4	2.84 x 10-4
Fish (game)	2.94 x 10-5	2.94 x 10-5	2.94 x 10-5
Elk	2.12 x 10-5	2.12 x 10-5	2.12 x 10-5
Deer	2.36 x 10-5	2.36 x 10-5	2.36 x 10-5
Honey	6.44 x 10-6	6.44 x 10-6	6.44 x 10-6
Pinyon nuts	2.34 x 10-4	2.34 x 10-4	2.34 x 10-4
Groundwater	5.42 x 10-4	5.42 x 10-4	5.42 x 10-4
Soil	3.72 x 10-5	3.72 x 10-5	3.72 x 10-5
Sediment	2.58 x 10-4	2.58 x 10-4	2.58 x 10-4
Surface water	N/A	1.21 x 10-3	1.21 x 10-3
Soil	N/A	1.09 x 10-6	1.09 x 10-6
Sediment	N/A	8.91 x 10-6	8.91 x 10-6
Fish (non-game)	N/A	N/A	1.09 x 10-4
Elk (heart, liver)	N/A	N/A	3.43 x 10-5
Indian Tea (Cota)	N/A	N/A	3.71 x 10-4
Total	**2.74 x 10-3**	**3.96 x 10-3**	**4.48 x 10-3**

Source: LANL 2008

4.1.11 Health and Safety

Current activities associated with routine operations at LANL have the potential to affect worker and public health. The following discussion characterizes the human health impacts from current releases of radioactive and nonradioactive materials at LANL. It is against this baseline that the potential incremental and cumulative impacts associated with the alternatives are compared and evaluated.

4.1.11.1 *Public Health*

4.1.11.1.1 Radiological

Releases of radionuclides to the environment from LANL operations provide a source of radiation exposure to individuals in the vicinity of LANL. During 2005, LANL's environmental radiological monitoring program was conducted according to DOE Orders 450.1, “Environmental Protection Program,” and 5400.5, “Radiation Protection of the Public and the Environment.” The program involved measuring radioactivity in environmental samples in addition to calculating the potential radiological dose to the offsite public. The program monitored for the principal radionuclides associated with plant operations.

The exposure of members of the public to all DOE sources of radiation is limited by the DOE to levels that shall not cause, in a year, an effective dose equivalent greater than 100 millirem above natural background. Demonstration of compliance with this limit is documented by a combination of measurements and calculations including the comparison of concentrations of radioactive material in air and water to DCGs listed in Chapter III of DOE Order 5400.5. The

DOE provides a level of protection for persons consuming water from a public drinking water supply equivalent to the drinking water criteria in 40 CFR 141 by limiting the effective dose equivalent in a year to 4 millirem. Compliance with the aforementioned criterion is accomplished by comparing measured concentrations of radionuclides in drinking water to 4 percent of the DCG values for ingested water. The DOE further limits emissions of radionuclides to the ambient air from DOE facilities to those amounts that would not cause any member of the public to receive, in any year, an effective dose equivalent of 10 millirem per year. This limit is equivalent to the limit for emissions of radionuclides other than radon to this pathway established by the EPA at 40 CFR 61.92.

Compliance with the dose limit specified in 40 CFR 61.92 (and hence that for the air pathway specified in DOE Order 5400.5) is demonstrated by calculating the effective dose equivalent received by the maximally exposed individual (MEI) member of the general public. This individual is a person who resides near LANL, and who would receive, based on theoretical assumptions about lifestyle that maximize exposure to radiological emissions, the highest effective dose equivalent from Plant operations. Calculations are performed using the EPA's CAP88-PC model (EPA 1992).

Based on the 2004 operational data, the total dose to the offsite MEI in 2004 was estimated at 1.68 millirem. This includes 1.52 millirem that would come from LANSCE stack emissions, 0.12 millirem from emissions at other LANL stacks, and 0.04 millirem from the radionuclides measured at the AIRNET station. The higher emissions and subsequent dose in 2004 are due to operations requiring higher beam power and increased radioactive gas production occurring in the water used to cool the beam target (LANL 2008).

The 2005 collective population dose attributable to LANL operations to persons living within 50 miles of the site was 2.46 person-rem, which is significantly higher than the dose of 0.90 person-rem reported for 2004 (LANL 2006b). Tritium contributed about 17 percent of the dose, and short-lived air activation products such as carbon-11, nitrogen-13, and oxygen-15 from LANSCE contributed about 83 percent. The increase in the 2005 collective population dose was attributable to a longer beam operation time at LANSCE (over twice that of 2004) and a malfunction in the LANSCE air emissions control system. LANSCE has historically been the major contributor to the population dose. Until 2005, population doses for the past 12 years had declined from a high of about 4 person-rem in 1994 to less than 1 person-rem in 2004. The collective population dose is expected to decrease in 2006 to the 2004 level (LANL 2006b).

Tritium concentrations near the LANL perimeter are measurably higher than regional concentrations, but the resulting doses from food stuffs grown there are far below 0.1 millirem per year. The concentrations of other radionuclides are either consistent with global fallout or below levels that would result in a dose of 0.1 millirem per year per pound consumed. The LANL contribution to the food dose is therefore too small to measure and is less than 0.1 millirem per year (LANL 2006b). In summary, the total annual dose to an average resident from all pathways is less than 0.1 millirem. This includes doses from inhalation, ingestion of food and water, and direct exposure. No observable health effect is expected from these doses.

4.1.11.2 *Worker Health*

Occupational radiation exposures for workers at LANL from 1999 to 2005 are summarized in Table 4.1.11-1. The collective Total Effective Dose Equivalent (TEDE) for the LANL workforce during 2005 was 156 person-rem, considerably lower than the workforce dose of 704 person-rem (LANL 2008).

Table 4.1.11-1—Radiological Exposures of LANL Workers

Parameter	Units	1999	2000	2001	2002	2003	2004	2005
Collective TEDE (external plus internal)	person-rem	131	196	113	164	241	125	156
Number of workers with measurable dose	Number	1,427	1,316	1,332	1,696	1,989	1,710	2,169
Average measurable dose (external plus internal)	Millirem	92	149	85	96	121	73	72
Average measurable dose (external only)	Millirem	90	65	83	95	111	68	69

Source: LANL 2008.
TEDE=Total Effective Dose Equivalent

Table 4.1.11-2 summarizes the highest individual dose data for 1999 through 2005. The highest individual doses in 2005 were 2.051, 1.603, 1.398, 1.285, and 1.146 rem. There were no doses that exceeded DOE's 5 rem per year Radiation Protection Standard. With one exception, all worker doses were below the 2 rem per year performance goal set by the as low as reasonably achievable Steering Committee in accordance with LANL procedures (LANL 2008).

The collective TEDE for 2005 is 75 percent of the 208 person-rem for 1993 through 1995 used as a baseline in 1999. Several offsetting factors can be responsible for helping keep the dose below the 1999 baseline. The primary factor is that pit manufacturing has not become fully operational while other factors include: (1) changes in work load and types of work, and (2) improvements in the as low as reasonably achievable program (LANL 2008).

Table 4.1.11-2—Highest Individual Doses to Los Alamos National Laboratory Workers (rem)

1999	2000	2001	2002	2003	2004	2005
1.910	1.048	1.284	2.214	3.0	1.539	2.051
1.866	1.013	1.225	1.897	1.8	1.510	1.603
1.783	0.905	1.123	1.813	1.710	1.500	1.398
1.755	0.828	1.002	1.644	1.569	1.148	1.285
1.749	0.815	0.934	1.619	1.214	1.061	1.146

Source: LANL 2008.

4.1.11.3 *Nonradiological*

Arsenic was identified as having a hazard index near 1 in groundwater that supplies Los Alamos County and San Ildefonso Pueblo. Excess latent cancer fatality (LCF) risk from arsenic greater than 1 in one million per year was also estimated for consumption of soils, sediments, and surface water, by some residents and recreational users of LANL. While the risk associated with arsenic ingestion was greater than 1 in one million per year, the arsenic was not associated with discharges at LANL. Arsenic is endemically present in the geology, soils, groundwater, and surface waters in the region in which New Mexico is located (LANL 2008).

Beryllium has no hazard index for ingestion exceeding 1. However, excess LCF rates greater than 1 in one million are estimated in several pathways. Beryllium concentrations in waters, soils, and sediments are typical of those in background readings in the northern New Mexico region. Based on the environmental surveillance data from LANL, the portion of beryllium associated with LANL operations is not a significant contributor to beryllium concentrations in the immediate area of LANL (LANL 2008).

4.1.12 Transportation

Motor vehicles provide the predominant mode of transportation utilized at LANL. The regional highway system and major roads in the vicinity of LANL are shown in Figure 4.1.12-1. Only two major roads, NM 502 and NM 4, access Los Alamos County. Traffic volume on the Los Alamos County segments of these roads is primarily associated with LANL activities. Most commuter traffic originates from Los Alamos County or east of the county. Less than 5 percent of commuters commute to LANL from the west along NM 4. The average daily traffic flow at LANL's main access points are provided in Table 4.1.12-1.

Most commuter traffic originates from Los Alamos County or east of Los Alamos County (Rio Grande Valley and Santa Fe) as a result of the large number of LANL employees that live in these areas. The passenger rate assumed is three passengers per vehicle, mainly due to park and ride services offered at many communities between Albuquerque and Los Alamos.

Table 4.1.12-1—Los Alamos National Laboratory Main Access Points

Location	Average Daily Vehicle Trips
Diamond Drive across the Los Alamos Canyon Bridge	24,545
Pajarito Road at State Route 4	4,984
East Jemez Road at State Route 4	9,502
West Jemez Road at State Route 4	2,010
DP Road at Trinity Drive	1,255
Total	**42,296**

Source: LANL 2008.

Average traffic volumes on the four at various points in the vicinity of NM 502 and State Road 4 were measured in September 2004 and are presented in Table 4.1.12-2.

4.1.12.1 *Aircraft Operations*

The primary commercial international airport in New Mexico is located in Albuquerque. The small Los Alamos County Airport is owned by the Federal Government, and the operations and maintenance are performed by the County of Los Alamos. The airport is located parallel to East Road at the southern edge of the Los Alamos community. The airport has one runway running east-west at an elevation of 7,150 feet. Takeoffs are predominantly from west to east, and all landings are from east to west. The airport is categorized as a private use facility; however, U.S. Federal Aviation Administration-licensed pilots and pilots of transient aircraft may be issued permits to use the airport facilities.

Table 4.1.12-2—Average Weekday Traffic Volume in the Vicinity of NM 502 and State Road 4

Location	Average Daily Vehicle Trips
Eastbound on New Mexico 502 east of the intersection with New Mexico 4	10,100
Westbound on New Mexico 502 east of the intersection with New Mexico 4	7,765
Eastbound on New Mexico 502 west of the intersection of New Mexico 502 and New Mexico 4	6,540
Westbound on New Mexico 502 west of the intersection of New Mexico 502 and New Mexico 4	4,045
Eastbound on State Route 4 between East Jemez Road and the New Mexico 502/4 intersection	6,665
Westbound on State Route 4 between East Jemez Road and the New Mexico 502/4 intersection	6,505
Transition road from northbound State Route 4 to eastbound New Mexico 502	5,170
Transition road from eastbound New Mexico 502 to southbound State Route 4	1,610

Source: LANL 2008.

4.1.12.2 *Transportation Accidents*

Motor vehicle accidents in Los Alamos County and nearby counties are reported in Table 4.1.12-3. In 2005, there were over 5,100 motor vehicle accidents in Los Alamos, Rio Arriba, and Santa Fe Counties resulting in 53 fatalities.

Table 4.1.12-3—New Mexico Traffic Accidents in Los Alamos and Nearby Counties, 2005

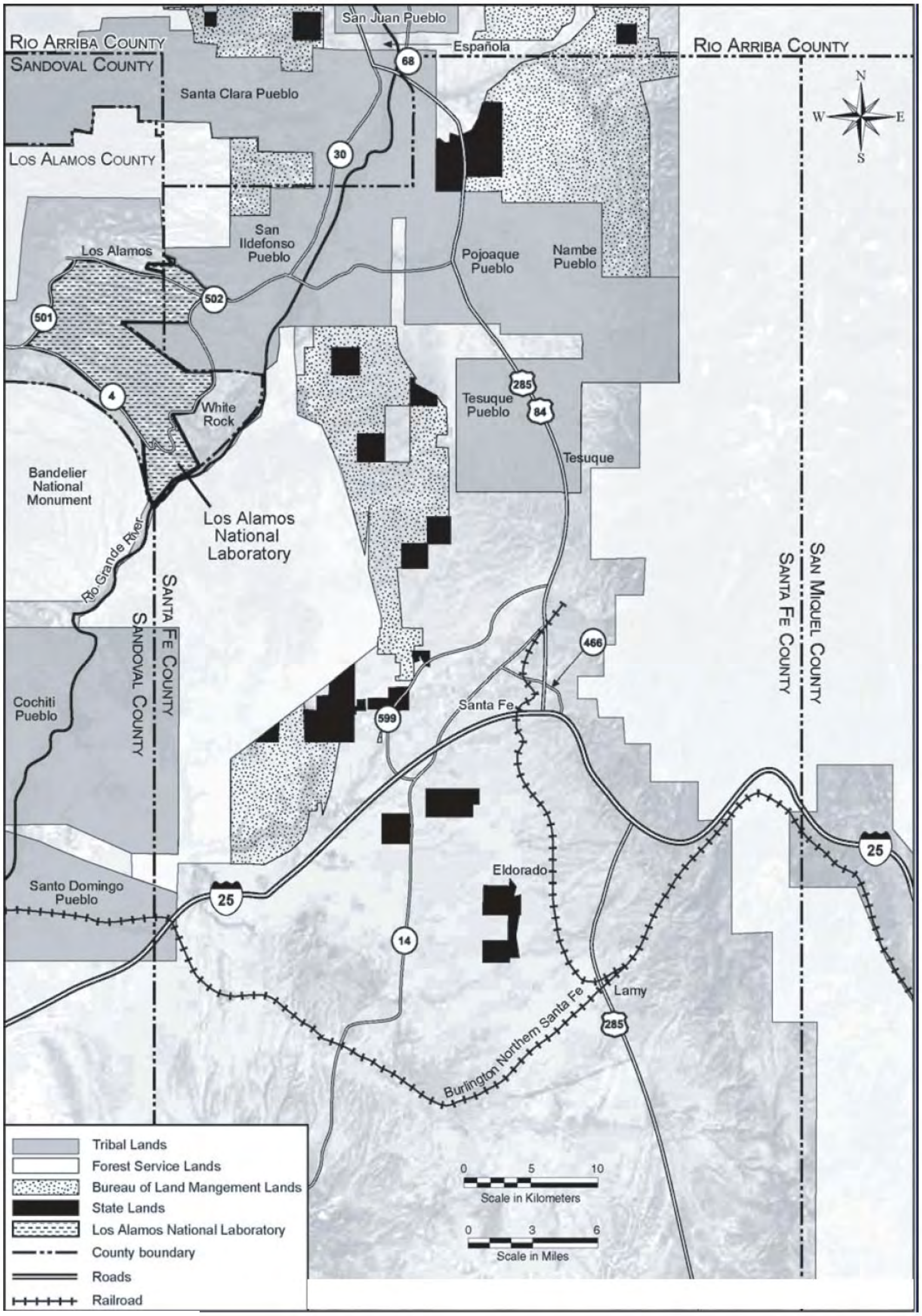
County	Total Accidents	Fatalities	Injuries
Los Alamos	300	2	105
Rio Arriba	588	18	356
Santa Fe	4,217	33	2,323
New Mexico	49,023	488	24,001

Source: NMDOT 2006.

4.1.13 Waste Management

A significant portion of waste management operations take place in facilities designed for and dedicated to waste management. Liquid wastes are treated in the Sanitary Wastewater Systems Plant, the High Explosives Wastewater Treatment Facility, and the Radioactive Liquid Waste Treatment Facility. Specialized facilities in TA-50 and TA-54 house a variety of chemical and radioactive waste management operations, including size reduction, compaction, assaying, and storage. Many hazardous wastes are now accumulated for up to 90 days at consolidated storage facilities and are then shipped directly offsite. Four of these consolidated storage facilities exist at LANL and two more are planned (LANL 2003d).

DOE achieved an overall rating of 97 percent towards the DOE 2005 Pollution Prevention goals for fiscal year 2005. In 2004, DOE established a prevention-based Environmental Management System at LANL based on the International Standards Organization 14001 standard to meet DOE Order 450.1. The Environmental Management System is a systematic method for assessing mission activities, determining environmental impacts of those activities, prioritizing improvements, and measuring results (LANL 2004p). Environmental Management System action plans have been developed to address environmental issues, including objectives for pollution prevention, compliance and continual improvement.



Source: LANL 2008.

Figure 4.1.12-1—LANL Regional Highway System and Major Roads

4.1.13.1 *Low-Level Wastes*

Most low-level radioactive waste generated at LANL is disposed onsite at TA-54, Area G. Disposal operations were expanded into Zone 4, providing sufficient capacity for operational wastes for the long term. Although there were several instances of individual facilities exceeding 1999 projections, overall LANL low-level radioactive waste generation was well below those levels predicted in 1999 for five years of the six-year period (LANL 2008).

4.1.13.2 *Mixed Low-Level Wastes*

Typical waste streams include; contaminated lead shielding bricks and debris, spent chemical solutions, fluorescent light bulbs, copper solder joints, and used oil. The largest single contributor to mixed low-level radioactive waste generation was the remediation of material disposal area (MDA) P (LANL 2004h). Overall LANL mixed low-level radioactive waste generation was below the 1999 projections for each year of the six-year period (LANL 2008).

4.1.13.3 *Hazardous Waste*

Non-Key Facilities exceeded 1999 projections for the years 2000 through 2004; these exceedances are all attributable to the Offsite Source Recovery Program (LANL 2003g, LANL 2004h, LANL 2005g). Overall transuranic waste generation at LANL was well below the 1999 projections for 5 years of the 6-year period. In 2003, transuranic waste quantities exceeded the LANL-wide 1999 projection due to repackaging of legacy waste for shipment to WIPP and receipt and storage of waste by the Offsite Source Recovery Program (LANL 2004h). On August 27, 2007, the New Mexico Environmental Department issued for comment a draft hazardous waste facility permit for LANL.

In the year 2000, Non-Key Facilities generated 82 cubic yards of mixed transuranic waste compared to a 1999 projection of zero; the mixed transuranic waste generation for this category is solely attributable to the Transuranic Waste Inspection and Storage Project drum retrieval project (LANL 2001e). The Solid Radioactive and Chemical Waste Facilities generated mixed transuranic waste beyond that projected for the years 2000 through 2004, most notably in 2003 due to increased rates of transuranic waste repackaging for shipment to WIPP (LANL 2003g, LANL 2004h, LANL 2005g). The increasing trend, through 2003, in mixed transuranic waste generation for the Plutonium Complex and the Chemistry and Metallurgy Research Building reflect operations scaling toward full-scale production of war reserve pits (LANL 2004h). In 2004, mixed transuranic waste generation rates at the Plutonium Complex and Chemistry and Metallurgy Research Building were lower due to the 2004 work suspension and less than full-scale production (LANL 2005g).

From 1999 through 2001, large quantities of chemical wastes were generated by environmental restoration activities through cleanups in TA-16, including MDA P, PRS 3-056(c) in TA-03, and MDA R (LANL 2003g). Wastes generated by the environmental restoration project generally are shipped offsite for treatment and disposal and do not directly impact LANL waste management resources.

Radioactive liquid waste treatment takes place at two facilities located at TA-53, and TA-50. Treatment facilities are connected to source facilities by 22,000 feet of piping. The treatment facility at TA-50 handles the vast majority of radioactive liquid waste, receiving liquid waste from about 1,800 points across LANL. The Radioactive Liquid Waste Treatment Facility at TA-50 is over 40 years old, and many systems are at the end of their design life.

Projections made in 1999 were exceeded for individual treatment activities in several instances, all related to quantities of sludge to be dewatered or solidified; the liquid waste treatment increases due to these activities are small compared to radioactive liquid treatment capacity. The overall radioactive liquid waste treatment rates at LANL were consistent with the 1999 projections for each year of the 6-year period.

4.1.13.4 *Other Waste*

DOE continues to operate the TA-46 Sanitary Wastewater System Plant to treat liquid sanitary wastes. Treated liquid effluent from the Sanitary Wastewater System Plant is pumped to storage tanks near the TA-3 Power Plant before being discharged to Sandia Canyon through NPDES permitted outfall. The Sanitary Effluent Reclamation Facility treats some liquid effluent for reuse in the cooling towers at the Metropolis Center for Modeling and Simulation. Sanitary sludge from the Sanitary Wastewater System Plant is dried for a minimum of 90 days to reduce pathogens and then disposed of as New Mexico Special Waste at an authorized, permitted landfill (LANL 2008).

Industrial effluent is discharged to a number of NPDES-permitted outfalls across LANL. Currently, LANL discharges wastewater to a total of 21 outfalls, down from the 55 outfalls. An effort to reduce the number of outfalls was initiated in 1997, with significant reductions realized in 1997 and 1998. Most of these reductions resulted from changes at the High-Explosives Processing Key Facility and High Explosives Testing Key Facility, with the redirection of some flows to the sewage plant at TA-46, and the routing of high explosives-contaminated flows through the High Explosives Wastewater Treatment Facility (LANL 2003g).

Solid waste is excess material that is not radioactive or hazardous and can be disposed in a solid waste landfill. Solid waste includes paper, cardboard, plastic, glass, office supplies and furniture, food waste, brush, and construction and demolition debris. Through an aggressive waste minimization and recycling program, the amount of solid waste at LANL requiring disposal has been greatly reduced. In 2004, 6,380 tons of solid waste was generated at LANL, of which 4,240 tons was recycled (LANL 2004p). The per capita generation of routine solid waste (for example food, paper, plastic) at LANL has decreased by about 58 percent over the 10-year period from 1993 through 2003 (LANL 2004h). Nonroutine solid waste is generated by construction and demolition projects, and also includes waste generated by Cerro Grande Rehabilitation Project cleanup activities. Rates for the recycled portion of sanitary waste have steadily increased from about 10 percent in 1993 to about 67 percent in 2004 (LANL 2005g).

Previously, solid waste and construction waste generated at LANL was disposed at the Los Alamos County Landfill, located within LANL boundaries, but operated by Los Alamos County.

The County operates a new transfer station, which would transport that waste to other commercially available solid waste landfills within the state.

Construction and demolition debris is regulated as a separate category of solid waste under the New Mexico Solid Waste Regulations. Construction and demolition debris is not hazardous and may be disposed in a municipal landfill or a construction and demolition debris landfill (NMED 1995).

4.1.13.5 *Waste Generation from Routine Operations*

Radioactive and chemical wastes are generated by research, production, maintenance, construction and environmental cleanup activities. Radioactive wastes are divided into the following categories: low-level; mixed low-level; transuranic; and mixed transuranic. Chemical wastes are a broad category including hazardous waste (designated under the RCRA regulations), toxic waste, construction and demolition debris, and special waste. Waste quantities vary with level and type of operation, construction activities, and implementation of waste minimization activities. Waste minimization efforts have resulted in overall waste reduction across most categories, due to process improvements and substitutions of nonhazardous chemicals for commonly used hazardous chemicals (LANL 2004h).

Table 4.1.13-1 presents a summary, by waste type, of radioactive and chemical waste quantities generated from 1999 through 2004. The quantities include contributions across LANL, including Key Facilities, Non-Key Facilities and the LANL environmental restoration project. Table 4.1.13-1

Table 4.1.13-1—Los Alamos National Laboratory Waste Types and Generation

Waste Type	1999 SWEIS ROD Projection	1999	2000	2001	2002	2003	2004	2005	2008 SWEIS Annual Projection 2007-2016	
									Normal Operation	D&D
Low-Level Radioactive Waste (yd^3 /year)	16,000	2,190	5,530	3,400	9,560	7,640	19,400	7,080	12,000	30,000 (Bulk) 8,700 (Packaged)
Mixed Low-Level Radioactive Waste (yd^3 /year)	830	30	780	80	30	50	50	90	130	400
TRU Waste (yd^3 /year)	440	190	160	150	160	530	50	100	570	Not Projected
Mixed TRU Waste (yd^3 /year)	150	110	120	60	110	210	30	130	Not Projected	Not Projected
Chemical Waste (10^3 lbs/year)	7,160	34,000	61,000	60,800	3,820	1,520	2,460	4,340	2,749	1,847

ROD=Record of Decision.
Source: LANL 2006a, LANL 2008.

4.2 LAWRENCE LIVERMORE NATIONAL LABORATORY AND SANDIA NATIONAL LABORATORIES/CALIFORNIA

This section describes the environmental setting and existing conditions associated with the current operations of LLNL and Sandia National Laboratories, California (SNL/CA).

Established in 1952, the LLNL consists of two sites—the main Livermore site located in Livermore, California in Alameda County, and the rural Experimental Test Site, Site 300 (Figure 4.2-1) located approximately 12 miles east, near Tracy, California, in San Joaquin and Alameda Counties. The main LLNL site occupies approximately 821 acres, while Site 300 occupies approximately 7,000 acres. For NNSA, LLNL conducts research and development of nuclear weapons; designs and tests advanced technology concepts; designs weapons; maintains a limited capability to fabricate plutonium components; and provides safety and reliability assessments of the stockpile. LLNL also maintains Category I/II quantities of SNM associated with the weapons program and material no longer needed by the weapons program (See section 3.7 regarding proposed consolidation of this SNM).

SNL/CA was established in 1956 by Sandia Corporation to provide a closer relationship with LLNL and their nuclear weapons design work. The SNL/CA facility evolved into an engineering research and development laboratory by the early 1960s, and into a multi-program engineering and science laboratory during the 1970s. As international arms control efforts increased in the late 1970s and throughout the 1980s, the U.S. emphasized treaty monitoring, safety, security, and control of the national nuclear weapons stockpile. With the end of the Cold War in the late 1980s, the role of SNL/CA to support stockpile stewardship ensuring nonproliferation and continued safety, security, and reliability, took on greater importance.

4.2.1 Land Use

4.2.1.1 *Onsite Land Uses*

4.2.1.1.1 Livermore Site

Onsite land uses at the 821-acre Livermore Site include offices, laboratory buildings, support facilities such as cafeterias, storage areas, maintenance yards, and a fire station; roadways, parking areas, buffer zones, and landscaping. The site also includes internal utility and communication networks. A 500-foot-wide security buffer zone lies along the northern and western borders of the Livermore Site. There are no prime farmlands on the Livermore Site (DOE 2005a).

4.2.1.1.2 Site 300

Site 300 comprises approximately 7,000 acres of largely undeveloped land. Site 300 is primarily a non-nuclear explosives and other non-nuclear weapons component test facility. The site has four remote explosive testing facilities supported by a chemistry processing area, a weapons test area, maintenance facilities, and a General Services Area (GSA) at the site entrance. Approximately 160 acres at Site 300 have been set aside as the large-flowered fiddleneck

(*Amsinckia grandiflora*) reserve" to protect this species' natural habitat. The existing land uses surrounding Site 300 are agricultural, primarily used for grazing cattle and sheep. There are no prime farmlands on Site 300 (DOE 2005a).

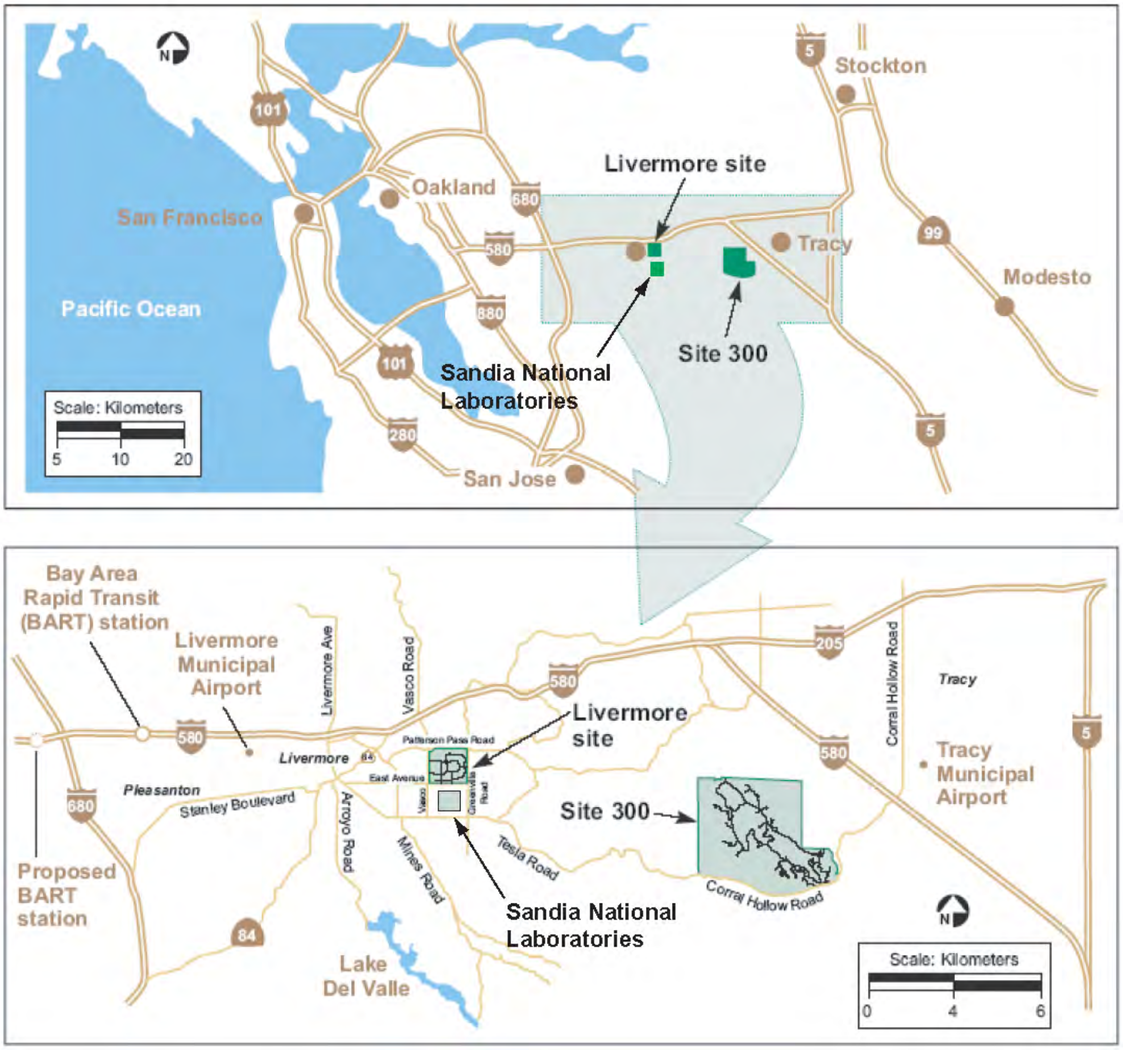


Figure 4.2-1—Livermore Site, Site 300, and SNL/CA

4.2.1.1.3 SNL/CA

The site comprises 410 acres to the south of LLNL. Primary land use at SNL/CA fits into the category of industrial/research park uses, although not all facilities are industrial in nature (for example, administrative offices). Land use at the site includes buildings and structures, infrastructure systems (water, sewer, gas, and electrical), a firing range, roadways, parking areas, and landscaping. Spaces between buildings are landscaped or used as paved service areas, roads, or sidewalks. Parking areas are positioned along the perimeter of the developed area and cluster along East Avenue. Open space within the developed area is set aside for future construction use, with the exception of Arroyo Seco. A security buffer surrounding the western, southern, and eastern edges of the developed area ranges in width from 600 to 1,200 feet and represents approximately 175 acres (SNL/CA 2003). There are no prime farmlands on SNL/CA.

4.2.1.2 *Surrounding Land Uses*

4.2.1.2.1 Livermore Site

Livermore site lies just east of Livermore. Adjoining the site border to the south is SNL/CA, operated by Lockheed-Martin under DOE contract. To the south of the LLNL and SNL/CA sites are mostly low-density residential areas and agricultural areas devoted to grazing, orchards, and vineyards. Farther south, property is primarily open space and ranchettes with some agricultural use. Residential developments, including houses and apartments, abut the property immediately to the west of the Livermore site. A small business park lies to the southwest.

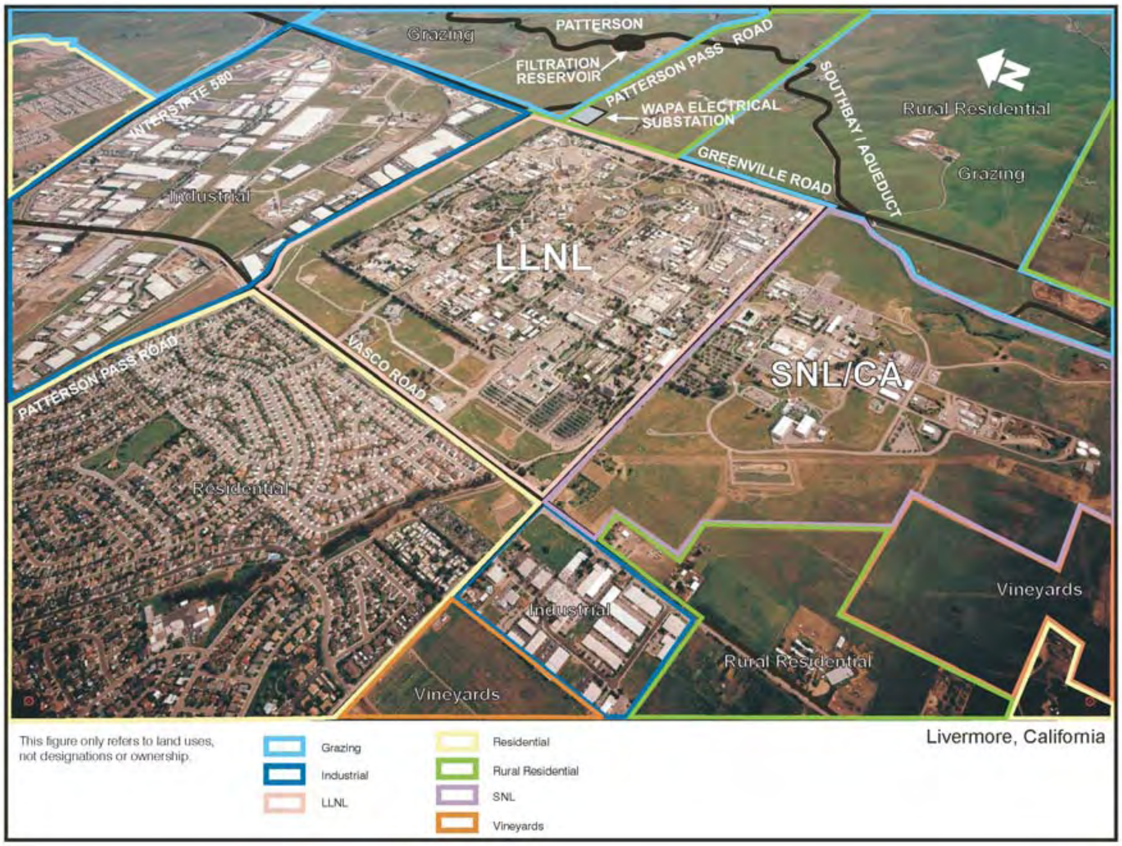
A small amount of very low density residential development lies to the east of the Livermore site, and agricultural land extends to the foothills that define the eastern margin of the Livermore Valley. An extensive business park is located to the north, and a 500 acre parcel of open space to the northeast has been rezoned to allow development of light industry. Land uses farther north include vacant land, industrial, and Interstate 580 (I-580). Land northeast of the site is agricultural and used primarily for grazing. Wind turbines are installed on the hills of the Altamont Pass, northeast of the site. The closest residences to the boundaries of the Livermore Site are 0.25 mile to the east, 0.35 mile to the west, 1.2 mile to the north, and 0.5 mile to the south.

Figure 4.2.1-1 illustrates land uses near the Livermore Site.

4.2.1.2.2 Site 300

Figure 4.2.1-2 shows the existing land uses surrounding Site 300, the majority of which are agricultural, primarily for grazing cattle and sheep. Two other smaller, privately operated research and testing facilities are located near Site 300. The property east of and adjacent to Site 300 is now owned by Fireworks America and is currently being used to store pyrotechnics. A portion of the property is leased to Reynolds Initiator Systems, Inc., and is used to manufacture initiators, which are agents that cause a chemical reaction to commence. A facility operated by SRI International, that conducts explosives tests, is approximately 0.6 mile south of Site 300.

Corral Hollow Road borders Site 300 on the south. The Carnegie State Vehicular Recreation Area is south of the western portion of Site 300, across Corral Hollow Road. It covers approximately 5,000 acres and is operated by the California Department of Parks and Recreation, Off-Highway Motor Vehicle Recreation Division, for the exclusive use of off-highway vehicles. The nearest urban area is the city of Tracy, approximately 2 miles northeast of Site 300. Rural residences are located along Corral Hollow Road, west of Site 300 and the Carnegie State Vehicular Recreation Area. Power-generating wind turbines occupy the land northwest of the site.



Note: A new residential development exists along the western boundary of SNL/CA.

Figure 4.2.1-1—Livermore Site Surrounding Land Use

4.2.1.2.3 SNL/CA

Land use in the region surrounding SNL/CA is a result of city and county planning and zoning regulations. The City of Livermore and the County of Alameda do not have planning jurisdiction over SNL/CA. SNL/CA is situated within the sphere of influence of the City of Livermore, but not within the incorporated area of the city. The area to the west of the site, including Vasco Road, is within the City of Livermore (SNL/CA 2003).

To the north across East Avenue is LLNL. To the east and south is agricultural and low-density residential (as discussed in section 4.2.1.2.1). East of SNL/CA are Greenville Road and a hilly area used for cattle grazing. The South Bay Aqueduct is located between the SNL/CA boundary and Greenville Road. A private residence is located near the southeastern corner of the site, between the aqueduct and the site boundary fence. The area south of the site is primarily vineyards with residences or buildings. West of SNL/CA is the City of Livermore and Vasco Road. Various private landowners own the property on this side of the site. A new residential development is located along the western boundary of the site (SNL/CA 2007). To the west of Vasco Road, the present and proposed uses are residential and light industrial (SNL/CA 2003). Figure 4.2.1–1 illustrates land uses near the SNL/CA.

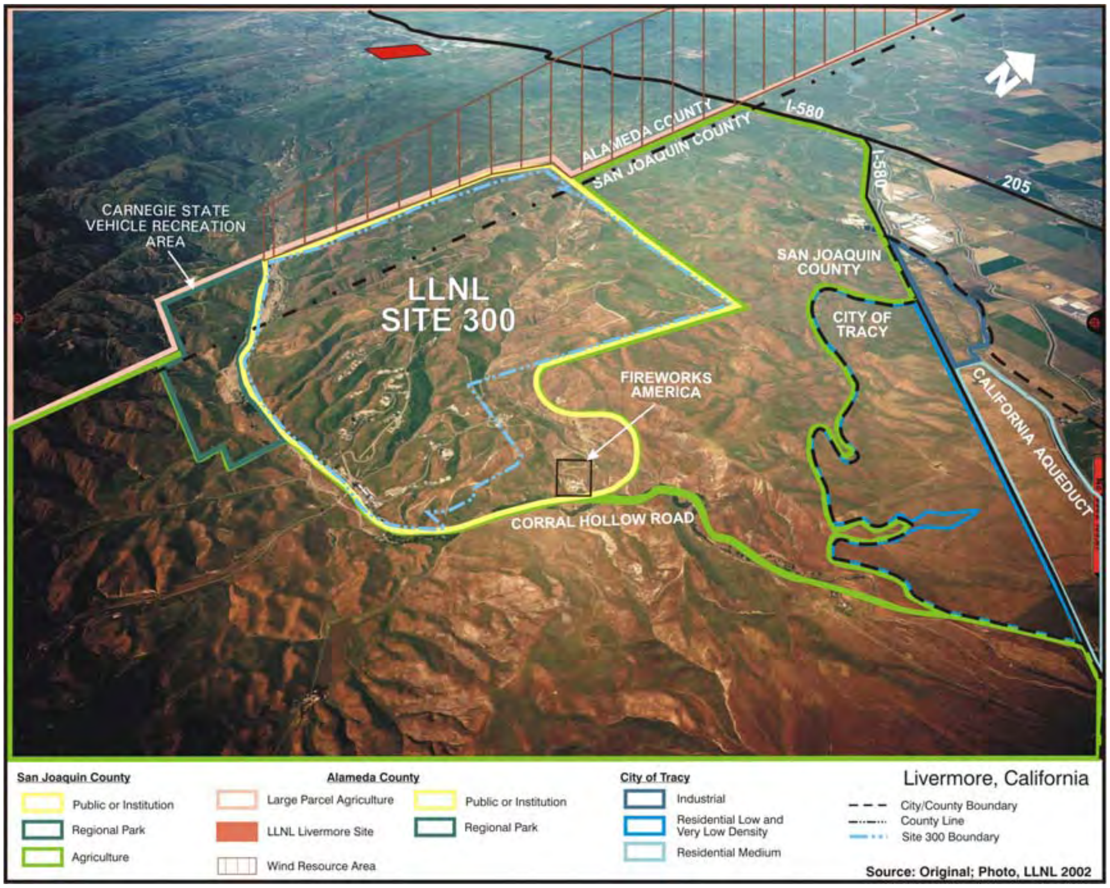


Figure 4.2.1-2—Site 300 Surrounding Land Uses and Land Use Designations

4.2.2 Visual Resources

4.2.2.1 *Livermore Site*

The Livermore Site has a campus-like or business park-like setting with buildings, internal roadways, pathways, and open space. Portions of the site along the western and northern boundaries remain largely undeveloped and serve as security buffer zones. A row of eucalyptus and poplar trees surrounds much of the developed portion of the Livermore Site and screens most ground-level views of the facility. Onsite buildings range in height from 10 to approximately 110 feet. The entire site is surrounded by a security fence. The most prominent buildings in the public viewshed are the administrative buildings off of East Avenue in the southwest corner of the site, the Sunshine building in the western portion of the site, and the National Ignition Facility (NIF) in the northeast corner. These buildings are visible from locations along adjacent roads.

The area surrounding the Livermore Site is a mixture of rural and pastoral uses and urban development. SNL/CA is located immediately south of the Livermore Site. Rural residences and grazing land are the primary visual features to the east. Detached residences occupy the area west of the Livermore Site, giving the area a suburban character. A small area of commercial use occupies lands immediately southwest of LLNL. A mixture of vineyards and residential uses surrounds the commercial area, although residential development is currently underway and the visual character of the area is shifting from pastoral to suburban. The area north of the Livermore Site to I-580 is industrial, primarily one-and two-story industrial buildings, business parks, and the Union Pacific railroad line that traverses the area. This area is visually similar with the research, business, and industrial character of the Livermore Site.

4.2.2.2 *Site 300*

The main gate and the General Services Area (GSA) of Site 300, including a number of buildings, roads, and infrastructure are foreground and middle-ground features in view from Corral Hollow Road, which forms the southern boundary of Site 300. Vegetative screening and topography partially obscure many of the features associated with the GSA. The majority of Site 300 is obscured from view by topography.

The surrounding area is primarily undeveloped open space or rural, with some exceptions. Fireworks America is adjacent to and northeast of Site 300. Although the sign at the entrance to the facility is visible from Corral Hollow Road, structures associated with this facility are obscured by topography. The SRI International Testing Facility is approximately 0.6 mile south of Site 300 and is not visible from Corral Hollow Road.

Carnegie State Vehicular Recreation Area, located south of the western portion of Site 300, is used by off-road vehicles. The park includes dirt trails on the surrounding hillsides and a ranger station, picnic areas, and several contoured riding areas in the valley floor adjacent to Corral Hollow Road. These features are all visible from Corral Hollow Road. The highly developed area is substantially out of character with the surrounding open space and rural features of the area.

4.2.2.3 *SNL/CA*

SNL/CA is situated on mostly flat terrain that provides little or no public views of the site from locations a mile or more away. The site has 72 buildings used for offices, laboratories, facilities, and storage. Views of the site are limited to immediately adjacent areas (SNL/CA 2003).

The view of SNL/CA from East Avenue consists of the built portion of SNL/CA in the middle and the buffer zones at the west and east ends. The view of SNL/CA from Vasco Road includes the northwest portion of the buffer zone and at one point, a view of the Micro and Nano Technologies Laboratory's (MANTL's) building shape, roof, and exhaust stacks. The view of SNL/CA from Tesla Road includes South Portal Road and the gated entrance, and the water towers on the hills at the south end of the site. Greenville Road is on terrain higher than SNL/CA, but there are hills between the road and the site. Thus, views of the site are available from the road only between these hills (SNL/CA 2003).

4.2.3 Site Infrastructure

Site infrastructure available at LLNL and SNL/CA is used to support the current missions. To support these missions an infrastructure exists as shown in Table 4.2.3-1.

Table 4.2.3-1—Baseline Characteristics for LLNL and SNL/CA

LLNL		
Characteristics	**Current Value**	
Land	**Main Site**	**Site 300**
Area (acres)	820.4	6,918.9
Roads (miles)	14.9	24.9
Railroads (miles)	0	0
Electrical		
Energy consumption (MWh/yr)	415,759[a]	15,661
Peak Load (MWe)	57.2	2.6
Fuel		
Natural Gas (yd^3 /yr)	2.4×10^7	NA
Liquid (L/yr)	31.688	43,527
Coal (t/yr)	0	0
SNL/CA		
	Usage (2006)	**Percent of Capacity**
Water (million gallons)	69.8	8
Wastewater (million gallons)	11.2	14
Electricity (MWh)	36,411	14
Natural Gas (ft^3 /yr)	71.8 million	17

Sources: DOE 2005a, SNL/CA 2007.

4.2.3.1 *Electricity*

Electricity consumption for the Livermore Site and Site 300 remained relatively flat from 1998 to 2000. Electricity use at the Livermore Site decreased in 1999 and 2000, and increased in 2001 and 2002. Electricity consumption at Site 300 remained relatively constant during the same period. The estimated electrical consumption for 2007 is 415,759 MWh per year at the Livermore Site and 15, 661 MWh per year for Site 300. The peak load for the Livermore site is 57.2 MWe and 2.6 MWe for Site 300. The electrical load at Site 300 averages 2.7 megawatts and is projected to increase to 2.8 megawatts as site improvements are completed. The peak electrical load in 2002 was 3.4 megawatts (DOE 2005a).

Pacific Gas and Electric and the Western Area Power Administration supply electrical power to the Livermore Site. Pacific Gas and Electric supplies the electrical power to Site 300. The peak electrical load at the Livermore Site was 57 megawatts (MWe) and 3.4 MWe at Site 300 (DOE 2005a). Pacific Gas and Electric also supplies natural gas to the Livermore Site. In 2002 the annual natural gas consumption at the Livermore Site totaled 24 million yd^3. At Site 300, fuel oil consumption averages 16,600 gallons per year (DOE 2005a). As shown in Table 4.2.3-1, SNL/CA electrical usage is about 12 percent as large as the LLNL Main Site.

4.2.3.2 *Natural Gas*

PG&E supplies natural gas to the Livermore Site by way of the meter station at the south end of Southgate drive. Natural gas is used mostly for comfort heating in the building category. In the metered process category, natural gas is used mostly for programmatic experiments and comfort heating. Continuing efforts to decrease energy use include modification to HVAC controls, the design of more efficient buildings, boiler tune-ups, and other site energy conservation efforts.

At Site 300, fuel oil is used mostly for backup electric power generation in the building category. In the metered process category, fuel oil is used for comfort heating and in some experiments. Fuel oil consumption at Site 300 averages 16,600 gallons per year (DOE 2005a) a 79-percent decrease from the 1992 average of 78,100 gallons per year (DOE 2005a). This substantial decrease in fuel oil consumption is primarily due to completion of HVAC retrofit and modernization projects.

4.2.3.3 *Water Consumption*

Water consumption rates at the Livermore Site have decreased from an average of 261.8 million gallons per year in 1986, to 212 million gallons per year (581,000 gallons per day) in 2002 (DOE 2005a). Currently, peak water usage is approximately 1.2 million gallons per day. The capacity of the domestic water system is 2.88 million gallons per day (DOE 2005a).

Site 300 is supplied with water from a system of wells. The existing capacity of usable wells is approximately 930,000 gallons per day. A project to connect Site 300 with water pumped from the city of San Francisco's Hetch Hetchy water supply system would add an estimated 648,000 gallons per day to the current capacity, with the capability of expanding to 1.2 million gallons per day (DOE 2005a). SNL/CA water usage is about 16 percent as large as the LLNL Main Site.

4.2.4 Air Quality and Noise

4.2.4.1 *Air Quality*

4.2.4.1.1 Meteorology and Climatology

The climate at the Livermore Site, Site 300, and the surrounding region is classic Mediterranean with hot dry summers and cold wet winters. Temperatures typically range from 25°F during the coldest winter mornings to 104°F during the warmest summer afternoons at the Livermore site. The typical temperature range at Site 300 is somewhat smaller, ranging from 30°F during the coldest winter mornings to 100°F during the warmest afternoons. The average annual temperature at the Livermore Site is 54.5°F. The highest and lowest annual precipitations on record are 30.8 inches and 5.4 inches, respectively. Prevailing winds at the Livermore Site are from the west and southwest. The climate at Site 300, while similar to the Livermore Site, is modified by higher elevation and more pronounced relief. Topography significantly influences surface wind patterns at Site 300 with prevailing winds from the west-southwest (DOE 2005a).

4.2.4.1.2 Ambient Air Quality

Ambient air pollutant measurements are used in determining an area's status with respect to NAAQS or State Ambient Air Quality Standards (SAAQS) (i.e., as an attainment or nonattainment area). Ozone and nitrogen dioxide are measured locally in Livermore and Tracy. Particulate matter and carbon monoxide are also measured in Livermore, as well as some toxic air contaminants. While attaining and maintaining compliance with NAAQS or SAAQS is a primary goal of all air pollution control agencies, both the Bay Area and San Joaquin Valley have been designated as nonattainment areas with respect to both the Federal ozone standard and the more stringent state standard. The Bay Area air district is classified as nonattainment with respect to California standards for particulates, attainment for the Federal PM_{10} annual standard, and unclassified for both $PM_{2.5}$ and 24-hour PM_{10} standards. The San Joaquin Valley air district is classified as nonattainment for state particulate matter standards and as a serious nonattainment area for Federal PM_{10} standards. The designation for the Federal $PM_{2.5}$ standard has not yet been determined. Although particulates are not measured in Tracy, it is recognized as a regional problem. The Bay Area has been a nonattainment area for carbon monoxide; however, in 1998, the Bay Area was redesignated as an attainment area for carbon monoxide, and further problems are not anticipated (DOE 2005a).

Regionally, the most complex air quality problem has been ozone. Ozone is not regulated directly because it is formed in the atmosphere by photochemical reactions (i.e., in the presence of sunlight). Nitrogen oxides and many organic compounds are precursors to the formation of ozone. For this reason, air districts are particularly interested in reducing precursor organic compounds and nitrogen oxides. The local topography, meteorology, and proximity to large metropolitan areas upwind, contribute to the buildup of air pollutants in the Livermore Valley. This area, in fact, experiences a disproportionate number of exceedances of NAAQS. Because it takes some time for the photochemical reactions to occur, emissions of precursors, primarily from motor vehicles and the morning commute, are transported away from their sources and affect ozone concentrations in downwind areas. Although the Bay Area's highest ozone levels can fluctuate from year to year depending on weather conditions, ambient ozone standards are exceeded most often in the Santa Clara, Livermore, and Diablo valleys. These same locations typically register the highest particulate matter levels as well, although in this case, the high levels are due to the dry conditions and limited mixing within the sheltered terrain.

With the goal of expeditiously attaining conformance with NAAQS, the *California Clean Air Act* requires air districts to reduce emissions of nonattainment pollutants or precursors by 5 percent per year, and requirements are adopted within each air district's clean air plan. The stringency of requirements within each local clean air plan and subsequent implementing air regulations is based on the severity of the problem and projected timeframe when the area is expected to achieve attainment. As part of this process, both the Bay Area Air Quality Management District (BAAQMD) and San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) have adopted "no net increase" provisions within their clean air plans. The "no net increase" programs require that, as a precondition to the issuance of an air permit for a significant new or modified emission source, any increases in emissions of nonattainment pollutants or precursors be offset by mandatory reductions in emissions of other sources onsite or potentially at other facilities. In the BAAQMD, the offset requirement is triggered for mid-size facilities (emissions of 15 tons per year or more of nonattainment pollutants), and a greater burden is placed on large facilities (emissions of 50 tons per year or more). These large facilities must offset any proposed emission increases by a slightly greater decrease, at a ratio of 1.15 to 1.0. The added 15-percent in part satisfies the 5-percent annual emission reduction requirement of nonattainment areas.

The Livermore Site falls into the mid-size facility category and must abide by the requirements of the BAAQMD for emission offsets. Site 300, the majority of which lies within San Joaquin County, is under the jurisdiction of the SJVUAPCD. In SJVUAPCD, offset requirements are triggered at 10 tons per year. Although this level is much lower than that established by the BAAQMD, emissions at Site 300 are substantially less than the offset trigger level (DOE 2005a).

Several PSD Class I areas have been designated in the vicinity of the Livermore Site, including Point Reyes National Wilderness Area, approximately 55 mi to the northwest; and Desolation National Wilderness Area, Mokelumne National Wilderness Area, Emigrant National Wilderness Area, Hoover National Wilderness Area, and Yosemite National Park, approximately 100 to 120 mi, respectively, to the east and northeast. Since the promulgation of the PSD regulations (40 CFR 52.21) in 1977, no PSD permits have been required for any emission sources at the Livermore Site.

4.2.4.1.3 Nonradiological Air Emissions

The Livermore site currently emits approximately 332 pounds per day of regulated air pollutants as defined by the Clean Air Act, including nitrogen oxides, sulfur oxides, particulate matter (PM-10), carbon monoxide, and reactive organic gases/precursor organic compounds (ROGs/POCs) (see Table 4.2.4-1). The stationary emission sources that release the greatest amount of regulated pollutants at the Livermore site are natural gas fired boilers, internal combustion engines (such as diesel generators), solvent cleaning, and surface coating operations (such as painting) (DOE 2005a).

LLNL air pollutant emissions are very low compared with daily releases of air pollutants from all sources in the entire Bay Area. For example, the total emissions of nitrogen oxides released in the Bay Area for 2005 were approximately 1.1×10^6 pounds per day, compared with the estimated release from the Livermore site of 151 pounds per day, which is 0.014 percent of total Bay Area source emissions for nitrogen oxides. The 2005 BAAQMD estimate for ROGs/POCs emissions was 7.9×10^5 pounds per day, while the estimated releases for 2005 from the Livermore site were 54.8 pounds per day, or 0.007 percent of the total Bay Area source emissions for ROGs/POCs (DOE 2005a).

Table 4.2.4-1—Nonradioactive air emissions, Livermore Site and Site 300, 2006

Pollutant	Estimated releases (lbs/day)	
	Livermore Site	Site 300
ROGs/POCs	54.9	0.90
Nitrogen oxides	151.2	1.15
Carbon monoxide	110.0	0.25
Particulates (PM-10)	12.3	0.62
Sulfur oxides	3.7	0.07

Source: LLNL 2007.

The total estimated air pollutant emissions during 2005 from operations (permitted and exempt stationary sources) at Site 300 are presented in Table 4.2.4-1. The stationary emission sources that release the greatest amounts of regulated air pollutants at Site 300 include internal combustion engines (such as diesel generators), a gasoline-dispensing facility, paint spray booths, drying ovens, and soil vapor extraction equipment. Overall, the emissions for all pollutant categories at Site 300 decreased in 2005 (DOE 2005a).

LLNL monitors ambient air to determine if radionuclides or beryllium are being released by Laboratory operations, what the concentrations are, and what the trends are in the environs. Beryllium is the only nonradiological emission from LLNL that is monitored in air. Normally for nonradiological emissions, LLNL obtains permits from local air districts (i.e., BAAQMD or SJVAPCD) that require monitoring of equipment usage, material usage, and record keeping during operations. The BAAQMD has exempted LLNL from the permitting process because LLNL can demonstrate that monthly average beryllium concentrations in air are well below regulatory limits at perimeter locations (DOE 2005a).

SNL/CA does not have any major sources of air pollutants (as defined in 40 CFR Part 70.2) present on site. SNL/CA works with the BAAQMD and CARB to permit or register all regulated emission sources. For the 2005/2006 permit period1, SNL/CA had 15 permitted emission sources. The number of permits remained at 15 for the 2006/2007 permit period (SNL/CA 2007).

4.2.4.1.4 Radiological Air Emissions

Some LLNL facilities discharge low quantities of radionuclides to the air. These releases can be evaluated according to the individual and population dose they create. The degree of hazard to the public is directly related to the type and quantity of the radioactive materials released. Dose estimates are modeled from emissions determined at each facility or, in the case of diffuse sources such as soil resuspension, from air sample measurements. Separate doses are calculated for the Livermore Site and Site 300 because of their spatial separation and are compared to regulatory dose limits for the protection of public health. Historically, doses have never exceeded regulatory limits. Recent annual doses to the hypothetical site-wide maximally exposed individual have been less than 2 percent of a chest x-ray (DOE 2005a).

LLNL monitors the stack effluent from its principal facilities and measures concentrations of radionuclides in ambient air both on and offsite, to determine if radionuclides are being released and in what concentrations. LLNL performs research using a variety of radioactive materials, including tritium, uranium, plutonium and other transuranic radionuclides, biomedical tracers, and mixed fission products. The contribution to the offsite dose is predominated by tritium from the Livermore Site and depleted uranium from Site 300. Although even less important than these, other radionuclides such as carbon-14, strontium-90 and other beta emitters, and transuranics such as plutonium-239, americium-241 and other alpha emitters can also be released.

Ambient air is monitored by a network of air particulate and tritium samplers located on the Livermore Site (7 particulate samplers and 12 tritiated water vapor samplers), in the Livermore Valley (9 and 6, respectively), at Site 300 (8 and 1, respectively), and in Tracy (1 particulate sampler) (LLNL 2007). There were no releases from the HEPA-filtered monitored stacks at the Livermore site. Stack releases of tritium from the Tritium Facility and the Decontamination and Waste Treatment Facility contributed 85 percent of the estimated of 40.5 Curies of tritium released from the Livermore site in 2005. The 2005 tritium release rate is essentially equal to the release rate in 2004, but, in 2005, the fraction of total tritium contributed by diffuse area sources was greater than in 2004. The 2005 LLNL SWEIS projected that tritium emissions would increase to 210 Curies/year. At Site 300, only very small quantities of gross alpha and gross beta radiation associated with particles (fewer than 1.6×10^{-6} Curies each) were estimated very conservatively to have been released from the Contained Firing Facility during 2005. Overall, LLNL operations involving radioactive materials had minimal impact on ambient air during 2005. Radionuclide particulate concentrations in air at the Livermore site and in the Livermore Valley were well below the levels that would cause concern for the environment or public health. Section 4.2.11 explains the public health effects (LLNL 2007).

SNL/CA does not currently have any radionuclide emission sources that are subject to the monitoring requirements of 40 CFR Part 61. To comply with national emission standards, SNL/CA evaluates individual projects with the potential to release radionuclide emissions to determine the worst-case dose to the public. Additionally, dose calculations are compared to the requirements to determine the need for annual monitoring. During 2006, SNL/CA evaluated one project with the potential to produce radionuclides through nuclear fission in a non-sealed source. Conservative estimates based on the rate of fission indicated that the amount of radionuclides produced would be several orders of magnitude below the annual possession quantities in 40 CFR 61 (SNL/CA 2007).

4.2.4.2 *Noise*

Noise sources at LLNL are, for the most part, common to other local industrial/commercial settings, although on a somewhat larger scale. Construction and demolition activities are similar, however, because of the size of the site, perimeter buffer zone, and intervening roads. The contribution of these activities to noise levels offsite is small. The contribution of mobile noise sources associated with heavy-duty trucks and employee vehicles is greater, due to the relatively large number of shipments of materials and waste to and from the site and the large employment base; i.e., compared with other area businesses. Occasionally, noise may also be heard from the pistol and rifle firing range located at Site 300. These activities are not in conflict with land use compatibility guidelines.

LLNL is somewhat unique in the category of impulse (short-blast) noise associated with explosives research testing. High explosive tests are conducted regularly (daily and/or weekly) at both the Livermore Site, in the High Explosives Application Facility (HEAF), Building 191; and at Site 300, within the Contained Firing Facility and on open firing tables. The maximum allowable sound pressure level of 126 decibels (db) would not be exceeded in populated areas.

A field survey was conducted in January 2003 to characterize typical daily maximum noise levels in the vicinity of the Livermore Site. Measurements were taken for 1-hour periods using standard sound-level meters during the heart of the morning and evening commute. The monitors were placed at eight locations surrounding and just outside the Livermore Site perimeter, in regions of maximum activity (intersections and site entrance and exit locations). Results of the survey indicated that, as expected, vehicular traffic was the dominant noise source at most monitored locations. Rail operations and light aircraft overflights were minor contributors. The only recognizable noise sources from site activities within LLNL were some heavy equipment backup warning beepers, which were detectable during low traffic intervals at the monitoring sites on Patterson Pass Road. All levels were within the acceptable range established by the city of Livermore and Alameda County (DOE 2005a).

4.2.5 Water Resources

4.2.5.1 *Surface Water*

4.2.5.1.1 Surface Water and Water Use

Livermore site. As shown on Figure 4.2.5-1, the four major intermittent streams that drain into the eastern Livermore Valley are Arroyo Mocho, Arroyo Seco, Arroyo Las Positas, and Altamont Creek. Arroyo Seco and Arroyo Las Positas pass through the Livermore Site, while Altamont Creek and Arroyo Mocho flow offsite to the north and southwest, respectively. Arroyo Las Positas drains in the hills directly east and northeast of the Livermore Site and usually flows only after storms. Arroyo Seco flows through the very southwest corner of the Livermore Site. Arroyo Las Positas flows into Arroyo Seco west of the site. Both stream channels are dry for most of the year. Nearly all surface water runoff at the Livermore Site is discharged into Arroyo Las Positas; only surface water runoff along the southern boundary and some storm drains in the southwest corner of the Livermore Site drain into Arroyo Seco. Although surface drainage and natural surface infiltration at the Livermore Site are generally good, drainage decreases locally with increasing clay content in surface soils. Surface flow may occur intermittently from October to April, during the valley's wet season. Only intermittent streams flow into the eastern Livermore Valley from the surrounding uplands and low hills, where they merge on the valley floor (DOE 2005a).

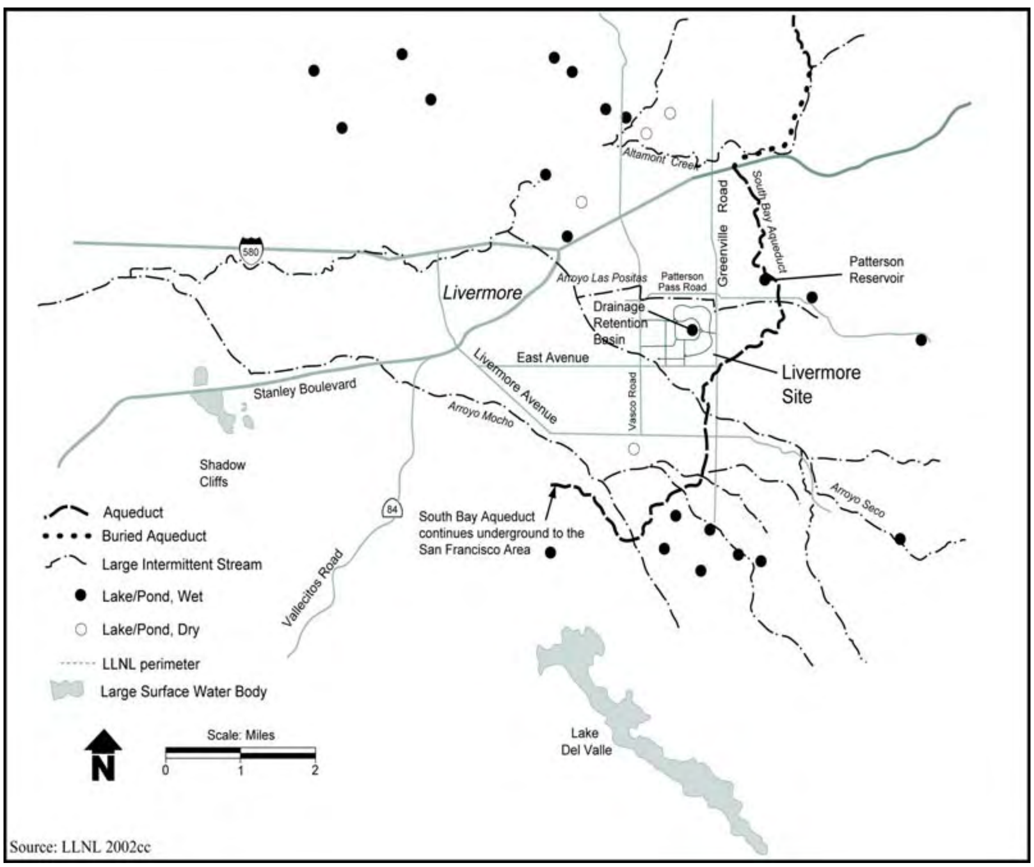


Figure 4.2.5-1—Livermore Valley Surface Water Features

The headwaters of the Arroyo Seco drainage are in the hills southeast of the Livermore Site. Arroyo Seco has a drainage length of approximately 12 miles and a watershed area of approximately 8,960 acres upstream of SNL/CA. The Arroyo Seco flows through SNL/CA before crossing over the southwest corner of the Livermore Site and continuing southwesterly. Flow only occurs in the arroyo during rainfall because discharge to the stream is from storm runoff only. The channel is well defined in the section that passes directly through the Livermore Site and is dry for at least 6 months of the year. In fact, during dry years, it may flow only 10 to 15 days per year in the vicinity of the Livermore Site vicinity.

Arroyo Las Positas is an intermittent stream that drains from the hills directly east of the Livermore Site with a watershed area of approximately 3,300 acres. This channel enters the Livermore Site from the east, is diverted along a storm ditch around the northern edge of the site, and exits the site at the northwest corner. Discharge from the onsite Drainage Retention Basin (DRB), discussed below, keeps the arroyo flowing perennially. Additionally, water from springs and runoff in the nearby hills feed into Arroyo Las Positas (LLNL 2002b). Flow has increased in the arroyo over the past several years, due to treated groundwater discharges (DOE 2005a).

The Livermore Site's primary water source is the San Francisco Hetch Hetchy Aqueduct system. This system obtains its water from a reservoir in the Hetch Hetchy Valley of Yosemite National Park. The secondary or emergency water source is the Alameda County Flood and Water Conservation District, Zone 7. This water is a mixture of groundwater and water from the South Bay Aqueduct of the state water project. In 2002, 1.2 million gallons per day were derived from the Hetch Hetchy Aqueduct and Zone 7 for use at the Livermore Site. Water is primarily used for industrial cooling processes, sanitary systems, and irrigation at the Livermore Site. Minor amounts of water are used for drinking, manufacturing, washing, system filters, and boilers.

In 2005, the Livermore site discharged an average of 285,306 gallons per day of wastewater to the City of Livermore sewer system, 4 percent of the total flow into the city's system. This volume includes wastewater generated by SNL/CA and very small quantities (26,420 gallons in 2005) of Site 300 wastewater, which is discharged to the LLNL collection system and combines with LLNL sewage before it is released at a single point to the municipal collection system. LLNL's wastewater contains both sanitary sewage and process wastewater and is discharged in accordance with permit requirements and the City of Livermore Municipal Code. LLNL also compares annual discharges with historical values to evaluate the effectiveness of ongoing discharge control programs.

During 2005, a total of 0.08 Curies of tritium was discharged to the sanitary sewer, an amount that is well within environmental protection standards and is comparable to the amounts discharged during the past 10 years. During 2005, no discharges exceeded any discharge limits for release of radioactive materials to the sanitary sewer. The data are comparable to the lowest historical values. All the values reported for radiological releases are a fraction of their corresponding limits. For nonradiological releases, LLNL achieved near perfect compliance with the provisions of its wastewater discharge permit; there were only two releases of pH outside permissible limits. The data demonstrate that LLNL continues to have good control of radiological and nonradiological discharges to the sanitary sewer. Monitoring results for 2005 reflect an effective year for LLNL's wastewater discharge control program and indicate no adverse impact to the LWRP or the environment from LLNL sanitary sewer discharges (DOE 2005a).

Site 300. There are no perennial streams at or near Site 300. The canyons that dissect the hills and ridges at Site 300 drain into intermittent streams. The majority of these onsite streams drain to the south into Corral Hollow Creek, also intermittent, which flows east along the southern boundary of Site 300 in the San Joaquin Valley. In addition to these streams, 24 springs and 2 vernal pools exist onsite. Some surface water discharge occurs from cooling towers and other process runoff areas.

Site 300 draws drinking water from two onsite groundwater production wells in the southeastern part of Site 300. Therefore, water is subject to the *Safe Drinking Water Act* of 1974 regulations. The system operates under Water Supply Permit No. 03-10-94-001. The system includes a primary drinking water supply well (well 20) and a backup well (well 18), several holding tanks, and a distribution network. Both are deep, high-production wells that can produce up to 23,700 gallons per hour of potable water (LLNL 2003l). Water production from these wells has declined from a peak of 32.7 million gallons in 1992 to 25 million gallons in 2002. LLNL disinfects well water with chlorine and monitors the quality of this water at the well and throughout the distribution system. In addition, the Hazards Control Department reviews the data to ensure that drinking water standards are met. Site 300 Plant Engineering submits the required reports to the California State Department of Health Services. In the near future, it is expected that Site 300 will obtain its drinking water from the Hetch Hetchy Aqueduct system. LLNL will maintain the onsite drinking water wells as a backup supply and will be responsible for the Site 300 Drinking Water Permit requirements (DOE 2005a).

At Site 300, stormwater, cooling tower water, and groundwater that has been treated to remove contaminants are discharged to onsite or adjacent drainages in accordance with NPDES permit conditions. Approximately 1.3 million gallons per year of wastewater is discharged to the wastewater sewage pond. The maximum capacity of the sanitary wastewater sewage pond in the General Services Area is 3.2 million gallons per year.

SNL/CA. SNL/CA does not operate a public water system, and is not involved in any environmental restoration activities for which Safe Drinking Water Act standards are being applied. Drinking water at SNL/CA is purchased through LLNL and obtained from the San Francisco Water District or the Alameda County Flood Control and Water Conservation District, Zone 7. The San Francisco Water District and Zone 7 are responsible for monitoring the quality of the incoming water. SNL/CA is not required to treat or sample the drinking water. LLNL maintains the drinking water distribution system for both sites and screens for water quality (SNL/CA 2007).

4.2.5.1.2 Surface Water Quality

Livermore site. Offsite surface water bodies in the vicinity of the Livermore Site are routinely monitored for radioactive parameters. In addition, stormwater runoff at the Livermore Site is routinely monitored for radioactive and nonradioactive parameters.

Tritium activities at effluent locations were less than 1 percent of the MCL. No gross alpha, gross beta, or tritium activities were above the LLNL site-specific thresholds in 2002 (Table 4.2.5-1). Radioactivity in the stormwater samples collected during 2002 had medians around background levels (DOE 2005a).

Table 4.2.5-1—Drinking Water Maximum Contaminant Levels and Livermore Site-Specific Threshold Comparison Guidelines for Radioactive Stormwater Constituents

Parameter	EPA Drinking Water MCL (pCi/L)	LLNL Comparison Guideline [a] (pCi/L)
Tritium	20,000	973
Gross alpha	15	9.19
Gross beta	50	13

Sources: DOE 2005a, EPA 2003a.
[a] Site-specific value calculated from historical data and studies.
EPA=Environmental Protection Agency; MCL=maximum contaminant levels; pCi/L=picocuries per liter.

Site 300. Site 300 stormwater monitoring continues to show that most contaminants (including dioxins and furans, naturally occurring lead and uranium) are transorbed to suspended sediments in the water; however, these concentrations pose no threat to the environment (DOE 2005a).

SNL/CA. Wastewater generated at SNL/CA is discharged to the City of Livermore Water Reclamation Plant, a publicly owned treatment works (POTW). The Livermore POTW maintains an NPDES permit, and then regulates industry discharges into their sewer system. A Wastewater Discharge Permit issued by the Livermore POTW regulates SNL/CA's wastewater discharges. The permit is updated annually and includes discharge limits for the site sanitary sewer outfall and for processes subject to EPA pretreatment standards. During 2006, SNL/CA did not exceed established discharge limits at the sewer outfall as shown (SNL/CA 2007).

SNL/CA has three categorical processes that are subject to EPA's pretreatment standards: two metal finishing operations, and a semiconductor manufacturing operation. The two metal finishing operations are closed-loop processes and do not discharge any effluents. Wastewater generated from the semiconductor manufacturing process is sampled and monitored as part of the Environmental Monitoring Program. There were no exceedances of the discharge limits from this source during 2006 (SNL/CA 2007).

SNL/CA's storm water management program also incorporates the six minimum control measures required by the California Small Municipal Separate Storm Sewer System (MS4) General Permit. The MS4 General Permit was adopted in 2003 to meet EPA Phase II storm water regulations. Although the MS4 General Permit is not yet a regulatory requirement for SNL/CA, the site anticipates that it will be regulated as a non-traditional small MS4 when notification is provided by the regulating agency.

In 2006, SNL/CA visually monitored 21 storm water discharge locations and sampled nine locations. The result of monitoring and sampling activities conducted in 2006 did not identify any issues of concern.

4.2.5.1.3 Surface Water Rights and Permits

LLNL holds several permits pertaining to local, state, and Federal regulations: NPDES permits; Waste Discharge Requirements permits for any discharge of wastes that could adversely affect the beneficial uses of water; a city of Livermore Water Reclamation Plant permit for wastewater discharges to the city sanitary sewer system; and California Department of Fish and Game permits for streambed alteration for any work that may disturb or impact rivers, streams, or lakes.

4.2.5.2 *Groundwater*

4.2.5.2.1 Groundwater Quality

Livermore site. LLNL conducts surveillance monitoring of groundwater in the Livermore Valley and at Site 300 through networks of wells and springs that include private wells off site and DOE Comprehensive Environmental Response, Compensation, Liability Act (CERCLA) wells on site. Groundwater from wells downgradient from the Livermore site is analyzed for pesticides, herbicides, radioactivity, nitrates and hexavalent chromium. To detect any offsite contamination quickly, the well water is sampled in the uppermost water-bearing layers. As in other years, all contaminants in groundwater away from the Livermore site were well below allowable limits for drinking water (LLNL 2007).

Groundwater at both the Livermore site and Site 300 is contaminated from historical operations; both are undergoing CERCLA cleanup. Within LLNL site boundaries, groundwater surveillance monitoring has detected that mostly volatile organic compounds (VOCs) exist in groundwater at various locations in concentrations above drinking water quality standards: trichloroethylene, perchloroethylene, 1,1-dichloroethylene, chloroform, 1,2-dichloroethylene, 1,1-dichoroethane, 1,2-dichloroethane (1,2-DCA), trichlorotrifluoroethane (Freon 113), trichlorofluoromethane (Freon 11), and carbon tetrachloride (DOE 2005a). Cleanup began in 1989. LLNL removes contaminants from groundwater at the Livermore Site through a system of 27 treatment facilities located throughout the 6 hydrostratigraphic units containing contaminants of concern. Since remediation began in 1989, approximately 1,960 million gallons of groundwater have been treated. Contaminated groundwater is pumped from individual wells and sent to a treatment facility (LLNL 2007).

In 2005, concentrations continued to decrease in most of the Livermore site VOC plumes due to active remediation and the removal of over 267 kilograms of VOCs from both groundwater and soil vapor. VOC concentrations on the western margin of the site continued their gradual decline, indicating effective hydraulic control of the boundary plumes. Within the interior of the site, remediation activities, including soil vapor extraction, dual extraction, and groundwater extraction, have resulted in declines of VOC concentrations in numerous source areas. Of special interest is the significant five-fold increase in the mass of VOCs removed from soil vapor during the past four years (LLNL 2007).

Groundwater monitoring at the Livermore site and Site 300 and their environs indicates that LLNL operations have minimal impact on groundwater beyond the site boundaries. During 2005, neither radioactivity nor concentrations of elements or compounds detected in groundwater were confirmed to be above potable water MCLs (LLNL 2007).

Tritium measurements of Livermore Valley groundwater continue to show very low and decreasing activities compared with the 20,000 picocuries per liter MCL established for drinking water in California. The maximum tritium activity measured off site was in the groundwater at well 12A2, located about 9 kilometers west of LLNL. The measured activity there was 116 picocuries per liter in 2005, less than 1 percent of the MCL (LLNL 2007).

Groundwater near the Livermore Site is generally suitable for use as a domestic, municipal, agricultural, and industrial supply; however, use of some shallower groundwater may be limited by its marginal quality. Groundwater less than 300 feet deep is usually unsuitable for domestic use without treatment (LLNL 1992).

Site 300. Near Site 300, monitored constituents for offsite groundwater include explosives residue, nitrate, perchlorate, metals, volatile and semivolatile organic compounds, tritium, uranium, and other (gross alpha and beta) radioactivity. Historically, the surveillance and compliance monitoring programs have detected higher than natural background concentrations of various metals, nitrate, perchlorate, and depleted uranium in groundwater at Site 300. Subsequent CERCLA studies have linked several of these contaminants, including depleted uranium, to past operations, while the sources of other contaminants, such as nitrate and perchlorate, are the objects of continuing study.

One groundwater sample collected from an offsite private well about 3.7 miles to the west of Site 300 had nitrate concentrations slightly above the drinking water limit (45 milligrams per liter). This result appears to be unrelated to LLNL activities. No other constituent reached any drinking water limit in offsite wells near Site 300. Site 300 cleanup began in 1991. VOCs are the main contaminant found at the eight Site 300 Operable Units (OUs). In addition, nitrate, perchlorate, tritium, high explosives, depleted uranium, organosilicate oil and metals are found at one or more of the OUs.

In 2005 at Site 300**,** perchlorate, nitrate, the high explosive RDX (cyclotrimethylenetrinitamine), and organosilicate oil were removed from groundwater in addition to about 90 kilograms of VOCs. Each OU has a different profile of contaminants, but, overall, groundwater and soil vapor extraction and natural attenuation at Site 300 continue to reduce the mass of contaminants in the subsurface. The cleanup of volatile organic compounds was completed at the Site 300 GSA. An additional four areas are under investigation and have not yet reached a final CERCLA remedy to address environmental contamination.

All discharges from the Site 300 sewage evaporation pond to the percolation pond, as well as discharges to the surface impoundments from the Explosives Process Area, chemistry buildings, and photographic processes were in compliance with discharge limits. Wastewater discharges to surface impoundments were discontinued in June 2005 in anticipation of their closure in November 2005 (DOE 2005a). Groundwater monitoring related to these areas indicates that there were no measurable impacts to the groundwater from the surface impoundment operations. However, the groundwater quality is generally poor and yields are low, and these perched water-bearing zones do not meet the State of California criteria for aquifers that are potential water supplies (DOE 2005a).

SNL/CA. SNL/CA has seven groundwater monitoring wells. Sandia monitors groundwater at two former restoration areas and along Arroyo Seco. Three groundwater monitoring wells are used to monitor residual contamination at former restoration areas under a 1989 site clean-up order issued by the Regional Water Quality Control Board, San Francisco Bay Region (RWQCB). Two of these wells are located at the Fuel Oil Spill site, and one at the Navy Landfill. Four monitoring wells are located along Arroyo Seco to monitor the effect of site operations on groundwater quality. Well AS-4 is located upgradient of the developed area of the site and provides background data about local groundwater quality. SNL/CA discontinued monitoring at MW-406 in 2005 but continues to report the result's of LLNL's monitoring in the SNL/CA annual site environmental report (SNL/CA 2007).

4.2.5.2.2 Groundwater Availability

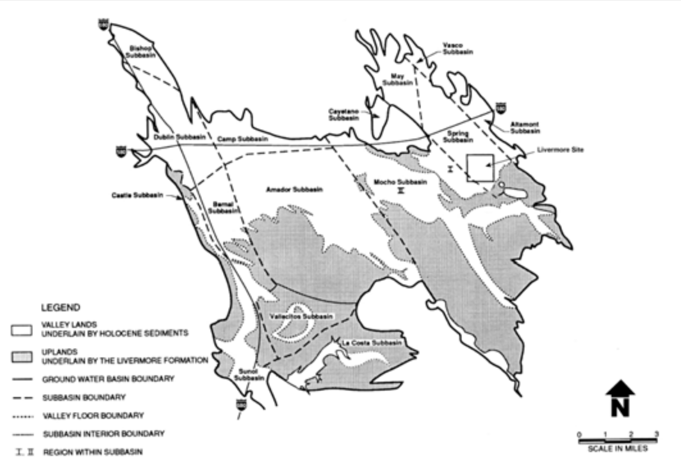
Livermore site. The majority of Livermore Valley sediments is water bearing and transmits groundwater in varying degrees. In contrast, the uplands generally do not yield groundwater in sufficient quantities to constitute a groundwater resource. The Livermore Valley has been divided into a series of 12 groundwater subbasins based on the locations of faults, topography, and other hydrogeological barriers that affect groundwater occurrence, movement, and quality (Figure 4.2.5-2). The Livermore Site lies primarily within the Spring and Mocho I subbasins. The water-bearing sediments in the Livermore Valley include late-Pleistocene to Holocene-age alluvial sediments, generally less than 200 feet thick, which overlie Plio-Pleistocene alluvial and lacustrine Livermore Formation sediments, up to 4,000 feet thick. The Livermore Formation consists of beds of gravel, sand, silt, and clay of varying permeabilities. Sandy gravelly layers alternate with fine-grained, relatively impermeable layers, and groundwater can be both confined and semiconfined.

Stream runoff from precipitation, controlled releases from the South Bay Aqueduct, direct rainfall, irrigation, and treated groundwater infiltration recharge the Livermore Valley groundwater basin. In addition, stream channels, ditches, and gravel pits west of the city of Livermore are important sources for shallow, alluvial aquifer recharge. Groundwater is naturally discharged from the basin at Arroyo de la Laguna, located over 11 miles southwest of the Livermore Site. Some minor discharges also occur at springs, including those along Arroyo Las Positas near its confluence with Altamont Creek. Natural recharge occurs primarily along the fringes of the Livermore Valley groundwater basin and through the arroyos during periods of winter flow. Artificial recharge, if needed to maintain groundwater levels, is accomplished by releasing water from Lake Del Valle or from the South Bay Aqueduct into arroyo channels in the east (DOE 2005a).

Groundwater generally moves east to west within the Livermore Valley, westward through the Amador Subbasin, eventually terminating in a large groundwater depression near two gravel mining areas located west of the city of Livermore. A former gravel mining company had extracted deep groundwater, causing the large groundwater depression. Current gravel mining is not as deep as in the past, decreasing the need for deep groundwater pumping. Subsequently, the groundwater depression has decreased. At the eastern edge of the Livermore Site, groundwater gradients are relatively steep, but under most of the site and farther to the west, the contours flatten.

Pumping of groundwater for agricultural uses has historically accounted for the major withdrawal of groundwater from the Livermore Valley groundwater basin. As the valley has become increasingly urbanized, a shift in groundwater users has caused the amount of pumping for municipal use and gravel quarrying to exceed agricultural withdrawals. Agricultural use, namely vineyards and a few ranches, account for approximately 1,000 acre-feet per year of water in the Livermore Site vicinity. Although agricultural withdrawals are still a major source of drawdown, agriculture is increasingly using more surface water from the state water project than groundwater.

Site 300. Site 300 lies on the eastern flank of the Diablo Range. Most surface runoff and most groundwater flow toward the San Joaquin Valley. Runoff that concentrates in the Elk Ravine and Corral Hollow Creek recharges local bedrock aquifers. The regional groundwater table beneath Site 300 largely occurs within sandstone and conglomerate beds of the Neroly Formation, and groundwater moves through both pores and fractures. A deep confined aquifer (400 to 500 feet deep) is present beneath the southern part of Site 300 within the lower Neroly Formation sandstones. This confined aquifer provides the Site 300 water supply. Pumping tests performed in Site 300 water supply wells affirm the integrity of the aquitard separating the shallow and deeper aquifers within the lower Neroly Formation. In addition to the regional aquifers, local perched aquifers containing small amounts of water occur in some deposits within the Neroly Formation and the marine Tertiary sequence. Because the water quality is generally poor and yields are low, these perched water-bearing zones do not meet the State of California criteria for aquifers that are potential water supplies (DOE 2005a).



Source: LLNL 1992a.

Figure 4.2.5-2—Location of Subbasins and Physiographic Features of the Livermore Valley

4.2.6 Geology and Soils

The Livermore Site and Site 300 are located within the California Coast Ranges, an area of north-northwest trending low, rugged mountains and narrow intervening valleys. The Livermore Site is located in the southeastern portion of the Livermore Valley, an east-west structural basin defined by branches of the San Andreas fault system. The Livermore Site occupies a smooth land surface that slopes gently to the northwest. The Livermore site ranges in elevation from 676 feet in the southeast corner to 571 feet in the northwest corner. Site 300 is located in the Altamont Hills near the western boundary of San Joaquin County. The site occupies approximately 7,000 acres of steep ridges and canyons with a decrease in elevation toward the southeast. Slopes vary greatly in the canyons and can exceed 45 degrees in places. The slopes are much gentler in the GSA, located in the southeastern portion of the site and can be as slow as 2 or 3 degrees (DOE 2005a). Site elevations range from 1,722 above mean sea level in northwest portions of the site to approximately 500 feet above mean sea level along the southern boundary.

4.2.6.1 *Geology*

4.2.6.1.1 Livermore Site

The Livermore Site is underlain by late Tertiary and Quaternary rocks that lie on basement rocks of the Franciscan assemblage, which consist of severely deformed sandstone, shale, and chert. In the Livermore area, this unit is mainly sandstone. The Livermore Valley topographic and structural basin was formed in Pliocene time by movements along faults to the east and west. The basin is filled with 4,000 feet of Pliocene to Holocene alluvial gravels, sands, and lacustrine clays of the Livermore Formation. Late Quaternary alluvial deposits immediately underlie the Livermore Site.

Four late Pleistocene vertebrate fossils were discovered in the peripheral parts of the excavation for the NIF: two of the locations yielded fragmentary remains of Equus or horse, the third location included remains of proboscidean or elephant order, probably Mammuthus or mammoth, and the fourth location yielded remains of Columbian Mammoth or *Mammuthus columbi*. The geologic unit in which all four localities occur is a geographically restricted fluvial valley fill deposit (DOE 2005a). The fossil localities were found 20 to 30 feet below the present surface. The only vertebrate fossil deposits in the vicinity of the Livermore Site, other than those from the NIF excavation mentioned above, are in the Quaternary deposits of the surrounding low hills of the east Livermore Valley. These fossils are few in number and quite scattered. They have been tentatively identified as Pleistocene age, specifically Rancho La Brean and Blancan, and consist of bone fragments of the mammoth and giant sloth. Invertebrate shells and leaf and stem fossils have also been found. These appear to be randomly dispersed, mainly within the Neroly Formation. No invertebrate or botanical fossil deposits of significance are believed to be present in the eastern Livermore Valley (DOE 2005a).

4.2.6.1.2 Site 300

Sedimentary rocks at Site 300 are generally older than the alluvial sediments that underlie the Livermore Site in the eastern Livermore Valley. This hilly terrain contains sedimentary units that dip 5 degrees or more to the east and southeast. The site lies in an area of northwest-trending steep hills and ridges separated by ravines and are underlain by Eocene to Pliocene sedimentary rocks that rest on a basement of the Cretaceous Great Valley Sequence. Late Miocene to Pliocene interbedded sandstones, siltstones, and claystones are exposed in much of the site. Cretaceous, Eocene, and Early Miocene rocks are also present along the northern and southern borders of the site. These rocks are locally overlain by Quaternary alluvial and terrace deposits and Holocene colluvium, alluvium, and valley fill deposits.

Several vertebrate fossil deposits have been found on Site 300 and in the vicinity of Corral Hollow. Most finds have been a result of road improvement or erosion along stream banks. Nearly all bone fragments found are considered to be Miocene age, specifically Clarendonian, and are scattered within the Neroly Formation. An assortment of mammalian groups is represented: camelids, mastodon, assorted early horses, shrews, beavers, and squirrels. Fossil finds are generally widely scattered, and none consist of more than one or a few fragments of bone. The eroded terraces of exposed Neroly Formation rocks on the south side of Corral Hollow Creek adjacent to Site 300 are the only locations where numerous fragments have been recovered (Hansen 1991).

4.2.6.1.3 SNL/CA

SNL/CA is located in the California Coast Ranges geologic province characterized by low rugged mountains and relatively narrow intervening valleys. Specifically, SNL/CA is located in the southeastern portion of the Livermore Valley. The valley forms an irregularly shaped lowland area about 16 miles-long east-to-west and 7 miles to 10 miles-wide north-to-south. The floor of the valley slopes to the west at about 20 ft per mile. In general, the site consists of relatively flat foothills that have low relief and slope gently northwest and north. Slopes at SNL/CA vary from 1 to 3 degrees. The southern area of SNL/CA is situated on the north side of a ridge (the Altamont Hills) approximately 150 ft above the surrounding land. The SNL/CA property ranges in elevation from 849 ft above MSL at the south end of the SNL/CA ridge top to 615 ft MSL at the northwest corner of the site (SNL/CA 2003).

4.2.6.2 *Soils*

4.2.6.2.1 Livermore Site

The soils in the Livermore Valley beneath the Livermore Site are formed primarily upon sediments deposited by local streams. Most of the deposits in the eastern part of the valley are relatively young, and thus, the soils are only moderately developed. These soils, generally loam, have minimal horizon or development of layers and can be locally several meters thick. The soils are used for crop production when provided with sufficient water and nutrients or minerals. Four soils cover most of the Livermore Site vicinity. In order of decreasing extent, they are Rincon loam, Zamora silty clay loam, San Ysidro loam, and Yollo gravelly loam. These soils are primarily Alfisols, or moderately developed soils, and grade into Mollisols, which are grassland soils. At the Livermore Site, there is generally little potential for non-seismically induced landslides because the site is situated on gently sloping to nearly flat topography (DOE 2005a).

LLNL has historically released tritium to the air during routine operations and, occasionally, by accident. Tritium is the only radionuclide released from LLNL activities that occurs in detectable concentrations in vegetation and foodstuffs. The LLNL contribution to tritium exposure levels in the Livermore Valley has trended downward by approximately one order of magnitude as evidenced by the decline in the dose to the site-wide MEI at the Livermore Site between 1990 and 2001 (DOE 2005a).

4.2.6.2.2 Site 300

Site 300 soils have developed on marine shales and sandstones, uplifted river terraces, and fluvial deposits. They are classified as loamy Entisols. Entisols are young soils that have little or no horizon development. Clay-rich soils, known as Vertisols, are also present and have been mapped as the Alo-Vaquero Complex. Vertisols are mineral soils characterized by high clay content that display shrink/swell capability. The remaining soil types identified at Site 300 occur only in limited areas. These units are mixtures of the soils described and are not readily separable, including grassland Mollisols, or are poorly developed Inceptisols (DOE 2005a). The Wisfiat-Arburnia-San Timoteo Complex soils cover most of Site 300, differing slightly depending upon slope. The Alo-Vaquero Complex and Vaquero-Carnoa Complex soils cover most of the rest the site. All Site 300 soil types are potentially useful for limited agriculture but are constrained by location and steepness of the slopes. The loamy soils easily erode, and vegetation can be churned into the soil by moderate livestock or other traffic during wet periods. Vertisols exhibit low permeability and are subject to moderate erosion. Wildlife habitat and limited grazing by livestock are the best uses of these soils.

At Site 300, the topography ranges from gently sloping to nearly vertical in places. The potential for nonseismically initiated landslides is great along the canyon walls, especially where soils consist of deep loams and clay loams. During periods of extended wet weather, the saturated soils can become structurally weakened and expand, with resulting slope failure. The potential for localized slope instability greatly increases if slopes are made steeper by road cutting or building excavation. The presence of landslide deposits and colluvium or other historic evidence of slope failure increases the probability of a failure in the future.

With the exception of vegetation from previously identified sites of contamination, the tritium levels at Site 300 were below the limits of detection and comparable to those observed in previous years. The areas where tritium is known to be present in the subsurface soil are well delineated and localized (DOE 2005a).

4.2.6.2.3 SNL/CA

Topically, surface soils and arroyo sediments cover the site. The soils beneath the site are formed primarily upon sediments deposited by local streams. Most of the deposits in the eastern part of the valley are relatively young, and thus soils are only moderately developed. These soils (generally loam) have minimal horizon, or development of layers, and can be several meters thick locally. Three soils cover most of SNL/CA: Rincon clay loam, Positas gravelly loam, and Livermore gravelly loam (SNL/CA 2003).

4.2.6.3 *Seismology*

4.2.6.3.1 Livermore Site

The Livermore Site is located near the boundary between the North American and Pacific tectonic plates, and the structural geology of the area is characterized by the San Andreas Fault system, which trends northwest southeast. As depicted in Figure 4.2.6-1, the two regional structural features located closest to the Livermore Site are the Greenville and Las Positas fault zones. Local plate interaction generally results in the accumulation of strain along fault structures, which may be released during an earthquake event. The high level of seismicity has resulted in the area's classification of Seismic Risk Zone 4, the highest risk zone in the California Building Code (DOE 2005a).

Major earthquakes have occurred in the region in the past and can be expected to occur again in the future. The greatest probability for large earthquakes is associated with the San Andreas Fault zone. However, the large earthquakes that have occurred in the San Francisco Bay Area such as the 1906 Great San Francisco Earthquake, with an estimated magnitude of 8.3 on the Richter Scale, produced limited structural damage in the Livermore Valley.

The local faults in the Livermore Valley region are still the main seismic hazard to the Livermore Site. The potential for local, damaging earthquakes was highlighted by the January 1980 Livermore earthquake sequence on the Greenville Fault, which produced two earthquakes of magnitudes 5.5 and 5.6 on the Richter Scale. The first earthquake caused discontinuous surface displacements along 3.9 miles of the fault and produced a maximum peak ground acceleration of 0.26 *g* at nearby Lake Del Valle. The unit *g* is equal to the acceleration due to the Earth's gravity or 32 feet/second/second. The earthquake caused structural and nonstructural damage to the Livermore Site. Seismic hazard analyses have been performed for the Livermore Site to quantify the hazard. The analyses identify the probability of exceeding a given peak ground acceleration. Maximum horizontal peak ground accelerations at the Livermore Site for return periods of 500, 1,000, and 5,000 years are 0.38 g, 0.65 g, and 0.73 g, respectively.

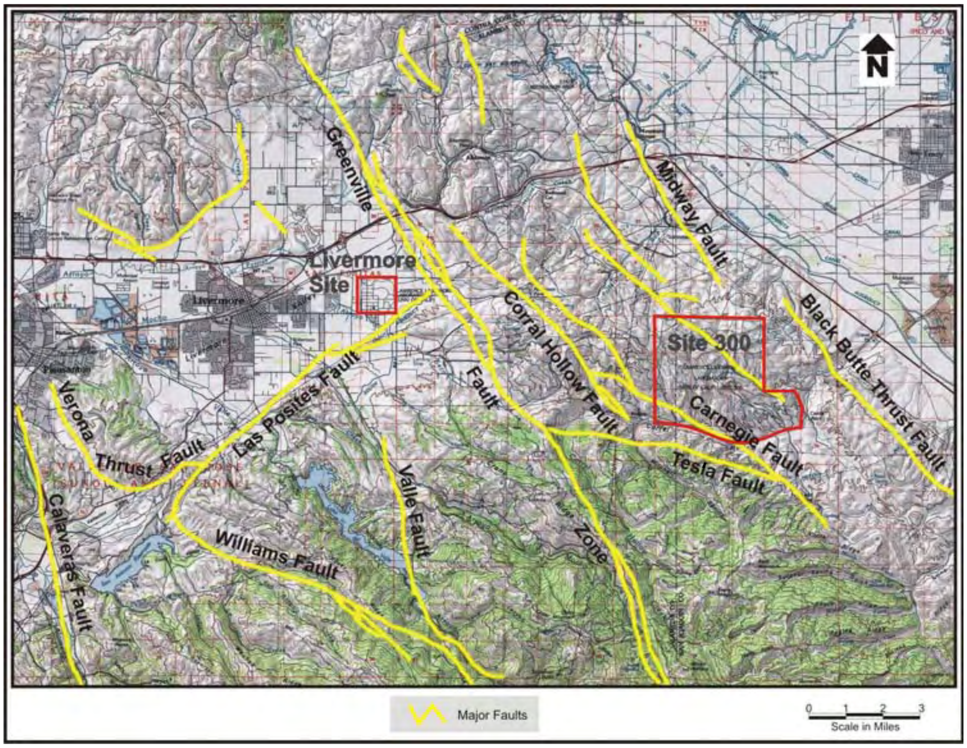


Figure 4.2.6-1—Location of the Major Faults Adjacent to the Livermore Site and Site 300

Faults that show evidence of Holocene and earlier activity in Quaternary time comprise the source of potential seismic hazard to the Livermore Site. Regionally significant structures are associated with the San Andreas Fault system, including the Hayward and Calaveras faults east of the San Francisco Bay Area. The closest structure to the Livermore Site associated with the San Andreas Fault system, the Calaveras Fault, is situated approximately 15 miles west of the site. The San Andreas, Hayward, and Calaveras faults have produced the majority of significant historical earthquakes in the Bay Area, and accommodate the majority of slip along the Pacific North American plate boundary. These structures will likely continue generating moderate to large earthquakes more frequently than other faults in the region (DOE 2005a).

4.2.6.3.2 Site 300

Site 300 is located near the eastern edge of the Coast Range Province, which is characterized by northwest trending, strike-slip faults of the San Andreas Fault system. The boundary between the Coast Ranges and the San Joaquin Valley lies immediately east of Site 300 and is characterized by east-northeast compression, resulting in reverse and thrust faulting and folding. The principal faults in the vicinity of Site 300 are the Corral Hollow-Carnegie, Black Butte, Midway, and the San Joaquin, all are sources of seismic hazard in the area (Figure 4.2.6–1). The active Carnegie Fault of the Corral Hollow-Carnegie Fault zone crosses the southern portion of the site. The Elk Ravine Fault, a complex structure composed of pre-Holocene strike-slip faults, reverse faults, normal faults, and local folds, crosses Site 300 from the northwest corner to the southeast corner. No significant recorded earthquakes have occurred on any of the local faults.

The region surrounding Site 300 has experienced strong ground shaking during historic earthquakes. In 1906 the Great San Francisco Earthquake on the San Andreas Fault produced structural damage a few miles west of Site 300 (DOE 2005a). Potential sources for future ground motion at Site 300 include major regional faults such as the San Andreas, Hayward, and Calaveras, as well as smaller faults including the Greenville, Las Positas, Corral Hollow-Carnegie, Black Butte, and Midway (DOE 2005a).

4.2.6.3.3 SNL/CA

The two regional northwest-southeast trending fault zones located closest to SNL/CA are the Greenville fault zone and the Tesla-Ortigalita fault zones, both shown in Figure 4-3. To the west, the San Ramon Valley fault is located approximately 10 mi. The South Branch Las Positas fault traverses the southern most section of SNL/CA. The North Branch Las Positas fault cuts through the center of the SNL/CA site (SNL/CA 2003).

SNL/CA is located near the boundary between the North American and Pacific tectonic plates, and the area is characterized by the San Andreas Fault system, which trends southeast northwest. Three principal components of the San Andreas Fault system, the San Andreas, Hayward, and Calaveras faults, have produced the majority of significant historical earthquakes in the Bay Area. These three faults also accommodate the majority of slip along the Pacific and North American plate boundary and they would likely continue to generate moderate to large earthquakes more frequently than other faults in the region. The potential for local, damaging earthquakes was highlighted by the January 1980 Livermore earthquake sequence on the Greenville fault, which produced two earthquakes of magnitudes 5.5 and 5.6 on the Richter Scale. The earthquake caused structural and nonstructural damage to the SNL/CA facilities (SNL/CA 2003).

In most cases, Calaveras fault earthquakes in the Livermore Valley region have occurred on strike-slip faults, generally indicating north-south-oriented compression. The fault segment nearest SNL/CA may be capable of generating a magnitude 6 to 6.5 earthquake (SNL/CA 2003).

These local faults in the Livermore Valley region are the main seismic hazard to the region. Due to the level of active seismic results this region is classified as Seismic Risk Zone 4, the highest risk zone in the California Building Code (DOE 2005a). Adverse impacts to structures, infrastructures, and surrounding communities could occur from hazardous materials release and/or structural failure of buildings and facilities following a major seismic event.

4.2.7 Biological Resources

The following section describes biotic resources at the Livermore Site and Site 300 including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species.

4.2.7.1 *Terrestrial Resources*

4.2.7.1.1 Livermore Site

The Livermore Site covers 821 acres of which approximately 640 acres are developed. Vegetation surveys at the Livermore Site have been conducted as part of previous projects. In June 2002, an additional survey was conducted. This survey confirmed that site conditions and species composition have changed relatively little during the past 10 years. The developed areas at the Livermore Site are planted with ornamental vegetation and lawns. There are also small areas of disturbed ground with early successional plant species. The undeveloped land in the security zone is an introduced grassland plant community dominated by nonnative grasses such as wild oat, brome grasses, foxtail barley, curly dock, and wild radish. The tree canopy consists of both native and nonnative species including willows, oaks, California buckeye, glossy privet, and black locust. Vegetation along the arroyo's channel includes perennial peppergrass, sweet fennel, and common cocklebur. Common species in the annual grassland along the upper channel bank of the arroyo include wild oats, brome grasses, alkali mallow, and yellow star-thistle (DOE 2005a).

Wildlife includes species that live in the undeveloped grassland in addition to a number of species that live in the developed areas of the site or along the arroyo. Representative species observed in the undeveloped grassland areas include the fence lizard, black-tailed hare, California ground squirrel, red fox, and western meadowlark. The California red-legged frog has been observed in the Arroyo Las Positas and the Drainage Retention Basin (DRB). The bullfrog, a known predator of the California red-legged frog, has been observed since 1997. Nesting birds include the American crow, American robin, house finch, mockingbird, and house sparrow. These species nest in the planted trees onsite. Canada geese and muskrats have been observed at the DRB. A raven's nest was observed among some pipes at the Livermore Site. Some bird species observed include the mourning dove, Nuttall's woodpecker, Cooper's hawk, and turkey vulture. Catfish, mosquito fish, goldfish, and sculpin have been observed in the DRB. Recent studies have provided new information about raptor activity at the Livermore Site. In 1996, the red-shouldered hawk, not previously known to occur on LLNL property, nested at the Livermore Site. Between 1994 and 2003, the white-tailed kite, a state-protected bird of prey, was observed foraging, nesting, and fledging young at the Livermore Site. The kites were marked with aluminum leg bands in 1999 to initiate long-term studies of the species in a semi-urban edge habitat. In 2000, a pair of white-tailed kites attempted to nest, but the nesting was unsuccessful, possibly due to climatic conditions or low incidence of prey. This reduced nesting trend was observed in other parts of California in 2000. Breeding success improved in 2003 with nine young fledged from two nests (DOE 2005a).

4.2.7.1.2 Site 300

Site 300, with large areas of wildland vegetation, interspersion of various plant community types, and availability of water at springs, provides habitat for a diversity of wildlife. Twenty amphibian and reptile species have been observed at Site 300. Aquatic habitat is available at some of the drainages containing aquatic vegetation supported by underground springs and seeps and in a seasonal pool in the northwest portion created to mitigate for the closure of the two

Class II surface impoundments. In addition, aquatic species may opportunistically use existing wastewater treatment facilities like the domestic sewage oxidation ponds. Two species of salamanders were observed: the California slender salamander and the California tiger salamander. The former species was observed during 1986 biological surveys, but not during 1991 surveys, although both species are currently known to occur onsite. Frog and toad species known to occur onsite are the western toad, western spadefoot toad, Pacific treefrog, and California red-legged frog. No exotic bullfrogs have been observed onsite to date. Conditions are far more favorable for reptiles than for amphibians at Site 300. Grassland provides ideal habitat for racers and gopher snakes. Rocky sites provide suitable habitat for such species as the western fence lizard, western skink, common kingsnake, and the western rattlesnake. Seeps and springs provide excellent habitat for the northern alligator lizard. Side-blotched lizards and California horned lizards frequent areas with vegetation that is more open and sandy soils (DOE 2005a).

Earlier avian surveys reported 70 bird species present at Site 300 on either a resident or transient basis. In 2002, an extensive survey was conducted using variable circular plot point counts and constant effort mist netting. During the 2002 survey, 90 bird species were observed, representing 73 genera and 32 families. Site 300 also supports nesting raptors. A breeding raptor survey conducted at Site 300 in April and July 2002 identified four species of diurnal raptors and four species of owls. The raptors included the turkey vulture, red-tailed hawk, golden eagle, and American kestrel (the most frequently observed raptor on Site 300). Owls observed included the barn owl, western screech owl, great horned owl, and western burrowing owl (DOE 2005a).

A 1986 botanical survey identified four upland major plant community types that are located within Site 300: (1) introduced grassland, (2) native grassland, (3) coastal sage scrub, and (4) oak woodlands. A recent survey (DOE 2005a) expanded that number to eight major upland plant-type categories. The revised list of major communities was further divided into the following vegetation types: annual grassland, native grassland, coastal scrub, coastal sage scrub oak, poison oak scrub, cottonwood riparian forest/woodland, Great Valley willow scrub, Mexican elderberry, blue oak woodland, valley oak forest/woodland, juniper-oak wood-land/scrub, juniper-oak cismontane woodland, disturbed land, and urban habitat (DOE 2005a).

Annual grassland covers more than 5,000 acres, and is dominated by annual grasses introduced from Mediterranean Europe during the Spanish Colonial Era (e.g., slender oat and ripgut brome); native grassland covers more than 700 acres, and is dominated primarily by one-sided bluegrass and purple needlegrass. The coastal sage scrub plant community type is dominated by California matchweed, California sagebrush, *Eriogonum fasiculatum*, and black sage. Oak woodland, dominated by blue oak, occurs in scattered areas on steep slopes in the southern half of the site and covers approximately 150 acres. The understory is dominated by grassland species such as brome grass and slender oat. Controlled burning takes place every year on approximately 2,000 acres of land during late May to early June depending on weather conditions (DOE 2005a).

4.2.7.1.3 SNL/CA

SNL/CA is located on 410 acres, with approximately 130 acres currently developed for use as research facilities, offices, support facilities, roadways, and parking areas (SNL/CA 2003). Undeveloped areas on the east, south, and west sides of the facility provide a security buffer zone and areas for future development. The following three terrestrial habitat areas have been identified in the undeveloped areas: grassland, coyote brush scrub, and riparian woodland (SNL/CA 2003).

Grasslands comprise 226 acres at SNL/CA and represent the predominant habitat in the open, undeveloped areas. Although both native and nonnative species are present, nonnative species are dominant. Common nonnative grasses include ripgut brome (*Bromus diandrus*), soft chess (*B. hordeaceus*), wild oats (*Avena* sp.), and Mediterranean barley (*Hordeum marinum*). Common nonnative herbs include red maids (*Calandrinia ciliata*), bur clover (*Medicago polymorpha*), and cheeseweed (*Malva* sp.). Scattered patches or individual native wildflowers can be observed in the grassland habitat including Brodianea (*Brodinea* sp.), California poppy (*Escholzia californica*), blue dicks (*Dishelostemma capitatum*), and farewell to spring (*Clarkia purpurea*) (SNL/CA 2003).

Two small areas of coyote brush scrub occur onsite. One is in the southwest corner of SNL/CA and the second is near the Arroyo Seco on the eastern property boundary. The total coyote brush scrub habitat is approximately 1.5 acres in size. It is located in steep and generally inaccessible areas where disturbance from site activities would be unlikely (SNL/CA 2003).

At SNL/CA, willow riparian woodland of approximately 2.4 acres is present along the eastern portion of the Arroyo Seco. This habitat has increased from just a few isolated patches in 1975 to a more dense and uniform cover along the arroyo (SNL/CA 2003). A recent survey determined that dominant species include Goodding's black willow (*Salix gooddingii*), arroyo willow (*Salix lasiolepis*), red willow (*Salix laevigata*), and narrow-leaved willow (*Salix exigua*). Other common plant species include Fremont cottonwood *(Populus fremontii*), western sycamore (*Plantanus racemosa*), and valley oak. A few immature trees were tentatively identified as northern California black walnut, although positive identification will not be possible for several years (SNL/CA 2003).

4.2.7.2 *Wetlands and Floodplains*

4.2.7.2.1 Wetlands

Wetlands were mapped at LLNL using the methodology provided in the *United States Army Corps of Engineers Wetland Delineation Manual* (USACE 1987). The following subsections provide a summary of the results of the analysis.

Livermore site. Wetlands, although very limited in the developed areas of the Livermore Site, do occur along Arroyo Las Positas at the northern perimeter of the site. These wetlands occur in three distinct areas and are associated with culverts that channel runoff from the surrounding area into this arroyo. In 1992, three areas totaling 0.36 acre were determined to qualify as jurisdictional wetlands. The wetlands were dominated by salt grass and a third by cattails. Since 1992, wetlands along Arroyo Las Positas have increased due to the release of water associated with environmental restoration activities at the Livermore Site. In 1997, an additional wetland delineation study was performed along Arroyo Las Positas. That study determined that the size of jurisdictional wetlands had expanded to 1.96 acres. Approximately 1,800 feet of Arroyo Seco is on the Livermore Site. In July 2001, a wetland delineation survey was performed. Within the arroyo, six vegetated areas were determined to be potential jurisdictional wetlands, totaling 0.04 acre (DOE 2005a) which would expand jurisdictional wetlands to 2.0 since the 1997 survey.

Site 300. A study for the 1992 LLNL Environmental Impact Statement/Environmental Impact Report (EIS/EIR) delineated 6.76 acres of wetlands at Site 300 (LLNL 1992). In August 2001, another wetland delineation study was conducted identifying 46 wetlands and determining that the total size of wetlands had increased to 8.61 acres. A total of 4.39 acres were found to meet criteria for jurisdictional wetlands. These wetlands are small and include freshwater seeps, cooling tower discharges from some of the buildings, vernal pools, and seasonal ponds. Many of the wetlands occur at springs in the bottom of deep canyons in the southern half of the site. These springs occur where water-bearing sandstone units outcrop in the canyon or valley bottoms. The wetlands that have developed at these springs are confined by the steep-sided canyon wall. They typically range in width from 5 to 30 feet wide with most being 10 to 20 feet wide. Most are relatively short, 100 to 600 feet; the longest, in Oasis Canyon, is approximately 2,800 feet long (DOE 2005a).

SNL/CA. The wetland area of SNL/CA is approximately 1,370 feet of the Arroyo Seco channel starting several hundred feet east of Thunderbird Lane and extending east to the SNL/CA boundary. The wetland is approximately 8 feet wide except near the property boundary where it averages 20 to 30 feet wide; it occupies 0.44 acres. The wetland area is a seasonal marsh (SNL/CA 2003).

Within the riparian woodland habitat are 0.44 acre of seasonal wetlands associated with Arroyo Seco, almost entirely in the east buffer zone. These delineated wetlands are present along 1,370 feet of the arroyo running from the eastern boundary to 200 feet east of the fence surrounding the developed part of the installation. Along this portion of arroyo are a number of obligate (limited to certain conditions) wetland species including Goodding's black willow, willow dock (*Rumex salicifolius*), southern cattail (*Typha domingensis*), and water cress (*Rorippa nasturtium-aquaticum*). Facultative (capable of living under varying conditions) wetland species include arroyo willow, red willow, mugwort (*Artemesia douglasiana*), rush, rabbit's foot grass (*Polypogon monspeliensis*), stinging nettle, and nutsedge (*Cyperus eragrostis*). Pepperweed (*Lepidium latifolium*), an invasive exotic species, is also present (SNL/CA 2003).

4.2.7.2.2 Floodplains

Two areas on the Livermore Site are within the 100-year floodplains of the Arroyo Las Positas and Arroyo Seco. However no existing onsite structures are within the 100-year floodplain. The channels routing Arroyo Las Positas and Arroyo Seco through the Livermore Site would be able to contain a 100-year flood. The 500-year flood levels have not been delineated.

Based on the flow and stream channel widths at Site 300, 100-year flood events would be contained within the channels except for portions of Corral Hollow Road. There is no information available for delineating the 500-year floodplain at Site 300. The lined drainage retention basin at Site 300 mitigates effects from significant flooding.

Upstream, in the upper two-thirds of the Arroyo Seco, there is a functional floodplain. In the lower one-third, the effects of channel incision become apparent as both banks are elevated 6 to

10 ft above the channel and there is no functional floodplain. Floodplain maps indicate that along most of the channel on SNL/CA property, the entire 100-year discharge is contained within the existing channel. Between A Street and Thunderbird Lane, however, FEMA mapping indicates that flood flows would spill out of the channel; this likelihood appears to be associated primarily with the culverts at a manmade land bridge, which was in place when the FEMA study was conducted. In 1998, during a period of heavy flow, the discharge did spill out of the channel at this location (SNL/CA 2003).

4.2.7.3 *Aquatic Resources*

4.2.7.3.1 Livermore Site

Potential aquatic habitat on the Livermore Site consists of an intermittent drainage system, seeps, springs, ditches, and a groundwater retention basin. The intermittent drainage system comprises westward-flowing arroyos that contain water during the winter months. Arroyos on the site include Arroyo Las Positas, located along the northern edge of the Livermore Site, and Arroyo Seco, which crosses the southwest corner of the site. Because of their temporary nature, the arroyos do not support fish. The seeps, springs, and ditches also do not support fish; however, the groundwater retention basin contains a population of mosquito fish *(Gambusia affinis)* (DOE 2005a). There are no federally designated Wild and Scenic Rivers onsite.

4.2.7.3.2 Site 300

Potential aquatic habitat on Site 300 consists of vernal pools, ponds, springs, and drainages. There is one perennial stream on the site. A sewage lagoon is located on the property, but it does not support any fish populations. Ponds located in the southeast-central portion of the site, and springs and drainages located throughout the site, do not support fish populations (DOE 2005a). There are no federally designated Wild and Scenic Rivers onsite.

4.2.7.3.3 SNL/CA

A man-made recharge basin consisting of two cells encompassing approximately 2.7 acres, is located in the west outer perimeter area at SNL/CA. LLNL constructed the basin in 1989 to serve as a recharge basin for their groundwater treatment program. Between 1989 and 2003, treated water from the LLNL site was routinely discharged to the recharge basin cells. LLNL's groundwater restoration program has progressed to a point where recharge through the basin is no longer necessary or desirable. Consequently, in June 2005, LLNL terminated its agreement with SNL/CA for use of this area. SNL/CA plans to return the area to pre-1989 condition by backfilling and reseeding with appropriate vegetation. Work will begin after an agreement is reached with the regulating agency and funding is obtained (SNL/CA 2007). There are no federally designated Wild and Scenic Rivers onsite.

4.2.7.4 *Threatened and Endangered Species*

No sensitive plants, invertebrates, reptiles, or mammals were observed during the 1992 or recent biological surveys at the Livermore Site (DOE 2005a). The California red-legged frog (a federally listed threatened species) occurs at the Livermore Site. This species is the largest native frog in California, growing to more than 5 inches in length. Critical habitat was determined for the California red-legged frog species in March 2001. Critical habitat for this species was designated in the North Buffer Zone and eastern edge of the Livermore Site.

Although the California tiger salamander (a federally proposed threatened species and a state species of special concern) is not presently found at the Livermore Site; it has been observed on nearby lands (DOE 2005a).

At Site 300, five species are listed under the Federal or California Endangered Species Act including two amphibians—the California tiger salamander and California red-legged frog; one reptile—the Alameda whipsnake; one insect—the valley elderberry longhorn beetle; and one plant—the large-flowered fiddleneck. The California red-legged frog is also known to occur at the Livermore site. The federally endangered San Joaquin kit fox is not known to occur at Site 300, however, it is known to occur in adjacent areas and is included since potential impacts may occur during activities at Site 300. California threatened Swainson's Hawks and California endangered Willow Flycatchers have been observed at Site 300 but breeding habitat for these species is not known to occur at Site 300.

Several other species considered rare or of special interest are tabulated including California Species of Special Concern (CASCS), species protected by the Migratory Bird Treaty Act (MBTA), and plant species included in the California Native Plant Society's (CNPS) Inventory of Rare and Endangered Plants. Monitoring programs are performed for the Tricolored Blackbird at Site 300 and for the White-tailed Kit at the Livermore site.

Four rare plant species are known to occur at Site 300 including the federally endangered large-flowered fiddleneck, the big tarplant, the diamond-petaled poppy and the round-leaved filaree.

4.2.7.4.1 Livermore Site

The California red-legged frog (a federally listed threatened species) occurs at the Livermore Site. This species is the largest native frog in California, growing to more than 5 inches in length. It was listed as a threatened species in June 1996 (61 FR 25813). The California red-legged frog is found in the Arroyo Las Positas and in the DRB at the Livermore Site. A single adult California red-legged frog was also found in the West Perimeter Drainage Ditch during the 2002 nocturnal surveys. No sensitive plants, invertebrates, reptiles, or mammals were observed during the 1992 or recent biological surveys at the Livermore Site.

Critical habitat was determined for the California red-legged frog species in March 2001 (66 FR 14626). Critical habitat for this species was designated in the North Buffer Zone and eastern edge of the Livermore Site. As a result of a court order in November 2002, critical habitat for this species at the Livermore Site was rescinded. In April 2004, the U.S. Fish and Wildlife Service (USFWS) issued a proposed rule to reinstate formerly designated critical habitat for the California red-legged frog at the Livermore Site (69 FR 19620, 69 FR 32966). The DRB was drained in 2000 and 2001 in an effort to eliminate bullfrog larvae, because this species is a known predator of the California red-legged frog. Bullfrogs were first detected at the Livermore Site in 1997. The USFWS was consulted and approved this management technique.

Although the California tiger salamander (a federally proposed threatened species and a state species of special concern) is not presently found at the Livermore Site; it has been observed on nearby lands (69 FR 47212). In August 2004, the USFWS issued a proposed rule to designate critical habitat for the California tiger salamander in the vicinity of the Livermore Site, but not on the facility itself (DOE 2005a)

The loggerhead shrike (a Federal species of concern and a state species of special concern) has recently been reported in the vicinity of the Arroyo Las Positas (DOE 2005a). Over 60 species of migratory birds have been observed in surveys at the Livermore Site and their status is monitored by LLNL wildlife biologists (DOE 2005a).

4.2.7.4.2 Site 300

Forty-four special status species are currently known to occur at Site 300 including five federally threatened or endangered species (Table 4.2.7-1) (LLNL 2007). Of these five, only the Large-flowered fiddleneck is classified as endangered, and a 160-acre portion of Site 300 has been designated as critical habitat for this plant. The large-flowered fiddleneck was considered one of the most endangered plant species in California and perhaps the Nation. This species is known to exist naturally in only three locations; two are at Site 300, and one is on a nearby ranch. The largest onsite population (Drop Tower population), located in designated critical habitat, was discovered in the 1960s. It fluctuates between as many as 355 individual plants and historic lows during the past 3 years with 14 plants observed in 2001, 40 plants observed in 2000, and 6 plants observed in 1999. The number of fiddleneck plants observed in the original experimental population area (59 plants) is similar to that observed during the past 2 years (45 plants in 2000 and 42 plants in 1999). A dramatic increase in seed predation by small rodents in 1998 and 1999 may be responsible for the reduction in Site 300's original experimental large-flowered fiddleneck population (DOE 2005a).

The valley elderberry longhorn beetle (a federally listed threatened species) is the only sensitive insect that has been observed at Site 300. This species occurs almost exclusively on elderberry bushes, so elderberries that grow within the range of this species are considered potential habitat. The California red-legged frog, a federally listed threatened species and a state species of special concern, occurs at Site 300. This amphibian was listed as a federally threatened species in June 1996 (61 FR 25813). Critical habitat was determined for the species in March 2001 (66 FR 14626). As a result of a court order in November 2002, critical habitat for this species at Site 300 was rescinded. In April 2004, the USFWS issued a proposed rule to reinstate formerly designated critical habitat for the California red-legged frog at Site 300 (69 FR 19620, 69 FR 32966). The final rule designating critical habitat for the California red-legged frog issued on April 23, 2005, did not include any habitat at the Livermore site or Site 300.

The California tiger salamander (a federally listed threatened species and a state species of special concern) is present at Site 300. In August 2004, the USFWS issued a proposed rule to designate critical habitat for the California tiger salamander in parts of Alameda and San Joaquin

Counties, but not at Site 300 (69 FR 48569). The final rule designating critical habitat for the California tiger salamander issued on August 23, 2005, did not include any habitat at the Livermore site or Site 300. The Western spadefoot toad is a Federal species of concern and state species of special concern. During wet years, this amphibian has been observed at the Overflow Pond located in the GSA of Site 300. The Alameda whipsnake (a federally listed and state listed threatened species) was observed onsite in 1986 (DOE 2005a). Proposed critical habitat for the Alameda whipsnake issued on October 18, 2005 includes the southwestern portion of Site 300. At Site 300, the Alameda whipsnake (*Masticophus lateralis euryxanthus*) is classified as the California whipsnake (*M. lateralis*) because it more closely resembles an intergrade between two species: the Alameda whipsnake and the Chapparral whipsnake (*M. lateralis lateralis*) (DOE 2005a).

4.2.7.4.3 SNL/CA

Thirteen Federal and state listed species or sensitive species have been reported at or near SNL/CA (SNL/CA 2003). The California red-legged frog (*Rana aurora draytonii*) and the California tiger salamander (*Ambystoma californiense)* are the only Federally threatened or endangered species that has been found onsite and in close proximity to SNL/CA. The California red-legged frog is known to occur at LLNL and in the farm stock pond on adjacent property on the east side of SNL/CA. It was not sighted during a 2001 survey of the Arroyo Seco drainage and the recharge basin on the west side of the site. This survey concluded that although the recharge basin provides suitable habitat for part of the year, the irregular drainage during the breeding season of the California red-legged frog minimizes the use of this habitat on a year-round basis (SNL/CA 2003).

Table 4.2.7-1—Species of Special Interest to Federal and State Resource Agencies Known to Occur at the Livermore Site and Site 300

Common Name		Scientific Name	Federal Status	State Status
Plants				
Big tarplant	a	*Blepharizonia plumosa plumosa*	-	CNPS List 1B
Large-flowered fiddleneck	a	*Amsinckia grandiflora*	FE (CH)	SE; CNPS List 1 B
Diamond-petaled poppy	a	*Eschschozia rhombipetala*	FSC	CNPS List 1B
Round-leaved filaree	a	*Erodium macrophyllum*	-	CNPS List 2
Gypsum-loving larkspur		*Delphinium gypsophilum gypsophilum*	-	CNPS List 4
California androsace		*Androsace elongata acuta*	-	CNPS List 4
Stinkbells		*Fritillaria agrestis*	-	CNPS List 4
Hogwallow starfish		*Hesperevax caulescens*	-	CNPS List 4
Mammals				
Pallid bat		*Antrozous pallidus*	-	CASCS
California pocket mouse		*Chaetodipus californicus*	-	CASCS
San Joaquin kit fox	a	*Vulpes macrotis mutica*	FE	ST
American badger		*Taxidea taxus*	-	CASCS
Amphibians				
California tiger salamander	a	*Ambystoma californiense*	FT	CASCS
California red-legged frog	a,b	*Rana aurora draytonii*	FT	CASCS
Western spadefoot toad		*Spea hammondii*	-	CASCS

Table 4.2.7-1—Species of Special Interest to Federal and State Resource Agencies Known to Occur at the Livermore Site and Site 300 (continued)

Common Name		Scientific Name	Federal Status	State Status
Reptiles				
Alameda whipsnake	a,e	*Masticophis lateralis euryxanthus*	FT (CH)	ST
San Joaquin coachwhip		*Masticophis flagellum*	-	CASCS
Coast horned lizard		*Phrynosoma coronatum*	-	CASCS
California legless lizard		*Anniella pulchra*	-	CASCS
Birds				
Cooper's Hawk		*Accipiter cooperii*	MBTA	CASCS
Sharp-shinned Hawk		*Accipiter striatus*	MBTA	CASCS
Golden Eagle		*Aquila chrysaetos*	MBTA	CAFPS,CASCS
Red-tailed Hawk		*Buteo jamaicensis*	MBTA	-
Rough-legged Hawk		*Buteo lagopus*	MBTA	-
Red-shouldered Hawk		*Buteo lineatus*	MBTA	-
Ferruginous Hawk		*Buteo regalis*	MBTA	CASCS
Swainson's Hawk	a	*Buteo swainsoni*	MBTA	ST
Northern Harrier		*Circus cyaneus*	MBTA	CASCS
White-tailed Kite	b,d	*Elanus leucurus*	MBTA	CAFPS
Osprey		*Pandion haliaetus*	MBTA	CASCS
Bushtit		*Psaltriparus minimus*	MBTA	-
Horned Lark		*Eremophila alpestris*	MBTA	CASCS
Northern Shoveler		*Anas clypeata*	MBTA	-
Cinnamon Teal		*Anas cuamptera*	MBTA	-
Mallard		*Anas platyryynchos*	MBTA	-
Bufflehead		*Blucephala albeola*	MBTA	-
Common Goldeneye		*Bucephala clangula*	MBTA	-
White-throated Swift		*Aeronautes saxatalis*	MBTA	-
Great Egret		*Ardea alba*	MBTA	-
Virginia Rail		*Rallus limicola*	MBTA	-
Cedar Waxwing		*Bombycilla garrulus*	MBTA	-
Common Poorwill		*Phalaenoptilus nuttalii*	MBTA	-
Blue-grosbeak		*Guiraca caerulea*	MBTA	-
Black-headed Grosbeak		*Pheucticus melanocephalus*	MBTA	-
Lazuli Bunting		*Passerina amoena*	MBTA	-
Turkey Vulture		*Cathartes aura*	MBTA	-
Killdeer		*Charadrius vociferus*	MBTA	-
Mourning Dove		*Zenaida macroura*	MBTA	-
Western Scrub Jay		*Aphelocoma californica*	MBTA	-
American Crow		*Corvus brachyrhynchos*	MBTA	-
Common Raven		*Corvus corax*	MBTA	-
Greater Roadrunner		*Geococcyx californianus*	MBTA	-
Bell's Sage Sparrow		*Amphispiza belli*	MBTA	CASCS
Black-throated Sparrow		*Amphispiza bilineata*	MBTA	-
Rufous Crowned Sparrow		*Aimophila ruficeps*	MBTA	-
Grasshopper Sparrow		*Ammodramus savannarum*	MBTA	-

Table 4.2.7-1—Species of Special Interest to Federal and State Resource Agencies Known to Occur at the Livermore Site and Site 300 (continued)

Common Name		Scientific Name	Federal Status	State Status
Lark Sparrow		*Chondestes grammacus*	MBTA	-
California Towhee		*Carpodacus mexicanus*	MBTA	-
Oregon Junco		*Junco hyemalis*	MBTA	-
Lincoln's Sparrow		*Melospiza lincolnii*	MBTA	-
Song Sparrow		*Melospiza melodia*	MBTA	-
Vesper Sparrow		*Pooecetes gramineus*	MBTA	-
Fox Sparrow		*Passerella iliaca*	MBTA	-
Savannah Sparrow		*Passerculus sandwichensis*	MBTA	-
Golden-crowned Sparrow		*Zonotrichia atricapilla*	MBTA	-
White-crowned Sparrow		*Zonotrichia leucophrys*	MBTA	-
American Kestrel		*Falco sparverius*	MBTA	-
Prairie Falcon		*Falca mexicanus*	MBTA	CASCS
House Finch		*Carpodacus mexicanus*	MBTA	-
Lesser Goldfinch		*Carduelis psaltia*	MBTA	-
Cliff Swallow		*Petrochelidon pyrrhonota*	MBTA	-
Northern Rough Winged Swallow		*Stelgidopteryx serripennis*	MBTA	-
Tree Swallow		*Tachycineta bicolor*	MBTA	-
Red-winged Blackbird		*Agelaius phoeniceus*	MBTA	-
Tricolored Blackbird	c	*Agelaius tricolor*	MBTA	CASCS
Brewer's Blackbird		*Euphagus cyanocephalus*	MBTA	-
Bullock's Oriole		*Icterus bullockii*	MBTA	-
Brown-headed Cowbird		*Molothrus ater*	MBTA	-
Western Meadowlark		*Sturnella magna*	MBTA	-
Loggerhead Shrike		*Lanius ludovicianus*	MBTA	CASCS
Northern Mockingbird		*Mimus polyglottos*	MBTA	-
California Thrasher		*Toxostoma redivivum*	MBTA	-
Oak Titmouse		*Baeolphus inornatus*	FSC, MBTA	-
Yellow-rumped Warbler		*Dendroica coronata*	MBTA	-
Black-throated Gray Warbler		*Dendroica nigrescens*	MBTA	-
Yellow Warbler		*Dendroica petechia*	MBTA	CASCS
Common Yellowthroat		*Geothlypis trichas*	MBTA	CASCS
MacGillivary's Warbler		*Oporornis tolmiei*	MBTA	-
Orange-crowned Warbler		*Vermivora bachmanii*	MBTA	-
Wilson's Warbler		*Wilsonia pusila*	MBTA	-
Double-crested Cormorant		*Phalacrocorax auritus*	MBTA	CASCS
Northern Flicker		*Colaptes auratus*	MBTA	-
Nuttal's Woodpecker		*Picoides nuttallii*	MBTA	-
Acorn Woodpecker		*Melanerpes formicivorus*	MBTA	-
Pied-billed Grebe		*Podilymbus podiceps*	MBTA	-
Phainopepela		*Phainopepla nitens*	MBTA	-
Ruby-crowned Kinglet		*Regulus calendula*	MBTA	-
Common Snipe		*Gallinago gallinago*	MBTA	-
Greater Yellowlegs		*Tringa melanoleuca*	MBTA	-

Table 4.2.7-1—Species of Special Interest to Federal and State Resource Agencies Known to Occur at the Livermore Site and Site 300 (continued)

Common Name		Scientific Name	Federal Status	State Status
Burrowing Owl		*Athene cunicularia*	MBTA	CASCS
Short-eared Owl		*Asio flammeus*	MBTA	CASCS
Great horned Owl		*Bubo virginianus*	MBTA	-
Western Screech Owl		*Otus kennicottii*	MBTA	-
Western Tanager		*Piranga ludoviciana*	MBTA	-
Anna's Hummingbird		*Calypte anna*	MBTA	-
Costa's Hummingbird		*Calypte costae*	MBTA	-
Rufous Hummingbird		*Selasphorus rufus*	MBTA	-
Allen's Hummingbird		*Selasphorus sasin*	MBTA	-
Rock Wren		*Salpinctes obsoletus*	MBTA	-
Bewick's Wren		*Thyothorus ludovicianus*	MBTA	-
House Wren		*Troglodytes aedon*	MBTA	-
Hermit Thrush		*Catharus guttatus*	MBTA	-
Swainson's Thrush		*Catharus ustulatus*	MBTA	-
Varied Thrush		*Ixoreus naevius*	MBTA	-
Mountain Bluebird		*Sialia currucoides*	MBTA	-
Western Buebird		*Sialia mexicana*	MBTA	-
American Robin		*Turdus migratorius*	MBTA	-
Pacific-slope Flycatcher		*Empidonax difficillis*	MBTA	-
Willow Flycatcher	a	*Empidonax traillii*	MBTA	SE
Ash-throated Flycatcher		*Myiarchus cinerascens*	MBTA	-
Western Wood-pewee		*Contopus sordidulus*	MBTA	-
Black Phoebe		*Sayornis nigricans*	MBTA	-
Say's Phoebe		*Sayornis saya*	MBTA	-
Western Kingbird		*Tyrannus verticalis*	MBTA	-
Cassin's Kingbird		*Tyrannus vociferans*	MBTA	-
Barn Owl		*Tyto alba*	MBTA	-
Insects				
Valley elderberry longhorn beetle	a	*Desmocerus californicus dimorphus*	FT	-

Source: DOE 2005a.
a: Species of particular interest known to occur at Site 300 or in adjacent area (San Joaquin kit fox).
b: Species of particular interest known to occur at Livermore site.
c: Monitoring program developed at Site 300.
d: Monitoring program developed at Livermore site.
e: At Site 300, Alameda whipsnake is classified as California whipsnake (*Masticophis lateralis*) because it resembles intergrade between Alameda and Chaparral whipsnake.
CAFPS=California Department of Fish and Game Fully Protected Species
CASCS=California Special Concern species
CH=Critical habitat within Site 300 (the USFWS may establish critical habitat for threatened or endangered species consisting of a geographic area determined essential for the conservation of the species).
FE=Endangered under the Federal Endangered Species Act
FT=Threatened under the Federal Endangered Species Act
MBTA=Migratory Bird Treaty Act
SE=Endangered under the State Endangered Species Act
ST=Threatened under the State Endangered Species Act
FSC =Federal Species of Concern for Alameda and San Joaquin Counties. May be endangered or threatened.
Not enough biological information has been gathered to support listing at this time (U.S. Fish and Wildlife Service1-1-03-SP-0162).
CNPS List 1B=Plants rare or endangered throughout range in California and elsewhere.
CNPS List 2=Plants rare or endangered in California and elsewhere.
CNPS List 4=Plants are uncommon enough to warrant monitoring but not considered rare.

4.2.7.5 *Biological Monitoring and Abatement Programs*

LLNL monitors several aspects of the terrestrial environment. LLNL measures the radioactivity present in soil, sediment, vegetation, and wine, and the absorbed gamma radiation dose at ground level receptors from terrestrial and atmospheric sources and monitors wildlife and plants at both the Livermore Site and Site 300. The LLNL terrestrial radioactivity monitoring program is designed to measure any changes in environmental levels of radioactivity and to evaluate any increase in radioactivity that might have resulted from LLNL operations (DOE 2005a).

Some terrestrial monitoring and research programs are required by existing permits, while additional monitoring programs are designed to track the distribution and abundance of rare species. In addition, baseline surveys are conducted to determine the distribution and abundance of rare and/or special status species on LLNL property. Monitoring and research of biota on LLNL property is conducted to ensure compliance with requirements of the U.S. Endangered Species Act, the California Endangered Species Act, the Eagle Protection Act, the Migratory Bird Treaty Act, and the California Native Plant Protection Act as they pertain to endangered or threatened species and other special status species, their habitat, and designated critical habitats that exist at the LLNL sites (DOE 2005a).

Details and results of LLNL and SNL/CA biological monitoring and abatement programs are updated annually in each site's environmental reports (LLNL 2007, SNL/CA 2007).

4.2.8 Cultural Resources

4.2.8.1 *Livermore Site*

Field surveys and records searches conducted prior to and for the 1992 LLNL Environmental Impact Statement/Environmental Impact Report (EIS/EIR) did not reveal the presence of prehistoric resources on the Livermore Site. Previous work included archival reviews conducted at the Northwest Information Center at Sonoma State University; the Central California Information Center at California State University, Stanislaus; a records search at Basin Research Associates in San Leandro, California; and review of the archaeological files at LLNL. In addition, field surveys conducted by Holman & Associates in the undeveloped western and northern perimeter areas, including a 500-foot-wide buffer, and an undeveloped area survey conducted in 1991 did not reveal the presence of prehistoric resources. Because most of the Livermore Site is developed, the likelihood of finding unrecorded and undisturbed prehistoric sites is low; however, there is still the possibility that undisturbed prehistoric sites lay buried under the modern landscaping (DOE 2005a).

In 1997 paleontological resources dating to the late Pleistocene age were found in the north eastern quadrant of the Livermore Site during construction of the National Ignition Facility (NIF). One location contained the partial skeleton of a mammoth (*Mammuths columbi*) and a second location contained a partial pelvis of a horse. A fossil at a third location also identified a partial mammoth skeleton, and a fossil at a fourth location was identified as a partial horse skeleton. Under the provisions of the *Antiquities Act of 1906*, these materials were excavated under an Antiquities Permit granted to DOE by the U.S. Department of the Interior (DOE 1999g).

As with prehistoric archaeological resources, the results of the record searches and field surveys indicates that there are no known historic archaeological sites at the Livermore Site. Because most of the Livermore Site is developed, the likelihood of finding unrecorded and undisturbed historic sites is low; however, there is still the possibility that undisturbed historic sites lay buried under the modern landscaping (DOE 2005a).

The Livermore Site has a number of buildings associated with historic events or significant LLNL achievements. These include buildings from the World War II-era Livermore Naval Air Station as well as buildings built after 1952 that are associated with the Cold War. An assessment of LLNL's buildings, structures, and objects for potential historic significance was undertaken in 2004 (Sullivan and Ullrich 200). As a result of this assessment, DOE/NNSA, in consultation with the SHPO, determined that four individual buildings and objects within one other building at the Livermore Site are eligible for listing in the NRHP because of their association with important research and development that was undertaken within the context of the Cold War.

LLNL prepared a draft historic buildings treatment plan in September 2005 that described specific resource management and treatment strategies that could be implemented by DOE/NNSA, in cooperation with LLNL, to ensure that these properties are managed in a manner that considers their historic values. At the end of fiscal year 2007, this document was under consideration by DOE/NNSA and the SHPO (DOE 2005a).

4.2.8.2 *Site 300*

Archaeological surveys undertaken at Site 300 over the past thirty years have resulted in the recordation of eight prehistoric and multi-component archaeological sites (DOE 2005a). The area was used by early populations for hunting, and for collecting and processing seasonal plant foods. This use is evidenced by small lithic scatters, and rockshelters that contain bedrock mortars and possible small midden deposits.

Of the eight prehistoric and multi-component archaeological resources recorded at Site 300, the DOE/NNSA, as the Federal agency responsible for historic properties at LLNL, concluded that two qualify for listing in the National Register of Historic Places (NRHP) because of their ability to yield information important in prehistory. The California SHPO concurred with this determination (DOE 2005a).

LLNL prepared a draft archaeological resources treatment plan in July 2005 that described specific resource management and treatment strategies that could be implemented by DOE/NNSA, in cooperation with LLNL, to ensure that these properties are managed in a manner that considers their historic values. At the end of fiscal year 2007, this document was under consideration by DOE/NNSA and SHPO. Development or ground disturbing activities are not permitted in or within 300 feet of the delineated area of the National Register-eligible archaeological sites unless the activity was approved or monitored by LLNL archaeologists.

Archaeological surveys undertaken at Site 300 over the past thirty years have resulted in the recordation of 23 historic archaeological sites (DOE 2005a). These sites provide evidence that homesteading, ranching, and mining were the predominant activities in the area during the historic period. The historic sites include an early 20th century homestead site; remnants of water and sewer lines; possible remnants of a small wood bridge; small trash dumps; a historic power/telegraph line; and a mine adit and associated features. Site 300 also contains remnants of the residential section of the former town of Carnegie. Carnegie was the location of a terra cotta plant and town from 1902 to circa 1914.

Of the 23 historic archaeological resources recorded at Site 300, the DOE/NNSA concluded that three qualify for listing in the NRHP because of their ability to yield important information in history. The California SHPO concurred with this determination (DOE 2005a).

4.2.8.3 *SNL/CA*

In 2001, SNL/CA completed an historic building survey. None of the buildings onsite are identified as historically significant or eligible for the National Register of Historic Places (SNL/CA 2007). The results of the historic building survey were submitted to NNSA/SSO. In December 2004, NNSA transmitted the survey results to the California State Historic Preservation Officer (SHPO). In April 2005, NNSA/SSO received concurrence from the California SHPO that none of the properties located at SNL/CA are eligible for inclusion in the National Register of Historic Places (SNL/CA 2007).

SNL/CA has conducted two comprehensive studies of cultural resources on the site. The goal of the assessment was to identify any potentially important cultural resources located on SNL/CA, including prehistoric, historic, and Native American resources. The field inventories included all areas outside of the central building compound. Within the compound, the field inventories included all open or otherwise undeveloped areas. An assessment of the existing buildings was also conducted. Finally, the Native American Heritage Commission, and a person knowledgeable of resources important to the tribe that inhabited the area historically, was consulted to identify any religious resources and sacred sites important to Native Americans. The only resources identified on the site were the buildings and structures associated with SNL/CA—no prehistoric resources, Native American resources, or historic archaeological sites were identified. None of the buildings or structures identified were eligible or potentially eligible for the NRHP.

4.2.8.4 *Native American Consultation for the Livermore Site and Site 300*

Native American groups known to have used Alameda and San Joaquin counties include the Costanoans (or Ohlone), Northern Yokuts, and Eastern Miwok. These groups were hunters and gatherers who relied on a variety of resources including deer, elk, antelope, fish, birds, nuts, and fruits. Individual tribes usually had a permanent village and occupied smaller campsites on a seasonal basis. These groups were decimated after European contact due to disease and acculturation. It is estimated that there are approximately 500 people of Costanoan (Ohlone) descent still living in the San Francisco Bay region. Yokut and Miwok tribal members are also increasing in number in recent years.

Sacred and important Native American resources that might be found in the vicinity of the Livermore Site and Site 300 include burials, cremations, vision quest sites, and traditional use areas. Initial consultation with identified local Native American groups to determine important resources has begun. In 2006, the DOE/NNSA conferred with the California Native American Heritage Commission to define a list of appropriate Native American representatives to contact and subsequently consulted with 11 representatives of the Ohlone/Costanoan groups concerning the continued operation of the Livermore Site and Site 300. No traditional cultural resources have been identified on either the Livermore Site or Site 300 (LLNL 2007).

4.2.9 Socioeconomic Resources

Socioeconomic characteristics addressed at LLNL and SNL/CA include employment, regional economy, and population, housing, and community services. Socioeconomic characteristics are presented for a ROI. The ROI was identified based on the distribution of residences for current LLNL and SNL/CA employees. The ROI is defined as those counties where approximately 90 percent of the workforce lives.

LLNL and SNL/CA are located in Alameda County, California. Statistics for socioeconomic characteristics are presented for the ROI, a region consisting of Alameda, Contra Costa, San Joaquin, and Stanislaus Counties. Figure 4.2.9-1 presents a map of the counties composing the LLNL and SNL/CA ROI.

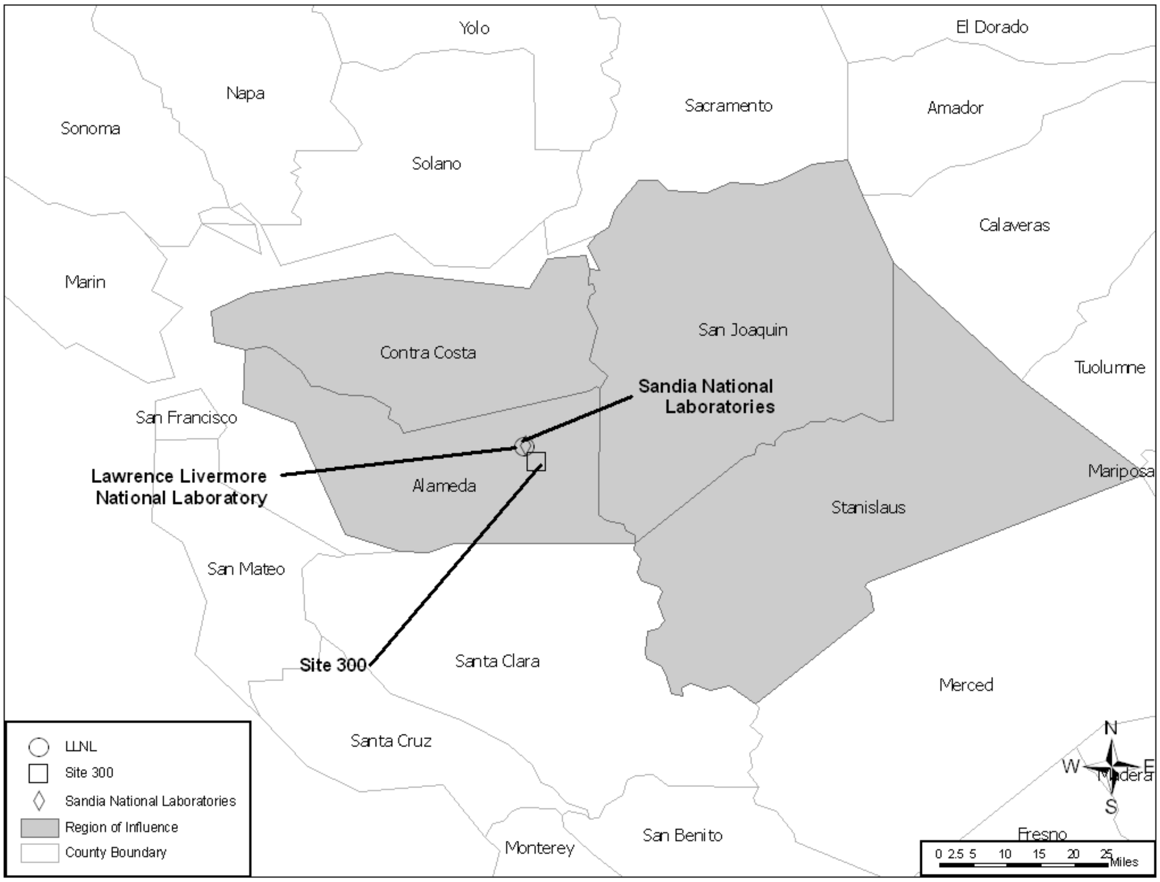


Figure 4.2.9-1—Region of Influence for LLNL and SNL/CA

4.2.9.1 *Employment and Income*

LLNL employs approximately 8,220 workers, including DOE employees and multiple contractors while SNL/CA employs approximately 1,040 employees.

Labor force statistics are summarized in Table 4.2.9-1. The civilian labor force of the ROI grew by approximately 2 percent from 1,736,690 in 2000 to 1,775,645 in 2005. The overall ROI employment experienced a growth rate of 1 percent with 1,657,064 in 2000 to 1,670,539 in 2005 as presented in Figure 4.2.9-2 (BLS 2007).

The ROI unemployment rate was 5.9 percent in 2005 and 4.6 percent in 2000. In 2005, unemployment rates within the ROI ranged from a low of 4.9 percent in Contra Costa County to a high of 8.4 percent in Stanislaus County. The unemployment rate in California in 2005 was 5.4 percent (BLS 2007).

Table 4.2.9-1—Labor Force Statistics for the ROI and California

	ROI		California	
	2000	2005	2000	2005
Civilian Labor Force	1,736,690	1,775,645	16,857,578	17,740,379
Employment	1,657,064	1,670,539	16,024,341	16,782,260
Unemployment	79,626	105,106	833,237	958,119
Unemployment Rate	4.6	5.9	4.9	5.4

Source: BLS 2007.

Income information for the LLNL and SNL/CA ROI is provided in Table 4.2.9-2. Stanislaus County is at the lower end of the ROI with a median household income in 2004 of $43,072 and a per capita income of $25,915. Contra Costa had the highest median household income in the ROI at $65,459 and a per capita income of $46,995 (BEA 2007).

Table 4.2.9-2—Income Information for the LLNL and SLN/CA ROI, 2004

	Per capita income (dollars)	Median household income (dollars)
Alameda	40,737	57,659
Contra Costa	46,995	65,459
San Joaquin	25,570	44,814
Stanislaus	25,915	43,072
California	35,380	49,894

Source: BEA 2007.

4.2.9.2 *Population and Housing*

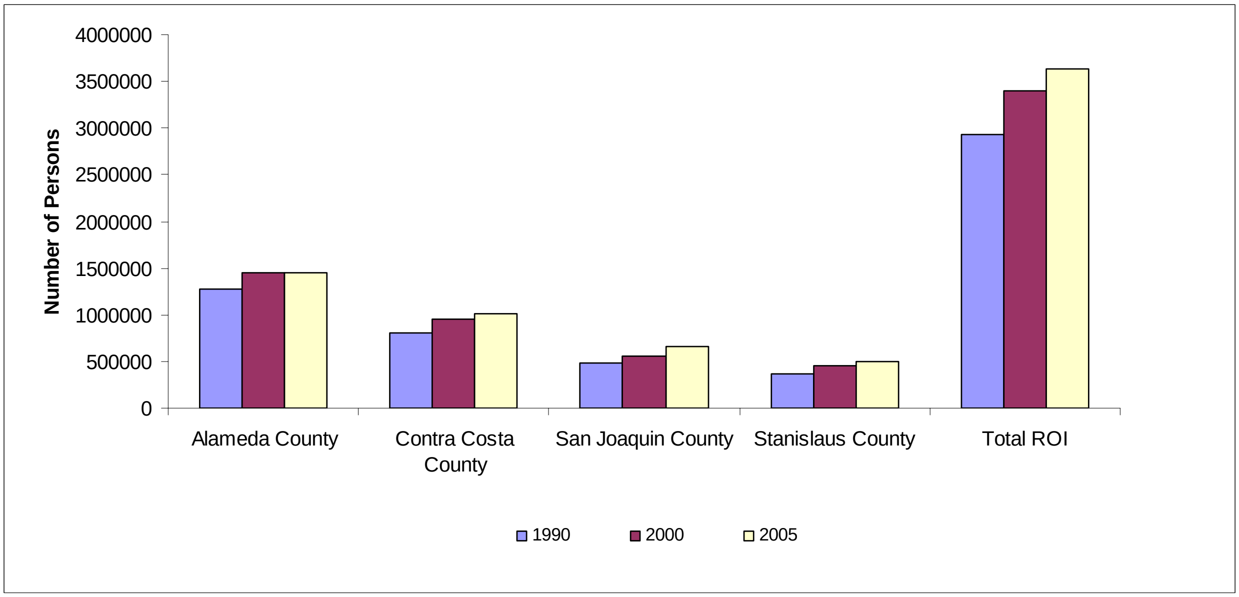
The ROI is used to analyze the primary economic impacts on population and housing. Table 4.2.9-3 presents historic and projected population in the ROI and the state.

Table 4.2.9-3—Historic and Projected Population

Region	1990	2000	2005	2010	2020
Alameda	1,279,182	1,443,741	1,451,065	1,550,133	1,663,481
Contra Costa	803,732	948,816	1,017,644	1,075,931	1,237,544
San Joaquin	480,628	563,598	664,796	741,417	965,094
Stanislaus	370,522	446,997	505,492	559,708	699,144
ROI	2,934,064	3,403,152	3,638,997	3,927,189	4,565,263
California	29,760,021	33,871,648	36,154,147	39,135,676	44,135,923

Source: USCB 2007.

Between 1990 and 2000, the ROI population increased 16 percent from 2,934,064 in 1990 to 3,403,152 in 2000. From 2000 to 2005, the population of the ROI increased 7 percent to 3,638,997 in 2005. San Joaquin County experienced the largest population growth within the ROI between 2000 and 2005 with an increase of 18 percent. Alameda County had a 0.5 percent increase from 1,443,741 in 2000 to 1,451,065 in 2005 (USCB 2007). Figure 4.2.9-2 presents the trends in population within the LLNL ROI.



Source: USCB 2007.

Figure 4.2.9-2—Trends in Population for LLNL ROI, 1990–2005

Table 4.2.9-4 lists the total number of housing units and vacancy rates in the ROI. In 2000, the total number of housing units in the ROI was 1,234,727 with 1,194,270 occupied (97 percent). There were 724,279 owner-occupied housing units and 469,991 rental units. The median value of owner-occupied units in Alameda County was the greatest of the counties in the LLNL ROI ($303,100). The vacancy rate was the smallest in Contra Costa County (2.9 percent) with the highest in San Joaquin County (4.0 percent).

Table 4.2.9-4—Housing in the LLNL ROI

	Total Units	Occupied housing Units	Owner Occupied Units	Renter Occupied Units	Vacant units	Vacancy Rate (percent)	Median value of Owner Occupied Units (dollars)
Alameda	540,183	523,366	286,277	237,089	16,817	3.1	303,100
Contra Costa	354,577	344,129	238,449	105,680	10,448	2.9	267,800
San Joaquin	189,160	181,629	109,667	71,962	7,531	4.0	142,400
Stanislaus	150,807	145,146	89,886	55,260	5,661	3.8	125,300
ROI	1,234,727	1,194,270	724,279	469,991	40,457	3.3	245,080

Source: USCB 2007.

4.2.9.3 *Community Services*

Community services in the ROI include public schools, law enforcement, fire suppression, and medical services.

There are 94 school districts which serve the LLNL ROI. Educational services are provided for approximately 623,077 students by an estimated 30,654 teachers in the ROI (IES 2006b). The student-to-teacher ratio in the ROI is 20:1.

The counties within the ROI employ approximately 287,000 firefighters and law enforcement officers. The Alameda County Sheriff's Department employs a total of 1,481 employees, 909 sworn and 572 civilian (DOJ 2004). The employs a total of 154 employees, 111 sworn and 43 civilian (DOJ 2004). Thirty two hospitals serve the LLNL ROI. These hospitals have a total bed capacity of approximately 7,489 (ESRI 2007).

4.2.10 Environmental Justice

The study area considered for environmental justice analysis is the area within a 50-mile radius of LLNL. Figure 4.1.10-1 shows counties potentially at risk from the current missions performed at LLNL. There are nine counties are included in the potentially affected area. Table 4.1.10-1 provides the demographic profile of the potentially affected area using data obtained from the 2000 Census.

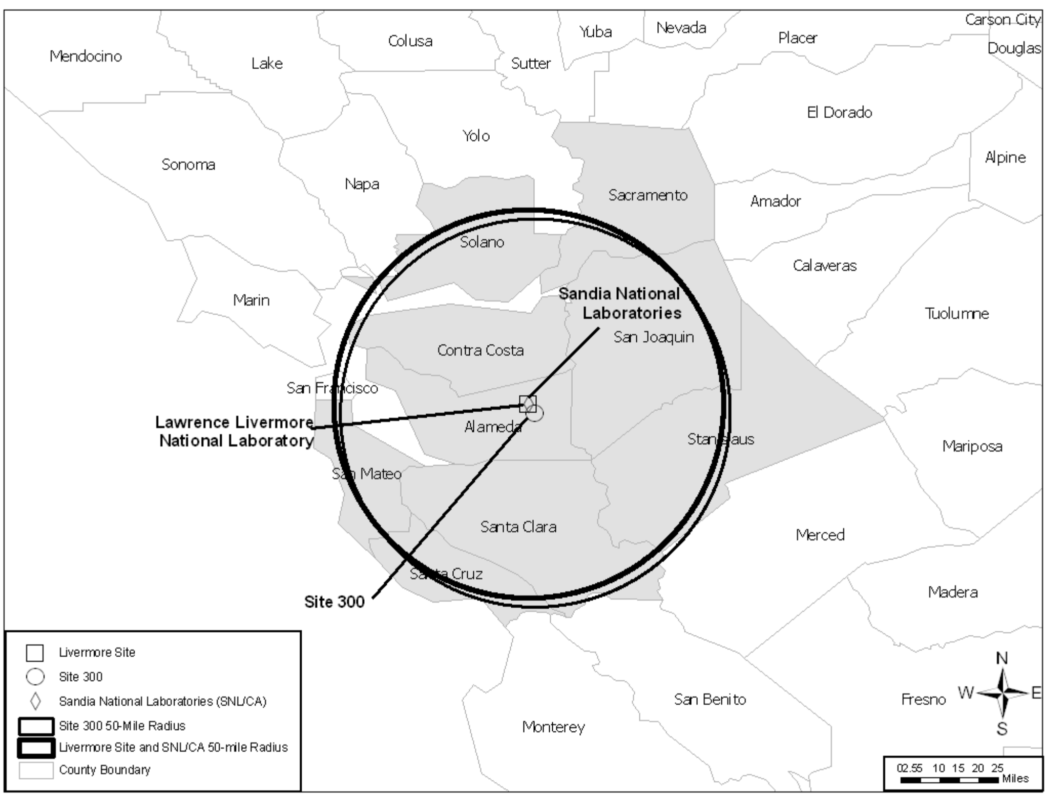


Figure 4.2.10-1—Potentially Affected Counties Surrounding LLNL Socioeconomic ROI

Table 4.2.10-1—Demographic Profile of the Potentially Affected Area Surrounding LLNL and SNL/CA, 2000

Population Group	Population	Percent
Minority	**3,837,996**	**50.1**
Hispanic alone	658,688	8.6
Black or African American	608,751	7.9
American Indian and Alaska Native	60,449	0.8
Asian	1,248,108	16.3
Native Hawaiian and Other Pacific Islander	41,992	0.5
Some other race	809,931	10.6
Two or more races	410,077	5.3
White alone	**3,828,545**	**49.9**
Total Population	**7,666,541**	**100.0**

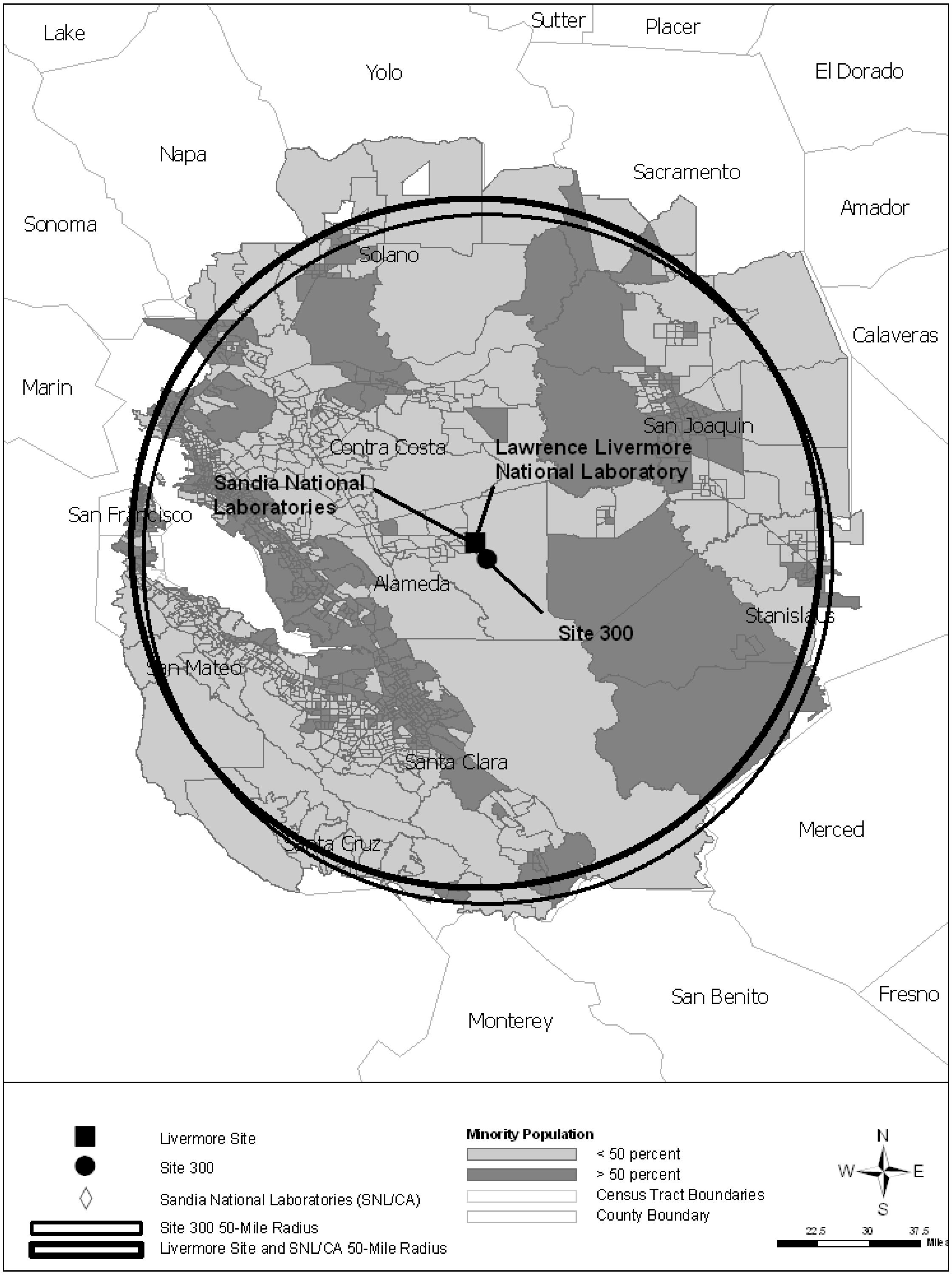
Source: USCB 2007.

In 2000, persons self-designated as minority individuals in the potentially affected area comprised 50.1 percent of the total population. This minority population is composed largely of Asian residents. As a percentage of the total resident population in 2000, California had a minority population of 53.3 percent and the U.S. had a minority population of 30.9 percent (USCB 2007).

Census tracts with minority populations exceeding 50 percent were considered minority census tracts. Based on 2000 census data, Figure 4.2.10-2 shows minority census tracts within the 50-mile radius where more than 50 percent of the census tract population is minority.

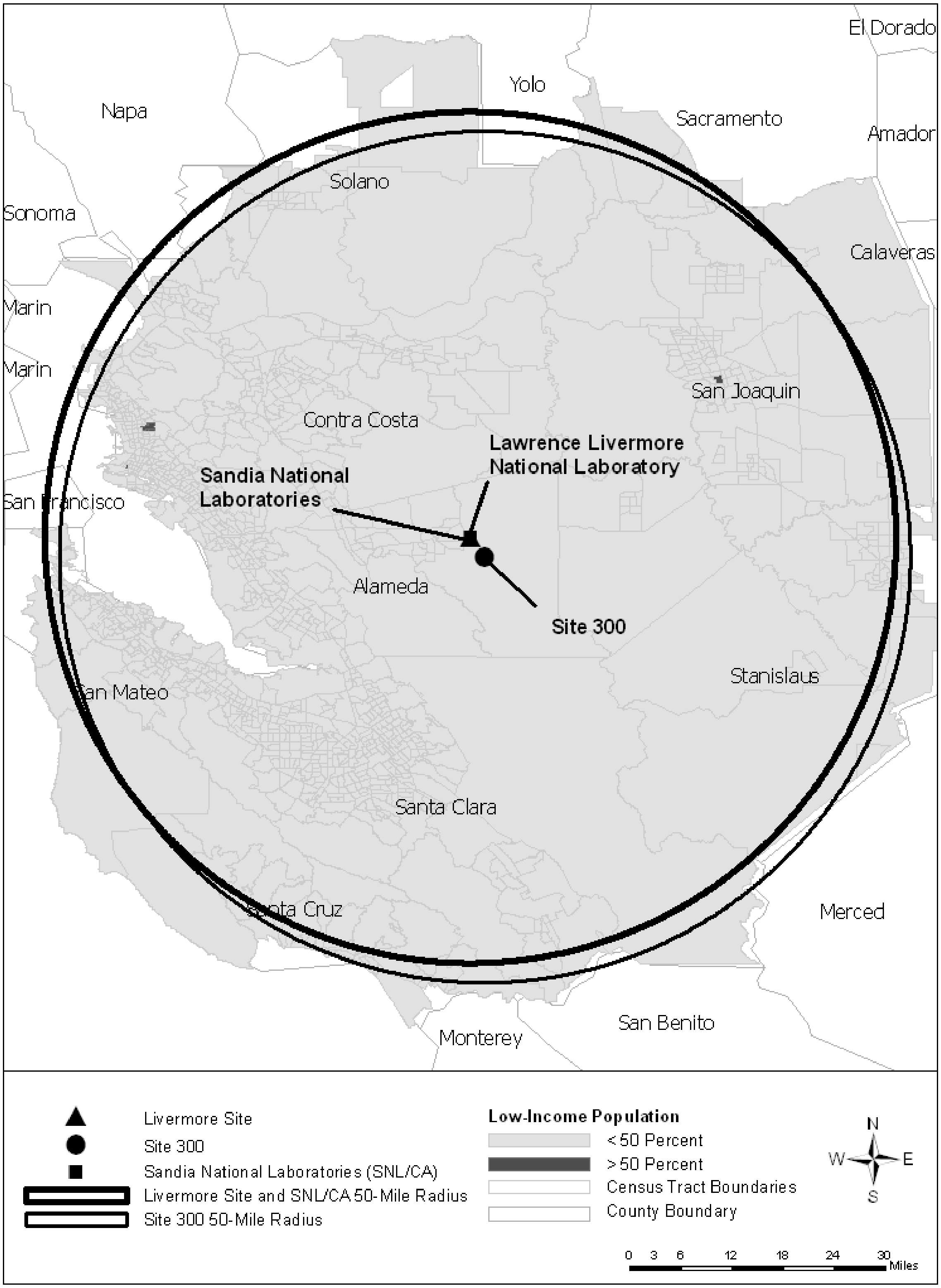
Census tracts were considered low-income census tracts if the percentage of the populations living below the poverty threshold exceeded 50 percent. Based on 2000 Census data, Figure 4.2.10-3 shows low-income census tracts within the 50-mile radius where more than 50 percent of the census tract population is living below the Federal poverty threshold.

According to 2000 census data, approximately 554,074 individuals residing within census tracts in the 50-mile radius of LLNL were identified as living below the Federal poverty threshold, which represents approximately 9.8 percent of the census tract population in the 50-mile radius. This percentage is lower than the 2000 national average of 12.4 percent and the statewide figure of 14 percent. There were five census tracts located in Alameda and San Joaquin counties with populations greater than 50 percent identified as living below the Federal poverty threshold. In 2000, 14.2 percent of individuals for whom poverty status is determined were below the poverty level in California and 12.4 percent in the U.S. (USCB 2007).



Source: USCB 2007.

Figure 4.2.10-2—Minority Population–Census Tracts with More than 50 Percent Minority Population in a 50-Mile Radius of LLNL

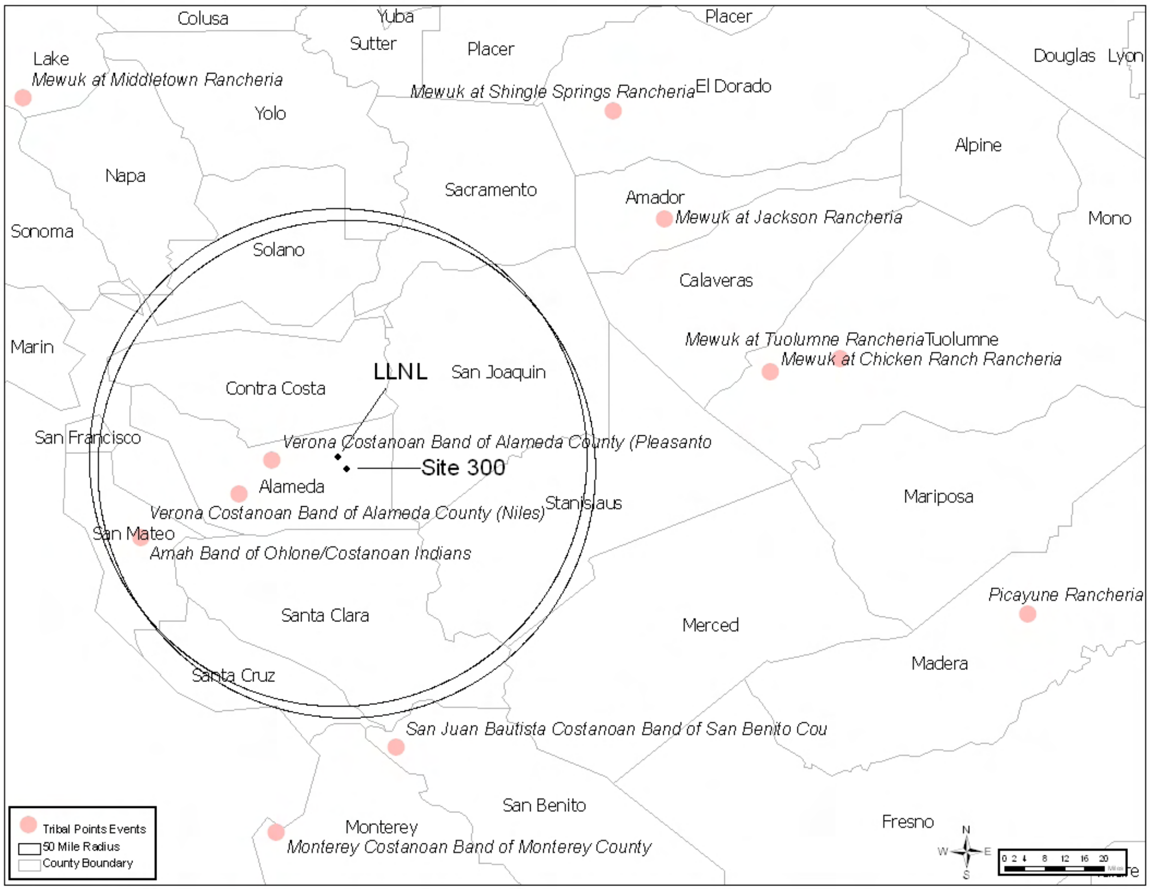


Source: USCB 2007.

Figure 4.2.10-3—Low-Income Population–Census Tracts with More than 50 Percent Low-Income Population in a 50-Mile Radius of LLNL

4.2.10.1 *Characteristics of Native American Populations within the Vicinity of or with Interest in LLNL Activities/Operations*

As discussed in Section 4.2.8.3, Native American groups which are known to have used the lands surrounding LLNL (Site 300) and SNL/CA are the Costanoans (or Ohlone), Northern Yokuts, and Eastern Miwok (or Me-Wuk). The 2000 U.S. Census Bureau was used to obtain characteristics, including population, employment, educational attainment, income, poverty level, average family size, and housing characteristics for all population subcategories associated with the ones mentioned above. The location of various tribes in relation to LLNL and Site 300 are shown in Figure 4.2.10-4. The results of this analysis are provided in the following section.



Source: ESRI 2007.

Figure 4.2.10-4—Location of Tribes in Relation to LLNL and Site 300

As shown in Table 4.2.10-2, the Yokuts had the highest of the three Native American populations with 3,191 and Costanoans with the least at 1,325. The Costanoans have the largest percentage of their population as members of the civilian labor force at 71.9 percent and the Yokuts with the smallest percentage of their population as members of the civilian labor force with 57 percent. The Yokuts had the highest unemployment rate at 6 percent and the Costanoan with the lowest unemployment rate at 4.0 percent (USCB 2007).

Of those individuals over 25 with some form of education, the largest constituency of all three Native American populations had received a high school diploma as shown in Table 4.2.10-3.

A slightly lesser percentage of individuals had attended some college and significantly lesser percentages of these populations had received degrees from institutions of higher learning (Associate, Bachelor, or Graduate/Professional) (USCB 2007).

The Costanoan population had the highest mean household earnings and per capita income with $53,308 and $18,018, respectively, in 2000 as shown in Table 4.2.10-4. The Me-Wuk population had the lowest mean household earnings with $41,835 and the Yokuts had the lowest per capita income with $13,904 as (USCB 2007).

Of the three Native American populations within the vicinity of LLNL, the Yokuts had the largest percentage of individuals below the poverty level in 2000 with 29 percent as compared to the Costanoan population which had 15.4 percent of the total population living below the poverty level as shown in Table 4.2.10-4 (USCB 2007).

In 2000, the Yokuts had the largest average family size with 4.26 persons, followed by the Costanoans with 3.63 and the Me-Wuk with 3.27 persons per family. The Yokuts had the greater number of occupied housing units which is consistent with their larger population and owner-occupied housing units compared to renter-occupied housing units were comparable as shown in Table 4.2.10-5 (USCB 2007).

Table 4.2.10-2—Population and Employment Estimates for Native American Populations within the Vicinity of or With Interest in LLNL, 2000

LLNL	Population	Civilian Labor Force	Civilian Labor Force (percent)	Employed	Employed (percent)	Unemployed	Unemployed (percent)
Costanoan	1,325	747	71.9	705	67.9	42	4.0
Me-Wuk	2,785	1,248	59.7	1,134	54.3	114	5.5
Yokuts	3,191	1,192	57.0	1,066	50.9	126	6.0
Picayune	917	366	55.8	327	49.8	39	5.9
Tachi	394	106	51.7	72	35.1	34	16.6
Tule River	637	249	62.6	215	54.0	34	8.5
Yokuts Alone	1,122	432	59.3	413	56.7	19	2.6

Source: USCB 2007.

Table 4.2.10-3—Level of Educational Attainment by Native American Populations within the Vicinity of or With Interest in LLNL, 2000

LLNL	High School Graduate	High School Graduate (percent)	Some College	Some College (percent)	Associate Degree	Associate Degree (percent)	Bachelor Degree	Bachelor Degree (percent)	Graduate/ Professional Degree	Graduate/ Professional Degree (percent)
Costanoan	210	23.3	255	28.3	49	5.4	61	6.8	59	6.5
Me-Wuk	576	33.4	419	24.3	111	6.4	91	5.3	15	0.9
Yokuts	538	32.5	382	23.1	99	6.0	103	6.2	25	1.5
Picayune	150	28.3	160	30.2	23	4.3	50	9.4	11	2.1
Tachi	43	30.5	64	45.4	3	2.1	9	6.4	0	0.0
Tule River	119	41.6	65	22.7	4	1.4	9	3.1	0	0.0
Yokuts Alone	193	31.8	72	11.9	47	7.8	35	5.8	14	2.3

Source: USCB 2007.

Table 4.2.10-4—Income and Poverty Level Estimates for Native American Populations within the Vicinity of or With Interest in LLNL, 2000

LLNL	Mean Household Earnings	Per Capita Income	Individuals Below the Poverty Level	Individuals Below the Poverty Level (percent)
Costanoan	$53,308	$18,018	201	15.4
Me-Wuk	$41,835	$14,601	466	17.2
Yokuts	$46,386	$13,904	912	29
Picayune	$55,208	$17,791	230	25.8
Tachi	$61,949	$19,239	114	29.3
Tule River	$35,616	$10,812	207	32.5
Yokuts Alone	$39,319	$10,786	354	31.7

Source: USCB 2007.

Table 4.2.10-5—Housing Characteristics for Native American Populations within the Vicinity of or With Interest in LLNL, 2000

LLNL	Average Family Size	Occupied Housing Units	Owner Occupied Housing Units	Owner Occupied Housing Units (percent)	Renter Occupied Housing Units	Renter Occupied Housing Units (percent)
Costanoan	3.63	430	246	57.2	184	42.8
Me-Wuk	3.27	975	481	49.3	494	50.7
Yokuts	4.26	909	469	51.6	440	48.4
Picayune	4.36	241	125	51.9	116	48.1
Tachi	5.21	145	83	57.2	62	42.8
Tule River	3.96	190	104	54.7	86	45.3
Yokuts Alone	4.09	314	146	46.5	168	53.5

Source: USCB 2007.

4.2.11 Health and Safety

Current activities associated with routine operations at LLNL and SNL/CA have the potential to affect worker and public health. The following discussion characterizes the human health impacts from current releases of radioactive and nonradioactive materials at LLNL. It is against this baseline that the potential incremental and cumulative impacts associated with the alternatives are compared and evaluated.

4.2.11.1 *Public Health*

4.2.11.1.1 Radiological

Releases of radionuclides to the environment from LLNL operations provide a source of radiation exposure to individuals in the vicinity of LLNL. During 2005, LLNL's environmental radiological monitoring program was conducted according to DOE Order 5400.5, "Radiation

Protection of the Public and the Environment." The program involved measuring radioactivity in environmental samples in addition to calculating the potential radiological dose to the offsite public.

The exposure of members of the public to all DOE sources of radiation is limited by the DOE to levels that shall not cause, in a year, an effective dose equivalent greater than 100 millirem. Demonstration of compliance with this limit is documented by a combination of measurements and calculations including the comparison of concentrations of radioactive material in air and water to derived concentration guide (DCG) listed in Chapter III of DOE Order 5400.5. The DOE provides a level of protection for persons consuming water from a public drinking water supply equivalent to the drinking water criteria in 40 CFR 141 by limiting the effective dose equivalent in a year to 4 millirem. Compliance with the aforementioned criterion is accomplished by comparing measured concentrations of radionuclides in drinking water to 4 percent of the DCG values for ingested water. The DOE further limits emissions of radionuclides to the ambient air from DOE facilities to those amounts that would not cause any member of the public to receive, in any year, an effective dose equivalent of 10 millirem per year. This limit is equivalent to the limit for emissions of radionuclides other than radon to this pathway established by the EPA at 40 CFR 61.92.

Compliance with the dose limit specified in 40 CFR 61.92 (and hence that for the air pathway specified in DOE Order 5400.5) is demonstrated by calculating the effective dose equivalent received by the maximally exposed individual member of the general public. This individual is a person who resides near LLNL, and who would receive, based on theoretical assumptions about lifestyle that maximize exposure to radiological emissions, the highest effective dose equivalent from Plant operations. Calculations are performed using the EPA's CAP88-PC model (EPA 1992).

As shown in Table 4.2.11-1, the total dose to the MEI from Livermore site operations in 2005 was 0.0065 millirem per year (LLNL 2007). Of this, the dose attributed to diffuse emissions (area sources) totaled 0.0038 millirem or 59 percent; the dose due to point sources was 0.0027 millirem or 41 percent of the total. The point source dose includes Tritium Facility elemental tritium gas (HT) emissions modeled as tritiated water (HTO), as directed by EPA Region IX. As shown on Table 4.2.112 presents the total dose to the Site 300 MEI from operations in 2005 was 0.018 millirem. Point source emissions from firing table explosives experiments totaled 0.0088 millirem accounting for 48 percent of the dose, while 0.0094 millirem, or about 52 percent was contributed by diffuse emission sources (LLNL 2007).

Table 4.2.11-1—Calculated Radiation Doses to the General Public from Normal Operations at LLNL Main Site, 2005 (Committed Effective Dose Equivalent)

Affected Environment	Atmospheric Releases		Liquid Releases		Total	
	Standard	Actual	Standard	Actual	Standard	Actual
Maximally exposed individual (mrem)	10	0.0038	4	0.0027	100	0.0065
Population within 50-miles (person-rem)	None	0.68	None	0.49	100	1.17
Average individual within 50-miles (mrem)	None	1.1×10^{-7}	None	6.9×10^{-8}	None	1.8×10^{-7}

Source: LLNL 2007.

Dominant radionuclides at the two sites were the same as in recent years. Tritium accounted for about 91 percent of the Livermore site's calculated dose. At Site 300, practically the entire calculated dose was due to the isotopes uranium-238, uranium-235, and uranium-234 from depleted uranium. Collective dose for both LLNL sites was calculated out to a distance of 50 miles in all directions from the site centers. Population centers affected by LLNL emissions include the nearby communities of Livermore and Tracy; the more distant metropolitan areas of Oakland, San Francisco, and San Jose; and the San Joaquin Valley communities of Modesto and Stockton. Within the 50 miles outer distance specified by DOE, there are 7.1 million residents included for the Livermore site collective dose determination, and 6.2 million for Site 300. The result for potential collective dose attributed to 2005 Livermore site operations was 1.17 person-rem, the corresponding collective EDE from Site 300 operations was 1.71 person-rem. These values are both within the normal range of variation seen from year to year. Collective doses from LLNL operations in 2005 are about 700,000 times smaller than ones from natural background radiation. The estimated maximum potential doses to individual members of the public from operations at the two LLNL sites (combined) in 2005 are nearly 12,000 times smaller than ones received from background radiation in the natural environment.

Table 4.2.11-2—Calculated Radiation Doses to the General Public from Normal Operations at Site 300, 2005 (Committed Effective Dose Equivalent)

Affected Environment	Atmospheric Releases		Liquid Releases		Total	
	Standard	Actual	Standard	Actual	Standard	Actual
Maximally exposed individual (mrem)	10	0.0094	4	0.0088	100	0.018
Population within 50-miles (person-rem)	None	0.89	None	0.82	100	1.71
Average individual within 50-miles (mrem)	None	1.4×10^{-7}	None	1.3×10^{-7}	None	2.7×10^{-7}

Employees working in the radioactive materials area are the site personnel most likely to be exposed to radiation either internally or externally. Exposure pathways for internal dose include inhalation and dermal absorption. Internal exposure is typically monitored by bioassays (e.g., urinalysis, whole-body scans, lung counts). Routine bioassays are done on workers who, under typical conditions, are likely to receive a dose from occupational exposures of 0.1 rem or more in a year. Others who would be assayed include occupationally exposed minors, members of the public, and pregnant workers who are likely to receive an internal dose of at least 0.05 rem (or, in the case of pregnant workers, an equivalent dose to the embryo/fetus). Internal exposures are minimized in keeping with the concept of as low as reasonably achievable, which is applied through the use of engineering devices (e.g., high-volume air hoods), administrative controls, and personal protective equipment such as gloves, protective clothing, and respirators. All work areas are sampled periodically, and areas susceptible to internal exposures are monitored continuously.

The total radiation dose for workers is the sum of internal and external exposure. The total radiation dose to all workers during 2005 was 10.0 person-rem. The maximum individual dose to a worker was less than 2 rem. This is within the regulatory standard for radiological workers, those given unescorted access to radiation areas, of 5 rem per year.

Worker doses from occupational exposure to radiation are projected based on recent experience with continuing operations and projections of specific additional operation impacts on involved workers. The bulk of the dose to involved workers from current operations (approximately 90 percent of total worker dose) is from operations at Building 332.

Prior to 1994, SNL/CA had only one radiological emission source requiring monitoring under the requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61, Subpart H), the Tritium Research Laboratory. Tritium operations ceased at SNL/CA in 1994. Under an agreement with the EPA, Region IX, SNL/CA continued stack monitoring and ambient air monitoring for tritium for one year after cessation of tritium operations. This monitoring showed no remaining airborne tritium and was discontinued in 1995 with EPA approval. Therefore, there are no SNL/CA sources of radioactive air emissions and thus no exposure to the offsite population from SNL/CA operations (SNL/CA 2003).

SNL/CA employs an Integrated Safety Management System (ISMS) to control hazards associated with site operations, including hazards related to the management and use of hazardous materials. The ISMS process includes project planning, hazard assessment, identification and feedback, and continuous improvement planning. SNL/CA also follows specific management processes to ensure adequate security and accountability requirements are met for radioactive and high-hazard materials. Inventory controls are implemented to ensure that material quantities are maintained at mission-essential levels (SNL/CA 2003).

SNL/CA worker doses have typically been well below DOE worker radiological exposure limits. DOE set administrative exposure guidelines at a fraction of the exposure limits to help enforce doses that ALARA (SNL/CA 2003).

4.2.11.1.2 Nonradiological

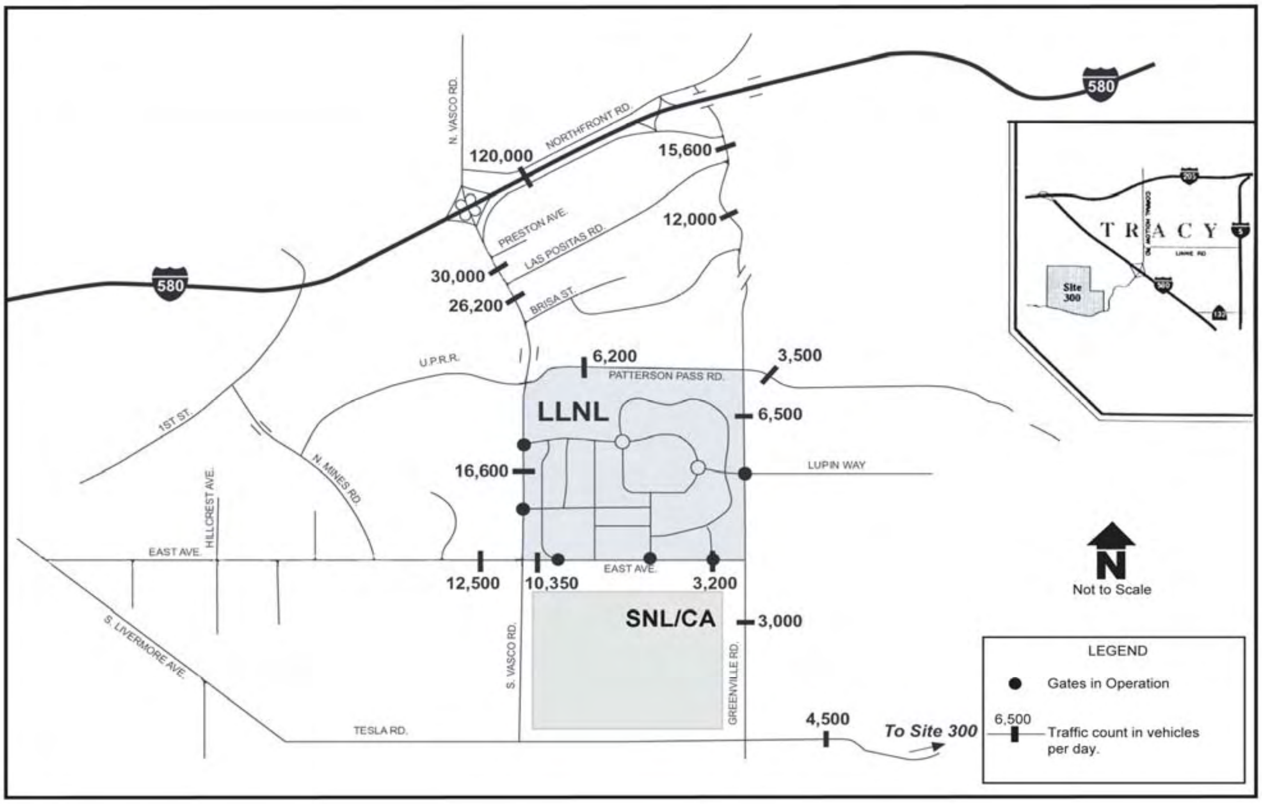
Adverse health impacts to the public can be minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operation at LLNL via inhalation of air containing hazardous chemicals released to the atmosphere by LLNL operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. LLNL workers are also protected by adherence to Occupational Safety and Health Administration (OSHA) and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at LLNL are expected to be substantially better than required by standards.

A worker protection program is in place at SNL/CA to protect the health of all workers. To prevent occupational illnesses and injuries and to preserve the health of all workers involved in site-related activities (construction and operations), DOE-approved health and safety programs have been implemented (SNL/CA 2003).

4.2.12 Transportation

Regional access to the Livermore Site and SNL/CA by motor vehicle is from I-580, which runs east and west approximately 1 mile north of the Livermore Site. As depicted in Figure 4.2.12-1, the Vasco Road/I-580 interchange provides access to the western site boundary, and the Greenville Road/I-580 interchange provides access to the eastern site boundary.



Source: DOE 2005a.

Figure 4.2.12-1—Regional Transportation Network with Traffic Counts

As shown in Figure 4.2.12-1, the major street system in the vicinity of LLNL and SNL/CA includes I-580, South Vasco Road, Greenville Road, East Avenue, and Patterson Pass Road. Most of these are primarily located in the city of Livermore, but with portions of all streets lying in unincorporated portions of Alameda County. Table 4.2.12-1 provides a summary of traffic volumes along the major streets in the LLNL and SNL/CA vicinity.

In addition to serving the Livermore Site and SNL/CA and existing residential districts west of the Livermore Site, South Vasco Road provides key access to the large industrial/business parks located north of the area extending from Greenville Road to west of South Vasco Road. South

Vasco Road also provides access to the existing Altamont Commuter Express (ACE) commute train station located near the southwest quadrant of the intersection of South Vasco Road and Brisa Street.

Table 4.2.12-1—Daily Traffic Volumes in the LLNL and SNL/CA Vicinity

Location	Average Daily Vehicle Trips
I-580 in the Livermore and SNL/CA vicinity	120,000
South Vasco Road between I-580 and Las Positas Road	30,000
South Vasco Road between Las Positas Road and Patterson Pass Road	26,200
South Vasco Road between Patterson Pass Road and East Avenue along the western border of the Livermore Site	16,600
Greenville Road near Southfront Road	15,600
Greenville Road between Las Positas Road and Patterson Pass Road	12,000
Greenville Road between Patterson Pass Road and East Avenue along the eastern border of the Livermore Site	6,500
Greenville Road between East Avenue and Tesla Road	3,000
East Avenue between South Vasco Road and the South Gate	10,350
East Avenue Between Greenville Road and the South Gate	3,200
Patterson Pass Road between South Vasco Road and Greenville Road	6,200
Patterson Road east of Greenville Road	3,500
Tesla Road East of Greenville Road (towards Site 300)	4,500

Source: DOE 2005a.

The northern section of South Vasco Road, generally between I-580 and Las Positas Road, experiences the greatest degree of congestion in this corridor due to higher traffic volumes and a greater density of intersections with traffic signals.

Regional access to Site 300 is from I-580 to Corral Hollow Road. Alternately, travel between the Livermore Site and Site 300 is by way of Tesla Road. Tesla Road changes to Corral Hollow Road at the Alameda-San Joaquin county line. There is one primary access gate to Site 300 from Corral Hollow Road plus another gate for the pistol range. Between Site 300 and Greenville Road, the daily traffic on Tesla Road averages approximately 4,500 vehicles per day.

Approximately 35 percent of the Livermore Site employees live within 12 miles of the Laboratory (DOE 2005a). The remaining employees come to work from greater distances, mostly from the counties of Alameda, San Joaquin, Contra Costa, and Stanislaus. Many of these commuters travel in personal vehicles and arrive either on local roads or on I-580. Trucks carrying radioactive or hazardous material shipments almost exclusively arrive from or depart to the east on I-580 and I-5, except for local deliveries from the Bay Area.

Regional access to Site 300 is from I-580 to Corral Hollow Road. Alternately, travel between the Livermore Site and Site 300 is by way of Tesla Road as shown in Figure 4.2.12-1. Tesla Road changes to Corral Hollow Road at the Alameda-San Joaquin county line. There is one primary access gate to Site 300 from Corral Hollow Road plus another gate for the pistol range.

4.2.12.1 *Aircraft Operations*

The Livermore Municipal Airport is located just south of I-580 at Airway Boulevard. The airport occupies 400 acres and has been in operation at its existing location since 1965. The airport has approximately 570 based aircraft and 250,000 annual aircraft operations. LLNL leases aircraft for research and conducts research while on aircraft managed by others. The manned and unmanned aircraft fly in the Livermore Valley and around Site 300, as well as other sites outside of the area (DOE 2005a).

4.2.12.2 *Transportation Accidents*

NNSA reviewed the California Statewide Integrated Traffic Records System accident reports for 1999, 2000, and 2001. The information was for all streets near the Livermore Site and Site 300 and included South Vasco Road, Greenville Road, Patterson Pass Road, East Avenue, and Tesla Road. The accidents are summarized in Table 4.2.12-2. The accident rates on the main roads serving the Livermore Site are also compared with the average accident rates for similar roads in the State of California. Average accident rates in California on urban four-lane divided roadways are 2.18 accidents per million vehicle miles (MVM). For two- and three-lane urban roadways, the average rate is 1.93 accidents per MVM. For two-lane rural roadways, the average rate is 1.21 accidents per MVM.

Overall, the accident history near the Livermore Site and SNL/CA is good, with 8 of the 10 sections analyzed having accident rates considerably below statewide averages, while 2 of the 10 sections had rates up to 14 percent higher than the statewide averages. The rates that are above the averages are either expected to be improved or are not considered to be significant (DOE 2005a).

Table 4.2.12-2—Three-Year Accident Rates for Roads Adjacent to the Livermore Site, Site 300, and SNL/CA (1999 through 2001)

Segment Location	Segment Distance (miles)	Number of Accidents	ADT	3-Year Volumes	Vehicle Miles of Travel	Accidents per MVM	Average Statewide Accidents per MVM
S. Vasco Rd (South of I-580 to Las Positas)[a]	0.5	39	30,000	31,455,901	15,727,951	2.48	2.18 [a]
S. Vasco Rd (South of Las Positas to Patterson Pass)[a]	0.6	40	26,200	27,471,487	16,482,892	2.43	2.18 [a]
S, Vasco Rd (South of Patterson Pass to East Ave)[a]	1.0	7	16,600	17,405,599	17,405,599	0.40	2.18 [a]
Greenville Rd (South of I-580 to Las Positas)[a]	0.3	3	15,600	16,357,069	4,907,121	0.61	2.18 [a]
Greenville Rd (South of Las Positas to Patterson Pass)[b]	1.2	11	12,000	12,582,361	15,098,833	0.73	1.93[b]
Greenville Rd (South of Patterson Pass to East Ave)[b]	1.1	2	6,500	6,815,445	7,496,990	0.27	1.93[b]
Patterson Pass Rd (East of S Vasco to West of Greenville)[b]	1.2	6	6,200	6,500,886	7,801,064	0.77	1.93[b]
East Ave (East of S. Vasco to West of Greenville)[b]	1.2	1	7,000	7,339,710	8,807,652	0.11	1.93[b]
Greenville Rd (South of East Ave to Tesla Rd)[c]	1.0	0	3,000	3,145,590	3,145,590	0.00	1.21[c]
Tesla Rd (Greenville to Site 300 Entrance)[c]	13.1	55	4,500	4,718,385	661,810,846	0.89	1.21[c]

Source: DOE 2005a.
[a] Urban four-lane divided roadway.
[b] Two- and three-lane urban roadway.
[c] Two-lane rural roadway.
ADT=average daily traffic; MVM=million vehicle miles.

4.2.13 Waste Management

Radioactive waste generated at LLNL includes low level waste (LLW), mixed low level waste (MLLW), transuranic (TRU) waste, and mixed TRU waste. LLNL does not manage or generate high-level waste (a highly radioactive material that results from the reprocessing of spent nuclear fuel). LLW, MLLW, and TRU waste are produced primarily in laboratory experiments and component tests.

DOE O 435.1 permits onsite storage of LLW and TRU wastes until appropriate disposal becomes available. Currently, there are no regulatory restrictions on the length of time this waste may be stored onsite, provided that disposal or offsite storage options are being pursued and the waste is stored in accordance with all applicable regulations. LLNL maintains the capability to treat solid radioactive wastes onsite. LLNL has treated liquid radioactive wastes at the Area 514 Tank Farm. This Area 514 has undergone D & D and no longer exists. The Decontamination and Waste Treatment Facility (DWTF) has replaced Area 514 (LLNL 2002a). LLNL disposed of solid LLW offsite primarily at the Nevada Test site. Available storage space for LLW and TRU waste is limited by exposure considerations (i.e., radiation exposure to personnel) at a given storage location. However, radioactive wastes, unlike RCRA-regulated wastes, can be stored at various locations onsite provided that the wastes are properly packaged, labeled, and monitored. Radioactive waste management facilities are listed in Table 4.2.13-1. Waste generation rates are listed in Tables 4.2.13-2 through 4.2.13-5. A discussion of the waste management activities associated with each of these waste categories follows.

Table 4.2.13-1—Livermore Site Waste Management Facilities and Capacities[a]

Facility	Unit Type	Waste Type	Capacity
Area 612 Facility			
Building 625 CSU	S	H, M, R, TSCA, CT	42,416 gal
Area 612 Tank Trailer Storage Unit	S	CT, H, M, R	5,000 gal
Area 612 Portable Tank Storage Unit	S	CT, H, M, R	10,000 gal
Area 612-1 CSU	S	CT, H, M, R	38,400 ft^3
Area 612-2 CSU	S	CT, H, M, R	10,560 gal
Area 612-4 Receiving, Segregation, and CSU	S	H, M, R, TSCA, CT	NA
Area 612-5 CSU	S	CT, H, M, R	26,900 ft^3
Building 612 Size Reduction Unit	T	CT, H, M, R	250 short tons/yr
Building Lab Packing/Packaging	T	CT, H, M, R	NA
Building 612 CSU	T	CT, H, M, R	7,150 gal
Building 614 West Cells CSU	S	CT, H, M, R	168 gals/cell (4 cells)
Building 614 East Cells CSU	S	CT, H, M, R	880 gals/cell (4 cells)
DWTF Complex			
Building 693 CSU	S	CT, H, M, R	141,240 gal
Building 693 Annex	S	CT, H, M, R	3,060 ft^3
Building 693 Yard—Freezer Storage Unit	S	CT, H, M, R	30 gal
Building 693 Yard—Roll-Off Bin Storage Unit	S	CT, H	2,160 ft^3
Building 695 Airlock	S	H, M	12,000 gal
Building 695 LWPA Waste Blending Station, Tank Blending Unit	T	CT, H, M, R	Part of 695 Tank Farm capacity
Building 695 LWPA Waste Blending Station, Portable Blending Unit	T	CT, H, M, R	Part of 695 Tank Farm capacity
Building 695 LWPA Cold Vapor Evaporation Unit	T	CT, H, M, R	Part of 695 Tank Farm capacity
Building 695 LWPA Centrifuge Unit	T	CT, H, M, R	55,000 gal/yr
Building 695 LWPA Solidification Unit	T	CT, H, M, R	115 short tons/yr
Building 695 LWPA Shredding Unit	T	CT, H, M, R	180 short tons/yr
Building 695 LWPA Filtration Unit	T	CT, H, M, R	2,750 gal/yr
Building 695 LWPA Drum Rinsing Unit, Bulking Station	T	CT, H, M, R	182 short tons/yr
Building 695 LWPA Debris Washer Unit	T	CT, H, M, R	45 short tons/yr
Building 695 LWPA Gas Adsorption Unit	T	CT, H, M, R	0.09 short tons/day
Building 695 LWPA Radwaste Evaporator	T (non RCRA)	R	
Building 695 LWPA Air Lock	(non RCRA)	R	
Building 695 RWPA/SSTL Water Reactor			0.09 short tons/day

Table 4.2.13-1—Livermore Site Waste Management Facilities and Capacities[a] (continued)

Facility	Unit Type	Waste Type	Capacity
Building 695 RWPA/SSTL Pressure Reactor			0.09 short tons/day
Building 695 RWPA/SSTL Amalgamation Reactor			0.09 short tons/day
Building 695 RWPA/SSTL Uranium Bleaching Unit			0.09 short tons/day
Building 696, Drum/Container crushing unit	T	CT, H, M, R	600 short tons/yr
Small Scale Treatment Laboratory	T	H, M, R	0.04 short tons/day
Reactive Waste Storage Room	S	CT, H, M, R	12,400 gal
DWTF Tank Farm	S, T	CT, H, M, R	45,000 gal (storage), 325,000 gals/yr (treatment)
DWTF Portable Tank Storage Pad	S	CT, H, M, R	22,000 gal
Building 513 CSU	S	H, M, R	NA[c]
Building 513 Shredding Unit	T	H, M, R	NA[c]
Building 513 Solidification Unit	T	H, M, R	
EWTF-Site 300			
Open Burn Unit –Pan	T	H	150 lb/event
Open Burn Unit –Cage	T	H	260 lb/event
Open Detonation Unit	T	H	350 lb/event
S1	S	H	275 gal
S2	S	H	110 gal
EWSF-Site 300			
Magazine 1	S	H	1,622 lb (net explosive weight)
Magazine 2	S	H	3,209 lb (net explosive weight)
Magazine 3	S	H	5,592 lb (net explosive weight)
Magazine 4	S	H	4,291 lb (net explosive weight)
Magazine 5	S	H	2,744 lb (net explosive weight)
Magazine 816	S	H	9,240 gal (no liquids)
Building 883-Site 300			
Building 883 CSU	S	H	3,300 gal
Building 804-Site 300			
Building 804	Staging and Storage Area	R – only	N/A

[a] Typically an operational limit including a combination of hazardous, radioactive, and mixed waste unless otherwise restricted by permit or LLNL management practice.
[b] Under all alternatives, this facility would undergo RCRA closure and operational capabilities would be transferred to the Decontamination and Waste Treatment Facility (DWTF).
[C] Values are included with those for B-695 Part B Permit.
CSU=container storage unit; CT=California Toxic (A non-RCRA hazardous waste defined by State of California, pursuant to Title 22, California Code of Regulations); R=radioactive (may include LLW and TRU); S=storage; T= Treatment; TSCA=*Toxic Substance Control Act*; H=hazardous; M=mixed; NA=not available; EWTF=Explosive Waste Treatment Facility; ft^3=cubic feet; ga=gallons; lbs=pounds; N/A=not applicable; SWSF=Solid Waste Storage Facility; RWPA/SSTL=Reactive Waste Packing Area/Small Scale Treatment Laboratory; DWTF=Decontamination and Waste Treatment Facility; LWPA=Liquid Waste Processing Area; RCRA=*Resource Conservation and Recovery Act*.

Radioactive waste generated at SNL/CA includes LLW and LLMW. SNL/CA does not manage or generate transuranic waste (TRU) or mixed transuranic waste. SNL/CA does not manage or generate high-level waste. LLW and LLMW are produced primarily in laboratory experiments and component tests.

As part of the effort to minimize the total quantity of radioactive waste that is generated at SNL/CA, facilities that generate this type of waste are designated as Radioactive Materials Management Areas (RMMA). An RMMA is an area where the reasonable potential exists for contamination due to the presence of unconfined or unencapsulated radioactive material or an area that is exposed to sources of radioactive particles (such as neutrons and protons) capable of causing activation. Managers of facilities must document the location of all RMMAs. Procedures to minimize the generation of radioactive wastes are then developed. SNL/CA does not maintain the capability to treat or dispose mixed wastes onsite. SNL/CA is not subject to a site-specific federal facility compliance agreement for mixed waste. The site does not possess or store any legacy mixed waste. All mixed waste generated at SNL/CA is managed under the site's RCRA Hazardous Waste Facility Permit (SNL/CA 2007).

4.2.13.1 *Routine Hazardous and Radioactive Waste*

Routine waste described in Table 4.2.13-2 includes waste from ongoing operations produced by any type of production, analysis, and/or research and development taking place at LLNL. Periodic laboratory or facility clean-outs and spill cleanups as a result of these processes are also considered normal operations. Residues, resulting from the treatment of routine waste, are not included to avoid double counting.

Table 4.2.13-2—Routine Hazardous and Radioactive Waste at LLNL, FY 2004–2006

Waste Category	FY2004	FY2005	FY2006
Routine hazardous waste generated	141.3 metric tons	127 metric tons	153 metric tons
Routine low-level waste generated	151.3 m^3	54 m^3	66 m^3
Routine mixed waste generated	18.8 m^3	16 m^3	18 m^3
Routine TRU/mixed TRU waste generated	1.2 m^3	1 m^3	1 m^3

Source: LLNL 2007.

The hazardous waste generated at SNL/CA is predominantly chemical laboratory trash generated from experiments, testing, other R&D activities, and infrastructure fabrication and maintenance. Table 4.2.13-3 contains a summary of routine hazardous and radioactive waste from 2004 through 2006.

Table 4.2.13-3—Routine Hazardous and Radioactive Waste at SNL/CA, FY 2004–2006

Waste Category	FY2004	FY2005	FY2006
Routine hazardous waste generated (kg)	85,382	31,200	56,530
Routine radioactive waste generated (kg)	3,094	90	19

Source: SNL/CA 2007.

4.2.13.2 *Routine Nonhazardous Waste*

Together, the Livermore site and Site 300 generated 4,107 metric tons of routine nonhazardous solid waste in FY 2006. This volume includes diverted waste (e.g., material diverted through recycling and reuse programs) and landfill waste. Both sites diverted a combined total 2,601 metric tons of routine nonhazardous waste in 2006, which represents a diversion rate of 63 percent. The diverted routine nonhazardous waste includes waste recycled by Radioactive and Hazardous Waste Management (RHWM) and materials diverted through the surplus sales program. The portion of routine nonhazardous waste sent to landfill was 1,506 metric tons (Table 4.2.13-4).

Table 4.2.13-4—Routine Nonhazardous Waste in FY 2006, Livermore Site and Site 300

Destination	Waste Description	Amount in FY 2006 (metric tons)
Diverted	Batteries, small[a]	1
	Batteries, lead-acid[a]	31
	Beverage containers	5
	Cardboard	135
	Compost	504
	Cooking grease	2
	Magazine, newspapers, phone books	19
	Metals	1,412
	Paper	207
	Street sweepings	93
	Tires and scrap	20
	Toner cartridges	12
	Wood	160
	Total Diverted	**2,601**
Landfill	Compacted (landfill)	1,506
	Total Landfill	**1,506**
Total Routine Nonhazardous Waste		**4,107**

[a]Batteries are managed as universal waste.
Source: LLNL 2007.

At SNL/CA, solid waste consists predominantly of office and laboratory nonhazardous trash. Nonhazardous building debris generated from D&D activities may also be considered solid waste. All solid waste is currently disposed of at off-site landfills (SNL/CA 2007). In calendar year (CY) 2000, SNL/CA generated 120.5 metric tons (excludes construction debris) (SNL/CA 2007).

4.2.13.3 *Nonroutine Hazardous Waste*

Hazardous waste refers specifically to nonradioactive waste, including RCRA chemical and explosives waste, state-regulated hazardous waste, biohazardous (for this document medical is included) waste, and TSCA waste (primarily asbestos and PCBs). Almost all buildings at LLNL generate hazardous wastes, ranging from common household items such as fluorescent light bulbs, batteries, and lead-based paint to solvents, metals, cyanides, toxic organics, pesticides, asbestos, and PCBs.

RCRA allows onsite management of hazardous waste at the point of generation or in designated waste accumulation areas or storage in permitted storage facilities. There are regulatory restrictions on the length of time that waste may be stored onsite and it must be stored in accordance with all applicable regulations. LLNL does maintain the capability to treat certain hazardous wastes onsite. LLNL treats explosive wastes at Site 300. Except for empty-container crushing, hazardous wastes are usually not treated before offsite shipment to a licensed treatment, storage, and disposal facility. Hazardous wastes are shipped offsite through licensed commercial transporters to various permitted treatment, storage, and disposal facilities. See Appendix B for a more detailed description of hazardous waste-related topics.

Non-routine nonhazardous solid wastes include excavated soils, wastes and metals from construction, and decontamination and demolition activities. The Livermore site and Site 300 generated a total of 15,992 metric tons of non-routine non-hazardous solid waste in 2006. In FY 2006, 14,323 metric tons of non-routine nonhazardous solid waste was diverted through reuse or recycling, which represents a diversion rate of 90 percent. Diverted non-routine nonhazardous solid waste includes soil reused either on site for other projects or as cover soil at Class II landfills, and metals recycled through the metals recycling programs. Only 10 percent of non-routine nonhazardous waste was sent to landfill (Table 4.2.13-5).

Table 4.2.13-5—Nonroutine Nonhazardous Waste in FY 2006, Livermore Site and Site 300

Destination	Waste Description	Amount in FY 2006 (metric tons)
Diverted	Class II cover (soil reused at landfill)	1,234
	Asphalt/concrete	10,545
	Nonroutine metals	2,544
	Total Diverted	**14,323**
Landfill	Construction demolition (noncompacted landfill)	1,502
	Industrial (Haz Track)[a]	159
	Non-friable asbestos	8
	Total Landfill	**1,669**
Total Non-routine Nonhazardous waste		**15,992**

[a] RHWM Waste Data Management Systems
Source: LLNL 2007.

4.2.13.3.1 Historic and Current Hazardous Waste Generation

The hazardous waste generated at LLNL is predominantly chemical laboratory trash generated from experiments, tests, other R&D activities, and infrastructure fabrication and maintenance. Figure 4.2.13–3 illustrates the quantities of routine and nonroutine hazardous waste generated for all operations from CY1993 through FY2001. From CY1993 to FY2002, annual total (routine plus nonroutine) RCRA hazardous waste generation ranged from 124 to 506 tons. During the same period, total annual state-regulated and total annual TSCA waste ranged from 152 to 712 tons and 8 to 507 tons, respectively.

4.2.13.3.2 Biohazardous Wastes

Division 104, Part 14, Sections 117600-118360 of the California Health and Safety Code is known as the *California Medical Waste Management Act*. This Act is a comprehensive program for regulating the management, transport, and treatment of medical wastes. The California Department of Health Services (known as DHS) administers the *California Medical Waste Management Act* and has given authority to Alameda County Health Care Services Agency/Dept. of Environmental Health to oversee LLNL's medical waste management practices.

The Livermore Site is considered a large-quantity generator of medical waste, which means that 200 or more pounds of medical waste are generated in any month of a 12-month period. Therefore, the Livermore Site is subject to annual inspections conducted by Alameda County, annual waste generator/treatment permit fees, and maintenance of the Medical Waste Management Plan that contains emergency plans for each program at LLNL that generates and treats medical waste.

Medical waste containing hazardous waste is designated as hazardous waste and is subject to regulation as specified in the statutes and regulations applicable to hazardous waste. Medical waste plus radioactive waste is designated as radioactive waste and is subject to regulation as specified in the statutes and regulations applicable to radioactive waste.

Site 300 is considered a small-quantity generator of medical waste, which means that less than 200 pounds of medical waste is generated per month. Therefore, Site 300 is not subject to medical waste generator and treatment permit fees and is not subject to annual inspections by San Joaquin County. In the past, Site 300 submitted a minimal annual fee for a Limited Quantity Hauling Exemption. However as of February 9, 2007 Site 300 notified San Joaquin County that it would no longer renew the application, as the facility no longer needs the option of transporting medical waste to the LLNL Main Site. Instead Site 300 medical waste is shipped directly offsite for treatment.

SNL/CA has two facilities identified as small quantity generators of medical waste, one with limited onsite treatment and one without onsite treatment (SNL/CA 2007).

4.2.13.4 *Waste Management Capacities*

The affected environment considered in this SPEIS is limited to those facilities that generate waste under normal (routine) operations at LLNL. Normal operations encompass all current operations that are required to maintain R&D at LLNL facilities. Table 4.2.13-6 displays nonhazardous waste sent to landfills in FY 2005.

Table 4.2.13-6—Total Nonhazardous Waste Sent to Landfills in 2006

Nonhazardous Waste	Waste Volume (metric tons)
Routine	
Compacted (landfill)	1,506
Nonroutine	
Total Diverted	14,323
Total Landfill	1,669
Total	**15,992**

Source: LLNL 2007.

4.2.13.5 *Waste Management Facilities*

Generally, wastes generated at individual buildings are accumulated at the point of generation in satellite accumulation areas. Generators, with support from RHWM staff, must segregate, identify, characterize, separate, package, label, document, and transfer waste to designated waste accumulation areas (DOE 2005a). These wastes (with the exception of medical waste) are collected in waste accumulation areas or retention tanks and then transferred to waste accumulation areas where hazardous and mixed wastes may be stored for up to 90 days. The wastes are then either transferred to onsite waste management facilities for treatment, storage, and/or preparation for offsite disposal or to various offsite permitted treatment, storage, and disposal facilities. Some LLW and all TRU radioactive wastes are currently being stored awaiting shipment to the Nevada Test Site, the Waste Isolation Pilot Plant, or another DOE-approved facility for storage or disposal. LLNL legacy mixed wastes are being managed in accordance with the *Federal Facility Compliance Act* Site Treatment Plan. With the exception of pharmaceutical wastes, medical wastes are typically collected at the generator facility before being treated onsite.

Most waste management facilities manage both radioactive and hazardous wastes. However, certain facilities are restricted to only one waste type (for example the EWTF). The DWTF, and Area 612, are the primary waste management facilities.

4.3 NEVADA TEST SITE

NTS is located on approximately 880,000 acres in southern Nye County, Nevada. The site is located 65 miles to the northwest of Las Vegas and 10 miles northeast of the California state line (see Figure 4.3-1). All of the land within NTS is owned by the Federal Government and is administered, managed, and controlled by DOE's NNSA. At NTS, NNSA maintains the capability to: conduct underground nuclear testing; conduct experiments involving nuclear material and high explosives; dispose of a damaged nuclear weapon or improvised nuclear device; conduct non-nuclear experiments; and conduct conventional weapons tests (as part of the hardened deeply buried target program), research and training on nuclear safeguards, criticality safety, and emergency response. NNSA also maintains Category I/II quantities of SNM associated with the nuclear weapons program at NTS and NTS is the only nuclear weapons complex site capable of LLW disposal from other DOE sites.

Source: NTS 2006a.

Figure 4.3-1—Location of NTS

4.3.1 Land Use

4.3.1.1 *Onsite Land Use*

Existing land use at NTS is summarized in Table 4.3.1-1 and shown on Figure 4.3.1-1. Within the land use zones are various sites such as Waste Management, Industrial, Research, and Support.

Table 4.3.1-1—NTS Land Use Zones

Zone	Description of Land Use
Nuclear Test Zone	Underground hydrodynamic tests, dynamic experiments, and underground nuclear weapons and weapons effects tests.
Nuclear and High Explosive Test Zone	Land within the Nuclear Test Zone for additional underground and aboveground high-explosive tests or experiments.
Research, Test, and Experiment Zone	Small-scale research, development projects, pilot projects, and outdoor tests and experiments for the development, quality assurance, or reliability of materials and equipment under controlled conditions.
Radioactive Waste management Zone	Shallow land burial of low-level and mixed wastes.
Defense Industrial Zone	Land designated for stockpile management of weapons including production, assembly, disassembly, modification, staging, repair, retrofit, surveillance and possible weapons storage.
Spill Test Facility Impact Zone	A downwind geographic area that would confine the impacts of the largest planned tests of materials released at the NPTEC Facility.
Solar Enterprise Zone	Land designated for development of a solar energy power-generation facility.
Reserved Zone	Controlled-access land area that provides a buffer between non-defense research, development, and testing activities. Includes areas and facilities that provide widespread flexible support for diverse short-term non-defense research, testing, and experimentation. Also used for short-duration exercises and training, such as Nuclear Emergency Search Team and Federal Radiological Monitoring and Assessment Center training, and DoD land navigation exercises and training.

Source: DOE 1996b.

In most cases, an area is assigned to a land use category based on the environmental characteristics it exhibits. Environmental characteristics, especially geography and geology, generally determine how suitable an area is for a particular use. Approximately 45 percent of NTS is currently unused or provides buffer zones for ongoing programs or projects, while about 7-10 percent (60,000-86,500 acres) of the site has been disturbed.

The NTS is surrounded by other Federal lands (Figure 4.3-1). The Yucca Mountain Project Area is on the southwest corner of the NTS, which is also bordered on the west and north by the NTTR, on the east by an area used by both the NTTR and the Desert National Wildlife Range, and on the south by undeveloped BLM lands. The combination of the NTTR and the NTS represents one of the larger unpopulated land areas in the United States, comprising some 3,500,786 acres. There are no agricultural activities present at NTS, nor are there any prime farmlands. Beyond the Federal lands surrounding NTS, principal land uses in Nye County in the vicinity of the site include mining, grazing, agriculture, and recreation. Of the total land area within the county, only a small number of isolated areas are under private ownership and, therefore, are subject to general planning guidelines.

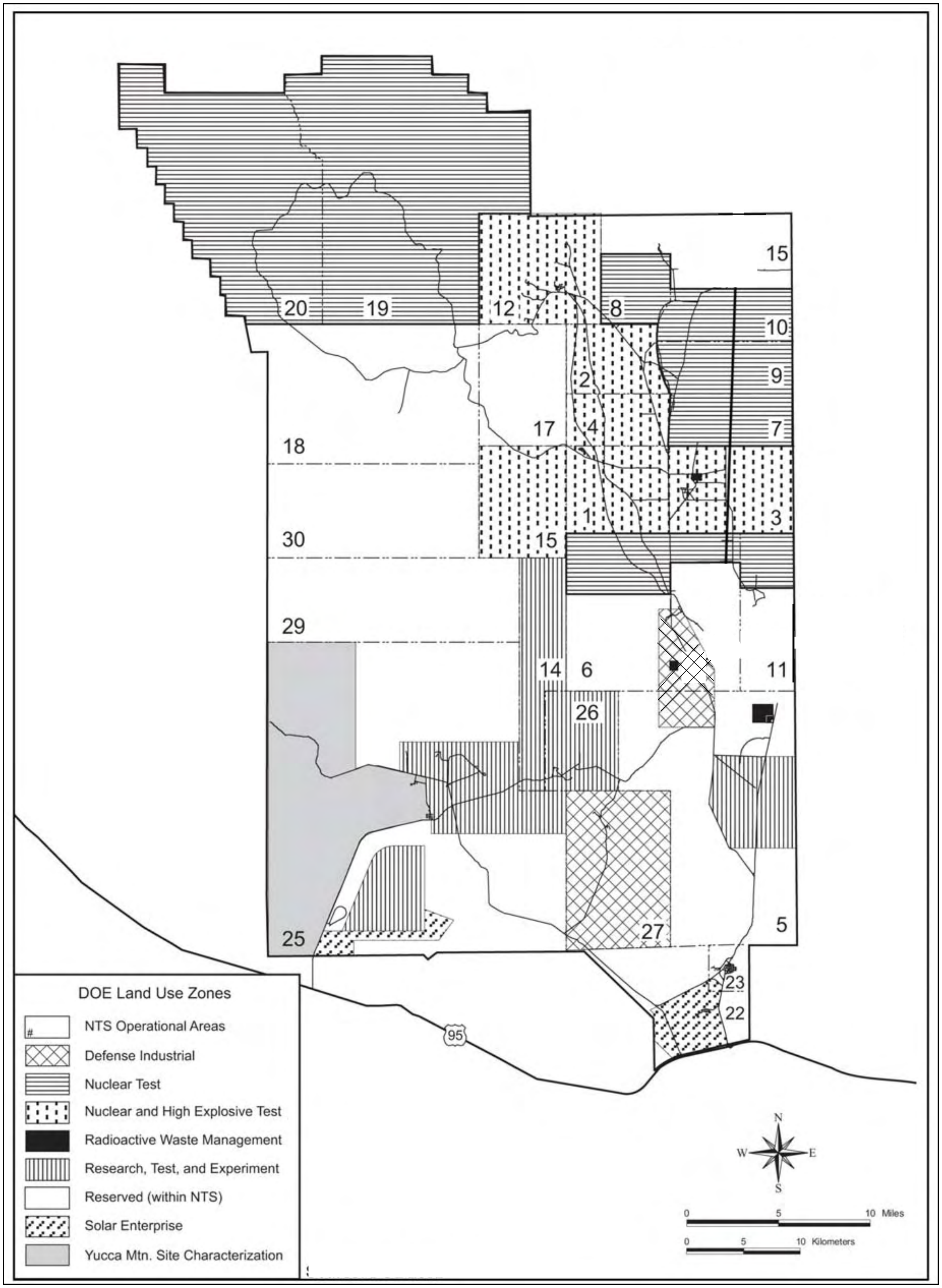
4.3.1.2 *Surrounding Land Uses*

Other Federal lands surround the NTS, including the U.S. Air Force (USAF) NTTR Complex on the north, east, and west and BLM lands on the south and southwest. Approximately 93 percent of the land area in Nye County is federally owned and managed. Federally managed areas include the NTS, the NTTR, the Toiyabe and Humboldt National Forests, the Duckwater Indian Reservation, Railroad Valley and Wayne E. Kirsch Wildlife Management Areas, a portion of Death Valley National Park, and the Ash Meadows National Wildlife Refuge. The communities within southern Nye County are widely scattered and separated by vast tracts of public lands managed by the BLM. The four nearest communities to the NTS are Amargosa Valley, Beatty, Indian Springs, and Pahrump. The nearest town to the NTS is Amargosa Valley, which is about 26 miles to the southwest, and supports a population of about 760.

Private land use in Nye County consists of residential, commercial, and industrial uses, primarily within the boundaries of unincorporated towns, and agricultural and mining uses both within and outside the boundaries of the towns. Much of the land within communities is subject to mixed use; it is common to find residential, commercial, industrial, and even agricultural uses on adjacent or even the same properties. The use of private land in Nye County has few county level regulations, thereby offering few impediments to development for most types of residential and commercial uses. Nye County has established certain ordinances regarding the subdivision of land; and some community design standards and zoning ordinances are in the planning stages.

4.3.2 Visual Resources

NTS is located in a transition area between the Mojave Desert and the Great Basin. Vegetation characteristic of both deserts is found on the site. The topography of the site consists of a series of north-south oriented mountain ranges separated by broad, low-lying valleys and flats. Site topography is impacted by numerous subsidence craters resulting from past nuclear testing. The southwestern Nevada volcanic field, which includes portions of NTS, is a nested, multi-caldera volcanic field. The facilities of NTS are widely distributed across this desert setting.



Source: DOE 1996b.

Figure 4.3.1-1 — Land Use at NTS

The region surrounding NTS ranges from unpopulated to sparsely populated desert and rural land. Access to areas that would have views of the site is controlled by NTS or the U.S. Air Force. Therefore, few viewpoints are accessible to the general public. Public viewpoints of NTS along U.S. 95, the principal highway between Tonopah and Las Vegas, include Mercury Valley and southwestern portions of the site. The primary viewpoint in Mercury Valley is a roadside turnoff containing Nevada Historical Marker No. 165 of the Nevada State Park System, entitled "Nevada Test Site." NTS facilities within 5 miles are visible from this viewpoint. The main base camp at Mercury, located in Area 23, is well defined at night by facility lighting. Lands within NTS have a BLM Visual Resource Management rating of Class II or III (see Table 4.3.2–1 for definitions of each class). Changes to the landscape within these classes may be seen, but should not dominate the view. Developed areas within the site are consistent with a Visual Resource Management Class IV rating in which management activities dominate the view and are the focus of viewer attention.

Table 4.3.2-1—BLM Visual Resource Management Rating System

Class	Objective
Class I	To preserve the existing character of the landscape, the level of change to the characteristic landscape should be very low and must not attract attention.
Class II	To retain the existing character of the landscape, the level of change to the characteristic landscape should be low.
Class III	To partially retain the existing character of the landscape, the level of change to the characteristic landscape should be moderate.
Class IV	To provide for management activities which require major modification of the existing character of the landscape, the level of change to the characteristic landscape can be high.

Source: BLM 1980.

4.3.3 Site Infrastructure

An extensive network of existing infrastructure provides services to NTS activities and facilities as shown in Table 4.3.3-1. Transportation access includes roads, and railroads (currently unutilized) while utilities include electricity and fuel (e.g., natural gas, gasoline, and coal).

Electricity

In the last several years, NTS has been provided power under contracts with Nevada Power Company and Western Area Power Administration. Table 4.3.3–1 shows that electrical capacity at NTS is approximately 177,000 million megawatt hours per year (MWh per year) and peak load capacity, approximately 45 megawatts (MWe). NTS electrical usage is approximately 101,000 MWh per year and peak load usage was 27 MWe (NNSA 2008b).

Fuel

Unleaded gasoline, diesel fuels, and E-85 fuels are used at NTS. NTS has 2 service stations each capable of storing 10,000 gallons of unleaded gasoline and 9,500 gallons of biodiesel, and each has an E-85 fueling station. The bulk storage tanks in Area 6 can store approximately 100,000 gallons of biodiesel and 40,000 gallons of unleaded gasoline.

Table 4.3.3-1—Baseline Characteristics for NTS

Resource	Current Usage	Site Capacity
Land		
Area (acres)	86,500	880,000
Roads (miles)	700	NA
Railroads (miles)	12	NA
Electrical		
Energy (MWh/yr)	101,377	176,844
Peak Power (MWe)	27	45
Steam		
Natural gas (yd^3/yr)	0	NA
Fuel		
Natural gas (yd^3/yr)	0	NA
Liquid fuels (L/yr)	4,201,805	Not limited
Coal (t/yr)	0	NA
Water		
Annual Maximum Production Capacity (billion gal/yr)	<2.1	2.1
Sustainable site capacity (billion gal/yr)	<1.36	1.36

Source: NNSA 2007, NNSA 2008b.
NA = not applicable.

Water

Groundwater is the only local source of potable water on NTS. The NTS water system consists of 8 water systems, 2 wildlife preservation reservoirs, and 2 isolated environmental sampling wells. Three of the water systems are permitted by the State of Nevada as public water systems. Five of the systems are non-permit required systems. The water system includes 12 wells, 36 water storage tanks, and 12 booster pump stations. NTS receives its water from a water system divided into 3 service areas with 6 wells for potable water, 3 wells for non-potable (construction) water, approximately 30 usable storage tanks, 13 usable construction water sumps, and 6 water transmission systems. Potable water is transported to support facilities not connected to the potable water supply system. The annual maximum production capacity of site potable supply wells is approximately 2.1 billion gallons per year. Sustainable site capacity is estimated to be approximately 1.36 billion gallons per year (DOE 2002l). Since 1995, annual water use at NTS has been less than 400 million gallons, and usually less than 300 million gallons (NNSA 2008b).

4.3.4 Air Quality and Noise

4.3.4.1 *Air Quality*

4.3.4.1.1 Meteorology and Climatology

The NTS is located in the extreme southwestern corner of the Great Basin. The climate is characterized by limited precipitation, low humidity, large daily temperature ranges, and intense solar radiation during the summer months (NTS 2006a). Areas in the lower elevations are characterized by hot summers and mild winters, which are typical of other Great Basin areas. As elevation increases, precipitation increases and temperatures decrease.

On average, annually, only 4.8 inches of precipitation are measured at the lower elevation while an annual average of 12.82 inches occurs on Rainier Mesa with a higher elevation (NTS 2006a). Annual climatological wind rose patterns within the site region are shown in Figure 4.3.4-1.

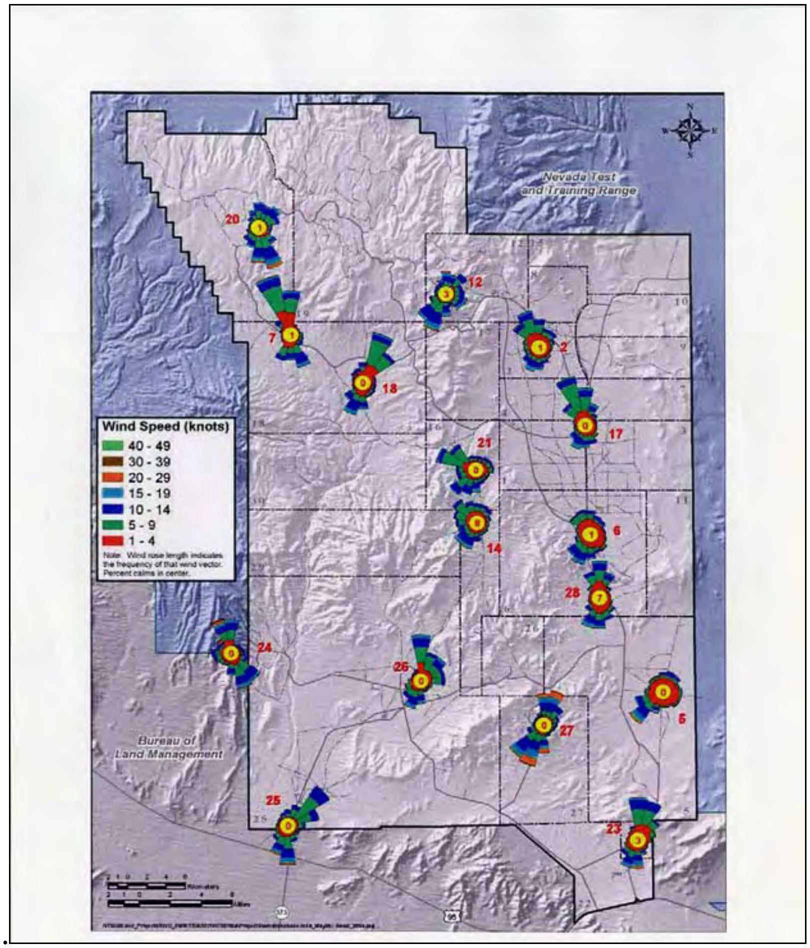
Additional severe weather in the region includes occasional thunderstorms, lightning, tornadoes, and sandstorms. Severe thunderstorms may produce high precipitation that continues for approximately 1 hour and may create a potential for flash flooding. Few tornadoes have been observed in the region, and they are not considered a significant event. The estimated probability of a tornado striking a point at NTS is extremely low (3 in 10 million years).

4.3.4.1.2 Ambient Air Quality

NTS is located in the Nevada Intrastate Air Quality Control Region (AQCR) 147. The region is classified as an attainment area for all six criteria pollutants (i.e., carbon monoxide, nitrogen dioxide, lead, ozone, sulfur dioxide, and particulate matter) under the NAAQS. The nearest non-attainment area is the Las Vegas area, located 65 miles southeast of NTS. Las Vegas Valley Hydrographic Area 212, located in Clark County, is in serious non-attainment for carbon monoxide and fugitive dust (PM_{10}) (EPA 2007). The remaining portion of Clark County is designated as unclassifiable/attainment for these pollutants.

Ambient air quality monitoring is currently conducted at the NTS for particulate matter, a nonradiological criteria pollutant, during Big Explosives Experimental Facility and Non-proliferation Test and Evaluation Center experiments. Elevated levels of criteria pollutants at the NTS may occasionally occur because of construction, aggregate production, surface disturbances, and fugitive dust from vehicles traveling on unpaved roads; various pollutants from fuel-burning equipment, and open burning; and volatile organics from fuel storage facilities.

The NTS has been issued a Class II air quality operating 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 Hazardous Air Pollutant (HAP), or 25 tons of any combination of HAPs). An estimated 4.57 tons of criteria air pollutants were released on the NTS in 2006 (NTS 2007). They included particulate matter equal to or less than 10 microns in diameter, carbon monoxide, nitrogen oxides, sulfur dioxide, and VOCs. The majority of these emissions (2.01 tons) were nitrogen oxides. The quantity of HAPS released in 2006 was 1.87 tons (NTS 2007). No emission limits for any criteria air pollutants or HAPS were exceeded (NTS 2007).



Source: NTS 2006a.

Figure 4.3.4-1—Annual Climatological Wind Rose Patterns at 11 NTS MEDA Stations from Wind Data Gathered, 1984 to 2004

As shown on Table 4.3.4-1, measured concentrations of criteria pollutants at NTS sources are below regulatory requirements.

Table 4.3.4-1—NTS Nonradiological Annual Air Emissions

Pollutant	Total Emissions (tons/yr)					
	2001	2002	2003	2004	2005	2006
PM10	2.05	3.61	2.39	0.94	0.84	0.69
CO	4.84	4.6	1.79	0.24	0.15	0.43
NO_x	22.23	21.09	8.11	1.01	0.69	2.02
SO_2	1.68	1.62	0.76	0.12	0.04	0.03
VOC	2.01	2.1	1.21	4.6	1.94	1.40
HAPs	0.03	0.01	0	0.41	0.05	1.87[a]

Source: NTS 2007.
[a] 92 percent of HAPs were emitted during chemical spill tests at NPTEC. <0.006 percent were from lead from all permitted operations.

Radiological Releases

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. 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 and transpiration of tritiated water from soil and vegetation, respectively, at sites of past nuclear tests and from the Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs); and
- The re-suspension of surface soil contaminated by past nuclear testing at NTS (NTS 2007).

For data reported for 2006, the concentration of man-made radionuclides in air on NTS were all less than the regulatory concentration limits specified by Federal regulations (NTS 2007). Table 4.3.4-2 presents the radionuclide emission rates (in curies per year) at the identified source locations. In the last row of the table, the total amounts of Americium-241, Plutonium-239, and Plutonium-240 emissions from soil re-suspension are presented. They are the sum of emission rates computed for each area of the NTS with surface contamination. Other radionuclides, 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 (NTS 2006a).

Table 4.3.4-2 — Radiological atmospheric releases from NTS for 2006

Source	Radionuclide	Emission Rate (Ci/yr)
Area 23 Building 650	^{3}H	0.0000225[a]
Area 12 E Tunnel Ponds	^{3}H	9.8[b]
Area 5 Sewage Lagoon	^{3}H	0.0003[b]
Area 3 RWMS	^{3}H	54[c]
Area 5 RWMS	^{3}H	19[c]
Area 14	U	0.0001[c]
Area 20 Schooner	^{3}H	77[c]
Area 10 Sedan	^{3}H	85 [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]

Source: NTS 2007.
[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, a re-suspension model, and equation parameters derived at the NTS.

4.3.4.2 *Noise*

The major noise sources at NTS include equipment and machines (e.g., cooling towers, transformers, engines, pumps, boilers, steam vents, paging systems, construction and material-handling equipment, and vehicles), blasting and explosives testing, and aircraft operations. During periods of human activity, such as construction, localized sound levels on the NTS could vary from loud (70 A-weighted decibels [dbA]) to painful (140 dbA) to deafening (160 dbA) depending on the distance between the noise source and receptor (NTS 2006a).

The acoustic environment in areas adjacent to NTS can be classified as either uninhabited desert or small rural communities. In the uninhabited desert, the major sources of noise are natural physical phenomena such as wind, rain, and wildlife activities, and an occasional airplane. The wind is the predominant noise source. Desert noise levels as a function of wind have been measured at an upper limit of 22 dBA for a still desert and 38 dBA for a windy desert.

A background sound level of 30 dBA is a reasonable estimate. This is consistent with other estimates of sound levels for rural areas. The rural communities' day-night average sound level has been estimated in the range of 35-50 dB (EPA 1974). A background sound level of 50 dB is a reasonable estimate for Mercury.

Except for the prohibition of nuisance noise, neither the State of Nevada nor local governments have established specific numerical environmental noise standards.

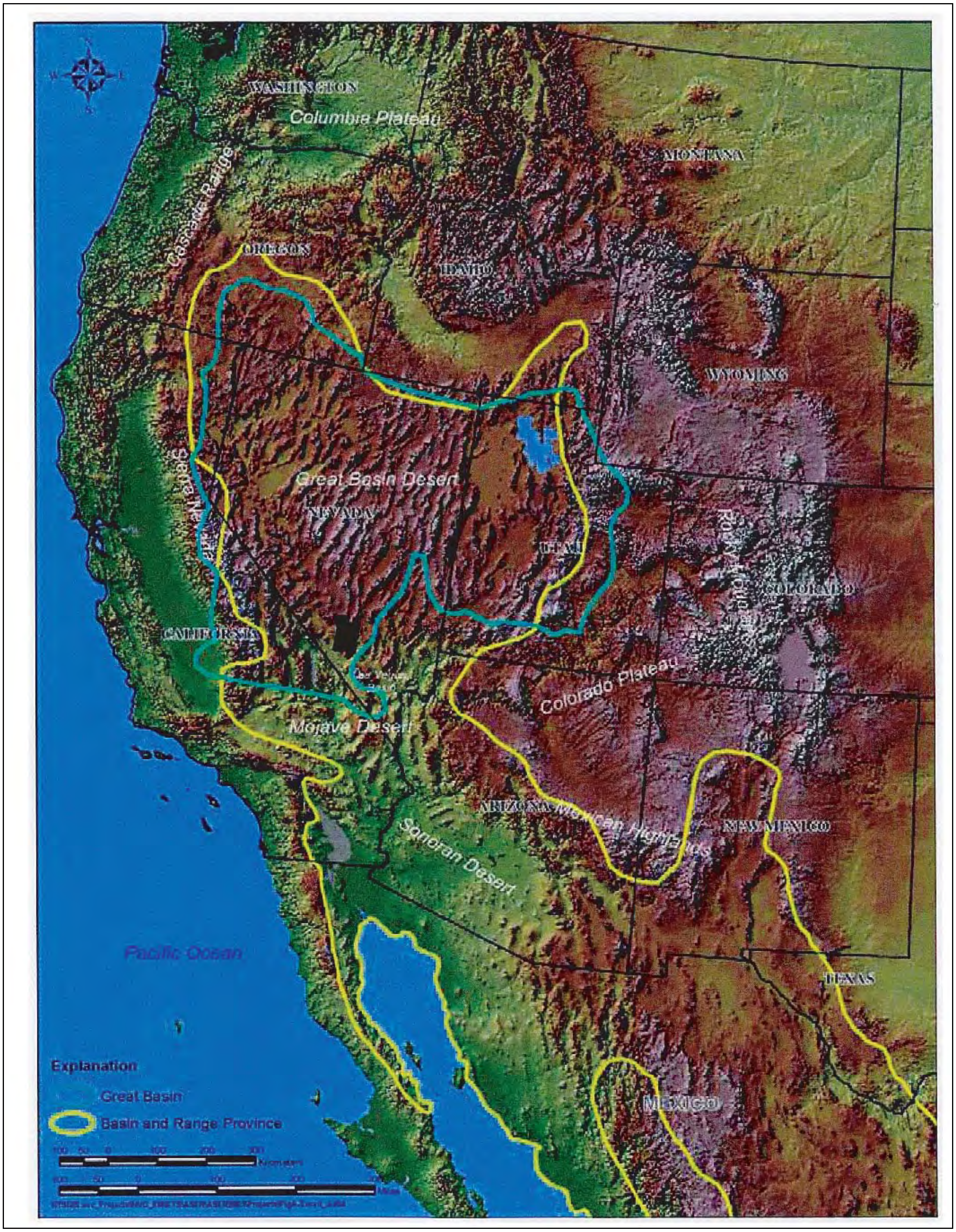
4.3.5 Water Resources

4.3.5.1 *Surface Water*

NTS is located within the Great Basin, a closed hydrographic basin from which no surface water leaves except by evaporation (Figures 4.3.5-1 and 4.3.5-2). There are no perennial streams or other naturally occurring surface waterbodies at NTS. Those streams (arroyos) existing in the region are ephemeral and are shown in Figure 4.3.5-3. Runoff results from snowmelt and from precipitation during storms that occur most commonly during winter and occasionally during fall and spring, as well as during localized thunderstorms that occur primarily in the summer. Much of the runoff quickly infiltrates rock fractures or the surface soils before being lost by evapotranspiration. Some runoff is carried down alluvial fans in arroyos, and some drains onto playas (dry, barren areas in the lowest part of an undrained desert basin that may be marked by an ephemeral lake) where it may stand for weeks as a lake. Runoff in the eastern half of the site ultimately collects in the playas Yucca and Frenchman Lakes of Yucca Flat and Frenchman Flat, respectively.

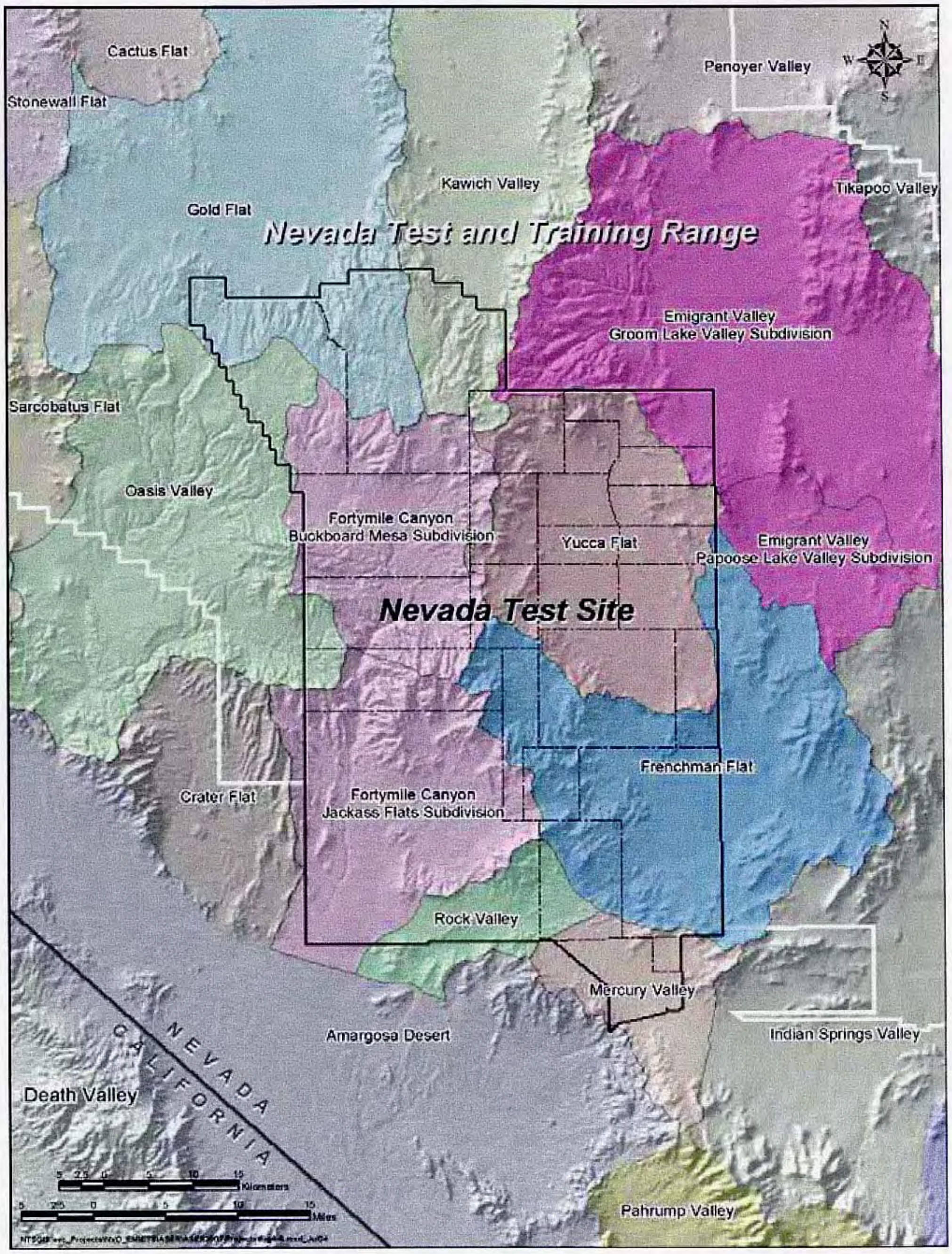
In the northeastern portion, runoff drains off the site and onto the NTTR Complex. In the western half and southernmost part of NTS, runoff is carried toward the Amargosa Desert (DOE 2002l). There are a number of springs on NTS, but seepage from springs travels only a short distance from the source before evaporating or infiltrating into the ground. In addition, there are a number of engineered ponds and open reservoirs for industrial water on the site.

Intermittent streams for sheet flow and channelized flow through arroyos cause localized flooding throughout NTS. However, because of the size of NTS, no comprehensive floodplain analysis has been conducted to delineate the 100- and 500-year floodplains. Nevertheless, a rise in the surface elevation of any standing water on a playa creates a potential flood hazard. Playas in the Yucca Flat weapons test basin and Frenchman Flat in the northeastern and eastern part of NTS, respectively, collect and dissipate runoff from their respective hydrographic basins. Several arroyos in the Yucca Flat weapons test basin pose a potential flood hazard to existing facilities, as do arroyos on Frenchman Flat. Ground-surface disturbance and craters associated with underground nuclear tests have rerouted parts of natural drainage paths in areas of nuclear testing. Some craters have captured nearby drainage, and headward erosion of drainage channels is occurring, however, this is considered to be negligible. In some areas of NTS, the natural drainage system has been all but obliterated by the craters. The western half and southmost parts of NTS have arroyos that carry runoff beyond NTS boundaries during intense storms. Fortymile Wash, the largest of these arroyos and prone to flooding, originates on Pahute Mesa and intersects the Amargosa River in the Amargosa Desert about 20 miles southwest of NTS. The Amargosa River continues to Death Valley, California. Topopah Wash, which runs southwesterly across Jackass Flats from Jackass Divide in the south-central part of NTS, is a major tributary of the Amargosa River (DOE 2002l).



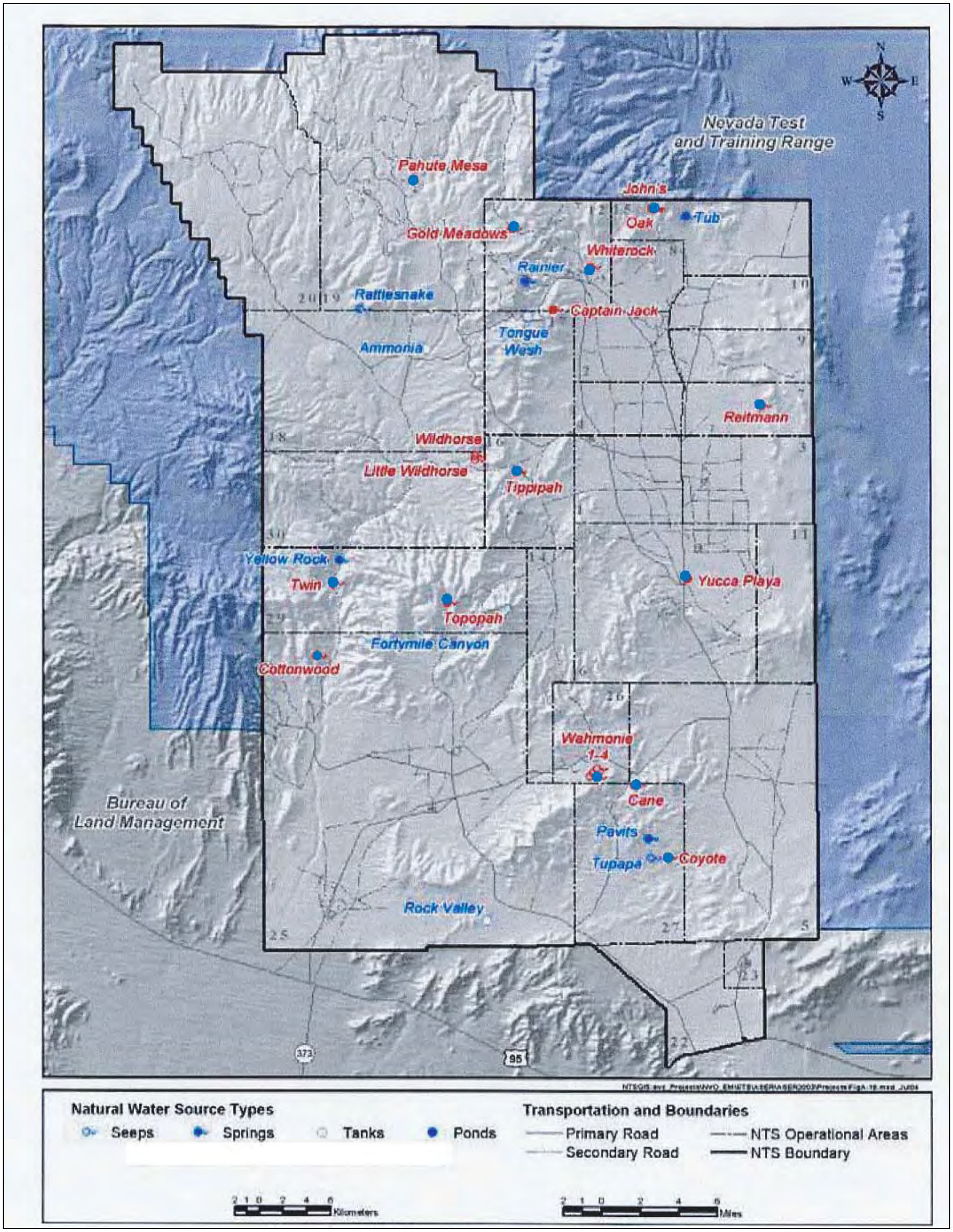
Source: NTS 2006a.

Figure 4.3.5-1—Basin and Range Physiographic Province and Great Basin Hydrologic Province



Source: NTS 2006a.

Figure 4.3.5-2—Closed Hydrographic Subbasins on the NTS



Source: NTS 2006a.

Figure 4.3.5-3—Natural Water Sources on the NTS

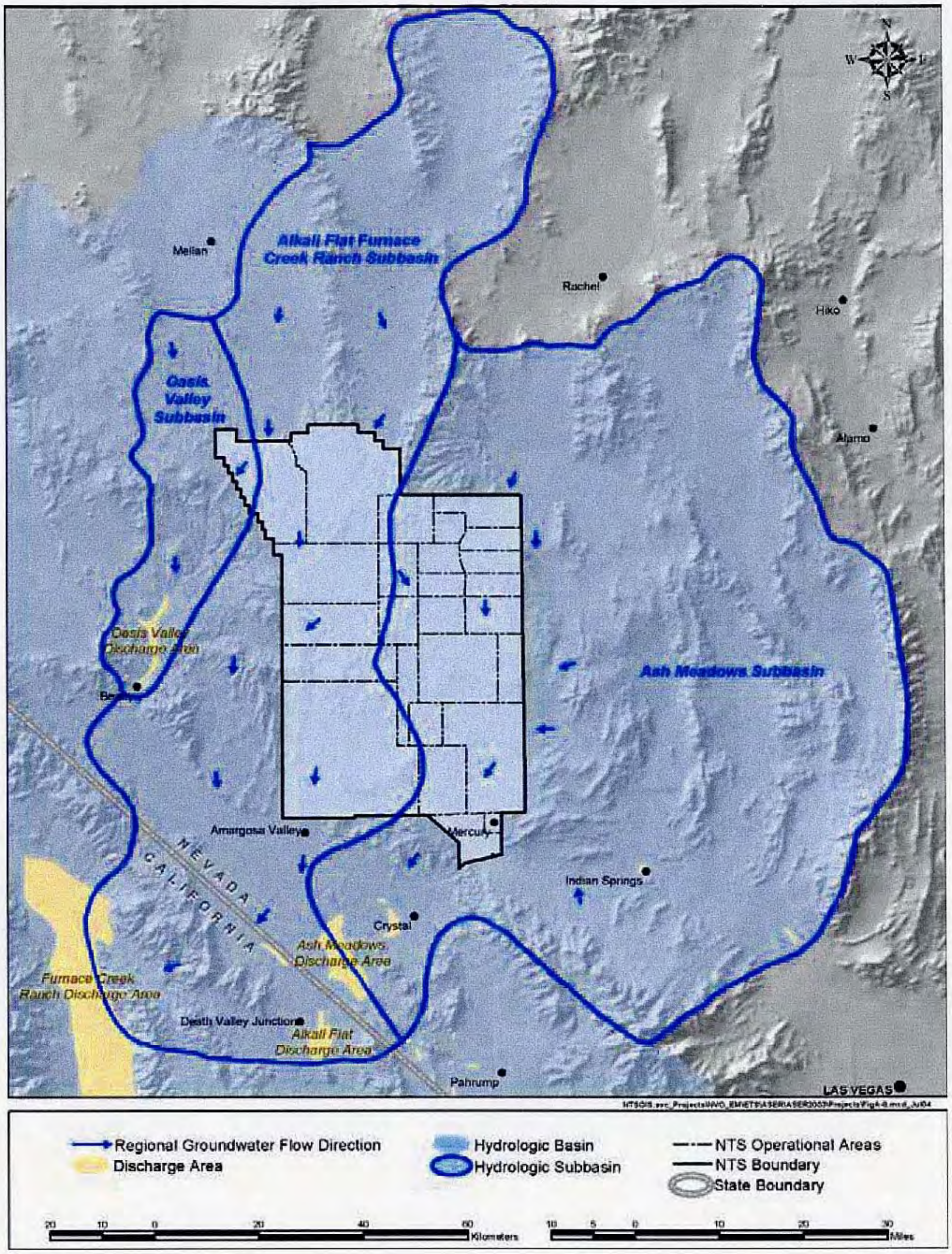
4.3.5.2 *Groundwater*

Groundwater beneath NTS exists within three groundwater subbasins of the Death Valley Basin flow system as shown in Figure 4.3.5-4. This flow system encompasses about 16,000 square miles of the Great Basin. In particular, the eastern half of NTS is located within the Ash Meadows Subbasin, and the western half of the site lies largely within the Alkali Flat Furnace Creek Ranch Subbasin. In addition, a small section of the northwest corner of the site is located within the Pahute Mesa Oasis Valley Subbasin (DOE 2002l). Hydrographic areas are mapped on the basis of topographic divides and are the geographic unit used by the State of Nevada for the purposes of water appropriation and management. NTS lies within at least part of 10 of these areas (i.e., Gold Flat, Buckboard Mesa, Kawich Valley, Emigrant Valley, Oasis Valley, Yucca Flat, Jackass Flats, Frenchman Flat, Rock Valley, and Mercury Valley) (DOE 2002l).

Three principal groundwater subbasins have been identified within the NTS region: the Ash Meadows, Oasis Valley, and Alkali Flat-Furnace Creek Ranch subbasins. The depth to groundwater at NTS varies from about 260 feet below land surface in the extreme northwest part of the site, and 525 to greater than 1,500 feet (DOE 2002l) below land surface in portions of Frenchman Flat and Yucca Flat weapons test basin, to more than 2,000 feet under the upland portions of Pahute Mesa. Perched groundwater is known to occur in some parts of NTS, mainly in the volcanic rocks of the Pahute Mesa area. Groundwater flows generally south and southwest. The flow system extends from the water table to a depth that may exceed 4,900 feet.

4.3.5.3 *Groundwater and Surface Water Quality*

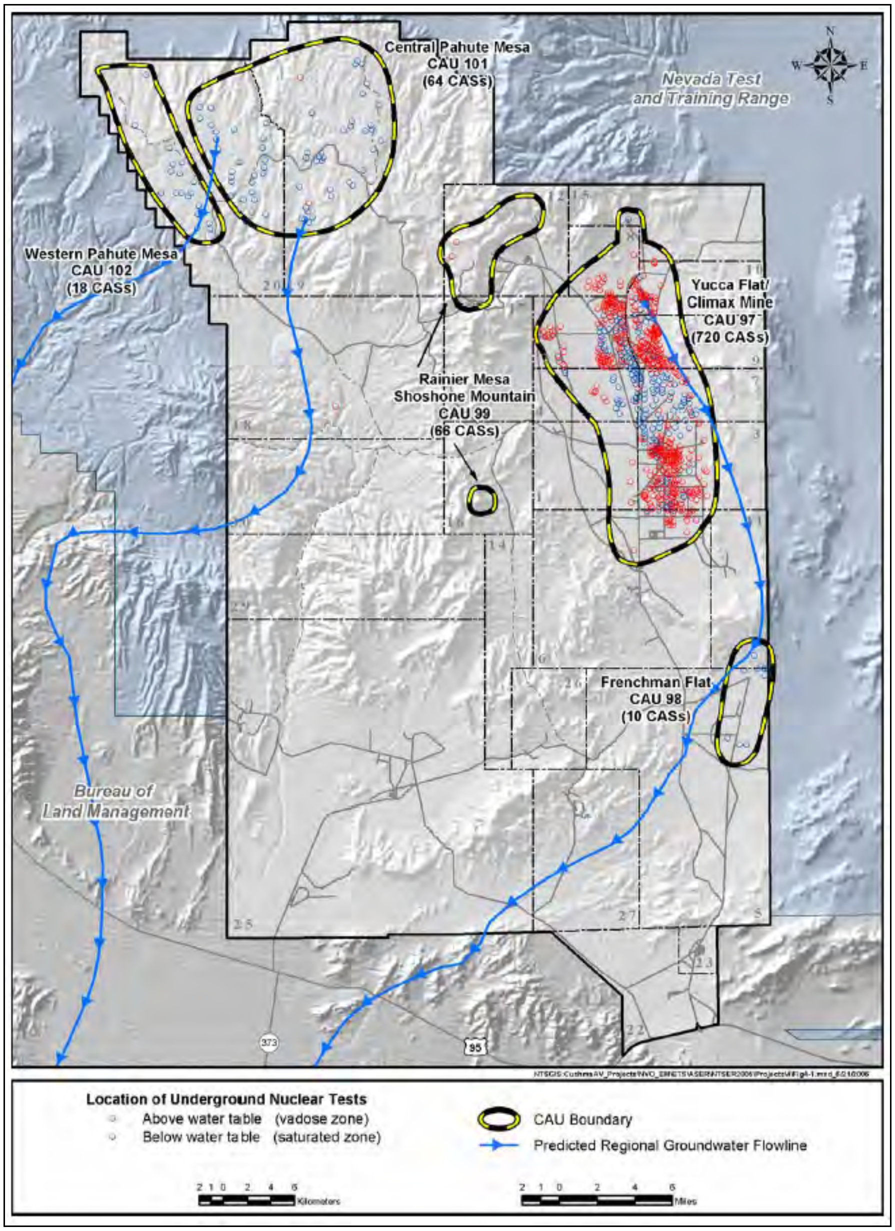
There have been 828 underground nuclear tests conducted at the NTS. Approximately one third of these tests were detonated near or below the water table. This legacy of nuclear testing has resulted in the contamination of groundwater in some areas. Detonations conducted near the water table have contaminated groundwater near underground nuclear test cavities with 43 residual radionuclides, with tritium being the most prevalent radionuclide. Radionuclides considered are residual and unburned fissile fuel and tracer material, such as uranium isotopes, plutonium isotopes, americium isotopes and curium-244; fission products such as cesium-137 and strontium-90; tritium, and activities induced by neutrons in device parts, in external hardware, and in the surrounding geologic medium (such as carbon-14, chlorine-16, and calcium-41).



Source: NTS 2006a.

Figure 4.3.5-4—Groundwater Subbasins of the NTS and Vicinity

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. Figure 4.3.5-5 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 (USGS), the EPA, and others. In 1998, NNSA/NSO established an NTS integrated and comprehensive radiological environmental monitoring program. 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.



Source: NTS 2006a.

Figure 4.3.5-5—Areas of potential groundwater contamination on the NTS

In 2005, a network of 55 groundwater locations was sampled and included: 27 offsite wells; 10 onsite water supply wells (9 of which are permitted); and 18 onsite monitoring wells (3 are compliance wells for the Area 5 RWMS and 1 was a compliance well for the Area 23 sewage lagoon). The 27 offsite locations sampled in 2005 included 9 private domestic wells, 6 community wells, and 12 NNSA wells related to NTS activities. The 2005 data indicate that groundwater at the offsite locations has not been significantly impacted by NTS nuclear testing operations. All but two of the tritium levels in samples from offsite wells were less than the minimum detectable concentration (MDC) (NTS 2006a).

Results from the nine NTS water supply wells and one water monitoring well 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. Analytical results from the network of onsite monitoring wells indicate that migration of radionuclides from the underground test areas is not significant. Four onsite monitoring wells are known to have detectable concentrations of tritium, although they are all well below the EPA MCL of 20,000 picocuries per liter (NTS 2006a).

The surface water monitoring locations sampled in 2005 included 3 offsite springs; 3 onsite springs; 1 NTS operations-related containment pond system (E Tunnel ponds); and 2 onsite sewage lagoons. 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. No detectable concentrations of tritium were found in any of the samples. 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. 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. 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. Tritium has been detected previously in a vegetation sample from White Rock Spring. 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 (NTS 2006a).

The sewage 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 and no man-made gamma-emitting radionuclides were detected (NTS 2006a).

There are no NPDES permits for the site because there are no wastewater discharges to onsite or offsite surface waters. However, the State of Nevada has issued one general discharge permit that covers all of the sewage lagoons and has issued permits for the septic systems for NTS facilities.

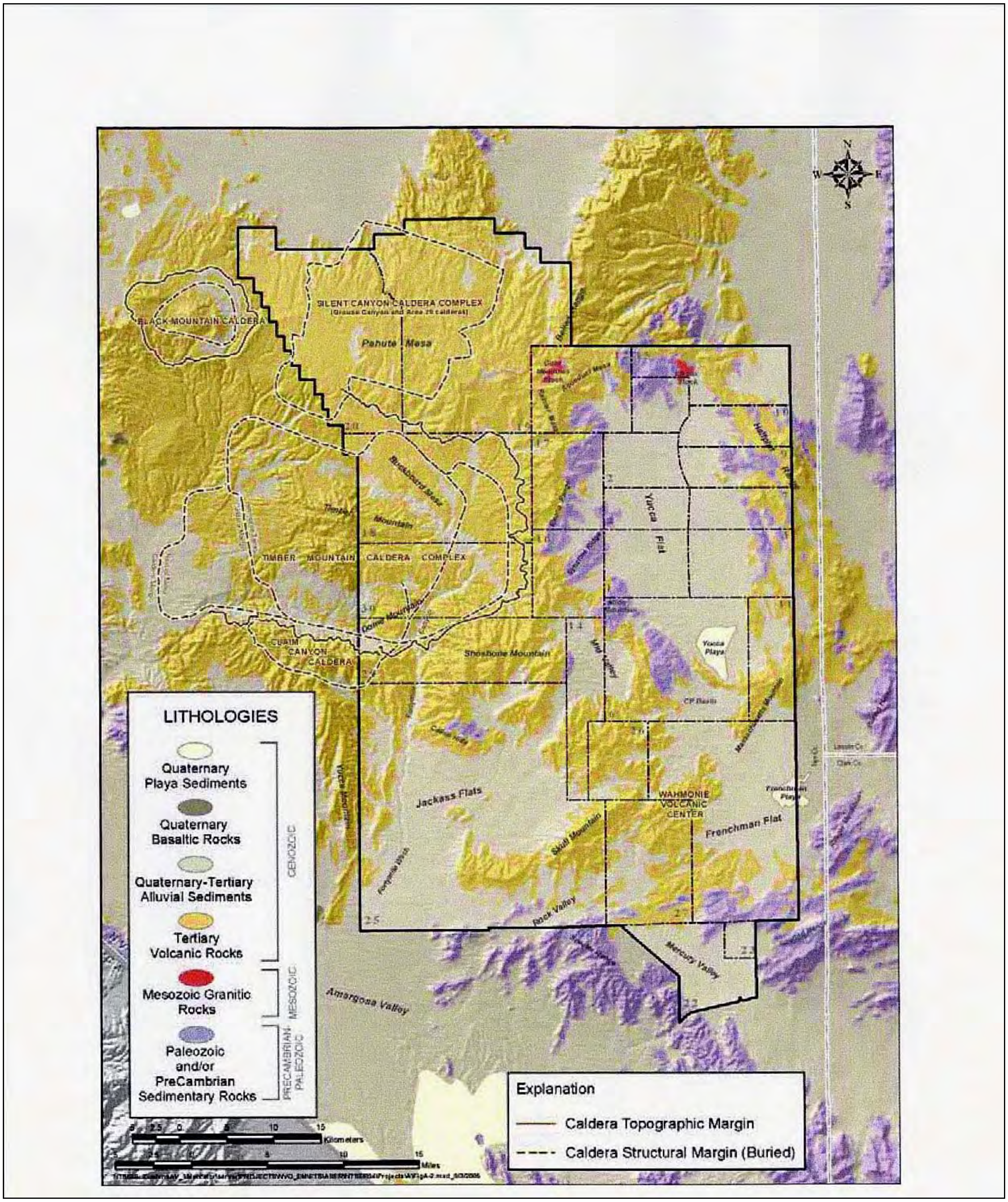
4.3.6 Geology and Soils

NTS lies within the southern part of the Great Basin, the northern-most subprovince of the Basin and Range Physiographic Province. The topography of the site consists of a series of north-south oriented mountain ranges separated by broad, low-lying valleys and flats.

4.3.6.1 *Geology*

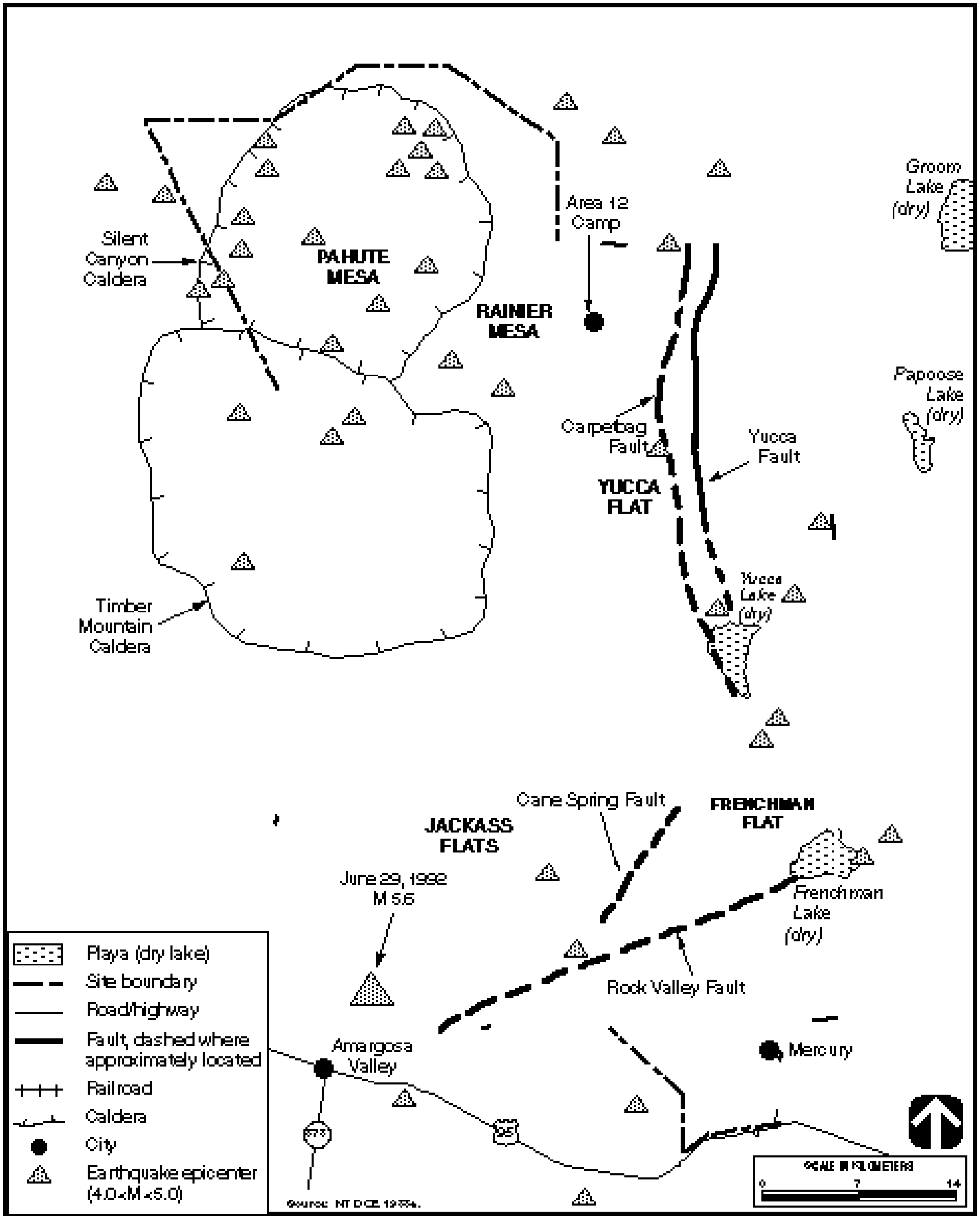
NTS is located about 65 miles northwest of Las Vegas, Nevada, and lies within the southern part of the Great Basin, (Figure 4.3.5-1). The site features desert and mountainous terrain. NTS is generally characterized by more or less regularly spaced, generally north-south trending mountain ranges separated by alluvial basins that were formed by faulting. The relief of NTS ranges from less than 3,280 feet above sea level in Frenchman Flat and Jackass Flats to about 7,675 feet on Rainier Mesa and about 7,216 feet on Pahute Mesa. There are three primary valleys on NTS: Yucca Flat, Frenchman Flat, and Jackass Flats. Figure 4.3.6-1 depicts the topography of the NTS.

The geology of NTS consists of a thick section (more than 34,768 feet) of Paleozoic and older sedimentary rocks, locally intrusive Cretaceous granitic rocks, a variable assemblage of Miocene volcanic rocks, and locally thick deposits of postvolcanic sands and gravels that fill the present day valleys as shown in Figure 4.3.6-1 (DOE 1996b).



Source: NTS 2006a.

Figure 4.3.6-1—Topography at NTS and Vicinity



Source: DOE 1996b.

Figure 4.3.6-2—Major Fault Systems and Historic Earthquakes in NTS Region

4.3.6.2 *Soils*

In general, the soils of NTS are similar to those of surrounding areas and include aridisols and entisols. The degree of soils development reflects their age, and the soils types and textures reflect their origin. Entisols generally form on steep mountain slopes where erosion is active. The aridisols are older and form on more stable fans and terraces.

The soils of the southern NTS reflect the mixed alluvial sediments upon which they form (DOE 1996b). These soils are generally young in profile development and show only weak evidence of leaching. In general, soils texture is gradational from coarse-grained soils near the mountain fronts to fine-grained soils in the playa areas of the Yucca Flat and Frenchman Flat. Most soils are underlain by a hardpan of caliche. Soil salinity generally increases dramatically in the direction of the playa areas, with the highest level of soluble salts having accumulated in the deeper soil profile horizons in Frenchman Flat. The soils at NTS are considered acceptable for standard construction techniques.

4.3.6.2.1 Soil Radiologic Contamination

As discussed in the Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada (ERDA 1977), underground nuclear testing resulted in unavoidable adverse impacts to land resources that render the resources unusable for most purposes. Underground nuclear tests were begun in November 1951, and through 1992 there were 828 underground tests conducted at the NTS with yields ranging from zero to 1,300 kilotons. Underground testing, for the purposes of discussion, can be divided into three broad categories; shallow borehole tests, deep vertical tests, and tunnel tests.

Shallow borehole tests were conducted between 1960 and 1968. The shallow tests resulted in the development of some large ejection craters, most notably the Sedan Crater in the northern end of the Yucca Flat testing area. Sedan, a 104-kiloton nuclear device detonated 194 meters (635 feet) underground, displaced about 1.2×10^7 tons of earth and created a crater 390 meters (1,280 feet) in diameter and 98 meters (320 feet) deep. McArthur (1991) estimates that the remaining inventory of surficial radioactivity at the Sedan Crater is 344 curies. The total estimate for all releases from shallow borehole tests to the surficial soil horizon at the NTS is 2,000 curies.

Deep vertical underground nuclear tests have been completed in Frenchman Flat, Yucca Flat, Pahute Mesa, Rainier Mesa, Shoshone Mountain, Buckboard Mesa, and Dome Mountain. The tunnel complex at Rainier Mesa has been extensively used for special experiments and tests that require access to materials and monitoring equipment left near the point of detonation. The historic tests have left their mark on the NTS both in terms of physical disruption and a large subsurface inventory of remaining radioactive isotopes.

Historic deep vertical underground testing has resulted in the formation of hundreds of craters at the NTS, leaving Yucca Flat with a "pockmarked" appearance that is even visible on satellite images of the area. The craters generally range in diameter from 61 to 610 meters (200 to 2,000 feet) and range in depth from a few meters to 60 meters (a few feet to 200 feet) depending on the depth of emplacement and the explosive energy yield. The development of craters has been the principal consequence of nuclear testing on the terrain of the NTS (DOE 1996b).

In addition to the cavity, chimney, and subsidence crater, pressure ridges and small displacement faults may occur at the surface. The surface fracturing and faulting are the result of the sudden uplift of the earth at the time of detonation and the collapse during the formation of the chimney and crater. Another permanent consequence of testing has been vertical displacement along existing faults, particularly along Yucca Fault and Carpetbagger Fault in Yucca Flat. Vertical displacement of as much as 2 meters (8 feet) has occurred along portions of the Carpetbagger Fault. Cratering has occurred on Pahute Mesa but, because of the greater competency of the rocks in that area and the depths of most tests, cratering in this test area has been infrequent. Fracturing has occurred on the top of Rainier Mesa as a result of the loss of strength in the rocks in that area.

Another consequence of past underground testing has been the formation of pockets of radioactive contamination surrounding each underground test. The total amount of radioactivity released into the underground environment during a test is called the radionuclide source term. The source term includes numerous isotopes that are both short- and long-lived. For the example used for atmospheric testing of a 1-kiloton nuclear weapon, an initial release of 41 billion curies decays to about 10 million curies in just 12 hours. According to information presented in NTS SWEIS (DOE 1996b), the quantity of radioactivity remaining from a 1-kiloton underground detonation 180 days after detonation is about 45,000 curies (including 18,570 curies of tritium).

It should be noted that there is considerable uncertainty concerning these estimates. It is indicated that the actual tritium activity after 180 days (expressed in this EIS on a per-kiloton-basis) could range from 5,570 to 55,770 curies (DOE 1996b). The radionuclide inventories that have been referred to are an order of magnitude estimate to illustrate the dominance of short-lived radionuclides soon after a nuclear detonation and the effect of radioactive decay in reducing that inventory if no level of remedial work is conducted.

4.3.6.2.2 Atmospheric Testing

Above ground nuclear weapons tests were initiated on January 27, 1951, with the detonation of a 1-kiloton air-dropped weapon over Frenchman Flat, and a total of 100 atmospheric tests were conducted prior to the signing of the Limited Test Ban Treaty in August 1963. Atmospheric testing included weapons that were dropped by planes, those detonated from towers constructed to heights of 30 to 213 meters (100 to 700 feet), tests conducted on land surface, and tests where the weapon was lofted using helium-filled balloons 137 to 457 meters (450 to 1,500 feet) above the ground.

Typical isotopes formed during the historic atmospheric testing included strontium, cesium, barium, tritium, and iodine. Of these, strontium-90 and cesium-137 are of the most concern because of their longer half-lives of 28 and 30 years, respectively.

The vast majority of radioactivity released during atmospheric testing decayed very quickly after each test was conducted. For example, for a 1-kiloton atmospheric test, the initial release after 1 minute is about 4.1 x 10^{10} curies. This activity is reduced to 1.0 x 10^{7} curies just 12 hours after the detonation. If the activity remaining after 12 hours is used as the basis for estimates, then about 6.0 x 10^{10} curies were released during atmospheric testing between 1951 and 1963 at the NTS (DOE 1996).

Many of the fission products released during the detonations were dispersed into the atmosphere, and much of the residual radioactivity decayed in the more than 40 years since the last atmospheric test. Nonetheless, some of the longer-lived radionuclides remain in the soil and physical structures. The primary radioactive isotopes that remain on the NTS from historic atmospheric testing include americium, plutonium, cobalt, cesium, strontium, and europium. According to the Desert Research Institute (DOE 1996), the remaining radioactivity in NTS soils within 6,000 to 10,000 feet of the Able test (a 1-kiloton airdrop) totaled almost 15 curies. Based on the most recent estimates for Frenchman Lake (McArthur 1991), about 20 curies of radioactivity remain in this area. Most, if not all, of this remaining activity can be attributed to historic atmospheric testing. Residual contamination from atmospheric testing may also be present in Yucca Flat in Areas 1, 2, 3, 4, 7, 8, 9, and 10 of the NTS and in Buckboard Mesa in Area 18. However, because of the number of underground tests that were conducted in these areas, it is not possible to discriminate what residuals are remaining from atmospheric tests.

4.3.6.2.3 Safety Tests

Portions of the NTS were used between 1954 and 1963 for chemical explosion tests of plutonium-bearing materials. The safety experiments were conducted to evaluate the safety of nuclear weapons in accident scenarios. Concurrent with and after these detonations, extensive studies were conducted to understand the dispersal and transport of these isotopes in the environment, including uptake by plants and animals. These studies were documented in a benchmark series of papers by the Nevada Applied Ecology Group, a panel of scientists chartered by the DOE to investigate the effects of testing at the NTS (DOE 1996b, ERDA 1977).

The immediate effects of the tests included the dispersal of plutonium and uranium over significant areas. To determine the area impacted by these tests, inventories were conducted by the Nevada Applied Ecology Group. These inventories were later augmented by extensive field-sampling efforts conducted under the Radionuclide Inventory and Distribution Program. These studies resulted in the definition of affected areas (DOE 1996b, ERDA 1977).

The primary isotopes remaining from the tests are plutonium, uranium, and americium, with lesser amounts of cesium, strontium, and europium. These long-lived radionuclides remain today in the surficial soils in the vicinity of the test areas and are available to be transported by wind and uptake by plants and animals. Extensive research into the mobility of the isotopes has found that wind can transport the contaminants and concentrate them in mounds around desert shrubs, and water can cause plutonium to migrate deeper into the soils with time; however due to the fact that the evapotranspiration rate exceeds the precipitation rate at NTS, significant downward migration is not expected. The isotopes are now relatively immobile unless the soils are disturbed (DOE 1996b, ERDA 1977).

4.3.6.2.4 Nuclear Rocket and Related Tests

A number of activities were conducted at the Nuclear Rocket Development Station in Area 25 of the NTS. From 1959 through 1973, the area was used for a series of open-air nuclear reactor, nuclear engine, and nuclear furnace tests and for the High Energy Neutron Reactions Experiment. Equipment and facilities remain from some of these activities, and there are some limited areas of contaminated soils. The total estimated inventory of isotopes remaining in the soils in this area of the NTS has been estimated to be about 1 curie (McArthur 1991). The primary soil contaminants in this area are isotopes of strontium, cesium, cobalt, and europium. The disposition of this contamination will be addressed as part of the Industrial Sites Corrective Action Unit under the ER Program.

Over the past two decades, the DOE has conducted many different types of surveys and research projects concerning these soils. A long-term data baseline has been established, the areas of contamination have been delineated, air monitoring and radiological surveying continue for key indicator parameters (plutonium, noble gases, and tritiated water vapor), and an extensive research and development project has evaluated alternative methods for remediating the soils for possible future land uses. The final disposition of the remaining isotope inventory in these soils will be determined as part of the ER Program. Appropriate corrective action level of total radionuclides is being formalized with the USAF and Nevada Division of Environmental Protection (NDEP) and negotiations with NNSA and USAF to address surface soil sites on the NTTR. Appropriate corrective action levels for radionuclides will be based on a 25 millirem per year dose rate, and will be compatible with future land use scenarios. The negotiated corrective action level will be based on site-specific parameters and as-low-as reasonably-achievable (ALARA) determinations. Confirmatory sampling of cleanup results will be done in conjunction with the U.S. Air Force.

4.3.6.3 *Seismology*

The general region has been tectonically active in the near past and has numerous faults (Figure 4.3.6-2). Since about 1848, more than 4,000 earthquakes have been recorded within a 150 mile radius of NTS. Most of these earthquakes were minor events with Richter magnitudes of less than 5.5. The largest event on record, which took place 100 miles west in Owens Valley, CA, had an estimated magnitude of 8.3. In 1992, an earthquake of 5.6 magnitude occurred in the southwest corner of the site under Little Skull Mountain. The maximum acceleration from this earthquake was approximately 0.21 g (g is the acceleration due to gravity) at Amargosa Valley. This is the largest earthquake recorded within the boundaries of NTS and may have been associated with the approximate Richter magnitude 7.5 earthquake near Landers, California, which occurred less than 24 hours earlier. Although there was no surface rupture, the Little Skull Mountain earthquake was the first to cause significant damage to facilities on NTS. These facilities, however, were built prior to the more stringent building codes presently followed on NTS. NTS is Seismic Zone 2B (DOE 1996b).

The most recent volcanic activity in the immediate area was 3.7 million years ago, and the likelihood for renewed activity in the next 10,000 years is slight. NTS lies approximately

150 miles southeast of the Long Valley area of California, an area with potential volcanic eruption of the Mount St. Helens type (DOE 1996b).

4.3.7 Biological Resources

4.3.7.1 *Terrestrial Resources*

NTS is located along the transition zone between the Mojave Desert ecosystem and the Great Basin Desert ecosystem. As a result, elements of both deserts are found in the Transition Zone. All three zones extend far beyond the boundaries of NTS, so the range of almost all species found onsite also extends beyond the site. There are 20 rare or endemic species present. In terms of total area, the Mojave Desert occupies the southern 22 percent of the NTS, the Great Basin Desert – the northern 40 percent, and the Transition Zone – the middle 37 percent. Extensive floral collections have identified 752 taxa of vascular plants within the boundary of the NTS. A third of the species belong to three families – the Sunflower (Asteraceae), Grass (Poaceae), and Buckwheat (Polygonaceae) families. Vegetation types that occur in the NTS are classified into plant assemblages or groupings called alliances and associations. Plant alliances may contain several plant associations. Of the ten plant alliances at NTS, nine are shrublands and one is woodland (in the Great Basin Desert).

Plant alliances on NTS are shown in Figure 4.3.7-1. Plant associations characteristic of the Mojave Desert are dominated by the creosote bush (*Larrea tridentata*). The largest and most important plant association in the Transition Zone is a shrubland dominated by blackbrush (*Coleogyne ramosissima*) and the Nevada jointfir (*Ephedra nevadensis*). This association covers 21.6 percent of the total area of the NTS. Much of this association has been disturbed on the NTS by testing and fires. These disturbed areas appear to be returning to a shrubland dominated by Nevada jointfir not blackbrush.

Above 5,000 feet (1,524 meters) in the Great Basin Desert, there are four alliances consisting of cold desert species. The sagebrush (*Artemesia spp.)* shrubland alliance represents 18.1 percent of the area of NTS. The dominant species in this alliance are basin big sagebrush (*A. tridentata*), black sagebrush (*A. nova*), Mormon tea (*E. viridis*), and green rabbitbrush (*Chrysothammus viscidiflorus*). At elevations above 6,000 feet (1,829 meters) where there is suitable moisture for trees, the singleleaf pinyon (*Pinus monophylla*) and sagebrush (*Artemesia spp*.) shrub woodland alliance occurs. This alliance covers 13.3 percent of the area of NTS.

Adjacent to the playas (temporary rain-filled lakes) in Frenchman and Yucca flats of the Great Basin Desert ecoregion is a shrubland plant alliance dominated by either shadscale (*Atriplex confertifolia*) or four-winged saltbush (*A. canescens*). This alliance covers only 3.1 percent of the NTS. The smallest alliance, covering only 0.4 percent of the NTS, is a thorn shrubland occurring in Frenchman Flat around the edge of Frenchman Playa. This alliance contains Shockley's desert thorn (*Lycium shockleyi*) and rabbit thorn (*L. pallidum*) (Wills and Ostler 2001).

Three hundred thirty-three species of terrestrial vertebrates have been recorded at NTS, including 60 species of terrestrial mammals (including 16 species of bats), 239 species of birds, 34 species of reptiles (1 tortoise, 16 lizards, and 17 snakes) (Wills and Ostler, 2001). Typical Mojave Desert species found at the site include kit fox (*Vulpes velox macrotis*), Merriam's kangaroo rat (*Dipodomys merriami*), desert tortoise (*Gopherus agassizii*), chuckwalla (*Sauromalus obesus*), western shovelnose snake (*Chionactis occipitalis)*, and sidewinder snake (*Crotalus cerastes)*.

Typical Great Basin Desert species include Townsend's ground squirrel (*Spermophilus townsendii*), Great Basin pocket mouse (*Perognathus parvus*), mule deer (*Odocoileus hemionus*), northern flicker (*Colaptes auratus*), scrub jay (*Aphelocoma coerulescens)*, Brewer's sparrow (*Spizella breweri)*, western fence lizard (*Sceloporus occidentalis)*, and striped whipsnake (*Masticophis taeniatus)*. About 40 wild horses (*Equus caballus*) live on the northern part of NTS. Water holes, both natural and manmade, are important to many species of wildlife, including game animals such as pronghorn (*Antilocapra americana*) and mule deer. Hunting is not permitted anywhere on NTS.

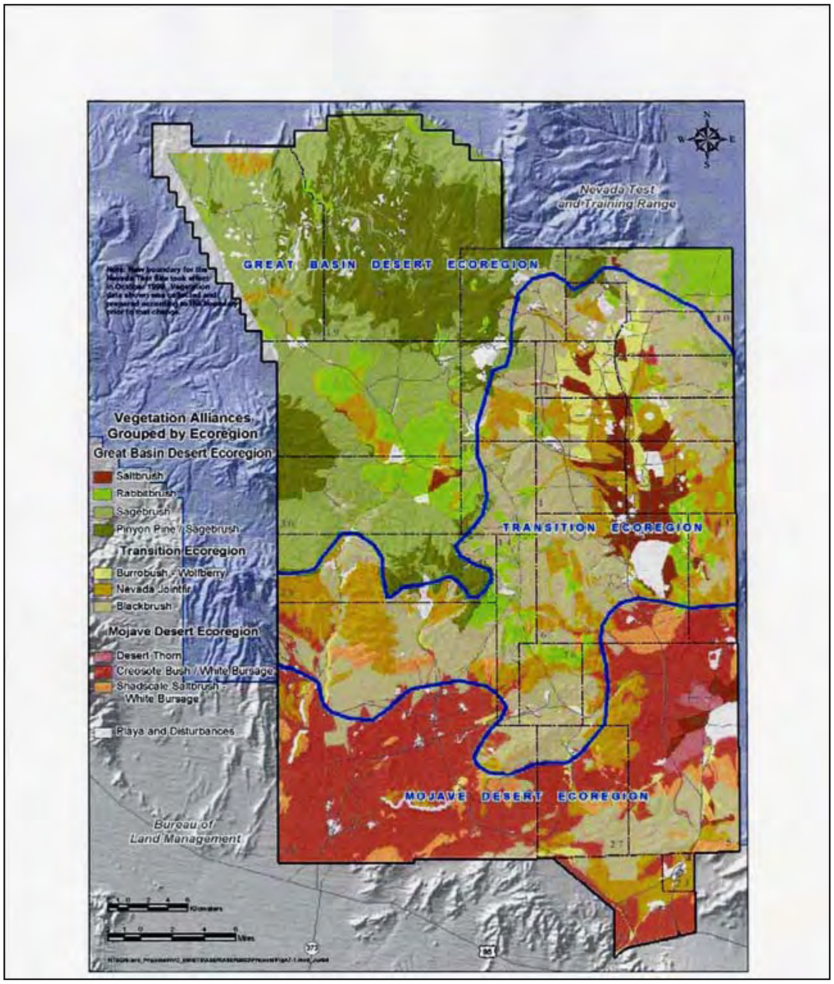
Raptors such as the turkey vulture (*Cathartes aura*) and rough-legged hawk (*Buteo lagopus*), and carnivores such as the coyote (*Canis latrans*), long-tailed weasel (*Mustela frenata*) and bobcat (*Lynx rufus*) are two ecologically important groups on the site. A variety of migratory birds have been found at NTS (DOE 2002l).

4.3.7.2 *Wetlands*

There are 30 natural water sources found at NTS, approximately 20 of which support wetland vegetation such as cattail (*Typha latifolia*), sedges (*Carex* spp.), and rushes (*Juncus* spp.). One newly identified wetland, a historic borrow pit that catches water in large enough quantities and for long enough periods of time to sustain wetland vegetation, has been identified (DOE 2002l).

4.3.7.3 *Aquatic Resources*

Known natural water sources on NTS consist of 15 springs, 9 seeps, 4 tanks (natural rock depressions that catch and hold surface runoff), and 2 ephemeral ponds (Pahute Mesa and Yucca Lake). There are no federally designated Wild and Scenic Rivers onsite. Ten water sources were unvegetated pools of water (four cave pools, four rock depressions and two ephemeral ponds). Eleven of the 24 springs and seeps have been observed to have surface flow of water sometime during the year. Man-made impoundments on NTS, that are scattered throughout the eastern half of the site and maintained by well water, support three introduced species of fish: bluegill (*Lepomis macrochirus*), goldfish (*Carassius auratus*), and golden shiners (*Notemigonus crysoleucas*). Eighty-one species of plants and 138 species of animals have been documented at or near aquatic sites on NTS (Wills and Ostler, 2001). Passerine birds (perching birds and songbirds) comprise the majority of birds using the NTS wetlands. Waterfowl use is negligible due to the small surface area of open water (Wills and Ostler, 2001).



Source: NTS 2006a.

Figure 4.3.7-1—Distribution of Plant Alliances on the NTS

4.3.7.4 *Threatened and Endangered Species*

The only federally-threatened species found at NTS is the Mojave Desert population of the desert tortoise (*Gopherus agassizii*) (NTS 2007). The desert tortoise inhabits the southern one-third of the NTS at fairly low estimated densities. In December 1995, the Nevada Site Office (NSO) completed consultation with the USFWS concerning the effects of NNSA/NSO activities on the desert tortoise. A final Biological Opinion (Opinion) was received from the USFWS 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 amount 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.

The Desert Tortoise Compliance Program was developed to implement the terms and conditions of all Opinions issued to NSO by the USFWS, to document compliance actions taken, and to assist NSO in USFWS consultations.

The abundance of tortoises at NTS is low to very low compared to other areas within the range of this species. NTS contains less than 1 percent of the total desert tortoise habitat of the Mojave Desert population (DOE 2002l). A cumulative total of 265.70 acres (107.6 hectares) of tortoise habitat on the NTS has been disturbed since the desert tortoise was listed as threatened in 1992 (NTS 2006a).

Mitigation for the loss of tortoise habitat is required under the terms and conditions of the 1996 Opinion. Two mitigation options are available: (1) payment of a mitigation fee to the Clark County Desert Tortoise Habitat Conservation Fund for habitat disturbed or (2) revegetate disturbed habitat following specific revegetation criteria. The current cost for the prepayment fee is $1,741 per hectare ($705 per acre) (NTS 2007).

All but five 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. Two are currently included in active long-term population monitoring activities – the western burrowing owl (*Athene cunicularia hypugaea*) and Swainson's hawk (*Buteo swainsoni*). In 2005, there were 126 known western burrowing owl locations (30 owl sightings and 96 burrow sites) on the NTS. Most non-rodent mammals of the NTS are protected by the State of Nevada and managed as either game or furbearing mammals. Recently, two rodents were added to the list of Nevada Protected species – the dark kangaroo mouse (*Microdipodops megacephalus*) and the pale kangaroo mouse (*M. pallidus*). Six of 16 bats on the NTS are considered state-protected species. Nineteen species of vascular plants and one moss that are considered sensitive species are known to occur at the NTS. These species are not listed as threatened or endangered under the Endangered Species Act, but are on either a "watch-list" (19 species) or are considered as threatened (1 species) by the Nevada Natural Heritage Program (NTS 2007). All 20 of these species are under long-term monitoring by NTS biologists in order to maintain an accurate assessment of the distribution of each plant species and to evaluate their status.

4.3.7.5 *Biological Monitoring and Abatement*

DOE Order 450.1, *Environmental Protection Program* requires ecological monitoring and biological compliance support for activities and programs conducted at the DOE facilities. The Ecological Monitoring and Compliance Program (EMAC) provides this support for the NTS and results are contained in the *Nevada Test Site Environmental Report for 2005* (NTS 2006a). 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). The EMAC program goals are to ensure compliance with all state and federal regulations and stakeholder commitments pertaining to NTS flora, fauna, wetlands, and sensitive vegetation and wildlife habitats; delineate NTS ecosystems; and 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. Information specific to the Desert Tortoise Compliance Program is contained in Section 4.3.7.4.

4.3.8 Cultural Resources

4.3.8.1 *Paleontological Resources*

Alluvium-filled valleys surrounded by ranges composed of Precambrian and Paleozoic sedimentary rocks and Tertiary volcanic tuffs and lavas characterize the surface geology of NTS. Although the Precambrian deposits contain only a few poorly preserved fossils, the Paleozoic marine limestones are moderately to abundantly fossiliferous, and can contain trilobites, conodonts, ostracods, corals, brachiopods, cephalopods, algae, gastropods, and archaic fish. These fossils are relatively common and have low research potential. The Tertiary volcanic deposits were not conducive to preservation when deposited and thus are not expected to contain fossils.

Late Pleistocene terrestrial vertebrate fossils could be expected in the Quaternary alluvial deposits. Discovery of mammoth, horse, camel, and bison remains could be expected since these types of remains have been found near NTS. Although no known fossil localities have been recorded on NTS, Quaternary deposits with paleontological materials may occur onsite (DOE 2002l).

4.3.8.2 *Prehistoric Cultural Resources*

Prehistoric sites found on NTS include habitation sites with wood and brush structures, wind breaks, rock rings, rock shelters, rock art, hunting blinds, rock alignments, quarries, temporary camps, milling stations, roasting pits, water caches, and limited activity locations (DOE 2002l). An example of a prehistoric petroglyph from Fortymile Canyon found on NTS is shown in Figure 4.3.8-1. Areas of NTS that appear to have the highest prehistoric site density are the northwest part, on and around Pahute and Rainier Mesas, and in the southwest part, on and around Jackass Flats, Yucca Mountain, and Shoshone Mountain. However, the distribution information is preliminary. The high number of cultural resources in these areas is somewhat related to the numerous NTS activities that have taken place there, as most cultural resource investigations are conducted in response to planned NTS activities (DOE 2002l).

4.3.8.3 *Historic Resources*

Historic sites found include mines and prospects, trash dumps, settlements, campsites, ranches and homesteads, developed springs, roads, trails, and nuclear weapon development sites. At least 600 buildings, structures, and objects dating to the Cold War era have been identified at NTS, but many have not been recorded or evaluated for significance. Frenchman Flat and Yucca Flat are rich in significant Cold War resources and have been documented as historic districts (DOE 2002l).

Source: NTS 2006a.

Figure 4.3.8-1—Prehistoric Petroglyph from Fortymile Canyon on NTS

4.3.8.4 *Native American Resources*

DOE has an extensive record of consultation with interested tribes concerning new, existing, and proposed activities at NTS. The NSO has been consulting with Native Americans since 1988. These consultations have led to the establishment of the Consolidated Group of Tribes and Organizations (CGTO), which includes members from 16 tribes, representing 3 ethnic groups which were found to have prehistoric and historic ties to NTS: Western Shoshone, Southern Paiute, and Owens Valley Shoshone-Paiute. Consultations with the CGTO are ongoing and follow the policies set forth by DOE and the current executive orders (DOE 2002i).

The CGTO has identified several sites at NTS that are important to Native American people, including storied rocks, rock shelters, wooden lodges, rock rings, springs, and certain archaeological sites. In addition, 107 plant and more than 20 animal species resident on NTS have been identified by Native American elders as part of their traditional resources (DOE 2002l).

4.3.9 Socioeconomic Resources

Socioeconomic characteristics addressed at NTS include employment, regional economy, and population, housing, and community services. Socioeconomic characteristics are presented for a ROI. The ROI was identified based on the distribution of residences for current NTS employees. The ROI is defined as those counties where approximately 90 percent of the workforce lives.

NTS is located in Nye County, Nevada. Statistics for socioeconomic characteristics are presented for the ROI, a region consisting of Nye and Clark Counties. Figure 4.3.9-1 presents a map of the counties composing the NTS ROI.

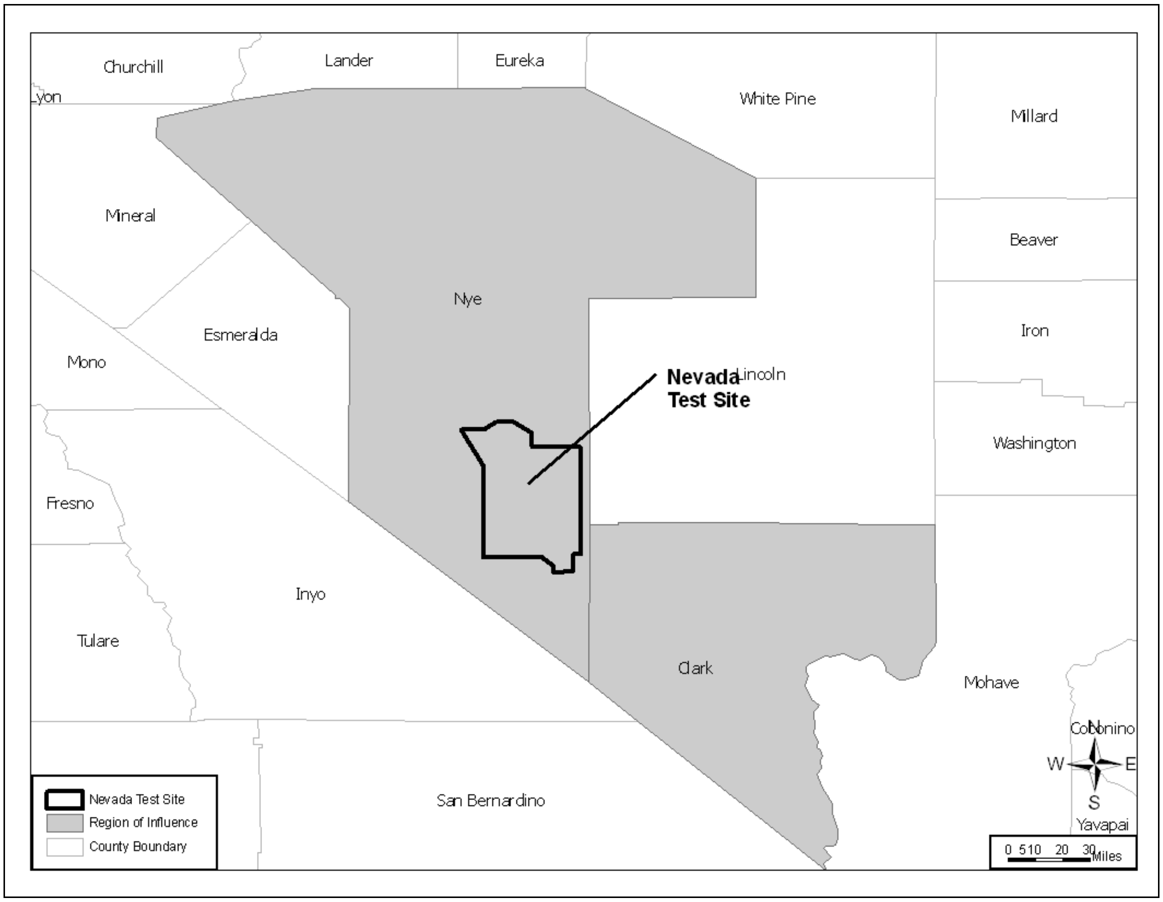


Figure 4.3.9-1—Region of Influence for Socioeconomic Impacts at NTS

4.3.9.1 *Employment and Income*

Although there have been fluctuations in these estimates, the available labor force (i.e., those more than 16 years of age and capable of work) of the ROI grew by approximately 29 percent from 824,109 in 2000 to 1,066,542 in 2006. The overall ROI employment experienced a comparable growth rate of 30 percent with 770,305 in 2000 and 1,003,912 in 2006 (USCB 2007).

Labor force statistics are summarized in Table 4.3.9-1. The civilian labor force (i.e., those more than 16 years of age and capable of work) of the ROI grew by approximately 20 percent from 741,583 in 2000 to 889,803 in 2005. The overall ROI employment experienced a growth rate of nearly 21 percent with 707,037 in 2000 to 852,496 in 2005 as presented in Figure 4.3.9-2 (BLS 2007).

The ROI unemployment rate was 4.7 percent in 2000 and 4.2 percent in 2005. In 2005, unemployment rates within the ROI were 4.2 percent in Clark County and 5.6 percent in Nye County. The unemployment rate in Nevada in 2005 was 5.3 percent (BLS 2007).

Table 4.3.9-1—Labor Force Statistics for ROI and Nevada

	ROI		Nevada	
	2000	2005	2000	2005
Civilian Labor Force	741,583	889,803	852,293	915,489
Employment	707,037	852,496	810,024	867,317
Unemployment	34,546	37,307	42,269	48,172
Unemployment Rate	4.7	4.2	5.0	5.3

Source: BLS 2007.

Income information for the NTS ROI is provided in Table 4.3.9-2. Nye County is at the low end of the ROI with a median household income in 2004 of $41,025, and at the high end of the ROI with a per capita income of $33,049. Clark County had a median household income of $45,793 and a per capita income of $27,910 (BEA 2007).

Table 4.3.9-2—Income Information for the NTS ROI, 2004

	Per capita income (dollars)	Median household income (dollars)
Nye	33,049	41,025
Clark	27,910	45,793
Nevada	34,021	49,894

Source: BEA 2007.

4.3.9.2 *Population and Housing*

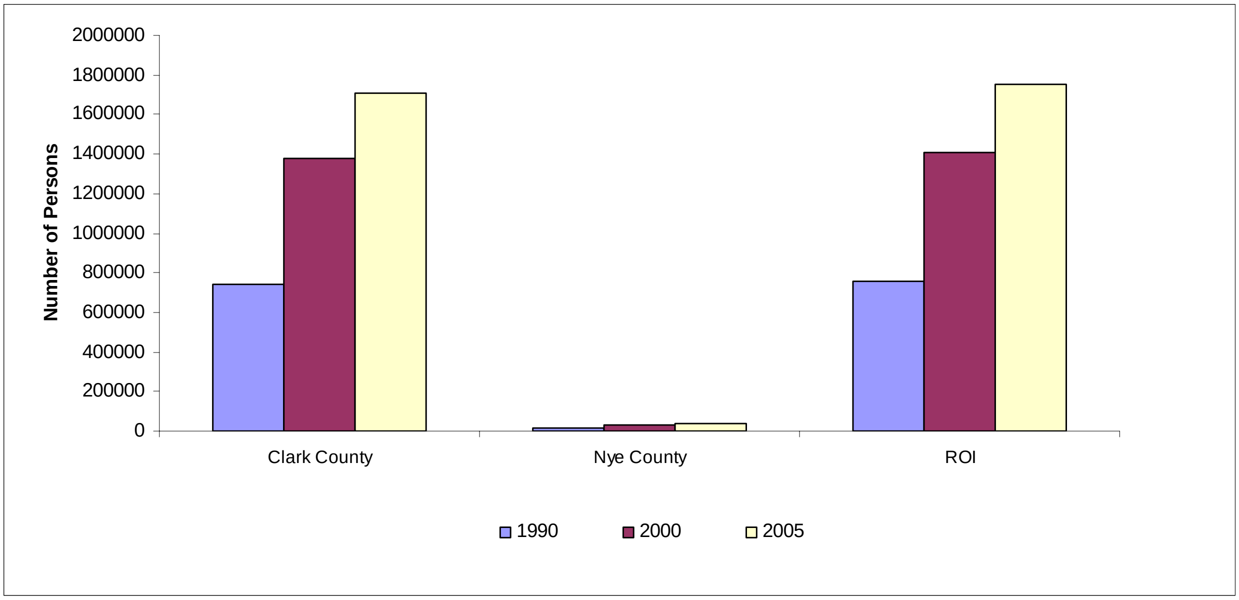
The ROI is used to analyze the primary economic impacts on population and housing. Table 4.2.9-2 presents historic and projected population in the ROI and the state.

Table 4.3.9-3—Historic and Projected Population

Region	1990	2000	2005	2010	2020
Clark	741,459	1,375,765	1,709,364	1,969,348	2,123,277
Nye	17,781	32,485	40,395	44,985	51,283
ROI	759,240	1,408,250	1,749,759	2,014,333	2,174,560
Nevada	1,515,069	1,819,046	1,925,985	2,690,078	2,910,959

Source: USCB 2007.

Between 1990 and 2005, population growth in the ROI was significantly higher than population growth in the State of Nevada. The ROI population increased by 85 percent between 1990 and 2000. Clark and Nye Counties both experience a population growth of approximately 24 percent between 2000 and 2005 (USCB 2007). Clark County is the largest in the ROI with 1,709,364 people, while Nye County had 40,395 people in 2005 (USCB 2007). Figure 4.3.9-2 presents the trends in population within the NTS ROI.



Source: USCB 2007.

Figure 4.3.9-2—Trends in Population for NTS ROI, 1990-2005

Table 4.3.9-4 lists the total number of housing units and vacancy rates in the ROI. In 2000, the total number of housing units in the ROI was 575,733 with 525,562 occupied (91 percent). There were 313,001 owner-occupied housing units and 212,561 rental units. The median value of owner-occupied units in Clark County was the greatest of the counties in the NTS ROI ($139,500). The vacancy rate in Clark County was 8.5 percent and 16.5 in Nye County (USCB 2007).

Table 4.3.9-4—Housing in the NTS ROI, 2000

	Total Units	Occupied housing Units	Owner Occupied Units	Renter Occupied Units	Vacant units	Vacancy Rate (percent)	Median value of Owner Occupied Units (dollars)
Clark	559,799	512,253	302,834	209,419	47,546	8.5	139,500
Nye	15,934	13,309	10,167	3,142	2,625	16.5	122,100
ROI	575,733	525,562	313,001	212,561	50,171	8.7	138,935

Source: USCB 2007.

4.3.9.3 *Community Services*

Community services in the ROI include public schools, law enforcement, fire suppression and medical services. Educational services are provided for approximately 300,256 students by an estimated 15,228 teachers in the ROI (IES 2006c). The student-to-teacher ratio in the Nye County School District was 17:1 during the 2005 to 2006 school year, while the Clark County School District had a student-to-teacher ratio of 20:1. The student-to-teacher ratio in the ROI was 20:1 (IES 2006c).

The counties within the ROI employ approximately 18,700 firefighters and law enforcement officers. There are approximately 13 hospitals that serve residents of the ROI with the majority located in Clark County near Las Vegas (ESRI 2007).

4.3.10 Environmental Justice

The potentially affected area considered for environmental justice analysis is the area within a 50-mile radius of NTS. Figure 4.3.10-1 shows counties potentially at risk from the current missions performed at NTS. There are three counties included in the potentially affected area. Table 4.3.10-1 provides the demographic profile of the potentially affected area using data obtained from the 2000 Census.

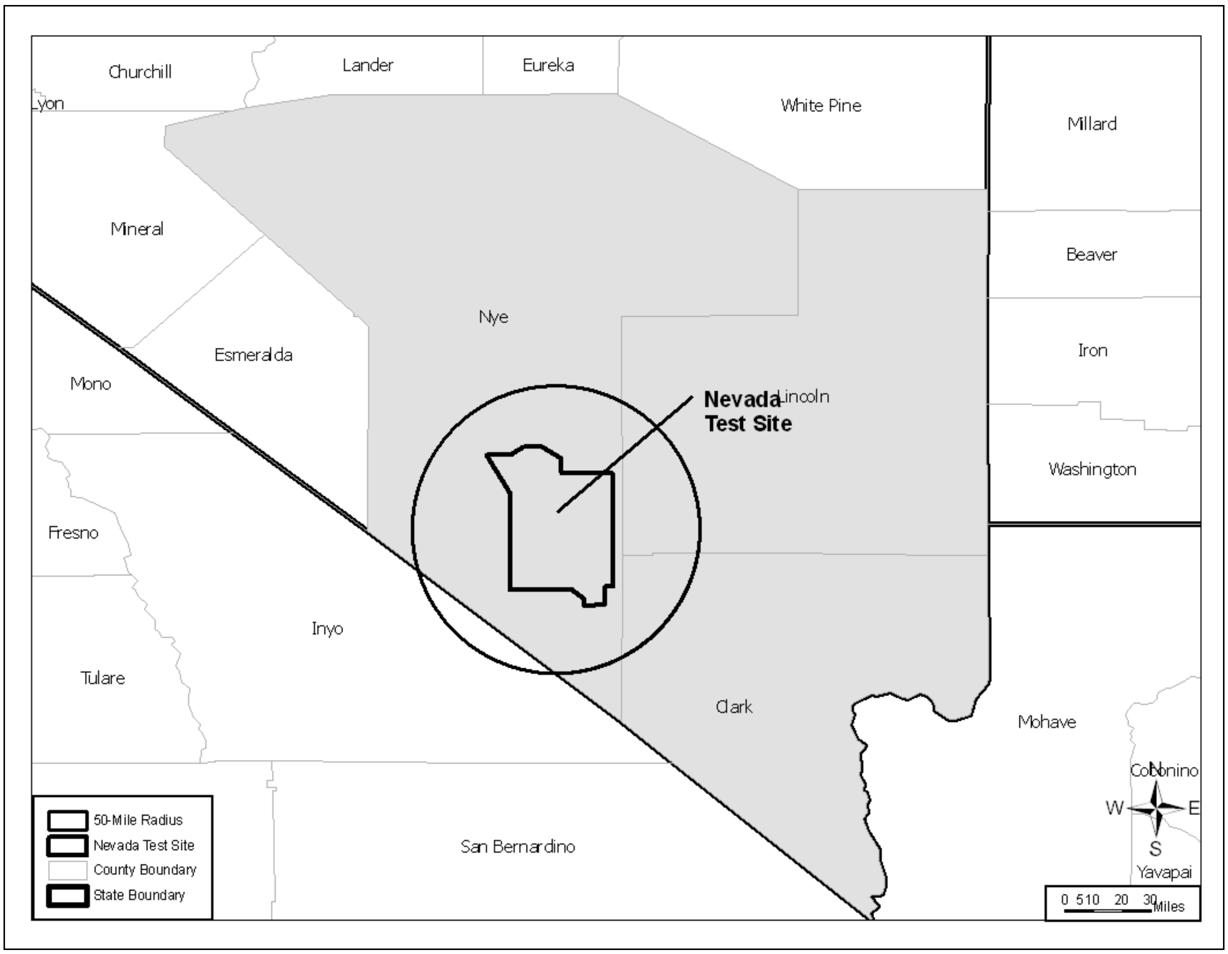


Figure 4.3.10-1—Potentially Affected Counties Surrounding NTS Environmental Justice

In 2000, persons self-designated as minority individuals in the potentially affected area comprised 39.1 percent of the total population. Hispanic residents are the largest group within the minority population. As a percentage of the total resident population in 2000, Nevada had a minority population of 34.8 percent and the U.S. had a minority population of 30.9 percent (USCB 2007).

Census tracts with minority populations exceeding 50 percent were considered minority census tracts. Based on 2000 census data, Figure 4.3.10-2 shows minority census tracts within the 50-mile radius where more than 50 percent of the census tract population is minority.

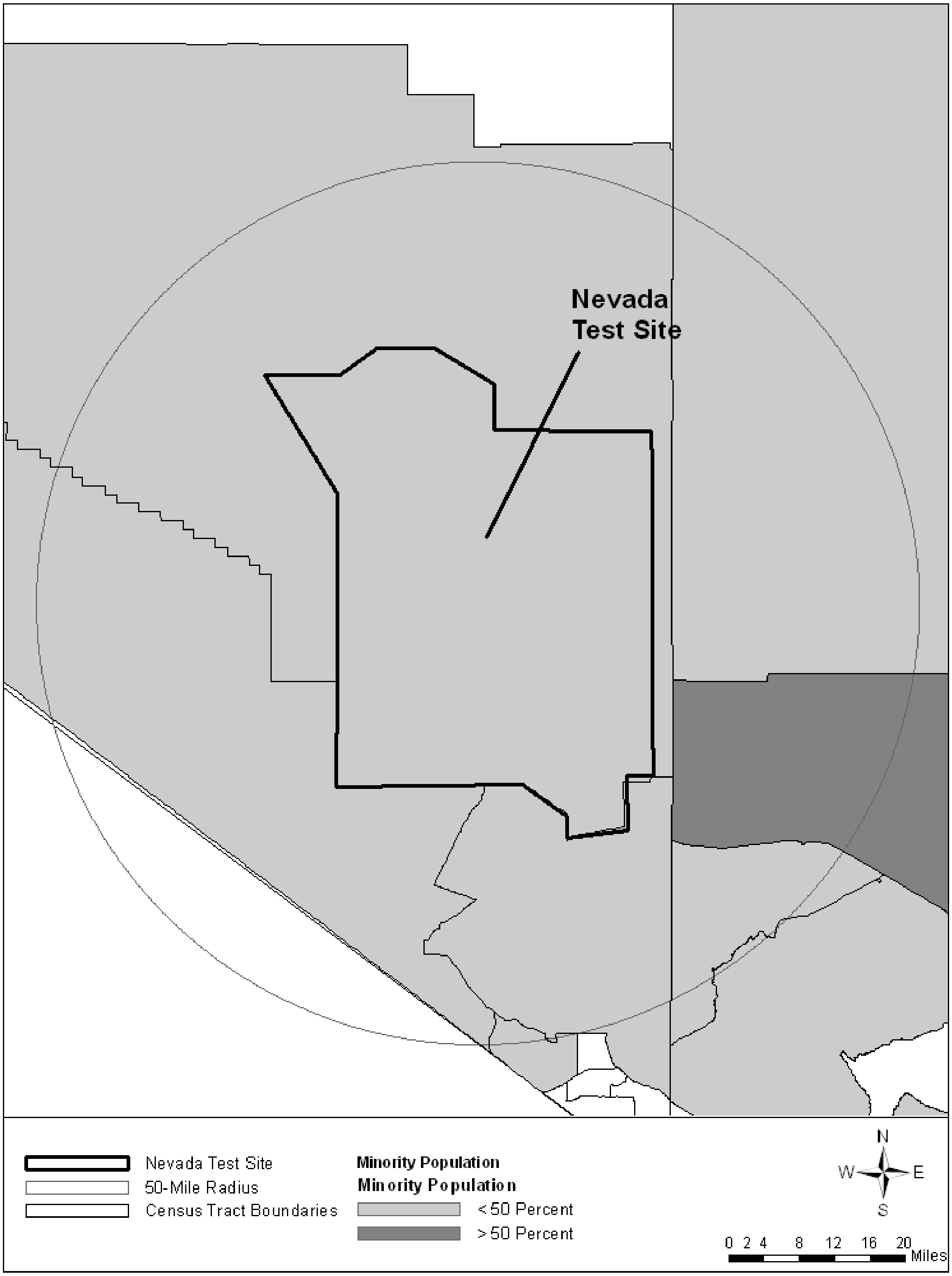
Table 4.3.10-1—Demographic Profile of the Potentially Affected Counties Surrounding NTS, 2000

Population Group	Population	Percent
Minority	**552,526**	**39.1**
Hispanic alone	157,835	11.2
Black or African American	125,342	8.9
American Indian and Alaska Native	11,604	0.8
Asian	72,814	5.2
Native Hawaiian and Other Pacific Islander	6,518	0.5
Some other race	119,546	8.5
Two or more races	58,867	4.2
White alone	**859,889**	**60.9**
Total Population	**1,412,415**	**100**

Source: USCB 2007.

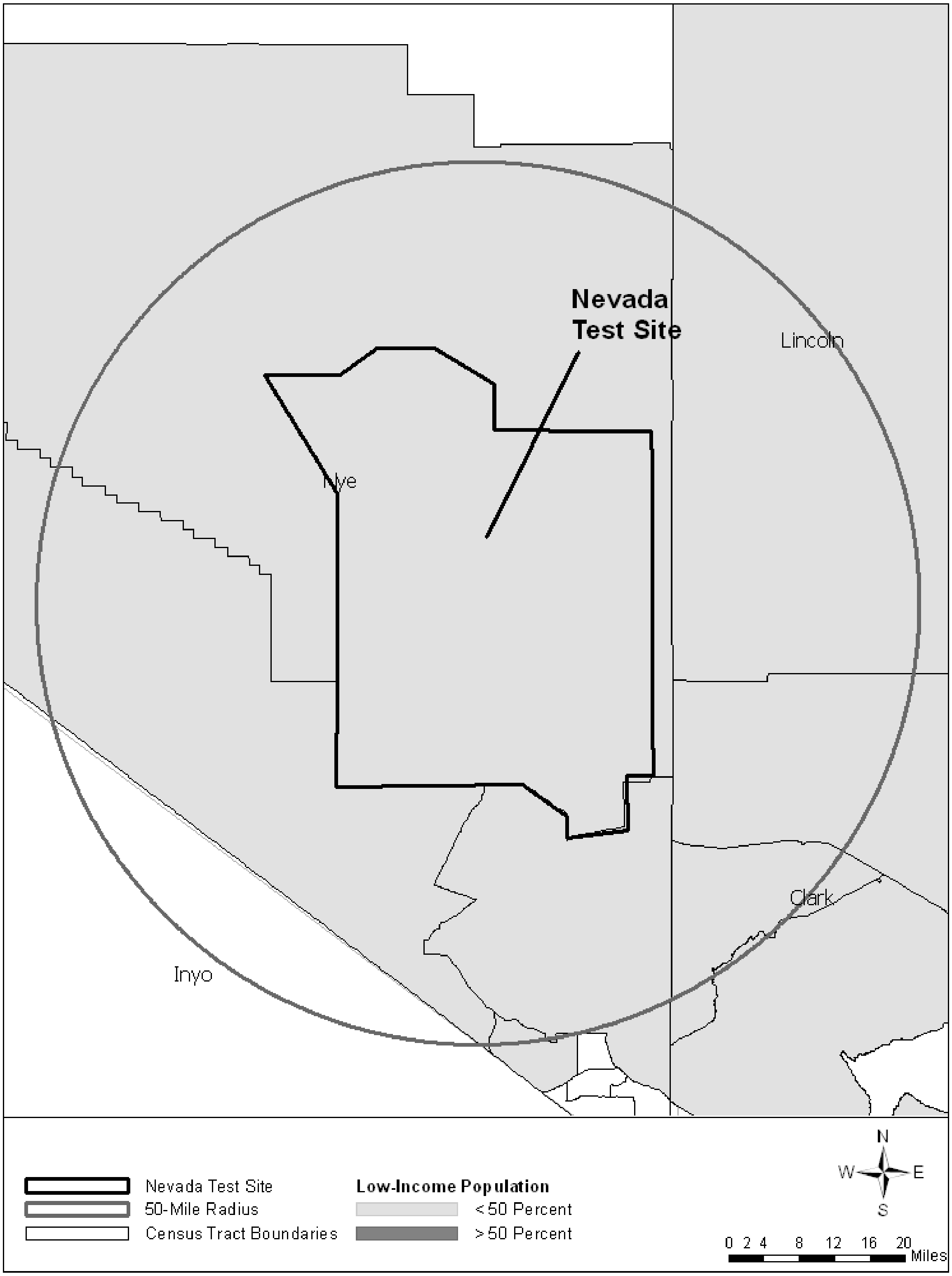
Census tracts were considered low-income census tracts if the percentage of the populations living below the poverty threshold exceeded 50 percent. Based on 2000 Census data, Figure 4.3.10-3 shows low-income census tracts within the 50-mile radius where more than 50 percent of the census tract population is living below the Federal poverty threshold.

According to 2000 census data, approximately 2,213 individuals residing within census tracts in the 50-mile radius of LANL were identified as living below the Federal poverty threshold, which represents approximately 13 percent of the census tract population within the 50-mile radius. There were no census tracts within the 50-mile radius where more than 50 percent of the census tract population was identified as living below the Federal poverty threshold. In 2000, 10.5 percent of individuals for whom poverty status is determined were below the poverty level in Nevada and 12.4 percent in the U.S. (USCB 2007).



Source: USCB 2007.

Figure 4.3.10-2—Minority Population—Census Tracts with More than 50 Percent Minority Population in a 50-Mile Radius of NTS

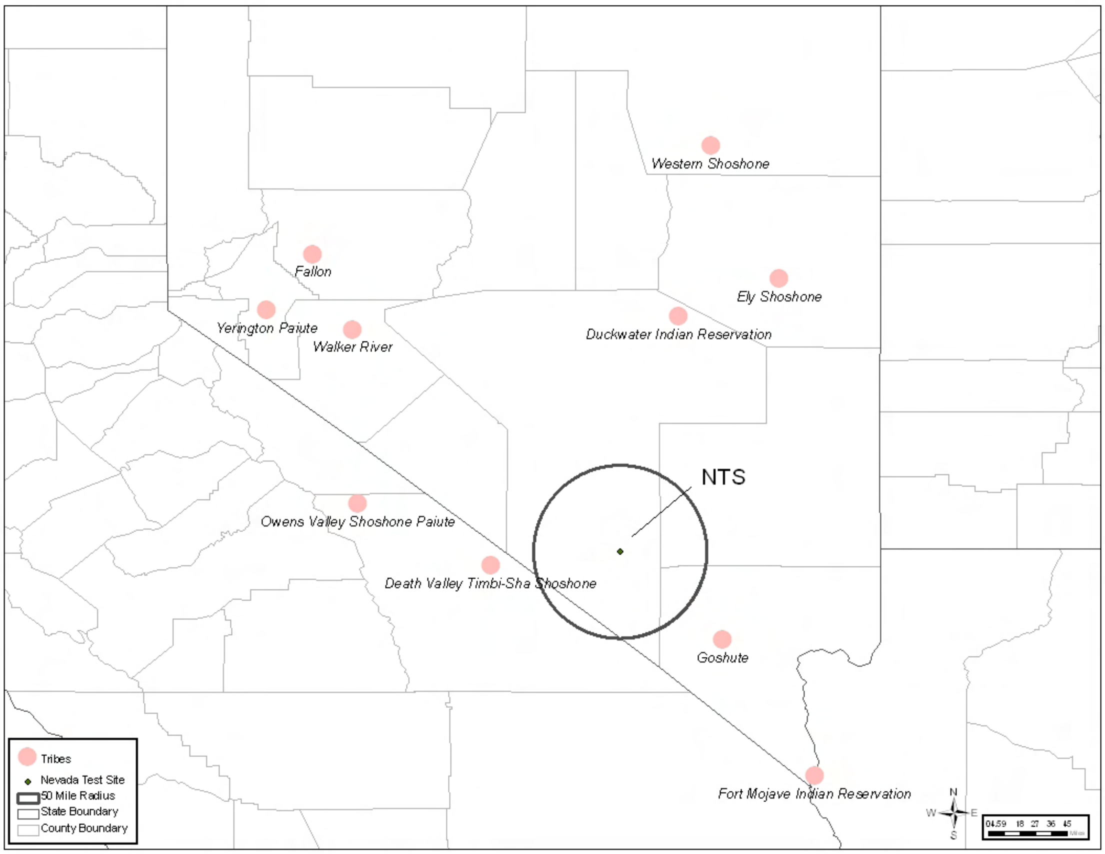


Source: USCB 2007.

Figure 4.3.10-3—Low-Income Population—Census Tracts with More than 50 Percent Low-Income Population in a 50-Mile Radius of NTS

4.3.10.1 *Characteristics of Native American Populations within the Vicinity of or with Interest in NTS Activities/Operations*

As discussed in Section 4.3.8.4, Native American groups which are known to have used the lands surrounding NTS and TTR are the Western Shoshone (four tribes), Southern Paiute (seven tribes), Owens Valley Shoshone Paiute (five tribes) and the Mojave (one tribe). The 2000 U.S. Census Bureau was used to obtain characteristics, including population, employment, educational attainment, income, poverty level, average family size, and housing characteristics for all population subcategories associated with the ones mentioned above. No data for the Mojave could be found using U.S. Census Bureau data. The locations of various tribes in relation to the NTS are shown in Figure 4.3.10-4. The results of this analysis are provided in the following section.



Source: ESRI 2007.

Figure 4.2.10-4—Location of Tribes within Vicinity of or with Interest in NTS

As shown in Table 4.3.10-2, the Shoshone had the highest of the Native American populations with 8,340 and the Paiute-Shoshone with the least at 3,311. The Paiute have the largest percentage of their population as members of the civilian labor force at 64.8 percent and the Death Valley Timbisha Shoshone Tribe with the smallest percentage of their population as members of the civilian labor force with 59.2 percent. The Owens Valley Shoshone-Paiute Tribes had the highest unemployment rate at 12 percent and the Paiute with the lowest unemployment rate at 7.8 percent (USCB 2007).

Of those individuals over 25 with some form of education, the largest constituency of all three Native American ethnic groups had received a high school diploma as shown in Table 4.3.10-3. A slightly lesser percentage of individuals had attended some college and significantly lesser percentages of these populations had received degrees from institutions of higher learning (Associate, Bachelor, or Graduate/Professional) (USCB 2007).

Table 4.3.10-2—Population and Employment Estimates for Native American Populations within the Vicinity of or With Interest in NTS, 2000

NTS	Population	Civilian Labor Force	Civilian Labor Force (percent)	Employed	Employed (percent)	Unemployed	Unemployed (percent)
Paiute	6,927	4,491	64.8	3,953	57.1	538	7.8
Paiute Alone	5,979	2,798	64.8	2,477	57.4	321	7.4
Shoshone	8,340	3,670	60.8	3,146	52.1	524	8.7
Shoshone Alone	7,050	3,098	60.7	2,653	51.9	445	8.7
Death Valley Timbi-Sha Shoshone	213	93	59.2	75	47.8	18	11.5
Owens Valley - Shoshone-Paiute	3,311	1,434	61.4	1,155	49.5	279	12
Shoshone Paiute Alone	2,037	927	65	725	50.8	202	14.2

Source: USCB 2007.

Table 4.3.10-3—Level of Educational Attainment by Native American Populations within the Vicinity of or With Interest in NTS, 2000

NTS	High School Graduate	High School Graduate (percent)	Some College	Some College (percent)	Associate Degree	Associate Degree (percent)	Bachelor Degree	Bachelor Degree (percent)	Graduate/ Professional Degree	Graduate/ Professional Degree (percent)
Paiute	1,898	35.1	1,548	28.6	340	6.3	265	4.9	126	2.3
Paiute Alone	1,122	33.7	942	28.3	206	6.2	162	4.9	84	2.5
Shoshone	1,532	31.6	1,292	26.7	316	6.5	364	7.5	135	2.8
Shoshone Alone	1,272	30.7	1,101	26.6	280	6.8	329	7.9	122	2.9
Death Valley Timbi-Sha Shoshone	42	37.2	24	21.2	15	13.3	4	3.5	0	0
Owens Valley Shoshone-Paiute	552	32.8	445	26.5	123	7.3	116	6.9	29	1.7
Shoshone Paiute Alone	324	33.4	276	28.5	89	9.2	69	7.1	16	1.7

Source: USCB 2007.

In 2000, the Paiute population had the highest mean household earnings and per capita income with $37,212 and $12,698, respectively as shown in Table 4.3.10-4. The Shoshone Tribe population had the lowest mean household earnings with $33,806. The Owens Valley Shoshone-Paiute Tribes had the lowest per capita income with $10,514 (USCB 2007).

Of the three Native American ethnic groups within the vicinity of NTS, the Shoshone Tribe had the largest percentage of individuals below the poverty level in 2000 with 29 percent as compared to the Paiute population which had 24.6 percent of the total population living below the poverty level as shown in Table 4.3.10-4 (USCB 2007).

Table 4.3.10-4—Income and Poverty Level Estimates for Native American Populations within the Vicinity of or With Interest in NTS, 2000

NTS	Mean Household Earnings	Per Capita Income	Individuals Below the Poverty Level	Individuals Below the Poverty Level (percent)
Paiute	$37,212	$12,698	2,388	24.6
Paiute Alone	$38,889	$12,848	1,396	23.9
Shoshone	$33,806	$11,920	2,330	29
Shoshone Alone	$34,685	$12,039	1,985	29.2
Death Valley Timbi-Sha Shoshone	$37,015	$12,136	57	27.5
Owens Valley Shoshone-Paiute	$34,986	$10,514	892	27.5
Shoshone Paiute Alone	$37,603	$10,448	615	31.1

Source: USCB 2007.

In 2000, the Owens Valley Shoshone-Paiute Tribes had the largest average family size with 3.63 persons per family compared to the Shoshone with 3.31 persons per family. The Paiute had the greater number of occupied housing units with 3,482, which was significantly higher than the Shoshone at 2,805, who had a larger population than the Paiute in 2000 as shown in Table 4.3.10-5 (USCB 2007).

Table 4.3.10-5—Housing Characteristics for Native American Populations within the Vicinity of or With Interest in NTS, 2000

NTS	Average Family Size	Housing Units	Owner-Occupied Housing Units	Owner-Occupied Housing Units (percent)	Renter-Occupied Housing Units	Renter-Occupied Housing Units (percent
Paiute	3.38	3,482	2,150	61.7	1,332	38.3
Paiute Alone	3.45	2,041	1,158	56.7	883	43.3
Shoshone	3.31	2,805	1,545	55.1	1,260	44.9
Shoshone Alone	3.3	2,352	1,283	54.5	1,069	45.5
Death Valley Timbisha Shoshone	2.61	82	66	80.5	16	19.5
Paiute-Shoshone	3.63	1,152	712	61.8	440	38.2
Shoshone Paiute Alone	3.63	684	383	56	301	44

Source: USCB 2007.

4.3.11 Health and Safety

4.3.11.1 *Public Health*

4.3.11.1.1 Radiological

Releases of radionuclides to the environment from NTS operations provide a source of radiation exposure to individuals in the vicinity of NTS. During 2005, NTS' environmental radiological monitoring program was conducted according to U.S. DOE Orders 450.1, "Environmental Protection Program,"1, 5400.5, "Radiation Protection of the Public and the Environment", and the CAA NESHAP. The program involved measuring radioactivity in environmental samples in addition to calculating the potential radiological dose to the offsite public.

The exposure of members of the public to all DOE sources of radiation is limited by the DOE to levels that shall not cause, in a year, an effective dose equivalent greater than 100 millirem. Demonstration of compliance with this limit is documented by a combination of measurements and calculations including the comparison of concentrations of radioactive material in air and water to DCGs listed in Chapter III of DOE Order 5400.5. The DOE provides a level of protection for persons consuming water from a public drinking water supply equivalent to the drinking water criteria in 40 CFR 141 by limiting the effective dose equivalent in a year to 4 millirem. Compliance with the aforementioned criterion is accomplished by comparing measured concentrations of radionuclides in drinking water to 4 percent of the DCG values for ingested water. The DOE further limits emissions of radionuclides to the ambient air from DOE facilities to those amounts that would not cause any member of the public to receive, in any year, an effective dose equivalent of 10 millirem per year. This limit is equivalent to the limit for emissions of radionuclides other than radon to this pathway established by the EPA at 40 CFR 61.92.

Compliance with the dose limit specified in 40 CFR 61.92 (and hence that for the air pathway specified in DOE Order 5400.5) is demonstrated by calculating the effective dose equivalent received by the MEI member of the general public. This individual is a person who resides near NTS, and who would receive, based on theoretical assumptions about lifestyle that maximize exposure to radiological emissions, the highest effective dose equivalent from Site operations. Calculations are performed using the EPA's CAP88-PC model (EPA 1992).

The doses received by the MEI are tabulated in Table 4.3.11-1. Based on the 2006 operational data, NTS caused a MEI dose of 0.32 millirem per year. This dose is significantly below the EPA maximum permissible exposure limit to the public (and the DOE "air pathway" limit) of 10 millirem per year. The monitoring and analysis results demonstrate that no adverse effects occurred from NTS operations in 2006. The collective population dose to residents within 50 miles of NTS emission sources was not estimated in 2006 because this assessment depends upon CAP88-PC estimations which ere not calculated (NTS 2007). Based upon the same CAP88-PC modeling results, the collective population dose received by those living within 50 miles of NTS would have been less than 0.6 person-rem per year in 2005. The radionuclide emissions contributing the majority of the dose to the offsite MEI were tritium, isotopes of plutonium, and americium-241 (NTS 2006a).

Table 4.3.11-1—Estimated Radiological Dose to the General Public from NTS Operations, 2006

Pathway	Dose to MEI (mrem/yr)	Percent of DOE 100-mrem/yr Limit
Air[a]	0.2	0.2
Water[b]	0	0
Wildlife[c]	0.12	0.12
Direct[d]	0	0
All Pathways	0.32	0.32

[a] Asumed from historical data from 1992 to 2004.
[b] Based on all offiste groundwater sampling in 2006.
[c] Assumes that the MEI consumes 20 jackrabbits from the NTS.
[d] Based on 2006 gama radiation monitoring data, 2006 property release tracking information, and previous year's CAP88-PC dose estimates
Source: NTS 2007.

NTS workers receive the same dose as the general public from background radiation, but they also may receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at NTS from operations in 2005 are presented in Table 4.3.11–2. These doses fall within the radiological regulatory limits of 10 CFR 835.

Table 4.3.11-2—Radiation Doses to Workers from Normal NTS Operations in 2005 (Total Effective Dose Equivalent)

Occupational Personnel	Standard	Actual
Average radiation worker dose (mrem)	5,000[a]	50.1
Collective radiation worker dose[b] (person-rem)	No Current Standard	3.6

Source: NTS 2006a.
[a] DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 mrem/yr (DOE 1999e); the site must make reasonable attempts to maintain individual worker doses below this level.
[b] There were 71 workers with measurable doses in 2001.

4.3.11.1.2 Nonradiological

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at NTS via inhalation of air containing hazardous chemicals released to the atmosphere by NTS operations; however, the remoteness of the NTS coupled with compliance with the NTS Air Quality Operating Permit reduces the risk of health impacts to the public from chemical releases. Risks to the public health from ingestion of contaminated drinking water or direct exposure are also potential pathways. NNSA conducts a comprehensive groundwater monitoring program to ensure that any contamination in the groundwater is not being transported beyond the boundaries of the NTS.

4.3.12 Transportation

NTS is approximately 65 miles northwest of Las Vegas, Nevada (Figure 4.3.12–1). The route to NTS from many locations east goes through the Las Vegas metropolitan area. Interstate highway I-15 passes through Las Vegas in a southwest to northeast direction. The Las Vegas Beltway encircles all but the east side of Las Vegas. This 53-mile beltway project is in interim status, with a targeted completion of upgrades in 2013. To relieve congestion over the Hoover Dam, a bypass project is in the works, with the Colorado River Bridge planned to be completed by late 2008.

Ninety-five percent of all commuters and shipments to the NTS arrive from the Las Vegas area on U.S. 95, a four-lane highway. The Mercury Interchange on U.S. 95 provides the principal access to NTS. Traffic is light and free flowing once clear of the Las Vegas area. Commuters, however, can experience gridlock within the beltway, especially at the interchanges of U.S. 93, U.S. 95, I-15, and I-515. With approximately 3,800 employees, the NTS contribution to the traffic congestion is minimal. Table 4.3.12-1 summarizes the daily traffic volume for the main access road to NTS. Information is based on best data available.

Table 4.3.12-1—Traffic Volume at the Main Access Road to NTS

Access Road	Average Vehicle Daily Trips	Peak Hourly Traffic	Volume to Capacity Ratio
U.S 95 near the Mercury Interchange	3,110	199	0.14

Source: DOE 2003b.

4.3.12.3 *Aircraft Operations*

NTS has four airstrips (including the Desert Rock Airport with a runway capable of accepting jet aircraft in Area 22 in the south of the NTS and Yucca Lake Airstrip, Pahute Air Strip and Area 6 Aerial Operations Facility), and is adjacent to the Nevada Test and Training Range. NTS also benefits from ready access to McCarran International Airport in Las Vegas. There are also two Air Force bases in the vicinity of the NTS: Nellis Air Force Base in Las Vegas and Creech Air Force Base in Indian Springs.

4.3.12.4 *Transportation Accidents*

Incidents, issues, and corrective actions regarding transportation of radioactive waste to and from NTS are tracked in the NTS Annual Reports. These reports can be accessed via the DOE/NNSA Nevada Site Office webpage. In 2003, there were no incidents reported; two in 2004; and one in 2005. There were no serious injuries or loss of containment in any of the three incidents listed (DOE 2004a, 2005b).

Table 4.3.12-2 provides crash statistics for the three-county area in the vicinity of NTS. The data provided is for Calendar Year 2002.

Table 4.3.12-2—Nevada Traffic Accidents in Clark and Nearby Counties, 2002

County	Total Crashes	Total AVM	Crash Rate in MVM	Total Injuries	Total Fatalities
Clark	45,748	12,108,907,355	3.78	24,666	213
Lincoln	163	118,543,162	1.38	69	11
Nye	587	349,626,311	1.68	323	23
Total for Nevada	62,237	19,219,813,538	3.24	31,522	381

AVM=automated vehicle monitoring; MVM=motor vehicle miles.
Source: NVDOT 2006.

4.3.13 Waste Management

DOE Order 435.1, Radioactive Waste Management, requires that DOE radioactive waste management activities be systematically planned, documented, executed, and evaluated. NTS is a designated receiving site for LLW under the Waste Management ROD. 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 Area 5 RWMS; and
- Characterization, visual examination and repackaging of TRU waste at the Waste Examination Facility (WEF) at the Area 5 Radioactive Waste Management Complex (RWMC) (i.e., the WEF and the Area 5 RWMS combined).

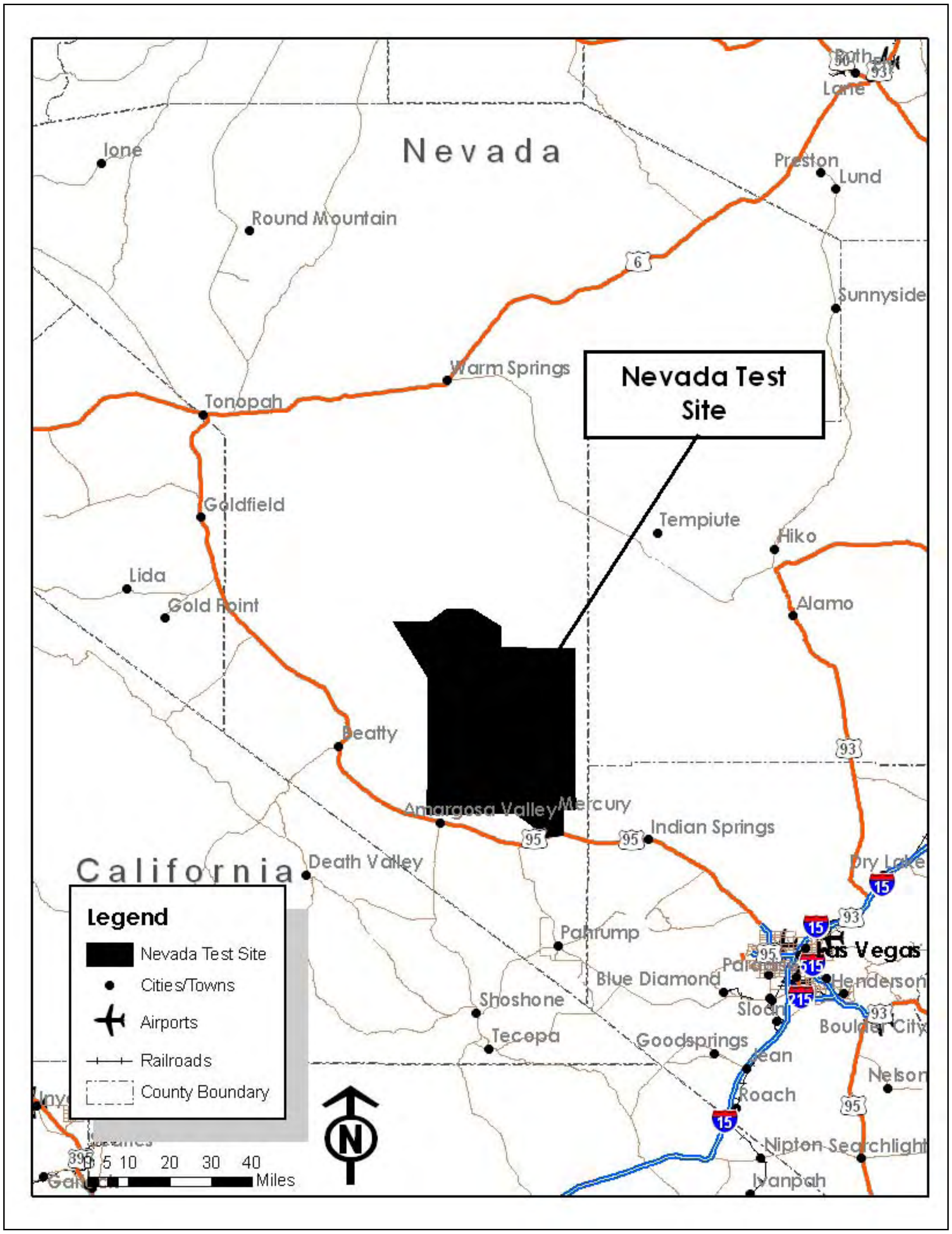


Figure 4.3.12-1—Roads in the Vicinity of NTS

NTS manages the following types of waste: TRU waste, including mixed TRU waste; LLW; mixed LLW; hazardous waste; and sanitary waste. Annual routine waste amounts are presented in Table 4.3.13-1.

Table 4.3.13-1 — Annual Routine Waste Amounts

Waste Type	1996	1997	1998	1999	2000	2001	2005
Transuranic	0	0	0	0	0	0	0
Low-level	0	0	0	7.1	0.46	0	1,055
Mixed	0	0	0	0	0	0	0
Hazardous[a] (tons)	46	11	50.2	14	24.5	4.86	NA
Non-Hazardous Sanitary[b] (tons)	4,550	2,280	6,460	7,460	5,080	4,550	NA

[a]Includes state-regulated waste. Hazardous waste reported in metric tons.
[b]From DOE 2002o (1996 data) and DOE's Central Internet Database. Sanitary waste reported in metric tons.
Source: DOE 2002o.

4.3.13.1 *Low-Level Waste and Mixed Low-Level Waste*

The Mixed Waste and LLW facilities are 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; and
- 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 RWMS receives LLW generated within the DOE complex from numerous DOE sites across the United States, LLW from Department of Defense (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 8 feet thick, as rows of containers reach approximately 4 feet below the original grade. The Area 5 RWMS includes 200 acres of existing and proposed disposal cells for burial of both LLW and LLMW, and approximately 500 acres of land available for future radioactive disposal cells. Waste disposal at the Area 5 RWMS has occurred in a 92 acre 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. 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 (NTS 2006a).

In 2005, the Area 5 RWMS received shipments containing 48,169 cubic yards of LLW for disposal. The Area 3 RWMS received shipments containing 12,576 cubic yards of LLW. The majority of disposed LLW was shipped from offsite. A total of 1,055 cubic yards of LLW disposed in 2005 was generated onsite.

4.3.13.2 *Transuranic Waste*

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.

4.3.13.3 *Hazardous Waste*

NTS has a permit to store hazardous wastes that have been generated at the NTS in containers on a pad specifically designed for waste storage. The Hazardous Waste Storage Unit (HWSU) is a pre-fabricated, rigid steel framed, roofed shelter which is permitted to store a maximum of 16,280 gallons of approved waste at a time. In 2005, a total of 38,228 pounds of hazardous wastes were received at the HWSU for temporary storage and 27,172 pounds were shipped offsite from the HWSU. The hazardous wastes managed at the HWSU in 2005 included drums of liquid polychlorinated biphenyls. In 2005, a total of 27,140 pounds of hazardous wastes were shipped offsite from SAAs. No hazardous wastes storage limits were exceeded (NTS 2006a).

The RCRA Hazardous Waste Operating Permit also covers operations at the Explosive Ordinance 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 hazardous wastes. The permit allows a maximum of 100 pounds 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.

NTS also manages waste containing PCBs regulated under TSCA. Regulated PCB waste is not generated during operations, but could be generated during remediation and decommissioning activities. Currently, PCB-contaminated mixed and LLW are stored on the TRU Waste Storage Pad in a designated area outside of the TRU Pad Cover Building. PCB-contaminated hazardous waste can be stored in the HWSU. Treatment and disposal options for the PCB wastes are available; therefore, the wastes are shipped offsite when sufficient quantities have accumulated.

4.3.13.4 *Nonhazardous Waste*

The NTS has three landfills for solid waste disposal that are regulated and permitted by the state of Nevada. 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; and
- 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 area.

These landfills are designed, constructed, operated, maintained, and monitored in adherence to the requirements of their state-issued permits. An average of 2.1 tons per 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 (NTS 2006a).

Wastewater at NTS is disposed either by a septic system or a lagoon system. Sewage lagoon systems are used at Area 23 Area 6, while septic systems are used for wastewater disposal at the remaining areas. Sludge removed from the systems is disposed in the Area 23 sanitary landfill or the Hydrocarbon Disposal Site, depending on hydrocarbon content. At areas not serviced by a permanent wastewater system, portable sanitary units are provided. Review of the historic flow records and design capacities by DOE did not indicate impacts to wastewater capacity beyond permit and design limitations (DOE 2002i).

4.4 TONOPAH TEST RANGE

TTR is located on approximately 179,200 acres (280 square miles) within the boundaries of the Nevada Test and Training Range (NTTR) (Figure 4.4-1) and is used to support DOE/NNSA and USAF activities and missions.

Current NNSA activities at TTR include:

- Stockpile reliability testing,
- Research and development testing support of structural development,
- Arming, fuzing and firing testing,
- Testing nuclear weapon delivery systems (does not include nuclear devices), and
- Environmental Restoration.

SNL utilizes a wide array of instruments to characterize performance parameters on projectiles in air for artillery, missiles, rockets, and drops from aircraft. No nuclear devices are tested at TTR (TTR 2006). No Category I/II quantities of SNM are normally maintained at TTR.

4.4.1 Land Use

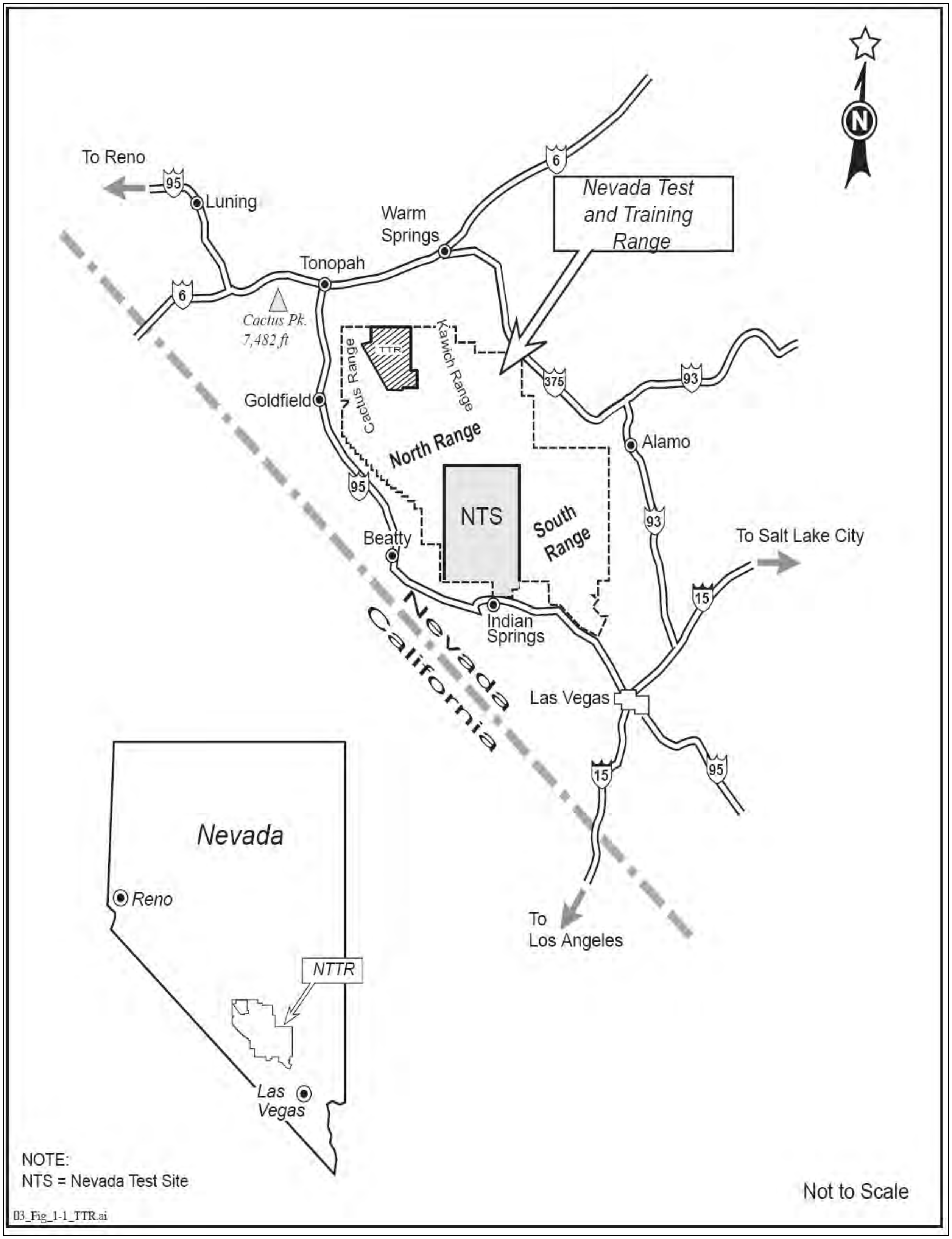
4.4.1.1 *Onsite Land Use*

In 1957, the Atomic Energy Commission (AEC) established TTR on lands withdrawn in 1940 when President Roosevelt established the Las Vegas Bombing and Gunnery Range. During World War II, the USAF used playas and other areas in Cactus Flat for aerial gunnery and bombardment training.

In April 2002, a Land Use Agreement was signed between the USAF and the NNSA entitled, “Department of the Air Force Permit to the NNSA To Use Property Located On The Nevada Test and Training Range, Nevada.” The current size of TTR is approximately 179,200 acres. Prior to the April 2002 lease agreement, the footprint was 335,655 acres (TTR 2006).

TTR is located within the NTTR at the northern boundary. With minor exception, TTR is used by the DOE as a research, design, and testing ground for defense-related activities. The eastern portion of TTR is designated as part of the 394,000 acres Wild Horse Range that is located in the north portion of the NTTR Complex. The Nevada Wild Horse Range is managed by the BLM under a 1974 cooperative agreement in compliance with the Wild Horse and Burro Act of 1971.

Area 3 of TTR contains the majority of administrative and industrial facilities. Within this area is the fenced technical compound of SNL. The facilities within the compound are administrative and research-related facilities.



Source: TTR 2006.

Figure 4.4-1—Location of TTR

Area 9 of TTR contains all facilities that directly support the NNSA weapons testing program. Rocket launchers, Davis gun support equipment, and weapon storage facilities are located in this area. Additionally, ground-to-air related tests are initiated from this facility. Main Lake is the primary target area for missiles and air drops. There are four targets on Main Lake, all located along the fight path. The soft target is a series of concentric circles scraped on the ground located just south of Main Lake and Edwards Freeway. It has been used for air-to-ground gunnery and contains depleted uranium (DU) projectiles. The hard target is a flat circular area 700 feet in diameter and constructed of poured concrete slabs. The target is instrumented and gridded to assess targeting accuracy of bombs and missiles. Only dummy warheads are used at this site in order to minimize damage to the target. Most tests are conducted at Antelope Lake Target and Mod 11 targets and will probably be the test bed of choice once lay downs are no longer required.

Area 10 of TTR is occupied by the USAF Northern Remote Base. These facilities include the industrial area and housing area. The remaining land on the TTR is open and used for testing and military training programs. All uses of the TTR are coordinated activities between DOE and the USAF to ensure they are within scope of the land use of the area (DOE 1996b). There are no prime farmlands on TTR.

TTR contains approximately 105 major buildings, providing a gross 161,505 square feet of space. TTR facilities also include approximately 90 smaller buildings, including towers and small sheds (DOE 1996b).

4.4.1.2 *Surrounding Land Use*

The area north of the TTR boundary is sparsely populated public lands administered by both the BLM and the USFS. The land is currently used to graze cattle. There is a substantial irrigated farming operation to the north of the range as well. To the east, west, and south of TTR, and within the NTTR, is the Nevada Wild Horse Range, which is also administered by the BLM.

The nearest residents are located in the town of Goldfield (population 659), approximately 22 miles west of the site boundary. The town of Tonopah (population 4,400) is approximately 30 miles northwest of the site (TTR 2007). Las Vegas, Nevada, is 140 miles southeast of TTR. The total population within the 50 mile radius around TRR is approximately 7,000, which includes the potential population at TTR if all housing units at the site were occupied (TTR 2007).

4.4.2 Visual Resources

The topography at TTR is characterized by a broad flat, valley bordered by two north and south trending mountain ranges; the Cactus Range to the west (occurring mostly within the boundaries of TTR) and the Kawich Range to the east. Cactus Flat is the valley floor where the main operational area of TTR is located. An area of low hills outcrops in the south. Elevations within TTR range from 5,347 feet at the valley floor to 7,482 feet at Cactus Peak. The elevation within the town of Tonopah is 6,030 feet (TTR 2007).

On the south, Cactus Flat is separated from Gold Flat by the volcanic hills around Gold Mountain (about 6,000 feet) and a low topographic divide through the alluvium to the east. Stonewall Flat is bounded on the south by Stonewall Mountain, which has a maximum elevation of 8,275 feet. On the west, Stonewall Flat is bounded by the Goldfield Hills, which rise to an elevation of almost 7,000 feet. On the valley floors of both basins, the dominant features are a number of small playas and the many washes that drain the upland areas (DOE 1996b).

Good views of the facility can be had from a hill northwest of the main entrance, on public BLM land. The access road to the facility is marked with a small missile and a sign on Route 6, ten miles east of Tonopah (DOE 1996b).

The landscape character of TTR is similar to the higher elevation areas of NTS. TTR is visible only from an access road off U.S. Highway 6; therefore, visual sensitivity would be low. Lands within TTR have a BLM Visual Resource Management rating of Class II or III (see Table 4.4.2–1 for definitions of each class). Changes to the landscape within these classes may be seen, but should not dominate the view. Developed areas within the site are consistent with a Visual Resource Management Class IV rating in which management activities dominate the view and are the focus of viewer attention.

Table 4.4.2-1—BLM Visual Resource Management Rating System

Class	Objective
Class I	To preserve the existing character of the landscape, the level of change to the characteristic landscape should be very low and must not attract attention.
Class II	To retain the existing character of the landscape, the level of change to the characteristic landscape should be low.
Class III	To partially retain the existing character of the landscape, the level of change to the characteristic landscape should be moderate.
Class IV	To provide for management activities which require major modification of the existing character of the landscape, the level of change to the characteristic landscape can be high.

Source: BLM 1980.

4.4.3 Site Infrastructure

Utilities at TTR include water systems, wastewater systems, and electrical systems. Table 4.4.3-1 provides an estimate of the current usage of various utilities at TTR. A number of water wells have been drilled on or near TTR to supply water to the facility (DOE 1996b). The water use (for entire TTR, including Air Force) for operations is approximately 6 million gallons per year (NNSA 2007).

Electrical System Power to DOE facilities at TTR is supplied by the Sierra Pacific Power Company. Sierra Pacific has two supply lines to TTR: one is 120 kilovolt (kV), and a backup line is 60 kV. Sierra Pacific transformers step the voltage down to 13.8 kV for the DOE distribution system.

Table 4.4.3-1—Baseline Characteristics for TTR

Resource	Current Usage
Land	
Area (mi^2)	280
Electrical	
Energy consumption (MWh)	595
Peak Demand (MWe)	812
Steam	
Other process gas (ft^3)	480
Fuel	
Diesel generators	44
Water	
Usage (yearly for entire range including AF) (million gal)	6

Source: NNSA 2007.

4.4.4 Air Quality and Noise

4.4.4.1 *Air Quality*

TTR is located in Nye County, Nevada, which is in attainment for all criteria pollutants except for a portion of the Pahrump Valley, near the California-Nevada border and southwest of TTR. TTR and its surrounding area are in attainment, and meet the criteria for air quality.

4.4.4.1.1 Meteorology and Climatology

The climate at TTR is typical of high desert, mid-latitude locations, with large diurnal and seasonal changes in temperature, and little total rainfall. Temperature extremes on the test range can vary from a high near 104ºF in the summer and approach -22ºF in the winter. July and August are the warmest months with daily highs ranging in the 90sºF and in the 50sºF in the evenings. January conditions vary from highs in the 40sºF to lows in the teens (ºF). Rainfall is dependent on elevation. Annual average rainfall on the desert floor is 4 inches, with as much as 12 inches falling in the mountains (TTR 2007).

4.4.4.1.2 Ambient Air Quality

TTR is located within Nevada Intrastate Air Quality Control Region 147. Air Quality Compliance at TTR is met by adherence to specific permit conditions and local, state, and federal air regulations. Ambient air quality monitoring is not currently required at TTR. Ambient air monitoring was last conducted in 1996 to ascertain the level of radiological constituents in the air (TTR 2007).

4.4.4.1.3 Radiological Air Emissions

Radiological air emissions are regulated by NESHAP under the CAA. Operations at TTR do not involve activities that release radioactive emissions from either point sources or diffuse sources such as outdoor testing. The only radionuclide sources at TTR are the three Clean Slate Sites, which are potential sources of diffused radionuclide emissions if there is re-suspension of contaminated soils. These sites are currently being addressed by DOE/NNSA/NSO under the ER Project.

Because EPA requires continuous air monitoring for any radionuclide source that contributes a dose in excess of 0.1 mrem/yr to the MEI, SNL instituted continuous air monitoring at a TTR site for one year from February 22, 1996 to February 25, 1997. The monitoring site was chosen at the TTR Airport, the location of the highest calculated dose for a member of the public. The dose assessment result from the monitoring was 0.024 mrem/year. This was about four times less than the 0.1 mrem/year threshold cutoff for which continuous monitoring would be required by EPA. The average air concentration in curies per cubic meter (Ci/m^3) were measured as follows:

AM-241	4.1×10^{-18} Ci/m^3
Pu-238	1.6×10^{-18} Ci/m^3
Pu-239/240	9.5×10^{-19} Ci/m^3

The 0.024 millrem dose rate is a NESHAPs compliance calculation (e.g., 10 millirem per year limit). The calculation is based on a MEI located at the TTR Airport (the highest calculated dose for a member of the public). This calculation only accounts for radionuclide air emissions. The 1,000 picocuries per gram level equates to a less than 25 millirem per year dose to the MEI for the specific military land use scenario. This calculation includes inhalation, ingestion, and external exposure pathways. Although an annual calculated dose assessment is not required for the site, SNL continues to produce an annual NESHAP report for TTR. Future TTR activities are not expected to change; however, if new sources or modifications to the existing sources are anticipated, they will be evaluated for NESHAP applicability (TTR 2007).

4.4.4.1.4 Nonradiological Air Emissions

The TTR Class II Air Quality Operating Permit was renewed in CY 2006. There are currently two sources that are not exempt at the facility, including the screening plant and the portable screen (TTR 2007). In 2005, the reported emissions from TTR activities were 0.001 tons per year of total particulate matter from the permitted portable screen (TTR 2006). In 2006, there were no emissions reported to the State of Nevada because neither of these two sources were used in that year (TTR 2007).

4.4.4.2 *Noise*

The acoustic environment around TTR and the NTTR Complex can be classified as uninhabited desert or small rural communities. The primary source of noise on TTR and the NTTR Complex is from the DOE and USAF aircraft operations and ordnance testing. The highest levels of noise are centered on the flight lines, with noise levels decreasing for sites or receptors located away from the flight line (USAF 2007). Because the public is prohibited from entering TTR and the NTTR Complex, public exposure to these noise sources is limited to occasional sonic booms produced by supersonic overflights of military aircraft (DOE 1996b).

4.4.5 Water Resources

4.4.5.1 *Surface Water*

There is no permanent surface water in Cactus Flat and few springs in surrounding ranges. Surface flow occurs only during and immediately after heavy rains. Drainage is internal, direct toward playas by sandy ephemeral washes. Playas such as Antelope Lake and Main Lake may contain water for brief periods during water years, but seldom, if ever, contain water year-round.

Drainage patterns within and near TTR are intermittent and end in closed basins. Ephemeral streams occasionally carry spring runoff to the center of Cactus Flat where there is a string of north-south trending dry lakebeds (USAF 2007).

There are several small springs within the Cactus and Kawich Ranges. Three springs occur within TTR boundaries: Cactus, Antelope, and Silverbow Springs. Water from these springs does not travel more than several tens of meters dissipating rapidly through evaporation and infiltration (TTR 2006).

4.4.5.1.1 Surface Water Quality

The quality of surface water on TTR is generally good and is suitable for domestic purposes, livestock, wild horse, and wildlife use. Wastewater monitoring results confirmed that all permit conditions set by the State of Nevada were met in 2006 (TTR 2007). Additional monitoring for Di (2-ethylhexyl) Phthalate is required by the State of Nevada because it was detected above the detection limit in a sample. This monitoring will continue to be required until 2-ethylhexyl is undetected in two consecutive quarterly samples. In 2006, all secondary containment sample results were within the State of Nevada defined maximum containment levels with the exception of iron and potential of hydrogen (pH) (TTR 2007).

At TTR, wastewater is discharged to the sewer system connected to the USAF sewage lagoon and to six septic tank systems. The USAF holds the National Pollutant Discharge Elimination System (NPDES) permit for TTR wastewater discharges. There were no excursions or other permit violations in 2006 with respect to wastewater discharges (TTR 2007).

4.4.5.1.2 Surface Water Rights and Permits

The TTR site is primarily a closed basin with runoff evaporating or infiltrating to the ground. The USAF has permitted its airfield and Area 10 for storm water runoff. Defense-related surface water rights represent approximately 148 acre-feet. Currently, Sandia Corporation has no requirement to perform storm water monitoring at TTR. All storm water issues and monitoring are managed by the USAF (TTR 2007).

4.4.5.2 *Groundwater*

TTR encompasses portions of 5 hydrographic basins that comprise portions of 2 regional groundwater flow systems. Past DOE operations have been concentrated in two areas: in the lowland portions of Cactus Flat and in Stonewall Flat. Groundwater that originates as precipitation over the Kawich Range flows west and then southwest under TTR, ultimately discharging in Death Valley as springs and evapotranspiration. Some groundwater may flow northwest off TTR and into the Southern Marshes flow system, with discharge at Mud Lake, Alkali Flat, and Clayton Valley (DOE 1996b).

There are three active wells used by TTR; Production Well 6, Well 7, and the Roller Coaster Well. Production Well 6, which supplies drinking water to the TTR Main Compound in Area 3, is the only well that has been sampled for contaminants. Outlying areas and buildings without water service use bottled water. The other wells are not used for potable purposes (construction and dust suppression), and there is no regulatory sampling requirement (TTR 2007).

The USAF Public Water System has provided water to the Area 3 compound from January 24, 2007 and into 2008 while awaiting design, approval and installation of a ne pH adjustment system that uses carbon dioxide instead of concentrated hydrochloric acid (TTR 2008).

4.4.5.2.1 Groundwater Quality

Groundwater has not been impacted by contaminants from any of the Corrective Action Units at TTR. The depth to ground water (100 to over 500 feet), low rainfall, and high evaporation limit infiltration. The small quantities of liquid water that may have been disposed of or released will therefore attenuate in the soil and are unlikely to affect groundwater. Soil samples were sampled for explosive residues from unexploded ordnance remedial activities. No reference can be found for groundwater sampling for perchlorate.

The nuclear safety tests conducted at the Clean Slate sites have resulted in surface soil contamination. Although groundwater contamination has not been detected at these sites, there is the potential for downward migration of some contaminants into the water table. Other potential sources of groundwater contamination include french drains, septic tanks and leachfields, underground storage tanks, landfills, and sewage lagoons (DOE 1996b). Radiological contaminants found on the surface due to nuclear safety tests conducted at the Clean Slate sites include plutonium isotopes, uranium isotopes, and daughter products.

4.4.5.2.2 Groundwater Availability

Groundwater at TTR has been used for domestic, industrial, and construction purposes. Groundwater is pumped from a number of wells, depending on the location of range activities and the total demand for water.

There are about 15,000 acre-feet (4.9 billion gallons) per year of water rights in the five hydrographic basins associated with TTR. Approximately 10,300 acre-feet (3.3 billion gallons) per year of this total are surface water rights; the remainder [almost 4,700 acre-feet (1.5 billion gallons)] represents groundwater rights. Currently, defense-related Federal water rights total 1,775 acre-feet (578 million gallons) per year, of which only 148 acre-feet (48 million gallons) are surface water rights. Table 4.4.5-1 lists the water yield and resources for each of the basins that encompass portions of TTR. Federal water rights are limited to two basins, Cactus Flat and Stone Cabin Valley and total 200 acre feet (65,170,200 gallons) per year. Both basins are over appropriated; i.e., the appropriations exceed the perennial yield in each basin. It is unlikely that additional water rights can be obtained in the area without groundwater mining (the removal of groundwater from storage).

Table 4.4.5-1—Water Rights Status for Hydrographic Basins at the TTR

Hydrographic Basin Number and Name	Perennial Yield (acre-feet)	Total Committed Groundwater Resources (acre-feet)	Comments
Ralston Valley	6,000	1,917	Basin designated by Order 742, Notice of Curtailment by Order 752. No TTR water rights or use.
Stonewall Flat	100	12	No TTR water rights or use.
Gold Flat	1,900	95	Estimated TTR water rights are 40 ac-ft.
Cactus Flat	300	619	Estimated TTR water rights are 160 ac-ft. [
Stone Cabin Valley	2,000	2,033	Basin designated by Order 720. Estimated TTR water rights are 240 ac-ft

Source: DOE 1996b.

4.4.6 Geology and Soils

TTR is situated in the Basin and Range physiographic province between the elevations of 5,500 and 7,800 feet. TTR occupies the broad, nearly flat Cactus Flat valley between the Cactus Range on the west and the Kawich Range on the east. Valley floor elevations average about 5,300 feet above mean sea level. Elevations in the Cactus Range reach nearly 7,500 feet, and the Kawich Range has peaks that reach over 9,400 feet. The ranges are rocky, rugged, with steep slopes and cliffs. Valleys are narrow and have steep gradients, but generally drain only small watersheds.

4.4.6.1 *Geology*

The general geology of the area is comprised of two major geologic units, alluvium and volcanic rocks. Intrusive igneous rocks and a few isolated outcroppings of Paleozoic sediments occur in the Cactus Range.

Alluvial fans are present at the mouth of the range canyons. Fans commonly coalesce to form bajadas that slope from the range to the basin center. These landforms are characterized by relatively smooth surface of uniform gradient, usually between 2 percent and 6 percent. Older fans or bajadas may be incised by ephemeral streams (washes), with younger fans forming nearer to the valley center.

The total thickness of alluvium is unknown. Exploratory drilling in Cactus Flat indicates that the thickness exceeds 1,000 feet. The alluvium is primarily coarse- to medium-grained and is derived from the volcanic rocks of the highlands that have been transported by fluvial and eolian processes from the adjacent highlands.

Volcanic rocks of the Cactus and Kawich Ranges are estimated to be as thick as 20,000 feet (TTR 2006). The Tertiary volcanics are composed of a series of welded and nonwelded ash-flow tuffs and basalts, andesites, dacites, and rhyolites. The Kawich Range is bounded on the east by normal faults. The northern part of the range (adjacent to TTR) is primarily composed of Tertiary tuffs, lavas, and intrusions of Miocene tuff. The Cactus Range is bounded by an elliptical ring of fractures that suggests a collapsed caldera. Some of these fractured areas were subsequently intruded with stocks, sills, and dikes. The central part of the range comprises minor Paleozoic sediments, a small granite mass, and a thick sequence of widespread Tertiary volcanic rocks. The hills to the south of Mellan comprise a series of lava ridges separated by valleys of tuff. The hills are capped with rubble formed from weathering and breccias in the lava piles, and breccias formed by the structural deformation (faulting and tilting) of the lava ridges (DOE 1996b).

The central axis of the Cactus Flat basin is marked by discontinuous series of playa (dry) lakes. Main Lake lies at the north end and Antelope Lake is at the south end of this group of playas. These playas collect water during wet periods. Playas drain largely by evaporation; there is no external drainage from Cactus Flat.

The geologic resources of TTR include metals, industrial minerals, and aggregate. The TTR has been the site of historic mining at the Silver Bow, Antelope Springs, Cactus Springs, Wilsons, and Mellan mining districts. TTR is also adjacent to a number of other mining districts, most notably the Goldfield, Gold Crater, Golden Arrow, Stonewall, Gold Reed, and Jamestown districts. Appreciable quantities of silver and gold have been produced from the Silver Bow district. The Antelope Springs district produced silver and minor amounts of gold. The Cactus Springs district produced small quantities of silver, and there are reports of turquoise, gold, and copper in the area. The Wilsons district produced small quantities of gold and silver in the early 1900s. Minor production of gold and silver came from the Mellan district. Of these areas, only the Silver Bow district is classified as having high potential for locatable minerals (DOE 1996b).

Immediately to the east of the Goldfield district in the area between TTR and Goldfield, there is moderate to high potential for the occurrence of quartz-alunite gold deposits. Although gold, silver, and lead have been produced from the Gold Crater and Stonewall districts, production from these areas had ceased by the mid-1930s, and the remaining potential for mineral resources is low.

No geothermal resources have been identified at TTR, and the potential for oil and gas resources is considered low. There are no reported occurrences of coal, tar sands, or oil shale on TTR or adjacent areas on the NTTR Complex. Similarly, no economic deposits of industrial minerals have been identified. Tertiary volcanic rocks and tuffaceous sedimentary rocks of silicic compositions occur on TTR and the NTTR Complex. Uranium host environments are located elsewhere in the Great Basin, but have not been identified at TTR (DOE 1996b).

The aggregate resources of TTR are considerable. Sand and gravel deposits are present, and the quality and quantity of these resources are likely to be sufficient to meet future demands for construction, roads, and other uses. The aggregate resources do not have any unique value compared to other areas throughout southern Nevada (DOE 1996b).

4.4.6.2 *Soils*

Approximately 15 percent of the soil survey is comprised of mountainous terrain with the remaining portion consisting of alluvial fans, ephemeral washes, valley floors, and dry lake beds. The soil parent material consists of a variety of igneous and sedimentary rock with rhyolitic tuffs and ignimbrite being the most common rock. The soils of TTR and adjacent areas can be separated into four general categories based primarily upon the following physiographic position (DOE 1996b);

- Valley bottoms,
- Dry lake beds (i.e. playas),
- Upper erosional portion of the alluvial fans,
- Mountains and hills.

The valley bottom and dry lake bed soils occur in the central portions of both Cactus and Stonewall Flats. These very deep, poorly drained saline and alkali, fine-textured soils occur on slopes of generally less than 1 percent. These low-lying areas are usually points of groundwater discharge. Therefore, depth to groundwater is usually fairly shallow and is manifested by discharging springs or plants that indicate in shallow water table (i.e., usually within 50 feet below ground surface). These plants are called phreatophytes with greasewood being the most common in the area. There is periodic flooding from runoff and the shrink-swell potential is generally high due to the abundance of smectitic clays. This can present problems with most construction projects. The corrosion hazard for steel and concrete is high due to the high concentrations of salts. Soil families include Typic Salorthids (e.g., Saltair soil series) and Typic Haplaquolls (e.g., Hutton soil series).

The lower, depositional portion of the alluvial fan consists of deep to very deep, well-drained, very coarse (coarse sand) to medium-textured (very fine sandy loam/loam) gravelly soils that occur on slopes ranging from gently sloping 2 to 4 percent) to strongly sloping (8 to 15 percent) slopes. The coarser-textured, very gravelly to extremely gravelly soils are located in the ephemeral washes (i.e., arroyos) and are subject to periodic flash floods.

The upper, erosional portion of the alluvial fan consists of older, very shallow (less than 10 inches thick) to moderately deep (between 20 and 40 inches in thickness) moderate to well drained, very coarse (coarse sand) to medium textured (very fine sandy loam/loam) gravelly to extremely stony soils. Some soils contain an old, well developed, fine textured (i.e., high in clay) subsoil called an argillic horizon. The presence of a duripan is common and is usually found between 15 and 30 inches) below the ground surface, however, in some areas may be exposed at the surface. Slopes range from moderately sloping (4 to 8 percent) to moderately steep (15 to 30 percent). Soil families include Xerollic Durorthids (e.g., Ursine soils series) and Xerollic Duragids (e.g., Ratto, Olson, Indian Creek, and Deer Lodge soil series) (DOE 1996b).

The upland mountains and hills consist of rock outcrops, areas with excessive stone, or very steep eroded slopes that generally contain a thin mantle of alluvial or colluvial soils usually less than 10 inches. These soils can range in texture from coarse to fine, gravelly to extremely stony, and are dependent upon primarily age and parent material for textural composition. Slopes generally range from moderately steep (15 to 30 percent slopes) to extremely steep (greater than 75 percent). These soils usually have a severe erosion hazard because of their slopes and runoff is generally rapid (DOE 1996b).

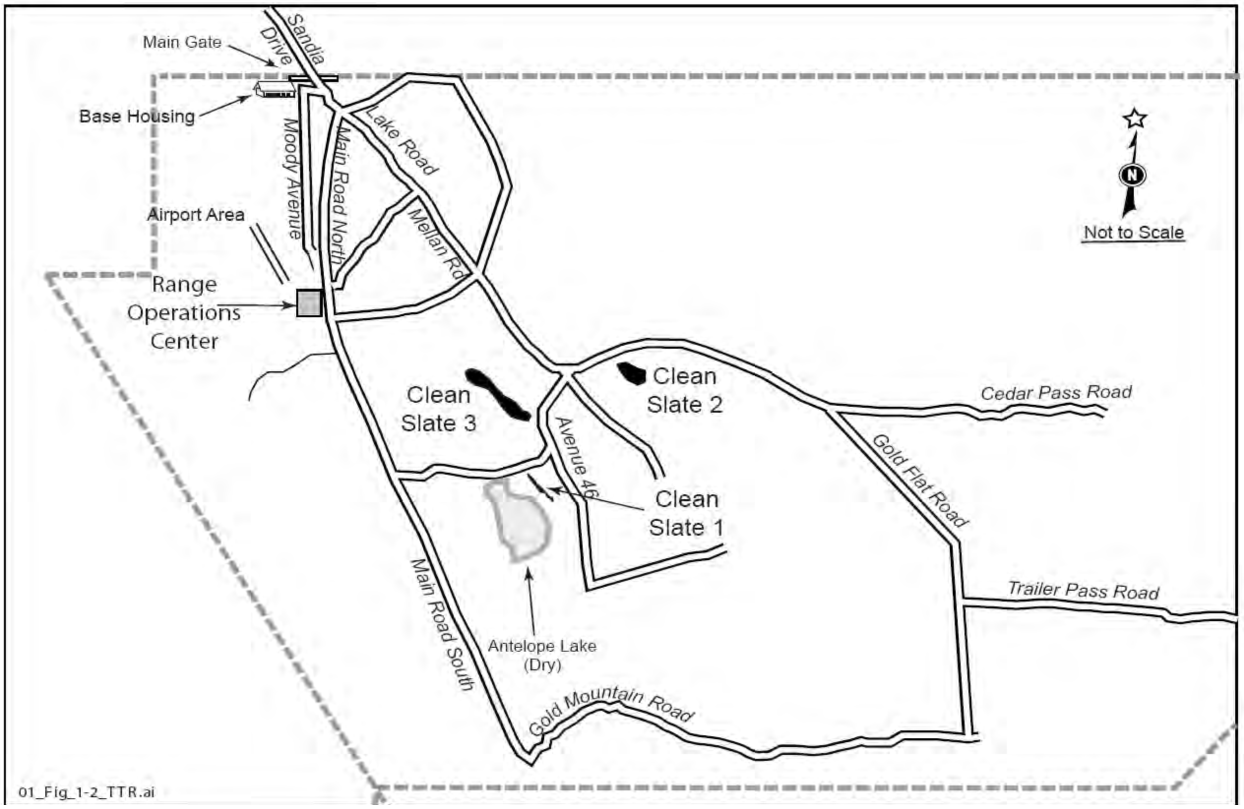
4.4.6.2.1 Past Soil Contamination

The historical impacts on soils as a result of past actions have been considerable and, in some instances, these impacts are considered significant. Lesser impacts include excavation of soils for roads and structures, alteration in nature drainages and erosion regimes, and the contamination of soils. This section describes the baseline soils conditions at TTR.

TTR was never used for detonation of nuclear weapons. However, in 1963 the AEC carried out project Roller Coaster. This operation involved four nuclear weapons destruction tests that dispersed plutonium in TTR soils with conventional explosives. Three of these tests were performed within TTR boundary. The fourth was conducted at NTTR. These were formally titled Storage-Transportation tests that were conducted to evaluate the safety of nuclear weapons in storage or transportation accident scenarios. All of the Project Roller Coaster tests had zero yield. The safety tests used mixtures of plutonium and uranium that were subjected to detonations of conventional explosives. Concurrent with and after these detonations, extensive studies were conducted to understand the dispersal and transport of these isotopes in the environment, including uptake by plants and animals. The immediate effects of the tests included the dispersal of plutonium and uranium over significant areas. On TTR, almost 670 acres were contaminated, with an estimated remaining inventory of about 65 curies.

The three Project Roller Coaster test sites at TTR are referred to as Clean Slate 1, 2, and 3 (Figure 4.4.6-1). The fourth test site at NTTR is referred to as Double Tracks. In 1996, Double Tracks was closed after soil contamination was remediated to a level of 350 picocuries per gram and less than 25 millirem per year dose rate. The 350 picocuries per gram remediation is based on the farmer rancher land use scenario. The 25 millirem per year dose is DOE's recommended release criteria for real property (DOE 1996b).

The Double Tracks Test was conducted in the North Range of NTTR, west of TTR. An environmental assessment analyzing the potential environmental effects of four remediation alternatives was completed for the Double Tracks Site in April (DOE 1996). During preliminary characterization at the site, several pieces of highly radioactively contaminated metal were located, retrieved, and placed in a drum at the site. Between 998 and 1,588 g (2.2 and 3.5 lbs) of plutonium were spread during the test. That characterization showed a contamination of 200 picocuries per gram or higher, affects approximately 2.5 acres. A single plutonium dispersal test conducted in 1957, referred to as Project 57 was conducted on the Nellis Air Force Range (later changed to the Nevada Test and Training Range, and then Tonopah Test Range for the portion leased to NNSA) in Area 13 (DOE 1996b).



Source: TTR 2007.

Figure 4.4.6-1—Clean Slate 1, 2, and 3

DOE/NNSA/NSO is responsible for the closure of the Clean Slate test sites and all other ER Program sites at TTR. The initial cleanup of each Clean Slate site was conducted shortly after each test. Test-related debris was bladed into a hole at test ground zero and backfilled. An initial fence was built around each test area where the soil contamination was set at approximately 1,000 micrograms per square meter of plutonium. The soil survey was conducted on 61-meter grids with a hand-held survey meter or field instrument for the detection of low-energy radiation. In 1973, additional outer fences were set at 40 picocuries per gram of plutonium in soil also using the hand-held meter method. Areas are evaluated and fences inspected periodically to monitor and curtail potential migration. Horses found within the fenced areas are relocated (TTR 2007).

In 1993, an aerial radiological survey was performed by EG&G, Inc. for the Nevada Applied Ecology Group (NAEG) (EG&G 1995). The aerial radiological surveys were conducted to supplement the field instrument, for the detection of low energy radiation and previous soil sample measurements of transuranics. The objective was to determine the extent of surficial distribution of plutonium and other transuranic elements dispersed during the Project Roller Coaster tests. Radiation isopleths showing soil activity due to americium-241 (Am-241), plutonium-239 (Pu-239), and plutonium-240 (Pu-240) were drawn for each area. The cumulative area of the diffuse sources, as determined by the aerial radiological survey, was approximately 4,900 acres. The results of the survey found transuranic contamination outside the fenced area in the downwind direction (EG&G 1995). An additional radiological survey was performed in

2006. This survey showed that no additional radiological migration had occurred since the 1993 survey (TTR 2006).

These long-lived radionuclides remain today in the surficial soils in the vicinity of the test areas and are available to be transported by wind and uptake by plants and animals. Extensive research into the mobility of the isotopes has found that wind can transport the contaminants and concentrate them in mounds around desert shrubs, and water can cause plutonium to migrate deeper into the soils with time. The isotopes are now relatively immobile unless the soils are disturbed (URS 2001).

A strategy for closing the radiologically contaminated soils at TTR is in development. Appropriate corrective action levels for radionuclides will be based on a 25 millirem per year dose rate, and will be compatible with future land use scenarios.

Clean Slate 1 is located in the central area of TTR and has been cleaned up to a corrective action level of 350 picocuries per gram and less than 25 millirem per year dose rate, DOE's recommended release criteria for real property. The 350 picocuries per gram remediation is based on the farmer rancher land use scenario.

Clean Slate 2 is located in the northeaster area of TTR and is in a stable configuration awaiting completion of the closure strategy. Clean Slate 3 is located in the south central part of TTR and is in a stable configuration awaiting completion of the closure strategy. As planned, the remediation efforts will be at or below the 1,000 picocuries per gram level at completion.

The 1,000 picocurie standard was an interim clean up standard based on current land use scenarios and does not reflect final clean up requirements. Although costs estimates have been developed for the 1,000 picocuries per gram level, the requirements for cleanup have not been identified by either the Air Force or the Bureau of Land Management (BLM). If cleaned up to this level, the remaining 17 and 18 acres, respectively, will be at or below the 1,000 picocuries per gram level (DOE 1996b, TTR 2006). Assessment activities are expected to continue through FY 2022 with an estimated remediation deadline of FY 2022 (EMIS Life Cycle Baseline Rev 7).

4.4.6.3 *Seismicity*

The eastern part of TTR is located within Seismic Zone 2B, as defined in the Uniform Building Code (ICBO 1991). The western part of TTR is located within Seismic Zone 3. Zone 2B is defined as an area with moderate damage potential, and Zone 3 is an area with major damage potential. Current design practices require facilities to be built to Seismic Zone 4 standards, where there is a one in ten chance of an active volcano occurrence (DOE 1996b).

Seismic activity in the region was characterized more than a decade ago. Naturally occurring seismic events are associated with extensional tectonic activity characteristic of the province. Three major fault zones in the region may be currently active: Mine Mountain, Cane Spring, and Rock Valley. Small earthquakes in the mid-1990s occurred at or near the Cane Spring Fault zone and the Rock Valley Fault zone, although no surface displacement was associated with either of these earthquakes (DOE 1996b). A fault near Little Skull Mountain in the southwest part of the

NTS was the site of a 5.6 magnitude earthquake in 1992. According to the USGS Earthquake database, from 1973 to 1996 there were 714 earthquakes within a 62 mile radius (DOE 1996b).

Additionally, the Yucca Fault in Yucca Flat weapons test basin has been active in the recent geologic past. Surface alluvium along this fault shows displacement of as much as 60 feet. Displacement of this young surface alluvium indicates that movement on Yucca Fault has occurred within the last few thousand to tens of thousands of years; subsurface displacement along this fault is 700 feet. The Carpetbagger Fault lies west of the Yucca Fault within Yucca Flat weapons test basin. In the subsurface, this fault shows about 2,000 feet of displacement in the past 7.5×10^6 years (DOE 1996b).

4.4.7 Biological Resources

4.4.7.1 *Terrestrial Resources*

Temperature extremes and arid conditions of the high desert limit vegetation coverage at TTR. Sparse vegetation that occurs in Cactus Flat is predominantly range grasses and low shrubs typical of the Great Basin Desert flora (TTR 2007).

Vegetation is divided into two basic types at TTR by elevation, salt desert shrub (low elevations) and northern desert shrub (higher elevations) (TTR 2007). Salt desert shrub is characteristic of poorly drained soils and is common along dry lakebeds. Table 4.4.7-1 includes common plant groups and characteristics for basic vegetation types found at TTR.

Table 4.4.7-1—Specific Plants and Characteristics of Basic Vegetation Types at TTR

Vegetation Type	Common Species of Plants	Location Characteristics
Salt Desert Shrub	*Atriplex confertilfolia* (shadscale) *Salsola kali* (Russian thistle) *Artemesia tridentate* (sagebrush)	Characteristic of poorly drained soils and is common along dry lakebeds
Northern Desert Shrub	Variety of sagebrush *Chrysothamnus nauseosus* (rabbitbrush) *Elymus longifolius* (squirrel tail) *Juniperus spp.*(juniper) *Poa nevadensis* (bluegrass)	Found in the Cactus Range

Source: TTR 2007.

The Nevada Wild Horse Range and other wild horse land-use areas compose a significant portion of Cactus and Gold Flats, Kawich Valley, Goldfield Hills, and the Stonewall Mountains. Hundreds of wild horses graze freely throughout TTR and activities onsite have had little affect on the horse population or their grazing habits (TTR 2007).

Other animals common to the area include pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), kit fox (*Vulpes macrotis*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), and gray fox (*Urocyon cinereoargenteus*), mountain lion (*Felis concolor*) and burros (*Equus asinus*) (TTR 2007).

4.4.7.2 *Wetlands and Floodplains*

4.4.7.2.1 Wetlands

TTR is located in an enclosed hydrographic basin with no connections to navigable waters of the U.S. No natural surface water resources are found in the area (USAF 2007). There are no significant wetlands at TTR, however, some very limited wetlands exist in the vicinity of several springs within the Cactus and Kawich Ranges. These provide an important source of drinking water for wildlife in the area. Three springs occur within TTR boundaries; Cactus, Antelope, and Silverbow Springs. Water from these springs does not travel more than several tens of meters dissipating rapidly through evaporation and infiltration (TTR 2007).

4.4.7.2.2 Floodplains

There are no floodplains at TTR (TTR 2007).

4.4.7.3 *Aquatic Resources*

No natural surface water resources are found in the area (USAF 2007). There are no federally designated Wild and Scenic Rivers onsite. There are several small springs within the Cactus and Kawich Ranges. Three springs occur within TTR boundaries: Cactus, Antelope, and Silverbow Springs. Water from these springs does not travel more than several tens of meters dissipating rapidly through evaporation and infiltration (TTR 2007). The habitat at TTR is not suitable to support aquatic species.

4.4.7.4 *Threatened and Endangered Species*

There are 16 species of plants, 1 species of insect, 16 species of fish, 2 species of amphibians, 2 species of reptiles, 4 species of mammals, and 36 species of birds that are Federal and/or state protected occurring within Nye County (TTR 2007). No current Federal threatened, endangered, or candidate plant or animal species have been observed on TTR. A majority of the habitat found at TTR is not suitable for the Federal or state listed species of concern present in Nye County (TTR 2007). Bald eagles and peregrine falcons may be rare migrants. Table 4.4.7-2 displays a list of species potentially occurring in Nye County.

Table 4.4.7-2—Federal and State Listed Species Occurring within Nye County and having the Potential to Occur at TTR

Common Name	Scientific Name	Federal Status	State of Nevada Status
PLANTS			
Sodaville Milkvetch	*Astragalus lentiginosus var. sesquimetralis*	---	State Protected
Halfring Milkvetch	*Astragalus mohavensis var hemigyrus*	SOC	State Protected
Ash Meadows Milkvetch	*Astragalus phoenix*	Threatened	State Protected
Armored Hedgehog Cactus	*Echinocereus engelmannii var. armatus*	---	State Protected

Table 4.4.7-2—Federal and State Listed Species Occurring within Nye County and having the Potential to Occur at TTR (continued)

Common Name	Scientific Name	Federal Status	State of Nevada Status
PLANTS (continued)			
Ash Meadows Sunray	*Enceliopsis nudicaulis var. corrugata*	Threatened	State Protected
Mojave Barrel Cactus	*Ferocactus cylindraceus var. lecontei*	---	State Protected
Sunnyside Green Gentian	*Frasera gypsicola*	SOC	State Protected
Ash Meadows Gumplant	*Grindelia fraxinopratensis*	Threatened	State Protected
Ash Meadows Mousetails	*Ivesia kingii var. eremica*	Threatened	State Protected
Ash Meadows Blazingstar	*Mentzelia leucophylla*	Threatened	State Protected
Amargosa Niterwort	*Nitrophila mohavensis*	Endangered	State Protected
Sand Cholla	*Opuntia pulchella*	---	State Protected
Williams Combleaf	*Polyctenium williamsiae*	---	State Protected
Blaine Pincushion	*Sclerocactus blainei*	SOC	State Protected
Tonopah Pincushion	*Sclerocactus nyensis*	---	State Protected
Hermit Cactus	*Sclerocactus polyancistrus*	---	State Protected
INSECTS			
Ash Meadows Naucorid	*Ambrysus amargosus*	Threatened	---
FISH			
White River Desert Sucker	*Catostomus clarki intermedius*	SOC	State Protected
Moorman White River Springfish	*Crenichthys baileyi thermophilus*	SOC	State Protected
Railroad Valley Springfish	*Crenichthys nevadae*	Threatened	State Protected
Devils Hole Pupfish	*Cyprinodon diabolis*	Endangered	State Protected
Ash Meadows Amargosa Pupfish	*Cyprinodon nevadensis mionectes*	Endangered	State Protected
Warm Springs Amargosa Pupfish	*Cyprinodon nevadensis pectoralis*	Endangered	State Protected
Pahrump Poolfish	*Empetrichthys latos latos*	Endangered	State Protected
White River Spinedace	*Lepidomeda albivallis*	Endangered	State Protected
Moapa Dace	*Moapa coriacea*	Endangered	State Protected
Lahontan Cutthroat Trout	*Oncorhynchus clarki henshawi*	Threatened	State Protected
Big Smoky Valley Speckled Dace	*Rhinichthys osculus lariversi*		State Protected
Ash Meadows Speckled Dace	*Rhinichthys osculus nevadensis*	Endangered	State Protected
Big Smokey Valley Tui Chub	*Siphateles bicolor* ssp. 8	SOC	State Protected
Hot Creek Valley Tui Chub	*Siphateles bicolor* ssp. 5	SOC	State Protected
Little Fish Lake Valley Tui Chub	*Siphateles bicolor* ssp. 4	---	State Protected
Railroad Valley Tui Chub	*Siphateles bicolor* ssp. 7	SOC	State Protected
AMPHIBIANS			
Amargosa Toad	*Bufo nelsoni*	---	State Protected
Columbia Spotted Frog	*Rana luteiventris* pop 3	Candidate	---
REPTILES			
Banded Gila Monster	*Heloderma suspectum cinctum*	SOC	State Protected
Desert Tortoise (Mojave Desert pop.)	*Gopherus agassizii*	Threatened	State Protected
MAMMALS			
Spotted Bat	*Euderma maculatum*	SOC	State Protected
Pygmy Rabbit	*Brachylagus idahoensis*	SOC	State Protected

Table 4.4.7-2—Federal and State Listed Species Occurring within Nye County and having the Potential to Occur at TTR (continued)

Common Name	Scientific Name	Federal Status	State of Nevada Status
MAMMALS (continued)			
American Pika	*Ochotona princeps*	---	State Protected
Kit Fox	*Vulpes macrotis*	---	State Protected
BIRDS			
Northern Goshawk	*Accipiter gentilis*	SOC	State Protected
Golden Eagle	*Aquila chrysaetos*	---	State Protected
Long-eared Owl	*Asio otus*	---	State Protected
Western Burrowing Owl	*Athene cunicularia hypugaea*	SOC	State Protected
Juniper Titmouse	*Baeolophus griseus*	---	State Protected
Ferruginous Hawk	*Buteo regalis*	SOC	State Protected
Swainson’s Hawk	*Buteo swainsoni*	---	State Protected
Sage Grouse	*Centrocercus urophasianus*	---	State Protected
Western Snowy Plover	*Charadrius alexandrinus nivosus*	Threatened	State Protected
Mountain Plover	*Charadrius montanus*	Proposed Threatened	State Protected
Black Tern	*Chlidonias niger*	SOC	State Protected
Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	Candidate	State Protected
Yellow Warbler	*Dendroica petechia*	---	State Protected
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	State Protected
Prarie Falcon	*Falco mexicanus*	---	State Protected
Common Yellowthroat	*Geothlypis trichas*	---	State Protected
Greater Sandhill Crane	*Grus canadensis tabida*	---	State Protected
Pinyon Jay	*Gymnorhinus cyanocephalus*	---	State Protected
Yellow-breasted Chat	*Icteria virens*	---	State Protected
Western Least Bittern	*Ixobrychus exilis hesperis*	SOC	State Protected
Loggerhead Shrike	*Lanius ludovicianus*	SOC	State Protected
Lewis’ Woodpecker	*Melanerpes lewis*	---	State Protected
Long-billed Curlew	*Numenius americanus*	---	State Protected
Macgillivray’s Warbler	*Oporornis tolmiei*	---	State Protected
Mountain Quail	*Oreortyx pictus*	---	State Protected
Flammulated Owl	*Otus flammeolus*	---	State Protected
Osprey	*Pandion haliaetus*	---	State Protected
Phainopepla	*Phainopepla nitens*	---	State Protected
White-faced Ibis	*Plegadis chihi*	SOC	State Protected
Vesper Sparrow	*Pooecetes gramineus*	---	State Protected
Yuma Clapper Rail	*Rallus longirostris yumanensis*	Endangered	State Protected
Red-naped Sapsucker	*Sphyrapicus nuchalis*	---	State Protected
Crissal Thrasher	*Toxostoma crissale*	---	State Protected
Orange-crowned Warbler	*Vermivora celata*	---	State Protected
Lucy’s Warbler	*Vermivora luciae*	---	State Protected
Grey viero	*Vireo vicinior*	---	State Protected

Source: TTR 2007.
SOC - Species of Concern

4.4.7.5 *Biological Monitoring and Abatement*

Terrestrial surveillance is conducted at TTR to detect the possible migration of contaminants to off-site locations. Terrestrial surveillance began at TTR in 1992. In addition to routine sampling, a large-scale baseline sampling was performed in 1994 (TTR 2007).

Routine terrestrial surveillance is conducted at onsite, perimeter, and off-site locations that remain essentially the same from year to year. Soil is the only terrestrial medium sampled at TTR since there are no bodies of water (other than the playa lakes) and vegetation is scarce.

Samples are generally collected from fixed locations to effectively make statistical comparisons with results from previous years. The results of the statistical analyses allow for prioritization of sample locations for possible follow-up action. To date, there have been no terrestrial sample results that have indicated a significant level of concern that would trigger actions at locations that are not already being addressed by environmental restoration projects (TTR 2007).

4.4.8 Cultural Resources

TTR is within an area considered by descendants of the tribes who called the area home as primarily occupied by the Shoshone cultural group. The Cactus Flat Valley and Gold Flat zones that surround TTR possess a relative paucity of food and water sources that would have attracted concentrated ceremonial, habitation, and hunting uses (USAF 2007).

In 2004, DOE/NNSA/SSO initiated a consultation with the SHPO on 212 buildings at TTR. The SHPO did not concur with the DOE determination of eligibility for the 212 at TTR. At the SHPO’s request, Sandia contracted with an architectural historian to evaluate the TTR buildings under National Register Criterion C. A revised report on the buildings at TTR will be submitted to SSO for transmittal to the Nevada SHPO during (TTR 2008).

A consultation with the Nevada SHPO for rebuilding the TTR power system was initiated in 2004. A cultural resource inventory was completed following an intensive archeological and historic inventory of the proposed project area. No historic properties were found within the proposed project area. As a result, in January 2005, the SHPO concurred with DOE/NNSA/SSO determination that no historic properties would be affected by the proposed project (TTR 2006).

In August 2007, NAFB released the *Integrated Cultural Resources Management Plan* (ICRMP) to research and address Section 110 of the *National Historic Preservation Act*. TTR was investigated as part of the ICRMP. At the time of the release of the ICRMP, 7,973 acres at TTR had been surveyed and 406 sites inventoried. In addition, a historic building inventory at TTR began in 2007 and is expected to be completed in the next several years (NAFB 2006).

4.4.9 Socioeconomic Resources

Socioeconomic characteristics addressed at TTR include employment, regional economy, and population, housing, and community services. Socioeconomic characteristics are presented for a

ROI. The ROI was identified based on the distribution of residences for current TTR employees. The ROI is defined as those counties where approximately 90 percent of the workforce lives.

TTR is located in Nye County, Nevada. Statistics for socioeconomic characteristics are presented for the ROI, a region consisting of Nye and Esmeralda Counties. Figure 4.4.9-1 presents a map of the counties composing the TTR ROI.

4.4.9.1 *Employment and Income*

Labor force statistics are summarized in Table 4.4.9-1. The civilian labor force of the ROI grew by approximately 16 percent from 14,573 in 2000 to 16,857 in 2005. The overall ROI employment experienced a growth rate of nearly 17 percent with 13,571 in 2000 to 15,912 in 2005 as presented in Table 4.4.9-1 (BLS 2007).

The ROI unemployment rate was 6.9 percent in 2000 and 5.6 percent in 2005. In 2005, unemployment rates within the ROI were 4.8 in Esmeralda County and 5.6 in Nye County. The unemployment rate in Nevada in 2005 was 5.3 percent (BLS 2007).

Table 4.4.9-1—Labor Force Statistics for ROI and Nevada

	ROI		Nevada	
	2000	2005	2000	2005
Civilian Labor Force	14,573	16,857	852,293	915,489
Employment	13,571	15,912	810,024	867,317
Unemployment	1,002	945	42,269	48,172
Unemployment Rate	6.9	5.6	5.0	5.3

Source: BLS 2007.

Income information for the TTR ROI is provided in Table 4.4.9-2. Nye County is at the high end of the ROI with a median household income in 2004 of $41,025 and at the low end of per capita income with a per capita income of $33,049. Esmeralda County had a median household income of $37,283 and a per capita income of $34,534 (BEA 2007).

Table 4.4.9-2—Income Information for the TTR ROI, 2004

	Per capita income (dollars)	Median household income (dollars)
Nye	33,049	41,025
Esmeralda	34,534	37,283
Nevada	34,021	49,894

Source: BEA 2007.

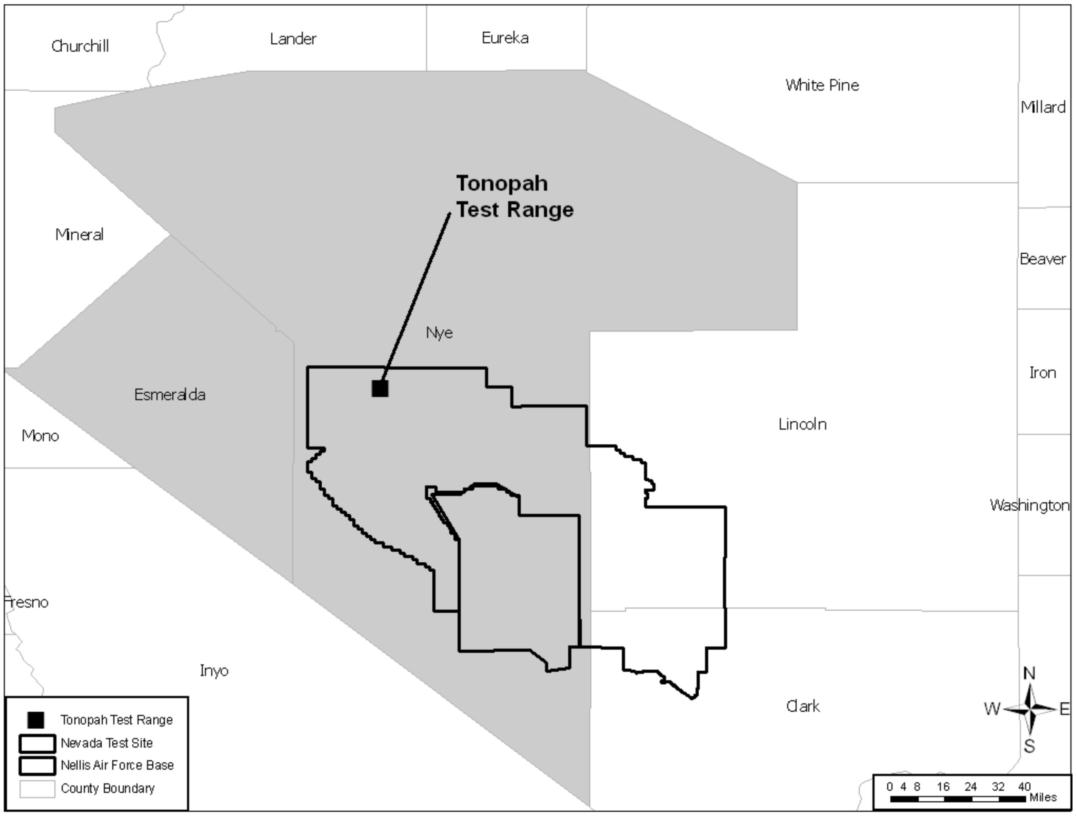


Figure 4.4.9-1—Region of Influence for Socioeconomic Impacts at TTR

4.4.9.2 *Population and Housing*

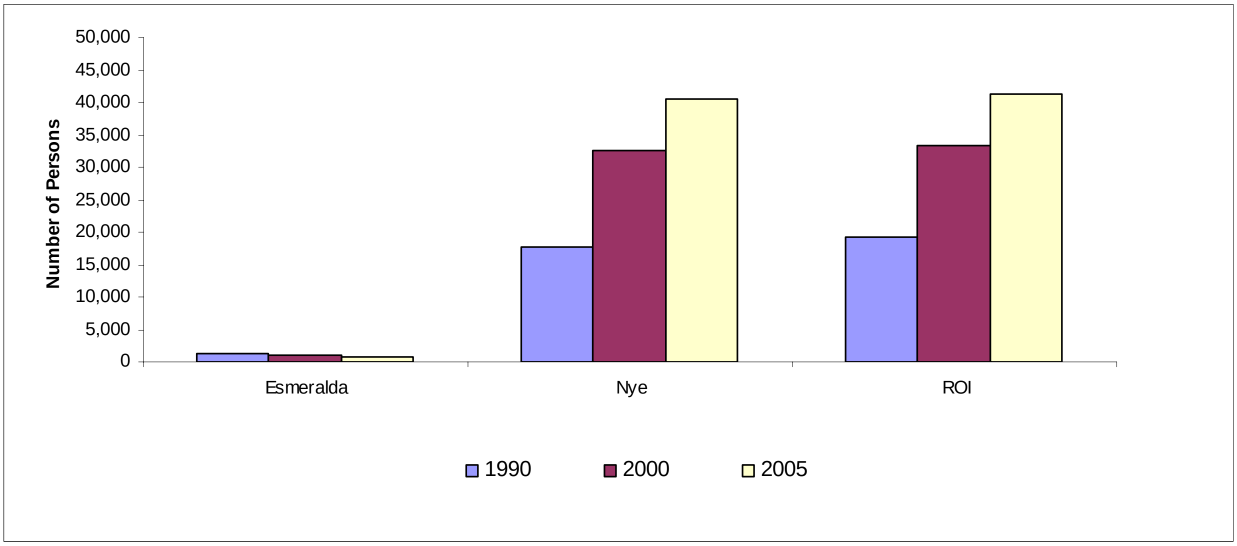
The ROI is used to analyze the primary economic impacts on population and housing. Table 4.4.9-3 presents historic and projected population in the ROI and the state.

Table 4.4.9-3—Historic and Projected Population

Region	1990	2000	2005	2010	2020
Esmeralda	1,344	971	805	1,076	1,169
Nye	17,781	32,485	40,395	44,985	51,283
ROI	19,125	33,456	41,200	46,061	52,452
Nevada	1,515,069	1,819,046	1,925,985	2,690,078	2,910,959

Source: USCB 2007.

The ROI population increased by 75 percent between 1990 and 2000. Esmeralda County had a 17 percent decrease in population and Nye County had a 24 percent population growth between 2000 and 2005 (USCB 2007). Nye County had 40,395 people while Esmeralda County had a population of 805 in 2005 (USCB 2007). Figure 4.4.9-2 presents the trends in population within the TTR ROI.



Source: USCB 2007.

Figure 4.4.9-2—Trends in Population for TTR ROI, 1990–2005

Table 4.4.9-4 lists the total number of housing units and vacancy rates in the ROI. In 2000, the total number of housing units in the ROI was 16,767 with 13,764 occupied (82 percent). There were 10,472 owner-occupied housing units and 3,292 rental units. The median value of owner-occupied units in Nye County was the greatest of the counties in the TTR ROI ($122,100). The vacancy rate in Esmeralda County was 45.4 percent and 16.5 in Nye County (USCB 2007).

4.4.9.3 *Community Services*

Community services analyzed in the ROI include public schools, law enforcement, fire suppression and medical services. Educational services are provided for approximately 6,211 students by an estimated 374 teachers in the ROI (IES 2006c). The student-to-teacher ratio in the Nye County School District was 17:1 during the 2005 to 2006 school year, while the Esmeralda County School District had a student-to-teacher ratio of 11:1. The student-to-teacher ratio for the ROI was 17:1 (IES 2006c).

The counties within the ROI employ approximately 18,700 firefighters and law enforcement officers. There is one hospital in the ROI with 44 beds (ESRI 2007).

Table 4.4.9-4—Housing in the TTR ROI

	Total Units	Occupied housing Units	Owner Occupied Units	Renter Occupied Units	Vacant units	Vacancy Rate (percent)	Median value of Owner Occupied Unites (dollars)
Esmeralda	833	455	305	150	378	45.4	75,600
Nye	15,934	13,309	10,167	3,142	2,625	16.5	122,100
ROI	16,767	13,764	10,472	3,292	3,003	17.9	120,745

Source: USCB 2007.

4.4.10 Environmental Justice

The potentially affected area considered for environmental justice analysis is the area within a 50-mile radius of TTR. Figure 4.4.10-1 shows counties potentially at risk from the current missions performed at TTR. Two counties are included in the potentially affected area. These counties include Esmeralda and Nye Counties. Table 4.4.10-1 provides the demographic profile of the potentially affected area using data obtained from the 2000 Census.

In 2000, persons self-designated as minority individuals in the potentially affected area comprised 15.4 percent of the total population. Hispanic residents are the largest group within the minority population. As a percentage of the total resident population in 2000, Nevada had a minority population of 34.8 percent and the U.S. had a minority population of 30.9 percent (USCB 2007).

Census tracts with minority populations exceeding 50 percent were considered minority census tracts. Based on 2000 census data, Figure 4.4.10-2 shows minority census tracts within the 50-mile radius where more than 50 percent of the census tract population is minority.

Census tracts were considered low-income census tracts if the percentage of the populations living below the poverty threshold exceeded 50 percent. Based on 2000 Census data, Figure 4.4.10-3 shows low-income census tracts within the 50-mile radius where more than 50 percent of the census tract population is living below the Federal poverty threshold.

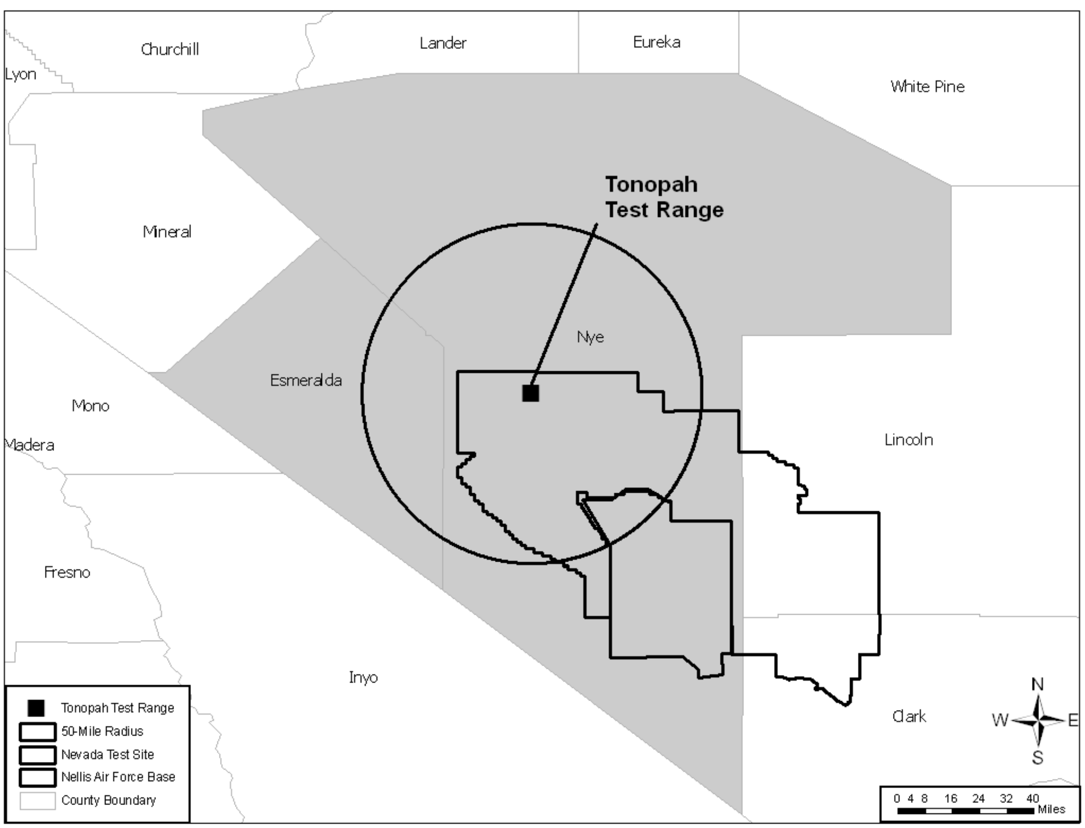


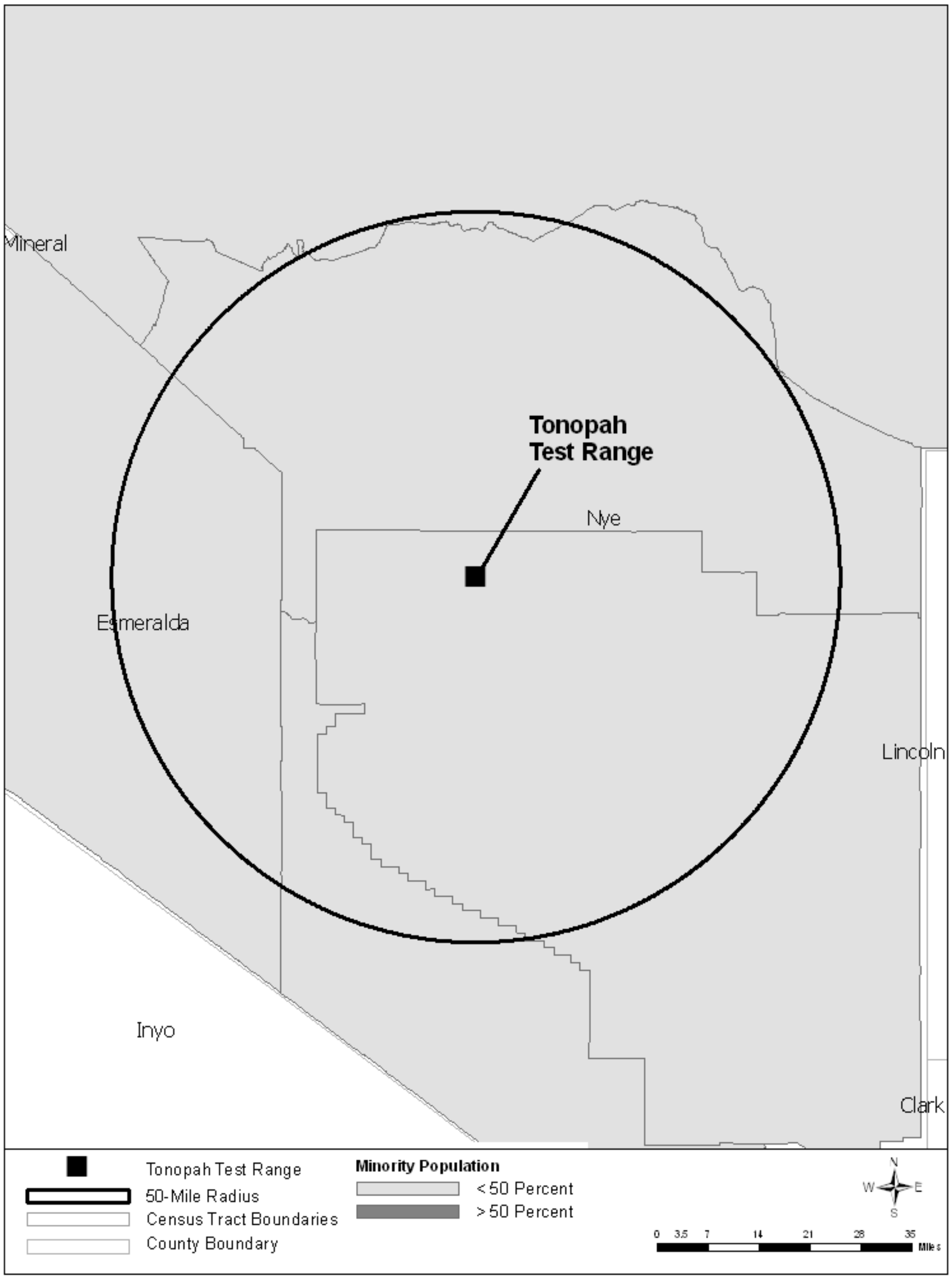
Figure 4.4.10-1—Potentially Affected Counties Surrounding TTR Socioeconomic ROI

Table 4.4.10-1—Demographic Profile of the Potentially Affected Area Surrounding TTR, 2000

Population Group	Population	Percent
Total Minority	**5,164**	**15.4**
Hispanic alone	1,621	4.8
Black or African American	384	1.1
American Indian and Alaska Native	686	2.1
Asian	253	0.8
Native Hawaiian and Other Pacific Islander	107	0.3
Some other race	1,043	3.1
Two or more races	1,070	3.2
White alone	**28,292**	**84.6**
Total Population	**33,456**	**100**

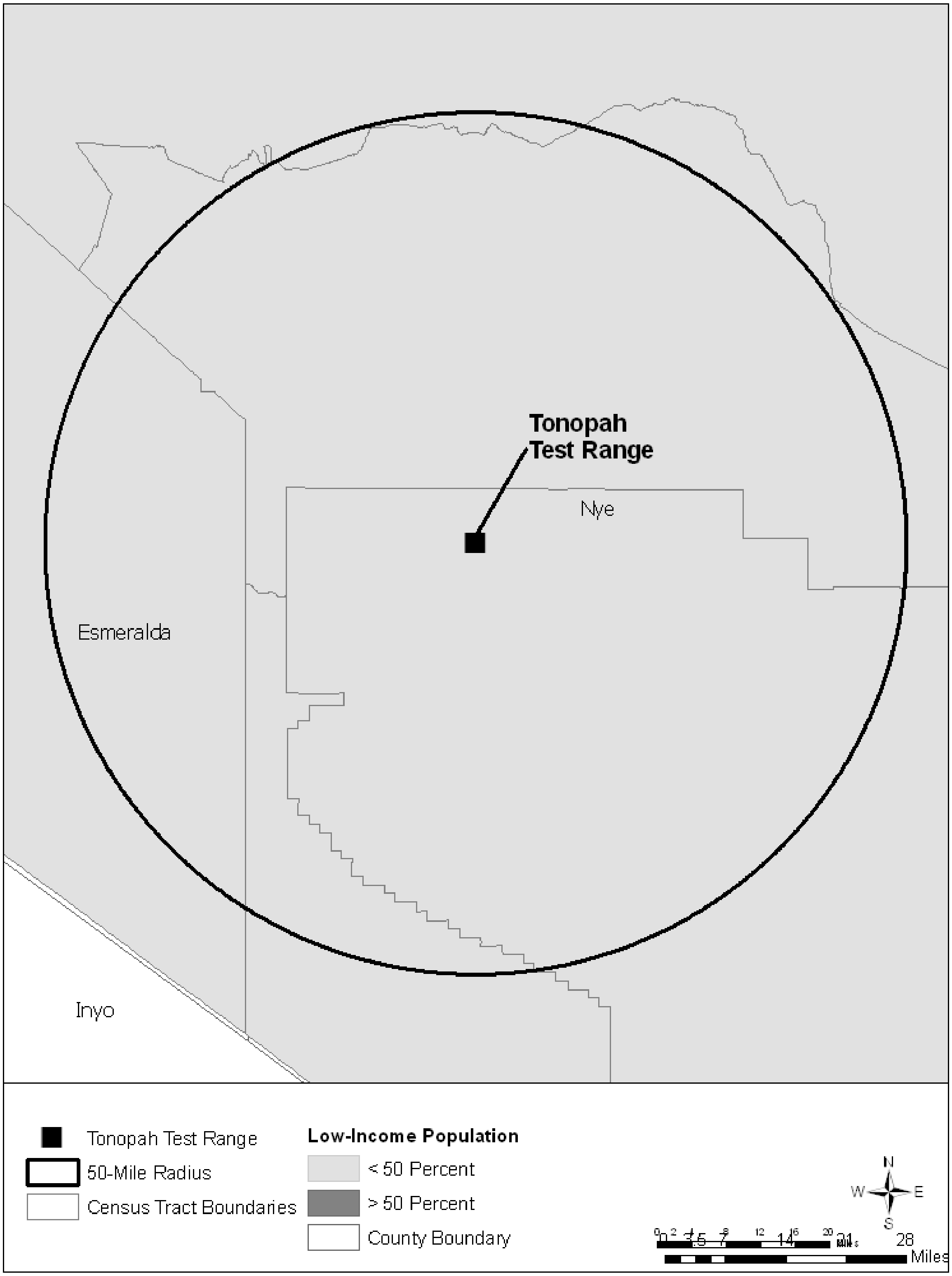
Source: USCB 2007.

According to 2000 census data, approximately 3,600 individuals residing within census tracts in the 50-mile radius of TTR were identified as living below the Federal poverty threshold, which represents approximately 11 percent of the census tract population within the 50-mile radius. There were no census tracts within the 50-mile radius where more than 50 percent of the census tract population was identified as living below the Federal poverty threshold. In 2000, 10.5 percent of individuals for whom poverty status is determined were below the poverty level in Nevada and 12.4 percent in the U.S. (USCB 2007).



Source: USCB 2007.

Figure 4.4.10-2—Minority Population—Census Tracts with More than 50 Percent Minority Population in a 50-Mile Radius of TTR

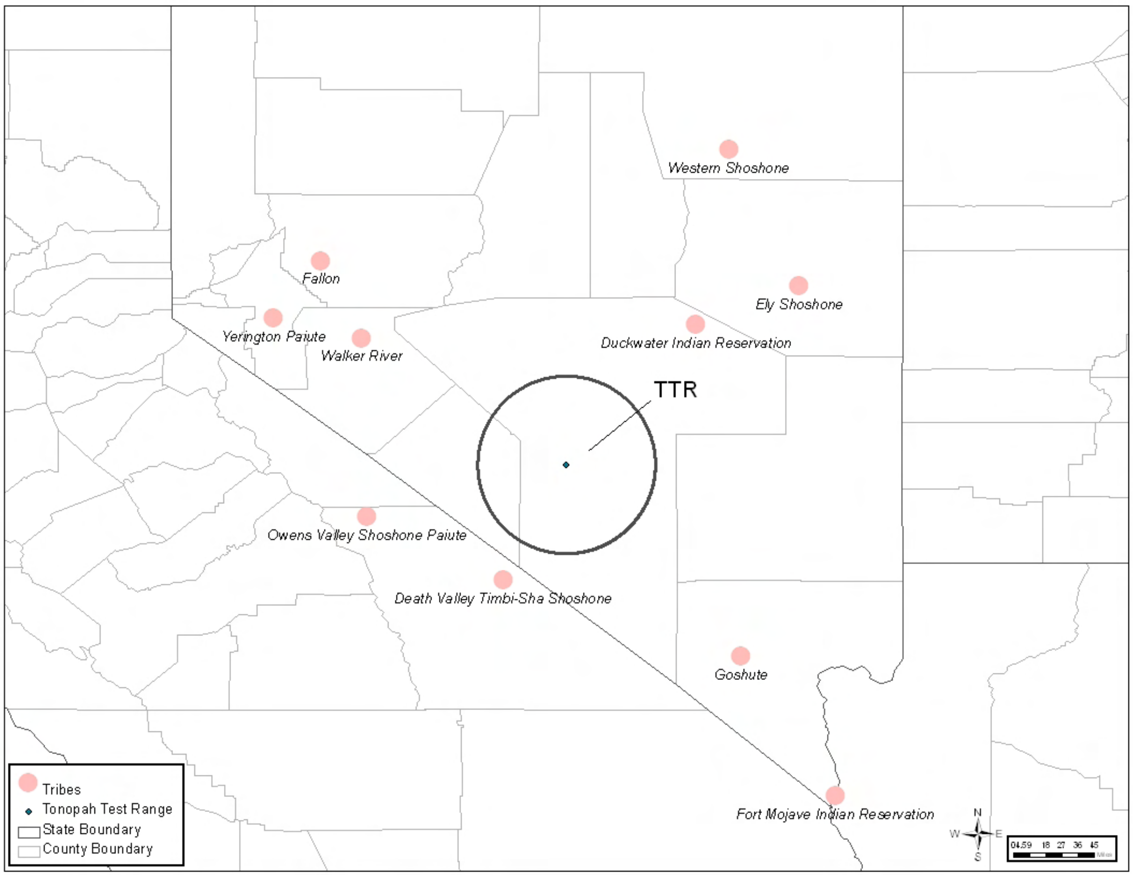


Source: USCB 2007.

Figure 4.4.10-3—Low-Income Population—Census Tracts with More than 50 Percent Low-Income Population in a 50-Mile Radius of TTR

4.4.10.1 *Characteristics of Native American Populations within the Vicinity of or with Interest in NTS Activities/Operations*

As discussed in Section 4.3.8.4, Native American groups which are known to have used the lands surrounding NTS and TTR are the Western Shoshone (four tribes), Southern Paiute (seven tribes), Owens Valley Shoshone Paiute (five tribes) and the Mojave (one tribe). The 2000 U.S. Census Bureau was used to obtain characteristics, including population, employment, educational attainment, income, poverty level, average family size, and housing characteristics for all population subcategories associated with the ones mentioned above. No data for the Mojave could be found using U.S. Census Bureau data. The locations of various tribes in relation to TTR are shown in Figure 4.4.10-4. The results of this analysis are provided in the following section.



Source: ESRI 2007.

Figure 4.4.10-4—Location of Tribes within Vicinity of or with Interest in TTR

As shown in Table 4.4.10-2, the Shoshone had the highest of the Native American populations with 8,340 and the Paiute-Shoshone with the least at 3,311. The Paiute have the largest percentage of their population as members of the civilian labor force at 64.8 percent and the Shoshone-Bannock Tribes with the smallest percentage of their population as members of the civilian labor force with 59.9 percent. The Shoshone-Bannock Tribes had the highest unemployment rate at 12.2 percent and the Paiute with the lowest unemployment rate at 7.8 percent (USCB 2007).

Of those individuals over 25 with some form of education, the largest constituency of all four Native American populations had received a high school diploma as shown in Table 4.4.10-3. A slightly lesser percentage of individuals had attended some college and significantly lesser percentages of these populations had received degrees from institutions of higher learning (Associate, Bachelor, or Graduate/Professional) (USCB 2007).

In 2000, the Paiute population had the highest mean household earnings and per capita income with $37,212 and $12,698, respectively as shown in Table 4.4.10-4. The Shoshone-Bannock Tribes population had the lowest mean household earnings with $30,373 and had the lowest per capita income with $9,180 (USCB 2007).

Table 4.4.10-2—Population and Employment Estimates for Native American Populations within the Vicinity of or With Interest in TTR, 2000

TTR	Population	Civilian Labor Force	Civilian Labor Force (percent)	Employed	Employed (percent)	Unemployed	Unemployed (percent)
Shoshone-Bannock Tribes of Ft Hall Reservation	4,922	1,910	59.9	1,522	47.7	388	12.2
Paiute	6,927	4,491	64.8	3,953	57.1	538	7.8
Burns Paiute	145	65	68.4	52	54.7	13	13.7
Paiute Alone	5,979	2,798	64.8	2,477	57.4	321	7.4
Pyramid Lake	1,291	560	65.7	475	55.8	85	10
Walker River	833	363	68.6	332	62.8	31	5.9
Yerington Paiute	452	147	50.9	140	48.4	7	2.4
Shoshone	8,340	3,670	60.8	3,146	52.1	524	8.7
Goshute	238	101	60.8	83	50	18	10.8
Shoshone Alone	7,050	3,098	60.7	2,653	51.9	445	8.7
Death Valley Timbi-Sha Shoshone	213	93	59.2	75	47.8	18	11.5
Wind River (Eastern Shoshone)	177	79	65.8	65	54.2	14	11.7
Paiute-Shoshone	3,311	1,434	61.4	1,155	49.5	279	12
Fallon	517	216	56.7	202	53	14	3.7
Ft McDermitt Paiute & Shoshone Tribes	388	122	44.9	80	29.4	42	15.4
Shoshone Paiute Alone	2,037	927	65	725	50.8	202	14.2

Source: USCB 2007.

Table 4.4.10-3—Level of Educational Attainment by Native American Populations within the Vicinity of or With Interest in TTR, 2000

TTR	High School Graduate	High School Graduate (percent)	Some College	Some College (percent)	Associate Degree	Associate Degree (percent)	Bachelor Degree	Bachelor Degree (percent)	Graduate/ Professional Degree	Graduate/ Professional Degree (percent)
Shoshone-Bannock Tribes of Ft Hall Reservation	819	33.1	627	25.3	169	6.8	114	4.6	57	2.3
Paiute	1,898	35.1	1,548	28.6	340	6.3	265	4.9	126	2.3
Burns Paiute	21	36.8	9	15.8	0	0	0	0	0	0
Paiute Alone	1,122	33.7	942	28.3	206	6.2	162	4.9	84	2.5
Pyramid Lake	278	40.8	213	31.3	19	2.8	32	4.7	11	1.6
Walker River	135	31.5	117	27.3	35	8.2	29	6.8	6	1.4
Yerington Paiute	83	35.3	50	21.3	51	21.7	7	3	2	0.9
Shoshone	1,532	31.6	1,292	26.7	316	6.5	364	7.5	135	2.8
Goshute	56	42.1	13	9.8	5	3.8	5	3.8	6	4.5
Shoshone Alone	1,272	30.7	1,101	26.6	280	6.8	329	7.9	122	2.9
Death Valley Timbi-Sha Shoshone	42	37.2	24	21.2	15	13.3	4	3.5	0	0
Wind River (Eastern Shoshone)	31	32	28	28.9	11	11.3	15	15.5	0	0
Paiute-Shoshone	552	32.8	445	26.5	123	7.3	116	6.9	29	1.7
Fallon	100	34.2	77	26.4	15	5.1	24	8.2	5	1.7
Ft McDermitt Paiute & Shoshone Tribes	75	35.2	28	13.1	2	0.9	2	0.9	2	0.9
Shoshone Paiute Alone	324	33.4	276	28.5	89	9.2	69	7.1	16	1.7

Source: USCB 2007.

Of the four Native American populations within the vicinity of NTS, the Shoshone-Bannock Tribes had the largest percentage of individuals below the poverty level in 2000 with 32.5 percent as compared to the Paiute population which had 24.6 percent of the total population living below the poverty level as shown in Table 4.4.10-4 (USCB 2007).

Table 4.4.10-4—Income and Poverty Level Estimates for Native American Populations within the Vicinity of or With Interest in TTR, 2000

TTR	Mean Household Earnings	Per Capita Income	Individuals Below the Poverty Level	Individuals Below the Poverty Level (percent)
Shoshone-Bannock Tribes of Ft Hall Reservation	$30,373	$9,180	1,567	32.5
Paiute	$37,212	$12,698	2,388	24.6
Burns Paiute	$32,489	$6,463	61	42.1
Paiute Alone	$38,889	$12,848	1,396	23.9
Pyramid Lake	$34,984	$11,837	292	22.8
Walker River	$30,700	$13,560	201	24.4
Yerington Paiute	$32,042	$10,297	115	25.6
Shoshone	$33,806	$11,920	2,330	29
Goshute	$16,430	$8,322	70	30.4
Shoshone Alone	$34,685	$12,039	1,985	29.2
Death Valley Timbi-Sha Shoshone	$37,015	$12,136	57	27.5
Wind River (Eastern Shoshone)	$20,427	$8,264	71	42.8
Paiute-Shoshone	$34,986	$10,514	892	27.5
Fallon	$36,588	$12,141	98	19
Ft McDermitt Paiute & Shoshone Tribes	$29,697	$6,570	99	25.5
Shoshone Paiute Alone	$37,603	$10,448	615	31.1

Source: USCB 2007.

In 2000, the Shoshone-Bannock Tribes had the largest average family size with 3.84 persons per family compared to the Shoshone with 3.31 persons per family. The Paiute had the greater number of occupied housing units with 3,482, which was significantly higher than the Shoshone at 2,805, who had a larger population than the Paiute in 2000 as shown in Table 4.4.10-5 (USCB 2007).

Table 4.4.10-5—Housing Characteristics for Native American Populations within the Vicinity of or With Interest in TTR, 2000

TTR	Average Family Size	Housing Units	Owner-Occupied Housing Units	Owner-Occupied Housing Units (percent)	Renter-Occupied Housing Units	Renter-Occupied Housing Units (percent
Shoshone-Bannock Tribes of Ft Hall Reservation	3.84	1,413	965	68.3	448	31.7
Paiute	3.38	3,482	2,150	61.7	1,332	38.3
Burns Paiute	3.89	53	34	64.2	19	35.8
Paiute Alone	3.45	2,041	1,158	56.7	883	43.3
Pyramid Lake	3.31	495	373	75.4	122	24.6
Walker River	3.22	310	241	77.7	69	22.3
Yerington Paiute	3.03	184	128	69.6	56	30.4
Shoshone	3.31	2,805	1,545	55.1	1,260	44.9
Goshute	3.59	61	23	37.7	38	62.3
Shoshone Alone	3.3	2,352	1,283	54.5	1,069	45.5
Death Valley Timbi-Sha Shoshone	2.61	82	66	80.5	16	19.5
Wind River (Eastern Shoshone)	3.95	67	47	70.1	20	29.9
Paiute-Shoshone	3.63	1,152	712	61.8	440	38.2
Fallon	3.43	215	177	82.3	38	17.7
Ft McDermitt Paiute & Shoshone Tribes	4.05	141	88	62.4	53	37.6
Shoshone Paiute Alone	3.63	684	383	56	301	44

Source: USCB 2007.

4.4.11 Health and Safety

The potential for activities at TTR to impact the health and safety of the general public is minimized by a combination of the remote location of TTR, the sparse population surrounding it, and a comprehensive program of administrative and design controls. Visitors to TTR are subject to essentially the same safety and health requirements as the workers. Safety briefings are provided as appropriate, personal protective equipment is provided when necessary, and radiation dosimeters are issued to long-term visitors. Secondary access control is provided, when necessary, for safety and or security reasons. Operations with higher-than-normal hazards are fenced or barricaded. The health and safety of TTR workers is protected by adherence to the requirements of federal and state law, DOE orders, and plans and procedures of each organization performing work on the range. A program of self-assessment of compliance with these requirements is conducted by the Sandia National Laboratories, support contractors, and the DOE. Workers are further protected from specific hazards associated with their jobs by training, monitoring the workplace environment, using personal protective equipment, and using administrative controls to limit their exposures to chemical or radioactive materials (TTR 2006).

All DOE activities on TTR are in compliance with all environmental and other requirements established by federal, state, and local agencies. The main environmental compliance activities included the operation of a less than 90-day storage area for hazardous waste, minimal cleanup activities associated with the environmental remediation program, and compliance sampling for the public water distribution system as required by the SDWA (TTR 2006).

All work at TTR is performed in accordance with the safety and health requirements of the OSHA as codified in Title 29 CFR Parts 1910 and 1926.

4.4.11.1 *Radiological*

Radiological air emissions are regulated by NESHAP under the CAA. Operations at TTR do not involve activities that release radioactive emissions from either point sources or diffuse sources such as outdoor testing. The only radionuclide sources at TTR are the three Clean Slate Sites, which are potential sources of diffused radionuclide emissions as a result of the re-suspension of contaminated soils. These sites are currently being addressed by DOE/NNSA/NSO under the ER Project. The calculated dose for the MEI was 0.024 millirem per year, which is approximately 400 times less than the 10 millirem per year standard set by the EPA. Based on this value, an annual dose assessment is not required to be calculated for the TTR site. Other ER sites with minor radiological contamination, such as DU, do not produce significant air emission sources from re-suspension (TTR 2006).

The 0.024 millirem dose rate and the 1,000 picocuries per gram are separate numbers with no correlation to how each was developed. The 0.024 millrem dose rate is a NESHAPs complaince calculation (e.g., 10 millirem per year limit). The calculation is based on a MEI located at the TTR Airport (the highest calcualted dose for a member of the public). This calculation only accounts for radionuclide air emmissions. The 1,000 picocuries per gram level equates to a less than 25 millirem per year dose to the MEI for the specific land use scenario. This calculation includes inhalation, ingestion, and external exposure pathways.

4.4.12 Transportation

The following sections discuss baseline transportation activities at TTR with respect to onsite traffic, off-site traffic, transportation of materials and waste, and other transportation. Figure 4.4.12-1 displays roads in the vicinity of TTR.

The TTR onsite transportation infrastructure consists of 118 miles of primary paved roads, 23 miles of secondary paved roads, 113 miles of primary compacted dirt roads and 39 miles of secondary dirt roads. The two primary traveled paved roads on TTR traverse north-south and east-west. These roads support the majority of the daily traffic, as well as traffic during operations. The dirt roads are used for secondary daily travel, but are primarily used during testing activities. A total 98 miles of roads on TTR are used on a regular basis (DOE 1996b).

The roadway system on TTR is jointly maintained by the DOE and the USAF. No personally owned vehicles are permitted on the site, however, personally owned vehicle passes will occasionally be issued to resident personnel. Workers either drive government-supplied vehicles from the main entry of TTR or ride government-supplied bus transportation to the work site. The majority of the on-site traffic is attributed to security support and facility operations (DOE1996b).

The primary highway access to the main entry gate of TTR is via U.S. Highway 6 to north-south alternate Road 504. U.S. Highway 6 links U.S. Highway 95 and U.S. Highway 93 and is an all-weather, two-lane paved roadway. In 1993 the annual average daily traffic on U.S. Highway 6 was 500 vehicles (DOE 1996b).

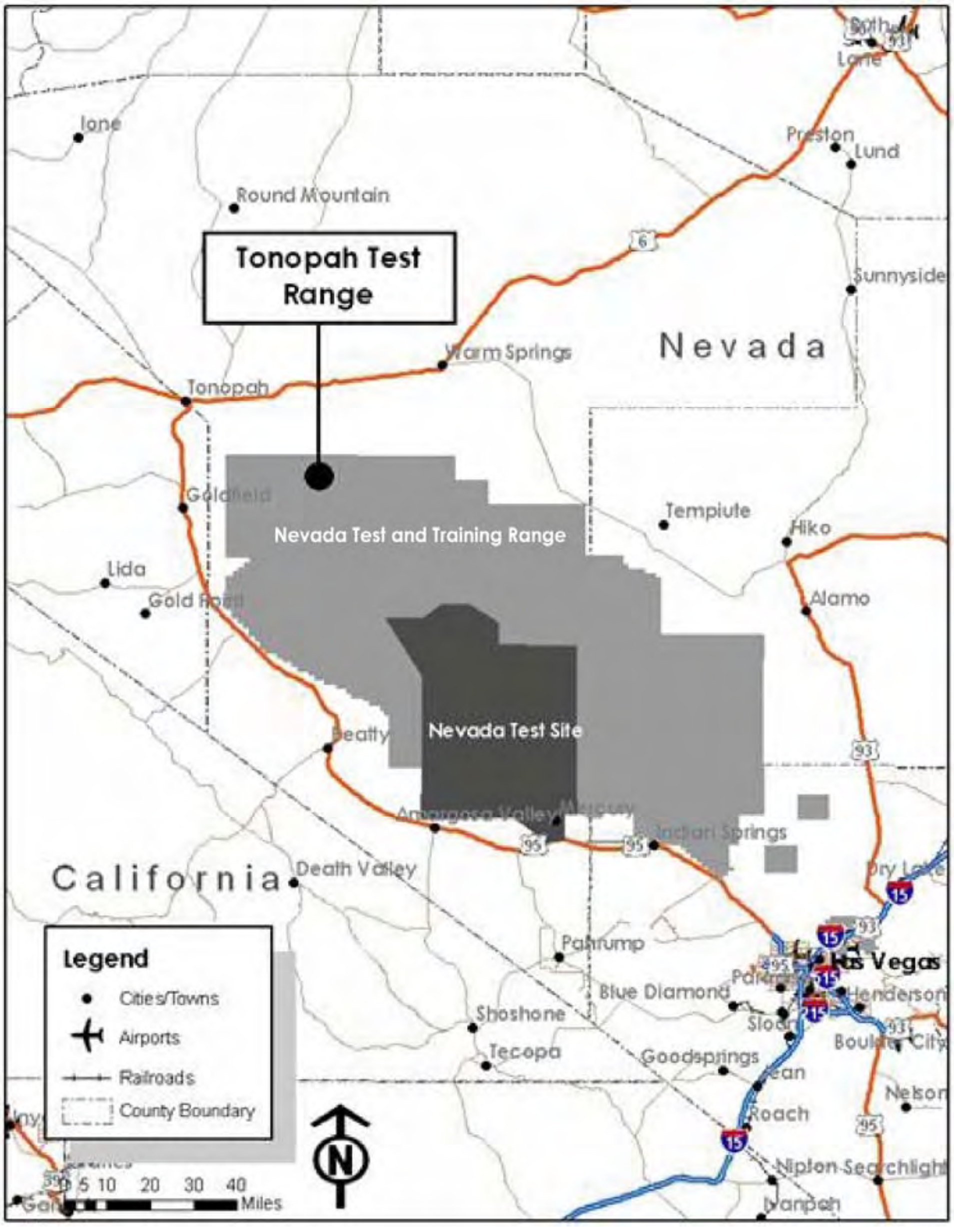


Figure 4.4.12-1—Roads in the Vicinity of TTR

4.4.13 Waste Management

All waste generated by the SNL activities at TTR is managed by Westinghouse Government Services under the Waste Management Program (TTR 2006). Waste minimization and recycling efforts are integrated into Waste Management Program activities. Waste generated at TTR in 2005 included hazardous waste regulated by the RCRA and non-hazardous industrial and sanitary waste. All hazardous waste was shipped to permitted treatment, storage, and disposal facilities. Hazardous material and petroleum products have been used and stored at several of the facilities at TTR, including acids/bases, adhesives/sealants, cleaning chemicals, compressed gases, corrosive, explosives, fuels, oxidizers, paint, PCBs, pesticides/herbicides, petroleum, oils, and lubricants, and solvents. SNL maintains a database of hazardous material stored and used in Area 3 facilities (TTR 2006).

Table 4.4.13-1 shows a detailed breakdown of RCRA waste categories and quantities. Table 4.4.13-2 lists regulated non-RCRA waste categories and quantities. Table 4.4.13-3 lists waste categories transported off-site for recycling or alternative fuel use.

Table 4.4.13-1—TTR RCRA Regulated Hazardous Waste Shipped Off-site, 2006

Waste Type	Waste Codes	Amount Generated (lbs)
Toxic Solid, Organic, Not Otherwise Specified	D035, F002, F003, F005	25
Lithium Battery	D001, D003	25
Aerosols	D001	120
Water Reactive Solid, Self Heating not otherwise specified	D001, D003, D008	235
Paint Related Material	D001	90
Flammable Liquids	D001	550
Flammable Liquids, not otherwise specified	D001, U220	225
Petroleum Distillates	D001, D008, D018, F005	190
Batteries, Wet Filled with Alkali	D002, D006	40
Hazardous Waste Solid, not otherwise specified	D008	70
Hazardous Waste Solid, not otherwise specified	D009, U151	70
Mercury Contained in Manufactured Articles, hazardous Waste Solid, not otherwise specified	D009	40
Diesel Fuel	D001	1,720
Solid Hazardous Waste, not otherwise specified	D035, F005	30
Corrosive Liquid Waste, not otherwise specified	D002	25
Solid Hazardous Waste, not otherwise specified	D006, D007	150
Solid Hazardous Waste, not otherwise specified	D008, D009	55
Liquid Hazardous Waste, not otherwise specified	D007, D011	280
Liquid Hazardous Waste, not otherwise specified	D006, D007, D011	455
	Total	**4,395**

Source: TTR 2007.

Table 4.4.13-2—Non-RCRA Regulated Hazardous or Toxic Waste Shipped Off-site, 2006

Waste Type	Waste Codes	Shipped	Amount Generated (lbs)
Non-Regulated Solid Waste	No Code Required		4,265
Non-Regulated Liquid Waste	No Code Required		100
Regulated Medical Waste	No Code Required		152
Polychlorinated Biphenyl's (PCB) Ballasts	TSCA		18
		Total	**4,535**
D&D Asbestos Waste	TSCA	10 yd^3	10 yd^3
Apex Solid Waste Landfill (Tires/Metal)	NCR	63 yd^3	63 yd^3
Environmental Restoration			
Hydrocarbon impacted soil and debris		0	0
Investigation-Derived Waste		300	300
Low-level Waste (soil, debris, and PPE)		0	0
Inert Unexploded Ordnance		0	283,500
		Total	**283,800**

Source: TTR 2007.

Table 4.4.13-3—Recycled Regulated Hazardous or Toxic Waste Shipped Off-site, 2006

Recycled Material or Energy Recovered Material	Amount Generated (lbs)
Batteries, Wet, Filled with Acid	1,035
Brass	11,290
Batteries Dry Containing Potassium Hydroxide Solid	15
Fluorescent Lights	490
Circuit Boards for Recycle	45
Total	**12,875**

Source: TTR 2007.

TTR sanitary waste from DOE and USAF operations are disposed of in a Class II solid waste landfill. The TTR landfill is located just east of the USAF industrial area. The materials disposed of are characterized as rubbish, construction debris, and sanitary waste from food service areas. The sanitary landfill currently in operation consists of one active cell.

The construction of an expansion to the existing solid waste storage facility has been proposed and an environmental assessment was completed by the USAF. A Finding of No Significant Impact was signed on March 2007 (USAF 2007). The expansion would handle only Class II solid waste, which excludes the storage of hazardous waste, septic waste, explosive materials or chemical wastes including herbicides and pesticides (USAF 2007). Table 4.4.13-4 shows waste capacities at TTR in 2005. There were no shipments of radioactive waste in 2005.

Table 4.4.13-4—Waste Capacities at TTR, 2006

Waste Type	Weight (lbs)
RCRA Hazardous Waste	4,395
Non-RCRA-regulated	4,535
TSCA waste (Asbestos/PCP)	1,879
Construction debris	43,090
Sanitary landfill waste	51,120
Recycled Waste	12,875
Radioactive Waste	0

Source: TTR 2007.

Only minor quantities of radioactive material are currently in use at TTR. Most of the radioactive material is intended for specific purposes. A 100 curies of Co^{60} source is used for industrial radiography. Several small “check sources” of alpha and beta radioactivity are used for the daily standardization or portable and stationary radiation detection systems. The cobalt radiography source is maintained in Building 09-09, and the check sources are located in a small safe in Building 03-81T. Access to these sources is limited to the TTR staff with authority to use the material. Based on the program use of the above material, the potential risk that any cobalt radiography source would contaminate other work areas is low. Based on discussion with SNL staff, there are no other known areas inside buildings where radioactive material has been used or stored (URS 2001).

The other radioactive materials present at TTR are less well controlled and are exposed to the elements (wind and storm water). The principal radionuclides involved are ^{238}U in the form of DU metal and Pu-239 and Pu-240 in the form of metal and oxide. DOE uses DU metal as an isotope surrogate in its weapons delivery system testing program. DOE has documented the number of instances where DU has been used and the location of this material. Plutonium isotopes, on the other hand, were used in 1963 (see Section 4.4.6.2) in a series of nuclear weapons safety shot tests (URS 2001).

4.5 PANTEX PLANT

The Pantex Plant is located approximately 17 miles northeast of Amarillo, Texas, on approximately 15,977 acres (Figure 4.5-1). The current missions at Pantex site include dismantling retired weapons; fabricating high-explosives (HE) components; assembling high explosive, nuclear, and non-nuclear components into nuclear weapons; repairing and modifying weapons; and evaluating and performing non-nuclear testing of weapons. Pantex maintains Category I/II quantities of SNM for the weapons program and material no longer needed by the weapons program. Weapons activities involve the handling (but not processing) of uranium, plutonium, and tritium components, as well as a variety of non-radioactive hazardous or toxic chemicals.

4.5.1 Land Use

4.5.1.1 Onsite Land Uses

Pantex is a 15,977-acre facility approximately 17 miles northeast of Amarillo, Texas, in Carson County (see Figure 4.5-1). DOE owns 10,177 acres, including 9,100 acres in the main plant area and 1,077 acres at Pantex Lake, located approximately 2.5 miles northeast of the main plant area. Another 5,800 acres of land south of the main Plant area are leased from Texas Tech University (TTU) for a safety and security buffer zone. Currently there are no government industrial operations conducted at the Pantex Lake (Pantex 2006). Figure 4.5.1-1 displays generalized land use at Pantex.

Pantex is composed of several functional areas, referred to as numbered zones (Figure 4.5.1-2). These include a weapons assembly/disassembly area, a weapons staging area, an area for experimental explosive development, a drinking water treatment plant, a sanitary wastewater treatment facility, and vehicle maintenance and administrative areas (Pantex 2006). Other functional areas include a utilities area for steam and compressed air, an explosive test-firing facility, a Burning Ground for thermally processing explosive materials, and landfills. One functional area is currently only used for storage. Overall, there are more than 400 buildings at Pantex, many of which are grouped into large functional zones. The weapons assembly/disassembly area covers approximately 200 acres and contains more than 100 buildings (Pantex 2006).

The explosive test-firing facility (firing sites) includes several test-shot stands and small-quantity, test-firing chambers. The firing site also includes supporting facilities. The Burning Ground is used for processing explosives, explosive components, and explosive-contaminated materials and waste by means of controlled open burning and flashing (Pantex 2006).

Figure 4.5–1—Location of Pantex

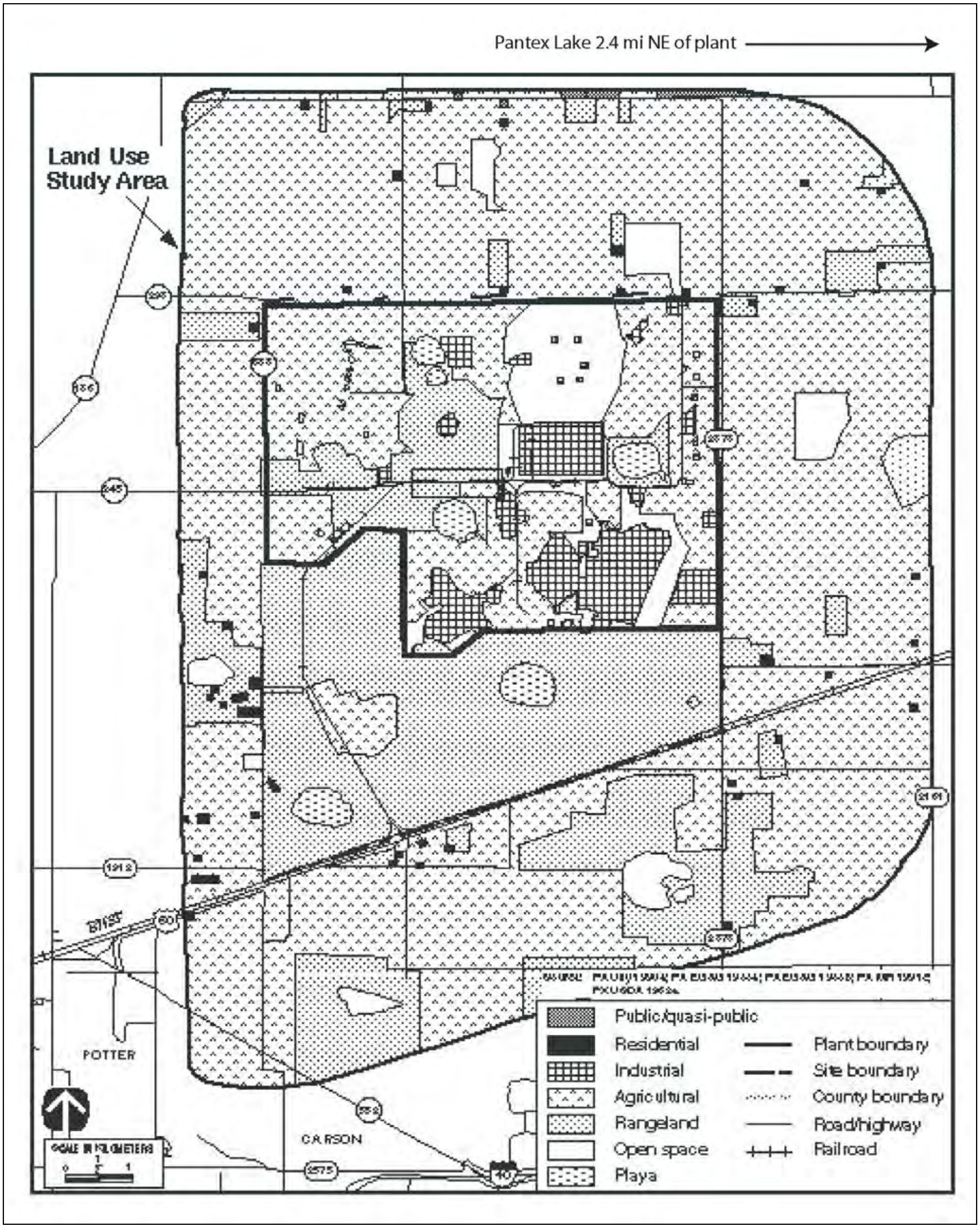
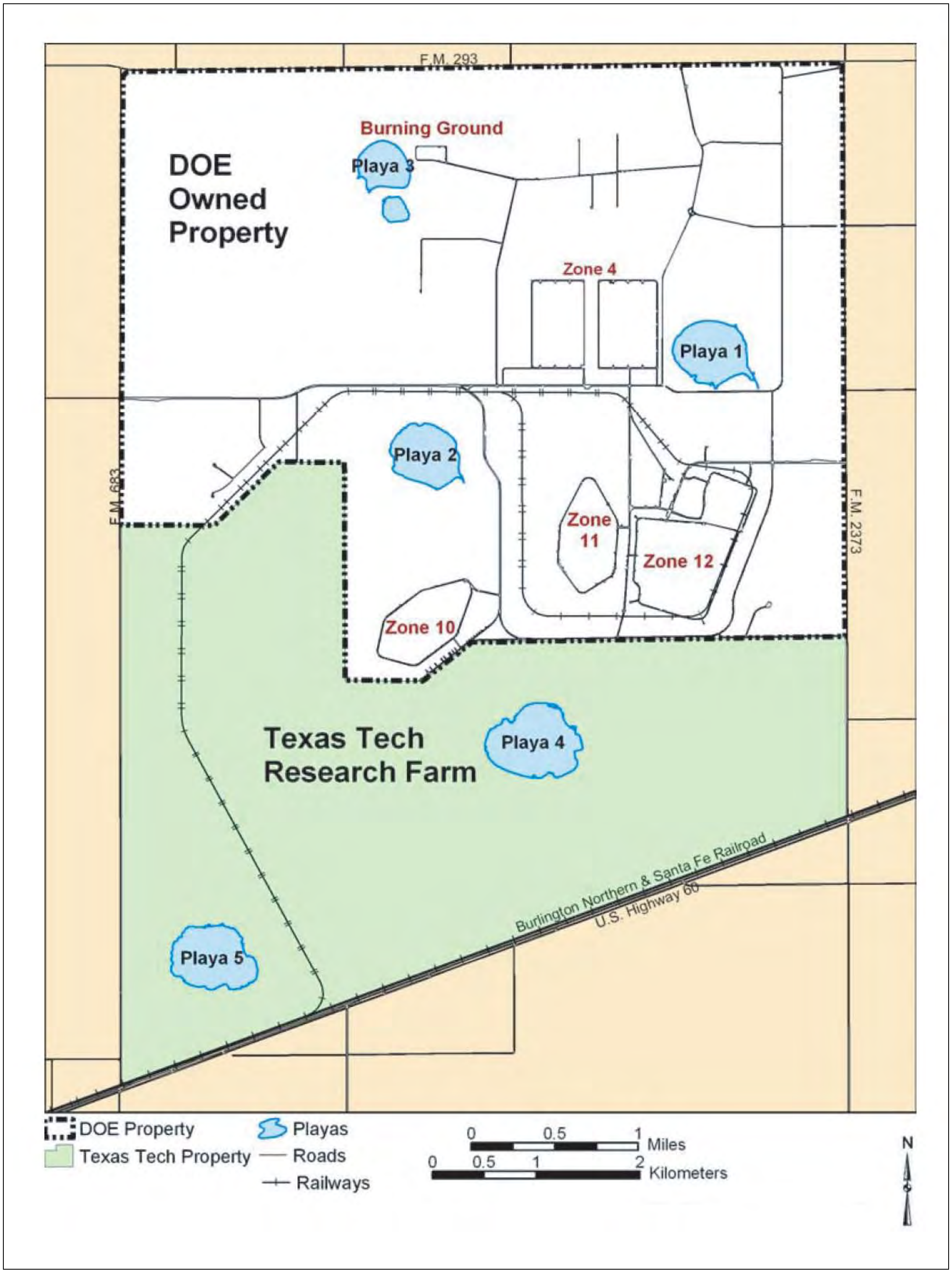


Figure 4.5.1–1—Generalized Land Use at Pantex and Vicinity



Source: Pantex 2006.

Figure 4.5.1–2—Principal Features of Pantex

4.5.1.2 *Surrounding Land Use*

The Pantex Plant is surrounded by agricultural land, but several significant industrial facilities are also located nearby (Pantex 2006). In the area near Pantex, residences occur mostly in the small town of Panhandle, 11 miles east of Pantex. Other concentrations of residences are at Highland Park Village, approximately 7 miles southwest and Washburn 6.5 miles south. The closest residences are approximately 100 feet west and north of the plant boundary along Texas Farm-to-Market Road (FM) 683 and 293, and within 0.5 miles east of the Plant boundary along FM 2373.

Most of the surrounding land is prime farmland when irrigated, with the exception of the area northwest of the plant site, which is rangeland. The majority of the surrounding land is cultivated. The packing plant of Tyson Fresh Meats, Inc. is the only industrial facility within 2 miles of the plant.

Four low-altitude Federal airways used by the Amarillo International Airport for aircraft landings and takeoffs cross or come near Pantex. The runway is located approximately 7 miles southwest of the site boundary.

4.5.2 Visual Resources

The Pantex Plant is located on the Llano Estacado portion of the Great Plains at an elevation of approximately 3,500 feet. The topography at Pantex is relatively flat and characterized by rolling grassy plains and numerous natural playa basins.

The Pantex Plant is in a treeless plain of a shortgrass prairie ecosystem. The plant consists of over 400 buildings which are surrounded by cropland and rangeland that blend into the offsite viewshed.

The developed areas at Pantex are consistent with a Visual Resource Management Class IV designation, as defined by the BLM (DOI 2001). The remainder of The Pantex Plant is consistent with a Visual Resource Management rating of Class III or IV (see Table 4.5.2-1 for descriptions of the Visual Resource Management Rating System). Plant facilities are visible from U.S. 60 and the local Farm-to-Market roads adjacent to The Pantex Plant's boundaries. At night, The Pantex Plant lights are visible from U.S. 60 and the local Farm-to-Market roads and I-40.

Table 4.5.2-1 — BLM Visual Resource Management Rating System

Class	Objective
Class I	To preserve the existing character of the landscape, the level of change to the characteristic landscape should be very low and must not attract attention.
Class II	To retain the existing character of the landscape, the level of change to the characteristic landscape should be low.
Class III	To partially retain the existing character of the landscape, the level of change to the characteristic landscape should be moderate.
Class IV	To provide for management activities which require major modification of the existing character of the landscape, the level of change to the characteristic landscape can be high.

Source: BLM 1980.

4.5.3 Site Infrastructure

An extensive network of existing infrastructure provides services to Pantex activities and facilities as shown in Table 4.5.3–1.

Table 4.5.3–1—Baseline Characteristics for Pantex

Resource	Current Usage	Site Capacity
Land		
Roads (miles)	47	47
Electrical		
Energy consumption (MWh/yr)	81,850	201,480
Available capacity (MWe)	13.6	47.5
Fuel		
Natural gas (yd^3/yr)	16,912,000	378,590,000
Oil (gal/yr)	15,830	No Limit
Coal (t/yr)	0	0
Water		
Usage (gallons)	130,000,000	422,700,000

Source: NNSA 2007.

4.5.3.1 *Electricity*

Pantex receives electrical energy from Southwestern Public Service Company. Current usage is 81,850 MWh per year. Two 115-kilovoltampere electrical substations are located onsite with a capacity of 23 megawatts (DOE 1996c). There are several generators, both fixed and portable, that provide standby power in the event of an interruption of normal service to critical systems.

4.5.3.2 *Natural Gas*

The Texas Panhandle is one of the major oil and gas producing regions in the country with considerable reserves. Natural gas is supplied to Pantex by Anthem Energy. The natural gas is delivered through a 10-inch main supply line, which is capable of supplying 10.22 billion cubic feet, sufficient capacity for all future plant requirements. Tank 12076 holds a reserve of 630,000 gallons of fuel oil for use, should interruption of the natural gas supply occur.

4.5.3.3 *Water*

Water for Pantex is pumped from the Ogallala aquifer by five production wells located in the northeast portion of the site. A well and two reservoirs were completed in 1994. Pantex uses about 130 million gallons of water per year, which is drawn from the Ogallala Aquifer. Water storage reservoirs are integrated into the water distribution system. The Ogallala formation is capable of yielding adequate water for all current and foreseeable uses by Pantex.

4.5.3.4 *Steam*

Pantex Plant provides steam for operations and facility heating. Building 1613, the plant's boilerhouse, contains four boilers and operates on natural gas. Two of the boilers each have the capacity to produce 50,000 pounds of steam per hour and the other two have the capacity to produce 25,000 pounds of steam per hour each (DOE 1996c). Steam heat is used where open flames, flammable liquids, and flammable gases pose a potential safety risk.

4.5.4 Air Quality and Noise

4.5.4.1 *Air Quality*

4.5.4.1.1 Meteorology and Climatology

The climate at Pantex is classified as semi-arid and is characterized by hot summers and relatively cold winters, with large variations in daily temperature extremes, low humidity, and irregular periods of rainfall of moderate amounts (Pantex 2006).

The normal rainfall in Amarillo is approximately 19 inches, however, 2005 was a relatively dry rainfall year in the area of Pantex. The official Amarillo Airport National Weather Service (NWS) rain gauge recorded 15.01 inches of precipitation. The potential gross lake surface evaporation in the area is estimated to be about 70 inches or 350 percent of the average annual rainfall (Pantex 2006). Seventy-five percent of the total annual precipitation falls between April and September. The average annual snowfall is 16.9 inches.

Average wind speeds at Amarillo are relatively high. The average annual windspeed is 13.5 miles per hour. Calms occur about 1 percent of the time. The wind blows predominantly from the south from May to September and from the southwest the remainder of the year.

The Pantex Plant is located in an area with a relatively high frequency of tornados; however, tornado occurrences in Amarillo are rare. In 2005, 14 tornados were recorded in the 20 Texas Panhandle counties. At least 10 tornados were sighted in Carson and other contiguous counties including four sightings in Armstrong County that were associated with severe thunderstorms and flash flooding that occurred in the region (Pantex 2006).

4.5.4.1.2 Ambient Air Quality

Pantex Plant operations can result in the release of nonradiological air pollutants that may affect the air quality of the surrounding area. The Pantex Plant is located within the Amarillo-Lubbock Intrastate AQCR. The Amarillo-Lubbock Intrastate AQCR is classified as an attainment area for all six criteria pollutants (i.e., carbon monoxide, nitrogen dioxide, lead, ozone, sulfur dioxide, and PM_{10}) (40 CFR 81.344). The Texas Commission on Environmental Quality (TCEQ) issued an alteration to "Air Quality Permit No. 21233" on September 12, 2005. This alteration removed the operations performed in Firing Chamber 11-38A from the Permit (Pantex 2006). There were two compliance inspections performed in 2006 by both the State of Texas and the U.S. Environmental Protection Agency (EPA) in regard to air quality. The State identified one noncompliance involving an inadvertent emission event of a cylinder discharge containing fire suppressant FM-200© (Hydrofluorocarbon-227ea) during the testing of a fire alarm system. Corrective actions with engineer controls were implemented for preventing other discharges from reoccurring, and were agreed appropriate by the State. The EPA identified no noncompliance during their inspection.

The primary emission sources of criteria pollutants at Pantex are the steam plant boilers, the explosives-burning operation, and emissions from onsite vehicles. Emission sources of hazardous or toxic air pollutants include the high-explosives synthesis facility, the explosives-burning operation, paint spray booths, miscellaneous laboratories, and other small operations. With the exception of thermal treatment of high explosives at the burning ground, most stationary sources of nonradioactive atmospheric releases are fume hoods and building exhaust systems, some of which have HEPA filters for control of particulate emissions.

At the present time there is no ambient air monitoring performed for hazardous air pollutants or nonradiological substances at Pantex.

Radiological Air Emissions

Atmospheric emissions of radionuclides from DOE facilities are limited under the EPA NESHAP regulation, 40 CFR Part 61, Subpart H. The EPA annual effective dose equivalent limit of 10 millirem per year to members of the public for the atmospheric pathway is also incorporated in DOE Order 5400.5, "Radiation Protection of the Public and the Environment."

In the Pantex region, airborne radionuclides originate from natural (i.e., terrestrial and cosmic) sources, worldwide fallout, and Pantex operations. Radiological ambient air monitoring was conducted at 27 locations in 2005.

In normal operating situations, little potential exists for exposure of Pantex personnel, the public, or the environment from release of radioactive materials. Most of the small numbers of radionuclide releases during normal operations are tritium releases. Very small amounts of tritium escape as a gas or vapor during normal operations, and some tritium residual is present onsite as a result of an accidental release in 1989 (Pantex 2006). The accidental release of tritium was conservatively estimated as 40,000 curies (DOE 1996d). The area of accidental release occurred in Zone 12 (Figure 4.5.1-2) where nuclear components have been handled (Pantex 2006).

Table 4.5.4-1 displays the average radiological atmospheric emissions from Pantex from 1995–2006. The maximum radiation levels measured at any station were less than three percent of the allowable standard (Pantex 2006).

Table 4.5.4-1—Average Pantex Radiological Atmospheric Emissions in Curies

Tritium (curies)	Total Uranium[a] (curies)	Total Plutonium	Total Other Actinides (curies)	Other[b]
6.88×10^{-1}	4.73×10^{-5}	None	2.04×10^{-6}	None

a Total Uranium (grams) = 1.94×10^{-3}.
b This category includes the following: ^{85}Kr, Total Radioiodine, Total Radiostrontium, Noble Gases ($T_{1/2}$ < 40 day), Short-lived Fission and Activation Products ($T_{1/2}$ < 3 hr), and Fission and Activation Products ($T_{1/2}$ > 3 hr).
Source: Pantex 2006.

As in previous years, relatively high values of tritium were recorded during 2005 at a monitoring location near the site of the aforementioned accidental release. These measurements occurred during periods of rapid changes in barometric pressure and were likely the result of continued off-gasing from soils during these pressure fluctuations. Despite the high measurements of tritium in 2005, there continues to be a downward trend in tritium measurements since the 1989 release in this area (Pantex 2006). The air monitoring program at Pantex continues to provide information that current plant operations do not have a detrimental effect on the quality of the environment at or near Pantex (Pantex 2006).

4.5.4.2 *Noise*

The major noise sources at Pantex include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, construction and materials-handling equipment, vehicles), as well as small arms firing, alarms, and explosives detonation. Most Pantex Plant industrial facilities are far enough from the site boundary that noise levels from these sources at the boundary are barely distinguishable from background noise. However, some noise from explosives detonation can be heard at residences north of the site, and small arms weapons firing can be heard at residences to the west (DOE 1996d).

The acoustic environment along Pantex boundary and at nearby residences away from traffic noise is typical of a rural location. The day-night average sound levels are in the range of 35 to 50 dBA. Noise survey results in areas adjacent to Pantex indicates that ambient sound levels are generally low, with natural sounds and distant traffic being the primary sources. Traffic is the primary source of noise at the site boundary and at residences near roads.

Traffic noise is expected to dominate sound levels along major roads in the area, such as U.S. 60. The residents most likely to be affected by noise from plant traffic along Pantex access routes are those living along FM 2373 and FM 683. Measurements of equivalent sound levels for traffic noise and other sources along the roads bounding Pantex are 53 to 62 dBA for FM 2373 at about 400 meters (1,300 feet) from the road; 51 to 58 dBA for FM 293 at about 230 feet; 44 to 65 dBA for FM 683 at about 130 feet; and 51 dBA for U.S. 60 at about 740 feet. These levels are based on a limited number of 30-minute samples taken during peak and off-peak traffic periods, mostly at locations within the site boundary. The levels represent the range of daytime traffic noise levels at residences near the site. Other sources of noise include aircraft, wind, insect activity, and agricultural activity (DOE 1996d).

4.5.5 Water Resources

4.5.5.1 *Surface Water*

The principal surface water feature on the Southern High Plains is the Canadian River, which flows southwest to northeast, approximately 17 miles north of Pantex. Plant surface waters do not drain into this system, but for the most part discharge into onsite playas. Storm water from agricultural areas at the periphery of Pantex drains into offsite playas. From the various playas, water either evaporates or infiltrates the soil. There are two water-bearing units below Pantex, the perched aquifer and the Ogallala Aquifer. The perched aquifer is located approximately 200 to 300 feet below the ground surface. The Dockum Group Aquifer is the lower boundry of the Ogallala Aquifer.

4.5.5.1.1 Stormwater

All surface water at Pantex drains to isolated playa lakes. Playas are shallow, ephemeral lakes that have clay-lined basins that fill periodically with runoff. There are six playas found on DOE-owned and -leased property (Pantex 2006). Most of the surface drainage on the DOE-owned and -leased lands flows via man-made ditches, natural drainage channels, or by sheet-flow to the onsite playa basins. Figure 4.5.5-1 shows the locations of the playas at the facility site with their respective drainage basins (watersheds).

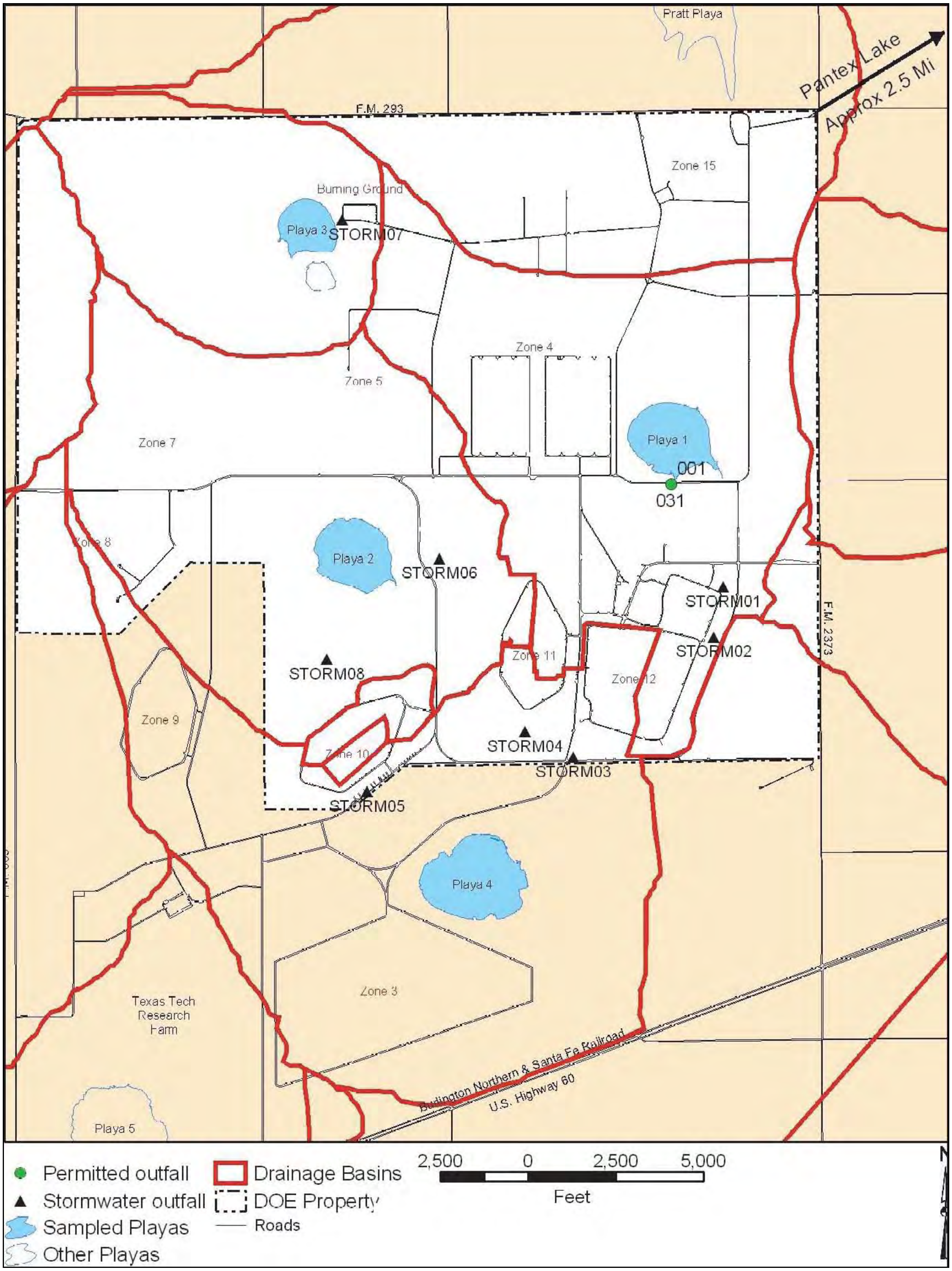
Stormwater runoff from impervious surfaces at Pantax flows overland and through unlined ditches. Runoff accumulates primarily in Playas 1, 2, 3, and 4, on the northeast, west, northwest, and southern sides of Pantex, respectively (Figure 4.5.5-1). Stormwater runoff from surrounding pastures and agricultural operations flows to offsite playa basins from the outer perimeter of the main Plant site. Although some of the surface water from the ditches and playas is associated with perched aquifer recharge, most is lost to evapotranspiration (Pantex 2006). The playa lakes are extremely important hydrologic features at Pantex that provide prime habitat for wildlife, especially waterfowl that winter in the southern High Plains. Playas are also believed to be an important source of recharge for the Ogallala Aquifer (Pantex 2006).

4.5.5.1.2 Surface Water Quality

Playa 1 received effluent from the Wastewater Treatment Facility (WWTF) until April 2005; now WWTF and Pump and Treat water are used to irrigate crops on approximately 300 acres by sub-surface drip irrigation system. Playa 1 receives effluent from the WWTF infrequently when farmland is already saturated due to heavy seasonal precipitation. Playas 1, 2, and 4 receive storm water from Pantex Plant’s industrial areas; Playa 3 receives storm water from the Burning Ground. All playas receive storm water runoff from agricultural areas. Table 4.5.5-1 displays the annual stormwater monitoring results for metals in 2005.

Permit-driven and environmental surveillance sampling were conducted at the playas for both radiological and nonradiological materials including metals, volatile organic compounds, semi-volatile organic compounds, and explosives. Radiological sampling included gross alpha/beta, tritium, and limited isotopic radiological analyses (Pantex 2006).

In 2005, sampling was conducted at seven of eight storm water outfalls and at 4 of 6 playa lakes. Storm water monitoring required by the Texas Pollutant Discharge Elimination System (TPDES) Multi-Sector General Permit (MSGP) in 2005 consisted of visual and annual metals monitoring. Visual samples taken and examined appeared to be of good quality, and none showed any abnormalities based on criteria specified in the Multi-Sector General Permit Plan (MSGPP) (Pantex 2006). Annual metals monitored consisted of the twelve metals listed in 30 Texas Administrative Code 319.22 (Inland Water Quality Parameters [IWQPs]). Storm water monitoring results indicated that there were no locations that exceeded IWQP limits (Pantex 2006).



Source: Pantex 2006.

Figure 4.5.5-1—Drainage Basins, Playas, and Outfalls at Pantex Plant

Table 4.5.5-1 — Annual Stormwater Results (metals), 2005 (mg/l)

Metal	Outfall STORM01	Outfall STORM02	Outfall STORM03	Outfall STORM04	Outfall STORM05	Outfall STORM06	Outfall STORM07	Outfall STORM08	IWQP
Arsenic	0.003	0.004	0.003	0.004	ND	0.001	NS	0.004	0.3
Barium	0.155	0.132	0.165	0.108	0.076	0.076	NS	0.137	4.0
Cadmium	0.0005	0.00021	0.0003	0.0002	0.0005	0.0005	NS	0.0002	0.2
Chromium	0.009	0.013	0.010	0.007	0.003	0.003	NS	0.007	5.0
Copper	0.012	0.007	0.007	0.007	0.005	0.005	NS	0.006	2.0
Lead	0.007	0.004	0.005	0.005	0.001	0.003	NS	0.003	1.5
Manganese	0.11	0.075	0.102	0.093	0.014	0.068	NS	0.059	3.0
Mercury	ND	ND	ND	ND	ND	ND	NS	ND	0.01
Nickel	0.007	0.005	0.008	0.005	ND	ND	NS	ND	3.0
Selenium	0.002	0.004	0.001	0.001	ND	ND	NS	0.002	0.2
Silver	ND	0.002	ND	0.002	ND	ND	NS	ND	0.2
Zinc	0.103	0.1	0.063	0.080	0.01	0.029	NS	0.018	6.0

Source: Pantex 2006.
NS=no sample; ND=no detection; IWQP=Inland Water Quality Parameter limits, 30 Texas Administrative Code 319.22

Sampling results from 2005 monitoring were consistent with historical data. Sampling continues to indicate that storm water discharges at Pantex are of good quality and that the operations at Pantex are not degrading storm water quality (Pantex 2006). During 2005, there was an unauthorized discharge of approximately 54,000 gallons of treated, non-chlorinated wastewater due to a mechanical failure of the wastewater treatment system (Pantex 2006). This incident was reported to the TCEQ. No long-term environmental or human health impacts were associated with this event (Pantex 2006). The surface water monitoring program at Pantex continues to provide information that supports the premise that current operations are not having detrimental impact to the quality of the surface waters at Pantex (Pantex 2006).

4.5.5.1.3 Surface Water Rights

The Pantex Plant does not use any surface water; therefore, it exerts no surface water rights.

4.5.5.2 *Groundwater*

There are two water-bearing units below Pantex, the perched aquifer, and the Ogallala Aquifer. The perched aquifer is located at approximately 200 to 300 feet below ground surface. Perched aquifers are common to regions with playas, such as the Texas Panhandle (Pantex 2006). A relatively low permeability zone referred to as the ‘fine-grain zone’ (FGZ) that consists of fine-grained sand, silt and clay separates the perched aquifer from the deeper Ogallala Aquifer (Pantex 2006). The Ogallala Aquifer is located below the FGZ, approximately 400 feet below ground surface.

The perched aquifer is a generic term that denotes a shallow reservoir of local extent, which typically does not provide potable water or potable water in sufficient quantities for general use. The perched aquifer ranges in saturated thickness from less than a foot to more than 75 feet. At Pantex, the perched aquifer is associated with natural recharge from Playas 1, 2, and 4, treated wastewater discharge to Playa 1, and historical releases to the ditches draining Zones 11 and 12. Historical operations at Pantex resulted in contamination of this perched aquifer, and the contaminant plume has migrated past the plant boundaries and beneath adjacent landowners’ property to the southeast.

The Ogallala Aquifer is the principal aquifer and major source of water in the vicinity of Pantex and the surrounding 8-county region, extending west across the New Mexico-Texas border. The Ogallala Aquifer can yield between 700 and 1,200 gallons per minute of high quality waters to the wells in the area. Depths to the Ogallala Aquifer generally run parallel to the regional land surface, which dips gently from northwest to southeast and varies at Pantex from about 344 feet at the southern boundary to 496 feet at the northern boundary. This south-to-north groundwater flow contrasts with the regional northwest-to-southeast trend of the remaining portion of the Southern High Plains. The current data reflect a decline in the Ogallala water table elevation of up to 30 feet beneath portions of Pantex. The drop in the water table for the Ogallala Aquifer is due to historical groundwater withdrawals and long-term pumping, which have exceeded the natural recharge rate to the Ogallala (Pantex 2006). These overdrafts have removed large volumes of groundwater from recoverable storage, and have caused substantial water-level declines. The withdrawal rate of the aquifer is greater than 10 times the estimated annual recharge rate. Historically, over 90 percent of groundwater withdrawals have been for agricultural use. Pantex's water use from the Ogallala Aquifer in 2005 was 140.6 million gallons (Pantex 2006).

4.5.5.2.1 Groundwater Quality

The plume management wells and monitoring network in the perched groundwater at Pantex is composed of 75 wells. Fifty-six perched groundwater wells are on-site, and 19 are off-site. Of the 75 wells, 16 perched groundwater wells are dry or do not have enough water to sample, and are monitored regularly for the presence of ground water. The Ogallala Aquifer surveillance and monitoring network is composed of 28 wells. Nineteen wells and 1 dry well are located on-site and 8 are off-site.

Forty-eight wells are used for investigative purposes and 5 are injection wells permitted under the Pantex RCRA permit for groundwater investigation and remediation. One monitor well and 2 investigation wells were plugged and abandoned in 2001. Ten investigation wells (9 perched and 1 Ogallala) have been dropped from the sampling plan and not used for monitoring purposes at this time in agreement with the TCEQ. (Pantex 2006)

Under the RCRA Hazardous Waste Compliance Plan, Pantex is permitted to inject treated wastewater into the perched aquifer (Permit NO. 5X2600215). The DOE/NNSA is considering implementing corrective measures to address perched groundwater impacts attributable to operations at Pantex. Among the actions being considered, discontinuation of treated groundwater back into the perched aquifer is a component of five of the six corrective measures. The DOE/NNSA released an EA considering the potential impacts of the proposed corrective measures in February 2007 (Pantex 2006).

The Risk Reduction Rule Guidance for Pantex is a guide used to identify the quantifiable detection limit for sampled constituents. The detection limit is defined as the Practical Quantitation Limit (PQL, lowest level that can be accurately and reproducibly quantified) for non-naturally occurring compounds. Groundwater investigation wells were sampled quarterly, semiannually, or annually, depending on the analyte for which the sampling was performed. Pantex groundwater wells are also monitored quarterly, semiannually or annually, depending upon the analyte being sampled. Pantex production wells are monitored on an annual basis.

The control well location near Bushland, Texas, was sampled quarterly in 2001. Sampling at the Bushland location allows Pantex technicians to obtain comparative data for the Ogallala from a location where the aquifer is perpendicular to the groundwater flow, or cross-gradient. It is unaffected by Pantex operations.

In 2005, 136 samples were collected from the Ogallala Aquifer and 188 samples from the perched aquifers (Pantex 2006). The following discussion regarding perched aquifer and Ogallala Aquifer sampling results is based upon the *2005 Annual Site Environmental Report* (ASER) (Pantex 2006).

Perched Aquifer System

Of the 15 high explosives that were analyzed for in the perched aquifer, 11 were detected at or above the method detection limit (MDL), 6 were detected at or above their respective laboratory PQLs at least once during 2005. These detections are indicative of impacts from historic Plant operations (Pantex 2006).

Of the 24 metals (including hexavalent chromium) analyzed for in the perched aquifer, 18 were detected at or above the MDL, and 3 were detected at or above their respective laboratory PQLs at least once during 2005. Metals, with the exception of hexavalent chromium (Cr+6), are naturally occurring in the sediments and soils at Pantex. Metal concentrations detected in perched groundwater at the Plant, can be attributed to heavy sediment loads that often occur in perched groundwater samples and to historic Plant operations (Pantex 2006).

Perchlorate was detected in 15 out of 163 perched groundwater samples at levels comparable to historical results and at expected values for 2005 (Pantex 2006). Sixty-two VOCs were analyzed for in the perched aquifer during 2005. Of these, 9 were detected at or above the MDL, and 5 were detected at levels at or above their respective laboratory PQLs. These detections are indicative of impacts from historic Plant operations. All of the VOCs have been previously identified as contaminants of potential concern in the perched aquifer through the RCRA Facility Investigation process (Pantex 2006).

Sixty-six semi-volatile organic compounds (SVOC) were analyzed for in the perched aquifer during 2005. Three compounds were detected at or above the MDL, but all were below the PQL. Bis (2-ethyl-hexyl) phthalate is a common laboratory contaminant. The other two compounds, Benzo-a-pyrene and Benzo-g,h,iperylene, are common combustion by-products from gasoline engines (e.g., sampling vehicles) and cross-contamination is suspected during sample collection in the field. None of the three compounds were confirmed in subsequent sampling (Pantex 2006).

Ogallala Aquifer

Of the 25 metals analyzed for in the Ogallala Aquifer, 10 were detected at or above their respective laboratory PQLs at least once during 2005. Metals, with the exception of Cr+6, are naturally occurring in the soils and sediments at Pantex. The metals concentrations that have been detected in Ogallala groundwater at the Plant are either attributable to heavy sediment loads that often occur in the groundwater samples or due to natural background variations (Pantex 2006).

There has never been a confirmed detection of perchlorate in the Ogallala Aquifer, and there were no VOCs, SVOCs, or HE compounds detected at or above the PQL in Ogallala Aquifer samples during 2005. Tables 4.5.5-2 and 4.5.5-3 show analytical results from monitoring efforts in the perched and Ogallala aquifers (Pantex 2006).

Table 4.5.5-2—Groundwater Monitoring Results From the Perched Aquifer System

Perched Compliance Plan Wells					
Analyte Type Code	**CAS Number**	**Constituent**	**Min (mg/L)**	**Max (mg/L)**	**RRS 2 Residential (mg/L)**
	99-65-0	1,3-Dinotrobenzene	0.001	0.003	0.0037
	121-14-2	2, 4-Dinitrotoluene	0.001	0.005	0.001
	606-20-2	2, 6 –Dinitrotoluene	0.0002	0.004	0.001
	35572-78-2	2-amino-4, 6-dinitrotoluene	0.0003	0.023	0.006
	1946-51-0	4-amino-2, 6-dinitrotoluene	0.0002	0.017	0.006
	2691-41-0	HMX	0.0004	0.187	1.800
	121-82-4	RDX	0.0003	1.910	0.0077
	118-96-7	TNT	0.0002	0.017	0.018
	99-35-4	1,3,5-Trinitrobenzene	0.0002	0.0005	1.1
	78-11-5	PETN	0.0007	0.020	0.008
Metals	7429-90-5	Aluminum	0.0.015	0.977	37.000
	7440-38-2	Arsenic	0.003	0.010	0.012
	7440-42-8	Boron	0.043	1.680	3.300
	7440-39-3	Barium	0.088	0.747	2.000
	7440-48-4	Cobalt	0.001	0.009	2.200
	7440-47-3	Chromium, Total	0.001	2.38	0.100
	18540-29-9	Chromium, Hexavalent	0.0005	2.756	0.100
	7440-50-8	Copper	0.002	0.014	1.300
	7439-89-6	Iron	0.016	7.600	N/A
	7439-95-4	Magnesium	4.380	57.300	N/A
Misc	57-12-5	Cyanide	0.002	0.010	0.200
	16984-48-8	Fluoride	0.130	2.120	N/A
	11/2/2009	Hardness	24.00	324.00	N/A
VOCs	67-64-1	Acetone	0.002	0.002	3.7
	107-06-2	1,2-Dichloroethane	0.0003	0.006	0.005
	156-59-2	Cis-1, 2-Dichloroethene	ND	ND	0.07
	75-69-4	Trichlorofluoromethane	ND	ND	1.1
	76-13-1	Freon-113 (1,1,2-Trichloro-1, 2,2-Trifluoroethane)	0.003	0.006	1100
	127-18-4	Tetrachloroethylene (PCE)	ND	ND	0.005
	79-01-6	Trichloroethene	0.0003	0.004	0.005
	67-66-3	Chloroform	ND	ND	0.37
	7439-98-7	Molybdenum	0.002	0.060	0.180
	7440-02-0	Nickel	0.001	0.278	0.730
	7782-49-2	Selenium	0.003	0.007	0.050
	7440-24-6	Strontium	0.404	1.830	22.000
	7440-62-2	Vanadium	0.001	0.030	0.260
	7440-66-6	Zinc	0.001	0.150	11.000
Misc	T-005	Alkalinity, Total	94.00	308.00	N/A
	16887-00-6	Chloride	10.10	60.80	N/A
	7439-96-5	Manganese	0.001	0.230	1.700

Table 4.5.5-3—Groundwater Monitoring Results From the Ogallala Aquifer System

Ogallala Compliance Plan Wells					
Analyte Type Code	**CAS Number**	**Constituent**	**Min (mg/L)**	**Max (mg/L)**	**RRS 2 Residential (mg/L)**
Metals	7440-22-4	Silver	0.001	0.003	0.180
	7429-90-5	Aluminum	0.020	0.905	37.000
	7440-38-2	Arsenic	0.003	0.010	0.012
	7440-42-8	Boron	0.074	0.254	3.300
	7440-39-3	Barium	0.064	0.203	2.000
	7440-47-3	Chromium, Total	0.001	0.026	0.100
	18540-29-9	Chromium, Hexavalent	0.001	0.018	0.100
	7440-50-8	Copper	ND	ND	1.300
	7439-89-6	Iron	0.013	1.020	N/A
	7439-95-4	Magnesium	16.00	33.60	N/A
	7439-96-5	Manganese	0.001	0.046	1.700
	7439-98-7	Molybdenum	0.001	0.032	0.180
	7440-02-0	Nickel	0.001	0.327	0.730
	7782-49-2	Selenium	0.003	0.011	0.050
	7440-24-6	Strontium	0.553	1.160	22.000
	7440-28-0	Thallium	0.0001	0.0004	0.034
	7440-62-2	Vanadium	0.006	0.026	0.260
	7440-66-6	Zinc	0.002	0.031	11.000
Misc	T-005	Alkalinity, Total	130.00	372.00	N/A
	16887-00-6	Chloride	4.01	41.8	N/A
	16984-48-8	Fluoride	0.32	59	N/A
	11/2/2009	Hardness	116	508	N/A

4.5.6 Geology and Soils

Pantex Plant is located in the Southern High Plains. The topography is relatively flat and marked by thousands of playa lakes. Pantex is located on the Amarillo Uplift, which, along with the Oldham-Harmon Trend, comprise a west-northwest trending uplifted area that separates the Anadarko Basin to the northeast and the Palo Duro Basin to the southwest. Pantex is located at the southeastern edge of the Whittenburg Trough that separates the Amarillo Uplift from Bush and Bravo Domes to the west (DOE 1996).

4.5.6.1 *Geology*

The primary surface deposits at Pantex are the Pullman and Randall soil series. These formations grade downward to the Blackwater Draw Formation, which consists of approximately 50 feet of interbedded silty clays and very fine sands with caliche (Pantex 2006).

The Ogallala Formation underlies the Blackwater Draw Formation. The Ogallala Formation consists of interbedded sands, silts, clays, and gravels. The base of the Ogallala Formation is an irregular surface that represents pre-Ogallala topography, as a result, the vertical distance to the base of the Ogallala Formation at Pantex varies from 300 feet at the southwest corner to 720 feet at the northeast corner (Pantex 2006).

Sedimentary rock of the Dockum Group underlies the Ogallala Formation. The Dockum group consists of shale, clayey siltstone, and sandstone. The deep geology (4,000 feet) below Pantex has a major influence on the natural radiation environment because radon is released from the granitic rocks there (Pantex 2006).

4.5.6.2 *Soils*

Surface soils at Pantex consist mainly of Randall clay and Pullman clay loam, with areas of Estacado, Lofton, and Pep clay loams in the playa bottoms. The Pullman clay loam series dominates in uplands, and Randall clay dominates in the playa bottoms. The Estacado, Lofton, and Pep clay loams are found in sloping areas surrounding playa bottoms (Pantex 2006).

Onsite soil monitoring results for 2005 were, with few exceptions, within the concentration ranges observed for uncontaminated local soil and was comparable to both historical results and those for control locations (Pantex 2006).

Exceptions included elevated Uranium -234 and -238 in soil samples at Playa 1 and one elevated level of Uranium-238 at the firing range. Elevated levels of uranium in Playa 1 are believed to be directly related to naturally occurring uranium concentrations in Ogallala water discharged to Playa 1 (Pantex 2006).

4.5.6.3 *Seismology*

The closest Tertiary or Quaternary volcanism in the region surrounding the Pantex plant is in New Mexico, over 100 miles from the site. No tectonic faulting younger than Late Permian is recognized at or near Pantex. Three major subsurface faults and one minor surficial fault exist in the area as follows: 1) 155 miles long, about 25 miles north of site; 2) 43 miles long, about 5 miles south of site; 3) 40 miles long, about 7 miles north of site; and 4) the surficial fault is 4 miles long, about 20 miles northwest of site.

Seismic events have occurred infrequently in the region, and their magnitudes have been low. The stress conditions at the site are such that the possibility of high-order seismic events is extremely unlikely. The anticipated seismic activity is well below the levels causing significant damage to structures at Pantex (Pantex 2006).

Approximately 25 earthquakes have been recorded in the Texas Panhandle. The largest earthquakes were the March 27, 1917, Panhandle event, about 15 miles east of the site, and the July 30, 1925, event northeast of Amarillo, about 15 miles northeast of Pantex. Both earthquakes had a Richter magnitude of 5.0 and a Modified Mercalli Scale of VI, with observed effects including pictures falling off walls, furniture moving or overturning, and cracks in weak masonry. Most shocks in the Texas Panhandle are located along the Amarillo Uplift, although uncertainties in the calculated epicenters preclude identifying specific active faults.

Slope stability is not an issue at Pantex because all structures are built on the essentially flat surfaces rather than on the gentle slopes of the playa basins. In general, the surficial soil extends to depths of no more than 10 feet. The underlying Blackwater Draw Formation is the material on which larger structures are founded.

Liquefaction is not considered to be an issue at Pantex because the near-surface materials are not saturated. Salt dissolution is an active and ongoing process in the Southern High Plains, but is extremely unlikely to affect the site. Most active salt dissolution is concentrated near the eastern caprock (an overlying rock layer usually hard to penetrate) escarpment and to a lesser degree near the northern margin in the Canadian River Valley. It is important to note that salt dissolution is a geologically active process; however, it is a very slow process relative to human activities (DOE 1996d).

4.5.7 Biological Resources

4.5.7.1 *Terrestrial Resources*

Pantex is located on the Llano Estacado (staked plains) portion of the Southern Great Plains of Texas on tableland at an elevation of approximately 3,500 feet. The topography at Pantex is relatively flat, characterized by rolling, treeless, grassy plains, and numerous natural playa basins. The term “playa” is used to describe shallow ephemeral (temporary) lakes with clay-lined basins that periodically fill with runoff; most are less than 0.6 mile in diameter. Playa lakes are important hydrologic features acting as sources of recharge to surficial groundwater and providing prime habitat for wildlife. Many wildlife species in the region are dependent on playas for their existence.

The region is a semi-arid farming and ranching area. Shortgrass prairie grasslands were the native vegetation until the prairie was converted to agricultural use for crops, grazing, or protective vegetative cover under the Conservation Reserve Program. Shortgrass prairie is dominated by two warm-season drought-resistant grass species: blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*). Other typical less abundant grass species include sideoats grama (*Bouteloua curtipendula*), western wheatgrass (*Agropyron smithii*), vine mesquite (*Panicum obtusum*) and silver bluestem (*Bothriochloa laguiriodes*) (DOE 1996c).

Since 1955, DOE-owned lands not required for facility operations are managed for agricultural operations under a Service Agreement with TTU. The previously cultivated southeastern portion of Pantex is dominated by silver bluestem (*Bothriochloa laguiriodes*) and rare individuals of yankee weed (*Eupatorium compositifolium*). The west central region of Pantex contains predominantly kochia (Kochia scoparia) and pigweed (Amaranthus spp.) with lesser extents of buffalo grass, planted Siberian elm, and cottonwood (*Populus deltoides*) (DOE 1996c). From 1996 to 2002, native prairie grasses have been seeded in formerly cultivated areas around the playas and in several disturbed areas. The vegetated buffer zone around the playas provide wildlife habitat and filter storm water runoff that drain to the playas.

Herbivorous mammals such as rabbits, deer, and rodents reach high densities in vegetated buffers surrounding playas. Mammalian and avian predators of herbivores also thrive in playa habitats. Waterfowl and shorebirds associated with playas rely heavily on aquatic and mud flat invertebrate populations in the shallow and receding waters.

At least 13 species of mammals were recorded at Pantex in 2005 during routine activities such as bird surveys, nuisance animal actions, and incidental observations. Species observed included the black-tailed jackrabbit (*Lepus californicus*), black-tailed prairie dog (Cynomys ludovicianus), Brazilian free-tailed bat (*Tadarida brasiliensis*), cottontail (*Sylvilagus spp.*), coyote (*Canis latrans*), hispid cottonrat (*Sigmodon hispidus*), mule deer (*Odocoileus heminonus*), pocket gopher (*Geomys or Cratogeomys*), prairie vole (*Microtus ochrogaster*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), white-tailed deer (*Odocoileus virginianus*), and woodrat (*Neotama spp.*) (Pantex 2006). Additional mammalian species observed previously include the American badger (*Taxidea taxus*), deer mouse (*Peromyscus maniculatus*), northern grasshopper mouse (*Onychomys leugaster*), plains harvest mouse (*Reithrodontomys montanus*), silky pocketmouse (*Perognathus flavus*), and the thirteen-lined ground squirrel (*Spermophilus tridecemlimneatus*) (Pantex 2006).

Prairie dog colonies are annually monitored and managed to prevent encroachment on areas of operational concern (Pantex 2006). Through 2006, prairie dog colonies occupied approximately 470 acres at Pantex and Pantex Lake (Pantex 2006). An active comprehensive management plan removes prairie dogs from areas of operational concern. To minimize the spread of prairie dogs, shrubs of four-winged saltbush and aromatic sumac were planted in 2002 as a visual barrier (Pantex 2006).

Counts of burrowing owls (*Athene cunicularia*) are monitored during prairie dog population surveys and in 2003 estimated 177 owls, with 137 at Pantex and 40 at Pantex Lake (Teaschner 2005). The relatively recent increase in availability of food and shrub cover has also resulted in an increasing deer population.

The uplands of Pantex support a variety of invertebrates, reptiles, and amphibians. The insect class is well represented with grasshoppers, beetles, true bugs, flies, bees, wasps, ants, moths, butterflies, and dragonflies. The most frequently occurring species of reptiles and amphibians include the Great Plains toad (*Bufo cognatus*), Woodhouses toad (*Bufo woodhousei*), Plains spadefoot toad (*Scaphiopus bombifrons*), Great Plains skink (*Eumeces obsoletus*), Western coachwhip snake (*Masticophis flagellum testaceus*), bullsnake (*Pituophis melanoleucus sayi*), checkered garter snake (*Thamnophis marcianus marcianus*), and prairie rattlesnake (*Crotalus viridis viridis*) (Pantex 2006).

Migratory birds are an important part of Pantex Plant's natural resources. Bird migrations vary from year to year, especially as conditions change. Some of the more common species of birds that have been observed at Pantex include the Western meadowlark (*Sturnella neglecta*), horned lark (*Eremophila alpestris*), mourning dove (*Zenaida macroura*), Bewicks wren (*Thryomanes bewickii*), mockingbird (*Mimus polyglottos*), house finch (*Carpodacus mexicanus*), common nighthawk (*Chordeiles minor*), greater roadrunner (*Geococcyx californianus*), killdeer (*Charadrius ociferous*), Swainsons hawk (*Buteo swainsoni*), red-tailed hawk (*Buteo jamaicensis*), and turkey vulture (*Cathartes aura*) (Pantex 2006).

4.5.7.2 *Wetlands and Floodplains*

4.5.7.2.1 Wetlands

There are six playas on DOE-owned or leased land at Pantex: Playas 1, 2, and 3 are on the main Pantex Site; Playas 4 and 5 are on land leased from TTU; and Pantex Lake is on a separate parcel of DOE-owned property, approximately 2.5 miles northeast of the main portion of Pantex. The playa lakes are extremely important hydrologic features at Pantex that provide prime habitat for wildlife, especially waterfowl that winter in the southern High Plains. Playas are also believed to be an important source of recharge for the perched aquifer (DOE, 1996, Pantex 2006). Playas 1, 2, and 4 receive stormwater from Pantex's industrial areas; Playa 3 receives stormwater from the Burning Ground. All playas receive runoff from agricultural areas. Prior to 2005, Playa 1 received continuous discharge from the WWTF and was a perennial waterbody with a stable water level.

The vegetation communities of playas are dependent upon the surrounding land use, the depth of the playa basin including modifications for irrigation, and the water regime. Concentric zones of vegetation are generally present in unmodified playas with fluctuating water levels. Wetter playas contain open water zones and narrow- or broad-leaved emergent vegetation that produce seeds for waterfowl. Drier playas contain more grassland vegetation (Pantex 2006).

Playa 1

This playa once received continuous discharge from the WWTF and was a perennial waterbody. Now, it receives only intermittent flow from stormwater. As a perennial waterbody, it supported 19 obligate aquatic plant species, the highest number of any playa at Pantex. Like most wet playas, the dominant plants are emergent and submergent species. A narrow leaved perennial emergent zone consisting of cattail *(Typha anqustifolia)*, spikerush (*Eleocharis macrostachya*), and bulrush (*Scirpus* spp.) was present at Playa 1. Open water habitat contained pondweed (*Potamogeton nodosus*). The broad leaved emergent zone contained seed-producing plants such as arrowhead (*Sagittaria montevidensis*), and smartweed (*Polygonum* spp.). The facultative aquatic or semi-aquatic species found at Playa 1 include slim aster (*Aster subulatus*), and western black willow (*Salix goodingii*). The uplands surrounding Playa 1 are typical High Plains grassland composed of buffalo grass, blue grama, and prickly pear.

Playa 2

The basin of this playa is dominated by several species of smartweed. Other significant species within the basin include mallow (*Malvella leprosa*), ragweed (*Ambrosia grayii*), and sunflower

(*Helianthus annuus*). One small association of cattails was also noted within the playa. The edge of the playa basin contains tumbleweed (*Salsola* spp.) and frog fruit (*Phyla* spp.), while, slightly above the basin, the major plant species are wheatgrass and snow-on-the-mountain (*Euphorbia marginata*). The plant composition of the uplands surrounding Playa 2 is very similar to that of Playa 1.

Playa 3

This playa, adjacent to the Burning Ground, has a basin floral composition of primarily spikerush with little vervain (*Verbena bracteata*) and hairy water clover (*Marsilea vestita*). The edge of the basin is dominated by spikerush, woollyleaf bursage (*Ambrosia grayi*) and cocklebur (*Xanthium strumarium*), and the uplands surrounding Playa 3 have a species composition similar to Playas 1 and 2.

Playa 4

The low areas of this playa contain abundant spikerush and ragweed, with some hairy water clover and buffalo grass. One of the lowest areas in the basin supports cattails and several species of smartweed. Extensive stands of wheatgrass are present on the slopes leading from the basin to the uplands. The shortgrass prairie immediately adjacent to Playa 4 has a composition similar to other areas at Pantex, but with a greater coverage of buffalo grass.

Playa 5

When mostly dry, this playa exhibits large areas of bare clay. The plant species found within the playa include suckleya (*S. suckleyana*), goose foot (*Chenopodium glaucum*), and cocklebur. In a small wet area of the playa, cattails and great bulrush were found to be locally prevalent, and their coverage expands when the playa contains more water from seasonal rains. The lower slopes, which transition into the surrounding grassland contain buffalo grass and wheatgrass. The High Plains grassland surrounding Playa 5 is similar in composition to the remainder of the site, except that three-awn has a more significant presence (DOE 1996c).

Pantex Lake

Major plants within the basin of Pantex Lake are spikerush, wheatgrass, and cocklebur. The area at the edge of the basin is dominated by wheatgrass, but there is a transition into High Plains grassland dominated by buffalo grass and, to a lesser degree, three-awn and blue grama. In the past, Pantex Lake received discharge from site activities, but currently does not.

4.5.7.2.2 Floodplains

Floodplains at Pantex were delineated by the U.S. Army Corps of Engineers (USACE) in accordance with Executive Order 11988 (E.O. 11988). This assessment also addressed DOE's environmental review requirement under *Compliance with Floodplain/Wetlands Environmental Review Requirements* (10 CFR 1022). The USACE delineated floodplain boundaries for Playas 1 though 4, Pantex Lake, and Pratt Lake, located north of the site, using criteria for 100-year, 500-year, and Standard Project Flood boundaries.

Except for Playa 3, floodplains at Pantex are within the drainage boundary for each playa. The 500-year and Standard Project Flood runoff into Playa 3 will overflow out of the drainage basin creating shallow (less than 1 foot) flooding of the drainage basins for Playas 1 and 2 (DOE 1996d).

4.5.7.3 *Aquatic Resources*

There are no federally designated Wild and Scenic Rivers onsite. No streams or rivers flow through Pantex. Major surface water in the vicinity includes the Canadian River, 17 miles to the north, Sweetwater Creek and the Salt Fork of the Red River, respectively 50 miles and 20 miles to the east, and the Prairie Dog Fork of the Red River, 35 miles to the south. The Canadian River flows into Lake Meredith about 25 miles north of the plant. The only naturally occurring waterbodies onsite are the playas and very small, unnamed, intermittent channels and ditches that may feed stormwater into the playas. Wastewater treatment lagoons, past concrete ponds and an earthen stock tank near Pantex Lake provide open-water habitat.

Aquatic resources at Pantex are not extensive. Since Playas 1 through 4 and Pantex Lake are considered wetlands, they are detailed in Section 4.5.7.2. The playas are frequently dry because of the high, naturally occurring evaporation rate combined with a rate of infiltration that normally exceeds the rate of inflow. Playas in the area of Pantex may be as large as 4,000 feet in diameter and more than 30 feet deep. Most of the playas are floored with a clay accumulation at the bottom that when dry offer littoral habitat of mud flats that provide foraging habitat for shorebirds. There are no surface waterways that flow throughout the year. Channels and ditches contain flows only after storm events. Although isolated from navigable waters, playas are considered as waters of the U.S. and are designated as jurisdictional wetlands, but are not subject to Section 404 of the *Clean Water Act*.

The aquatic regions of Playa 1 support over 6 genera of plants. The dominant vegetation is narrow-leaved emergent plants such as cattail, or great bulrush *(Scirpus validus)*, and 3 species of seed-producing broad-leaved emergent, smartweed (*Polygonum* spp.). During surveys in 1992, 26 families of macroinvertebrates were collected from Pantex playas. Insects identified included mayflies (1 family), dragonflies and damselflies (3 families), beetles (6 families), true bugs (6 families), and flies (3 families). There were also 4 families of crustaceans, two families of mollusks, leeches, and water mites. Vertebrate species recorded at Playa 1 include the Plains leopard frog (*Rana blairi*), the Woodhouses toad, and the upland chorus frog (*Pseudoacris triseriata feriarum*). The concrete ponds, representing another aquatic habitat at Pantex, are inhabited by 6 different species of amphibians, including the barred tiger salamander (*Ambystoma tigrinum mavoritum*), the upland chorus frog, and the Great Plains toad. In May 1996, Pantex personnel resampled the earthen stock tank near Pantex Lake. Specimens of fathead minnows (*Pimephales promelus*) and 1 black bullhead (*Ictalurus melas*) were collected (Pantex 2006). Birds are the most conspicuous animal associated with the playas in terms of numbers, diversity, and biomass. Situated along the central flyway migratory route, the playas provide valuable habitat for migration, wintering, and nesting. The most common wintering ducks are mallards, northern pintails, green-winged teals, and American wigeons. Species known to breed in playas include the mallard, northern pintail, blue winged teal, cinnamon teal, northern bobwhite, western meadowlark, yellow-headed blackbird, red-winged blackbird, and ring-necked pheasant (Pantex 2006).

Fishes do not inhabit most playas however those modified for irrigation may contain black bullheads (*Ictalurus melas*).

4.5.7.4 *Threatened and Endangered Species*

The Pantex Plant provides habitat for several species protected by Federal and state endangered species. The current status of threatened and endangered (T&E) species known to appear on, or in the vicinity of Pantex is shown in Table 4.5.7-1.

Five special status species have been observed at Pantex. The ferruginous hawk *(Buteo regalis)* is a common winter resident that feeds on prairie dogs and cottontail rabbits. The area west of Zone 4 West is a potential feeding location because of its prairie dog towns. Also associated with the prairie dog towns is the western burrowing owl *(Athene cunicularia hypugaea)*. Up to 10 pairs of western burrowing owls have been identified as nesting in the area just west of Zone 4 West. The Texas horned lizard (*Phrynosoma cornutum*) is a Pantex resident and has state-threatened status (Pantex 2006).

Other rare or protected species listed in Table 4.5.7-1 are known to exist in Carson County, but have not been observed at Pantex.

Table 4.5.7-1—Rare or Federal and State Listed Species Potentially Occurring at Pantex

Species[a]	Federal Classification	State Classification	Presence Documented at Pantex Plant in 2005
Birds			
Arctic peregrine falcon *Falco peregrinus tundrius*	Concern	Threatened	
Baird’s sparrow *Ammodramus bairdii*	Concern	Not Listed	
Ferruginous hawk *Buteo regalis*	Concern	Not Listed	X
Lesser prairie chicken *Tympanuchus pallidicinctus*	Candidate (Threatened)	Not Listed	
Mountain plover *Charadrius montanus*	Concern	Not Listed	
Peregrine Falcon *Falco peregrinus*	Concern	Endangered. Threatened	
Snowy plover *Charadrius alexandrinus*	Concern	Not Listed	
Western burrowing owl *Athene cunicularia hypugaea*	Concern	Endangered	X
Western Snowy Plover *Charadrius alexandrinus nivosus*	Concern	Not Listed	

Table 4.5.7-1—Rare or Federal and State Listed Species Potentially Occurring at Pantex (continued)

Species[a]	Federal Classification	State Classification	Presence Documented at Pantex Plant in 2005
Birds *(continued)*			
Whooping crane *Grus americana*	Endangered	Endangered	
Mammals			
Big free-tailed bat *Nyctinomops macrotis*	Concern	Not Listed	
Black Bear *Ursus americanus*	Threatened by Similarity of Appearance; Concern	Threatened	
Black-footed ferret *Mustela nigripes*	Endangered	Endangered	
Black-tailed prairie dog *Cynomys ludovicianus*	Concern	Not Listed	X
Cave myotis *Myotis velifer*	Concern	Not Listed	
Gray Wolf *Canis lupus*	Endangered	Endangered	
Pale Townsend's big-eared bat *Corynorhinus townsendii pallescens*	Concern	Not Listed	
Plains spotted skunk *Spilogale putorius interrupta*	Concern	Not Listed	
Swift fox *Vulpes velox*	Concern	Not Listed	
Plants			
Mexican mud-plantain Heteranthera mexicana	Concern	Not Listed	
Texas horned lizard *Phrynosoma cornutum*	Concern	Threatened	X

Source: TPWD 2007.
a = Species that may be of concern to the US Fish and Wildlife Service but do not receive Endangered Species Act recognition, are included for completeness.

4.5.7.5 *Biological Monitoring and Abatement Programs*

The Pantex Plant has developed management activities designed for biodiversity. In addition, flora and fauna surveillance is conducted to assess potential short and long-term effects of Pantex Plant operations on the environment. Radionuclide and fluoride analyses were performed on both native and vegetation crops and animals were sampled to determine whether Pantex Plant activities have an impact on them (Pantex 2006).

Concentrations of inorganic fluoride were not detected at significant levels in vegetation near the Burning Ground or at offsite locations. Radionuclide concentrations in fauna samples, as well as vegetation samples, which included both native vegetation and crops from onsite and offsite locations, were compared to values observed in samples from control locations. These comparisons indicated no detrimental impacts from Pantex Plant operations in 2005 (Pantex 2006).

To manage for biodiversity, Pantex developed a plan for the revegetation of some formerly cultivated areas and implemented it in 1996. Areas of formerly cultivated land were planted with native grasses. Native grasses were seeded on several disturbed areas, such as abandoned parking areas, well construction sites, landfill covers, and roadsides in an effort to minimize soil erosion (Pantex 2006).

4.5.8 Cultural Resources

Cultural resources identified at Pantex Plant include archeological sites from prehistoric Native American use of Pantex Plant land, standing structures that were once part of the World War II-era, and buildings, structures, and equipment associated with the Plant's Cold War operations. 69 archeological sites have been identified at Pantex which consists of 57 prehistoric sites represented by scatters of stone artifacts, and 12 Euro-American farmstead sites represented by foundation remains and small artifact scatters (Pantex 2006).

In consultation with the SHPO, the Pantex Site Office (PSO) determined that the 12 Euro-American historic sites are not eligible for inclusion in the NRHP.

4.5.8.1 *Archaeological Resources*

Systematic archaeological inventories at Pantex have included approximately half of the facility acreage with the other half of the site consisting mainly of industrial areas, playa wetlands, or uplands between playas with very low probability of site occurrence (DOE and TTU areas combined). Through these inventories, 57 prehistoric sites have been identified (DOE 1996d). Archaeological test excavations conducted at 23 of these sites suggest that a majority of the sites were occupied during the Late Archaic and Late Prehistoric periods (1000 B.C.-A.D. 1541). These sites are generally associated with local playas, located within 0.25 mile of the playa margin or along distinct drainages into the playa. However, some sites are located in the upper areas between playas. Sites consist mainly of lithic scatters with varying amounts of fire-cracked rock.

The surficial geology of the Pantex region consists of silts, clays, and sands of the Blackwater Draw Formation. In other areas of the High Plains, this formation contains Late Pleistocene vertebrate remains, including bison, camel, horse, mammoth, and mastodon, with occasional and significant evidence of their use by early North American human populations. Evidence of woolly mammoths has been found north of Pantex near the Canadian River (DOE 1996b). However, no Archaeological resources have been found on Pantex.

The PSO and the SHPO concluded that two of the 57 prehistoric sites are potentially eligible for the National Register, but that additional field work would be required to make a final eligibility determination (Pantex 2006). The PSO will continue to protect the two potentially eligible sites and monitor them on a regular basis, as though they are eligible. In addition, 22 prehistoric sites are protected within playa management units surrounding the four DOE-owned playas (Pantex 2006).

In addition, DOE has decided to protect 22 of the 55 ineligible sites because they are a unique grouping of Southern High Plains sites. The uniqueness is based on the sites' location near contiguous playas and the sites' research potential to illuminate prehistoric human use of the region's playas. This is the largest such grouping of sites currently under Federal protection.

4.5.8.2 *Historic Resources*

Historic resources located at Pantex include archaeological sites dating to pre-1942, World War II-era resources, and Cold War-era resources. Twelve pre-1942 Euro-American historic sites have been identified at Pantex. These sites include foundations of demolished buildings such as homes and agricultural support structures (e.g., barns, windmills), and surface scatters of metal, ceramic, and glass artifacts.

The World War II-era historical resources of Pantex consist of 121 standing buildings and structures, all of which have been surveyed and recorded. In consultation with the SHPO, the PSO has determined that these properties are not eligible for inclusion in the NRHP (Pantex 2006). However, 69 buildings that were constructed during World War II and used during the Cold War are eligible for inclusion in the NRHP under the Cold War context (Pantex 2006).

From 1951-1991, Pantex had a Cold War mission centered around nuclear weapons, including fabrication of high explosives, assembly and disassembly, and repair and modification (DOE 1996d). A literature search was conducted that identified approximately 650 buildings and structures and a large inventory of related equipment and documents from this era.

A draft Pantex Plant Cold War context statement was completed in 1999, to assist in the evaluation of these resources for eligibility in the NRHP. In addition, a draft cultural resources management plan was completed in 2000 to describe the management of all Pantex Plant resources determined eligible for the NRHP. In 2003, the Cold War context statement was finalized and the draft cultural resources management plan was revised. Both documents were presented to the SHPO and the Advisory Council in early 2004 and the final was completed in October 2004. The cultural resources management program at Pantex is now focused on implementing the new program and completing the range of preservation of activities described in the management plan (Pantex 2006).

4.5.8.3 *Native American Resources*

To date, no known Native American traditional cultural properties, sacred sites, or mortuary remains have been identified at Pantex, and based on completed inventories, none are anticipated. A recently completed search of treaty records has indicated that no federally recognized Native American tribes have recognized title or treaty rights to Pantex land area; however, the U.S. Indian Claims Commission has found that the Kiowa, Comanche, and Apache Tribes of Oklahoma have legally recognized traditional interests in the Texas Panhandle (DOE 1996d).

4.5.9 Socioeconomic Resources

Socioeconomic characteristics addressed at Pantex include employment, regional economy, and population, housing, and community services. Socioeconomic characteristics are presented for a ROI. The ROI was identified based on the distribution of residences for current Pantex employees. The ROI is defined as those counties where approximately 90 percent of the workforce lives.

Pantex is located in Carson County, Texas. Statistics for socioeconomic characteristics are presented for the ROI, a region consisting of Potter, Carson, Randall, and Armstrong Counties. Figure 4.5.9-1 presents a map of the counties composing the Pantex ROI.

4.5.9.1 *Employment and Income*

Labor force statistics are summarized in Table 4.5.9-1. The available labor force (i.e., those greater than 16 years old and able to work) of the ROI grew by approximately 9 percent from 117,511 in 2000 to 128,348 in 2005. The overall ROI employment experienced a growth rate of nearly 9 percent with 112,986 in 2000 to 123,280 in 2005 (BLS 2007).

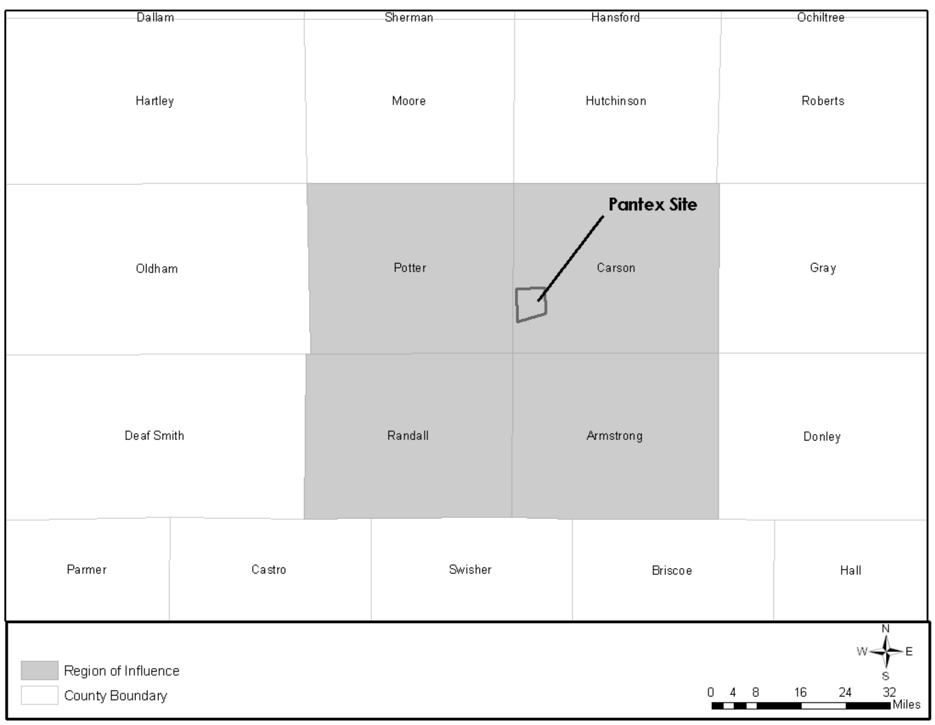


Figure 4.5.9-1—Region of Influence for Socioeconomic Impacts at Pantex

The ROI unemployment rate was 3.9 percent in 2000 and 3.9 percent in 2005. In 2005, Potter County had the highest unemployment rate within the ROI, 4.6 percent. Randall County had the lowest unemployment rate within the ROI, 3.4 percent (BLS 2007).

Table 4.5.9-1—Labor Force Statistics for ROI and Texas

	ROI		Texas	
	2000	**2005**	**2000**	**2005**
Civilian Labor Force	117,511	128,348	10,347,847	11,282,845
Employment	112,986	123,280	9,896,002	10,677,171
Unemployment	4,525	5,068	451,845	605,674
Unemployment Rate	3.9	3.9	4.4	5.4

Source: BLS 2007.

Income information for the Pantex ROI is provided in Table 4.5.9-2. Potter County is at the low end of the ROI with a median household income in 2004 of $30,294 and a per capita income of $25,048. Randall County had a median household income of $47,377 and a per capita income of $29,164 (BEA 2007).

4.5.9.2 *Population and Housing*

The ROI is used to analyze the primary economic impacts on population and housing. Table 4.5.9-3 presents historic and projected population in the ROI and the state.

Table 4.5.9-2—Income Information for the Pantex ROI, 2004

	Per capita income (dollars)	Median household income (dollars)
Armstrong	28,743	40,857
Carson	25,796	38,724
Potter	25,048	30,294
Randall	29,164	47,377
Texas	30,664	41,645

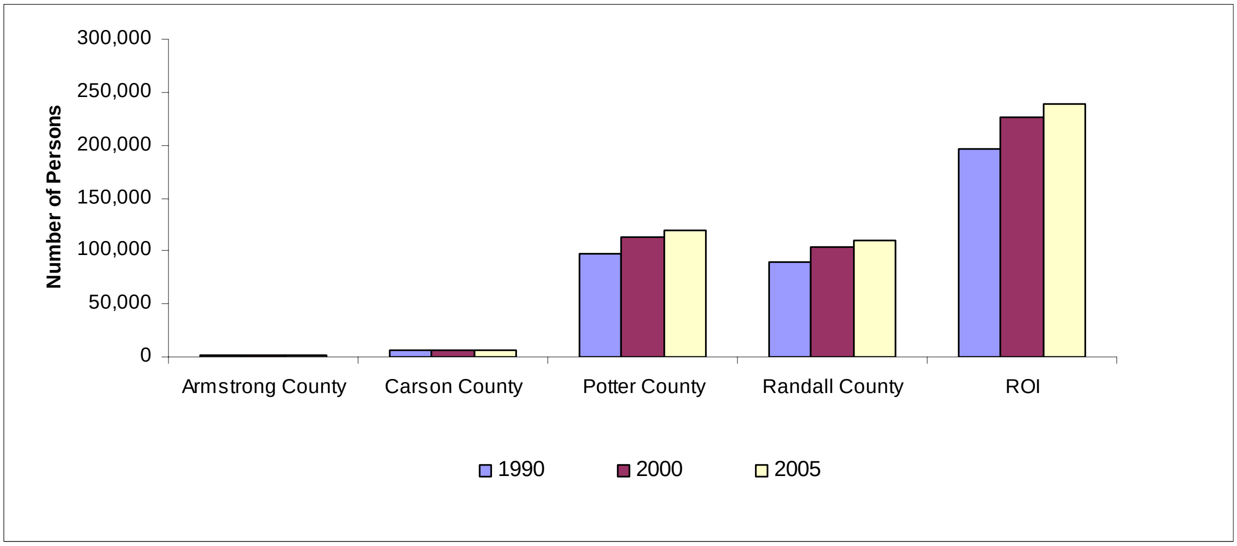
Source: BEA 2007.

Table 4.5.9-3—Historic and Projected Population

	1990	2000	2005	2010	2020
Armstrong County	2,021	2,148	2,176	2,236	2,355
Carson County	6,576	6,516	6,577	6,702	6,925
Potter County	97,874	113,546	120,033	125,209	135,313
Randall County	89,673	104,312	110,021	108,230	110,090
ROI	196,144	226,522	238,807	242,377	254,683
Texas	16,986,510	20,851,820	22,928,508	22,802,947	24,330,685

Source: USCB 2007.

Between 1990 and 2000, the ROI population increased 15 percent from 196,144 in 1990 to 226,522 in 2000. From 2000 to 2005, the population of the ROI increased 5 percent to 238,807 in 2005. Potter County experienced the largest population growth within the ROI between 2000 and 2005 with an increase of 5.7 percent (USCB 2007). Figure 4.5.9-2 presents the trends in population within the Pantex ROI.



Source: USCB 2007.
Note – Number of persons for Armstrong and Carson Counties are also presented in Table 4.5.9-3.

Figure 4.5.9-2—Trends in Population for the Pantex ROI, 1990-2005

Table 4.5.9-4 lists the total number of housing units and vacancy rates in the ROI. In 2000, the total number of housing units in the ROI was 91,594 with 85,272 occupied (93 percent). There were 56,173 owner-occupied housing units and 29,099 rental units. The median value of owner-occupied units in Randall County was the greatest of the counties in the Pantex ROI ($93,500). The median value of owner-occupied units was $54,400 in Potter County. The vacancy rate was the lowest in Randall County (4.7 percent) and the highest in Armstrong County (12.8 percent) (USCB 2007).

Table 4.5.9-4 — Housing in the Pantex ROI, 2000

	Total Units	Occupied housing Units	Owner Occupied Units	Renter Occupied Units	Vacant units	Vacancy Rate (percent)	Median value of Owner Occupied Units (dollars)
Armstrong County	920	802	633	169	118	12.8	60,500
Carson County	2,815	2,470	2,067	403	345	12.3	52,400
Potter County	44,598	40,760	24,484	16,276	3,838	8.6	54,400
Randall County	43,261	41,240	28,989	12,251	2,021	4.7	93,500
ROI	91,594	85,272	56,173	29,099	6,322	6.9	74,573

Source: USCB 2007.

4.5.9.3 *Community Services*

Community services analyzed in the ROI include public schools, law enforcement, fire suppression and medical services. There are 11 school districts with 87 schools serving the Pantex ROI. Educational services are provided for approximately 43,054 students by an estimated 3,031 teachers for the 2005 to 2006 school year (IES 2006d). The student-to-teacher ratio in these school districts ranges from a high of 16:1 in the Canyon School District in Randall

County to a low of 9:1 in the Claude and Groom School Districts, in Armstrong and Carson Counties, respectively. The student-to-teacher ratio in the ROI was 14:1 (IES 2006d).

The counties within the ROI employ approximately 2,900 firefighters and law enforcement officers. There are 5 hospitals that serve residents of the ROI and are all located in Potter County. These hospitals have a total bed capacity of 1,133 (ESRI 2007).

4.5.10 Environmental Justice

The potentially affected area considered for environmental justice analysis is the area within a 50-mile radius of Pantex. Figure 4.5.10-1 shows counties potentially at risk from the current missions performed at Pantex. There are 14 counties included in the potentially affected area. Table 4.5.10-1 provides the demographic profile of the potentially affected area using data obtained from the 2000 Census.

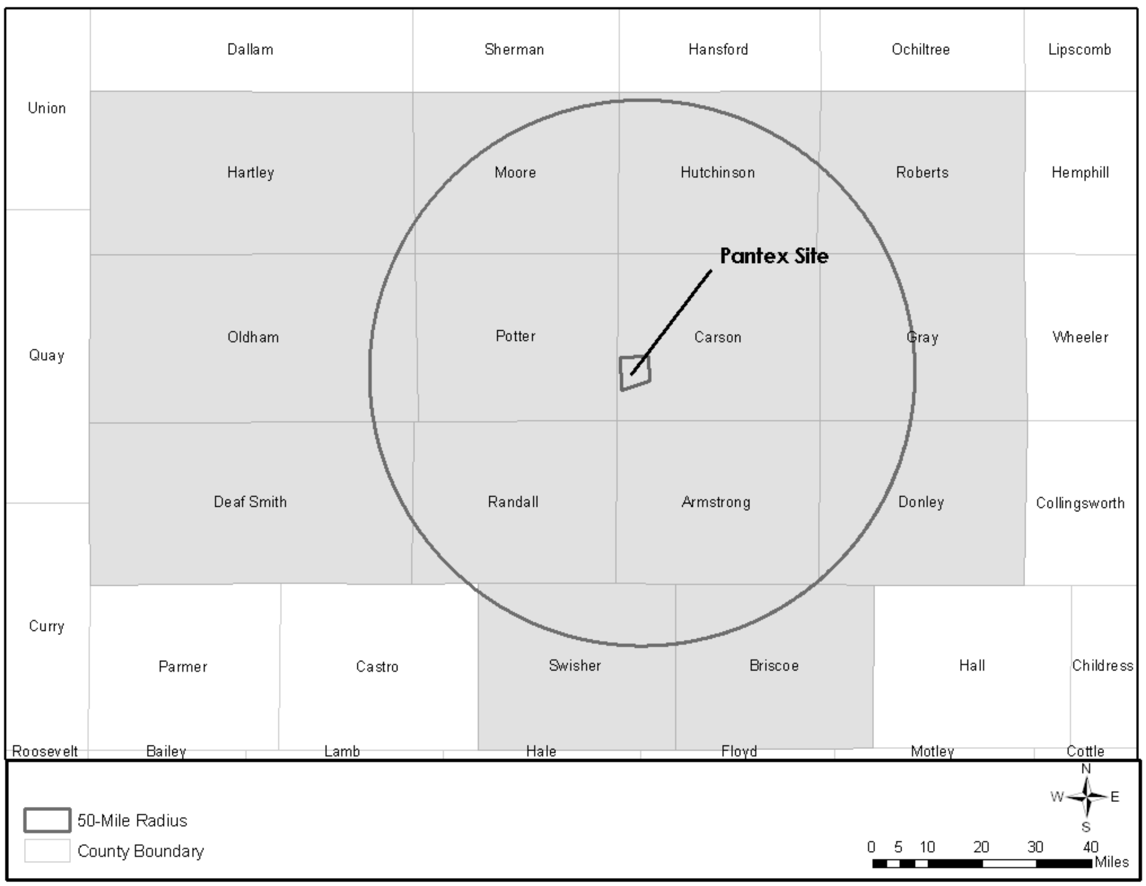


Figure 4.5.10-1—Potentially Affected Counties Surrounding Pantex Environmental Justice

Table 4.5.10-1—Demographic Profile of the Potentially Affected Area Surrounding Pantex, 2000

Population Group	Population	Percent
Total Minority	**100,657**	**30.1**
Hispanic alone	30,644	9.2
Black or African American	16,416	4.9
American Indian and Alaska Native	2,708	0.8
Asian	4,347	1.3
Native Hawaiian and Other Pacific Islander	120	0.04
Native Hawaiian	44	0.01
Some other race	39,218	11.7
Two or more races	7,160	2.1
White alone	**233,753**	**69.9**
Total Population	**334,410**	**100**

Source: USCB 2007.

In 2000, persons self-designated as minority individuals in the potentially affected area comprised 30.1 percent of the total population. Residents designated as some other race are the largest group within the minority population. As a percentage of the total resident population in 2000, Texas had a minority population of 47.6 percent and the U.S. had a minority population of 30.9 percent (USCB 2007).

Census tracts with minority populations exceeding 50 percent were considered minority census tracts. Based on 2000 census data, Figure 4.5.10-2 shows minority census tracts within the 50-mile radius where more than 50 percent of the census tract population is minority.

Census tracts were considered low-income census tracts if the percentage of the populations living below the poverty threshold exceeded 50 percent. Based on 2000 Census data, Figure 4.5.10-3 shows low-income census tracts within the 50-mile radius where more than 50 percent of the census tracts population is living below the Federal poverty threshold.

According to 2000 census data, approximately 44,312 individuals residing within census tracts in the 50-mile radius of Pantex were identified as living below the Federal poverty threshold, which represents approximately 14 percent of the census tracts population within the 50-mile radius. There were no census tracts within the 50-mile radius where more than 50 percent of the population was identified as living below the Federal poverty threshold. In 2000, 15.4 percent of individuals for whom poverty status is determined were below the poverty level in Texas and 12.4 percent in the U.S. (USCB 2007).

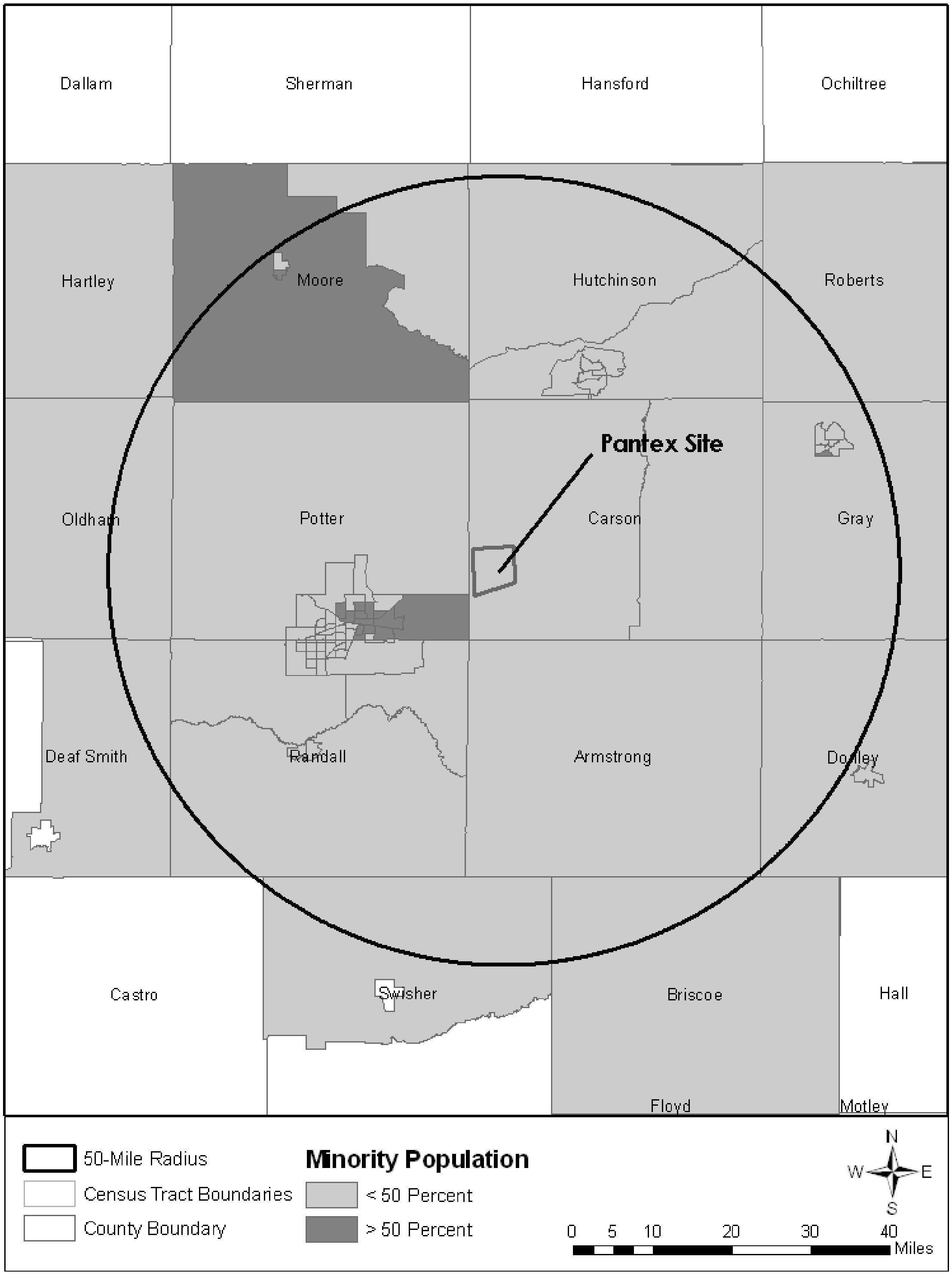


Figure 4.5.10-2—Minority Population—Census Tracts with More than 50 Percent Minority Population in a 50-Mile Radius of Pantex

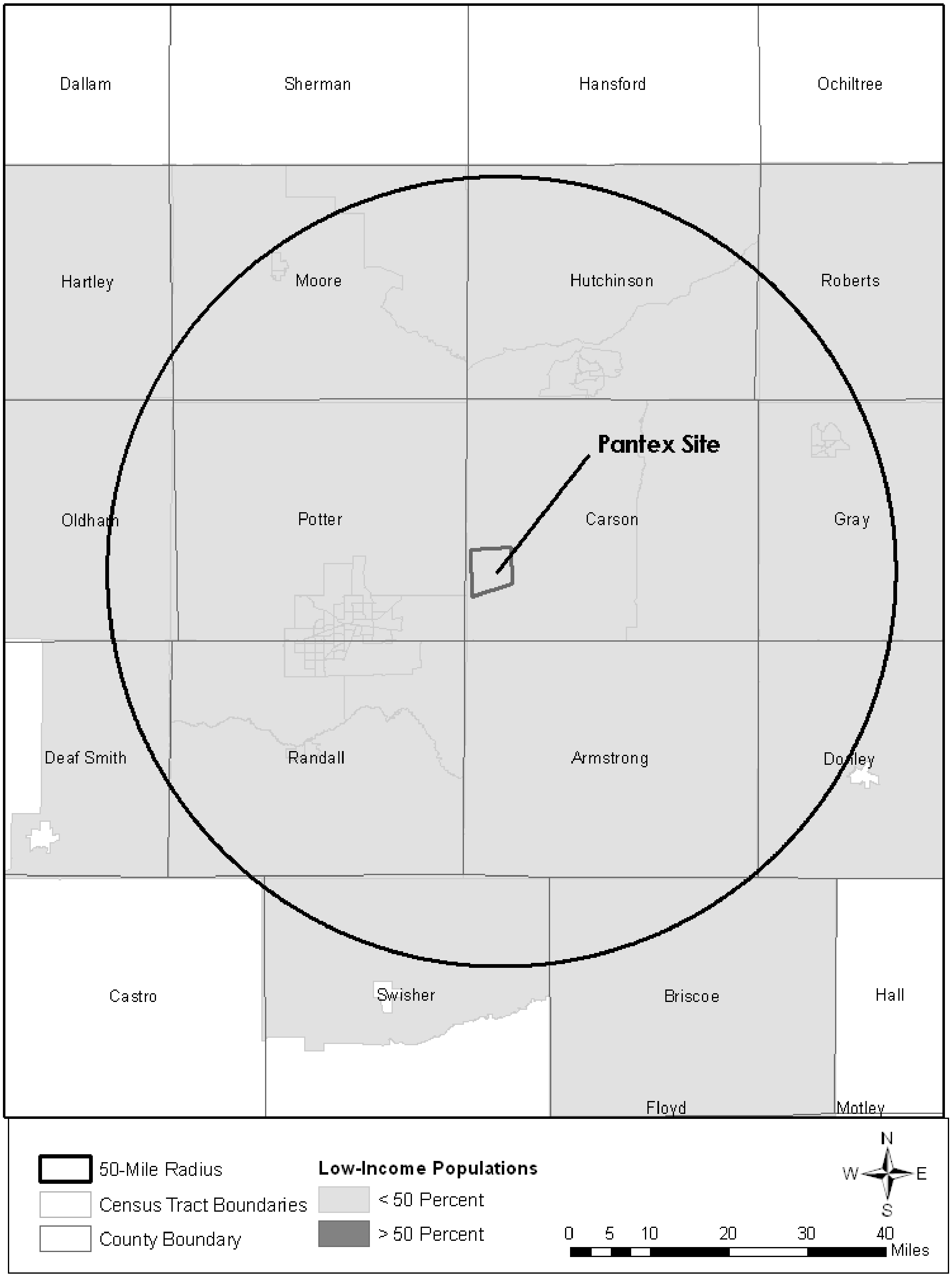
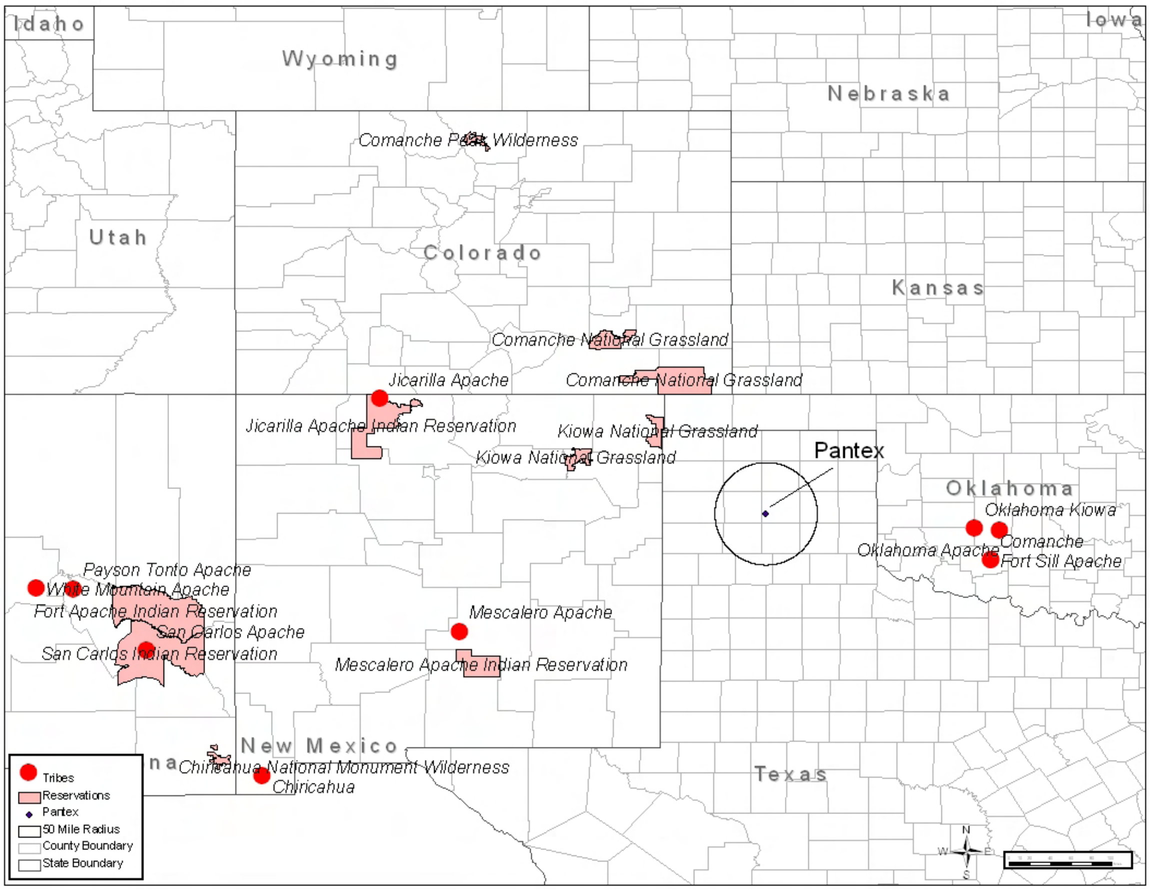


Figure 4.5.10-3—Low-Income Population—Census Tracts with More than 50 Percent Low-Income Population in a 50-Mile Radius of Pantex

4.5.10.1 *Characteristics of Native American Populations within the Vicinity of or with Interest in Pantex Activities/Operations*

As discussed in Section 4.5.8.3, no federally recognized Native American tribes have recognized title or treaty rights to Pantex land area; however, the U.S. Indian Claims Commission has found that the Kiowa, Comanche, and Apache Tribes of Oklahoma have legally recognized interests in the Texas Panhandle and were included in this analysis. The 2000 U.S. Census Bureau was used to obtain characteristics, including population, employment, educational attainment, income, poverty level, average family size, and housing characteristics for all population subcategories associated with the ones mentioned above. The locations of various tribes and areas of tribal interest in relation to Pantex are shown in Figure 4.5.10-4. The results of this analysis are provided in the following section.



Source: ESRI 2007.

Figure 4.5.10-4—Location of Tribes within Vicinity of or with Interest in Pantex

As shown in Table 4.5.10-2, the Apache had the highest of the Native American populations with 57,199 and Kiowa with the least at 8,321. The Comanche have the largest percentage of their population as members of the civilian labor force at 63.9 percent and the Aapche with the smallest percentage of their population as members of the civilian labor force with 53.9 percent. The Apache had the highest unemployment rate at 9.3 percent and the Comanche with the lowest unemployment rate at 5.6 percent (USCB 2007).

Of those individuals over 25 with some form of education, the largest constituency of all the three Native American populations had received a high school diploma as shown in Table 4.5.10-3. A comparable percentage of individuals had attended some college and significantly lesser percentages of these populations had received degrees from institutions of higher learning (Associate, Bachelor, or Graduate/Professional) (USCB 2007).

Table 4.5.10-2—Population and Employment Estimates for Native American Populations within the Vicinity of or With Interest in Pantex, 2000

Pantex	Population	Civilian Labor Force	Civilian Labor Force (percent)	Employed	Employed (percent)	Unemployed	Unemployed (percent)
Apache	57,199	23,610	58.5	19,841	49.2	3,769	9.3
Apache Alone	24,266	12,080	63.8	10,696	56.5	1,384	7.3
Chiricahua	1,155	702	69.8	618	61.4	84	8.3
Fort Sill Apache	237	109	74.1	106	72.1	3	2
Jicarilla Apache	3,109	1,243	57.7	1,028	47.7	215	10
Mescalero Apache	5,482	2,455	62.6	2,128	54.3	327	8.3
Oklahoma Apache	408	158	48	136	41.3	22	6.7
Payson Tonto Apache	133	26	42.6	25	41	1	1.6
San Carlos Apache	9,867	2,922	47.6	2,049	33.4	873	14.2
White Mountain Apache	12,377	3,822	50.7	2,987	39.6	835	11.1
Comanche	10,518	5,205	63.9	4,745	58.3	460	5.6
Kiowa	8,321	3,851	63.5	3,376	55.7	475	7.8
Kiowa Alone	7,853	3,630	63.1	3,187	55.4	443	7.7
Oklahoma Kiowa	467	220	71.2	188	60.8	32	10.4

Source: USCB 2007.

Table 4.5.10-3—Level of Educational Attainment by Native American Populations within the Vicinity of or With Interest in Pantex, 2000

Pantex	Highschool Graduate	Highschool Graduate (percent)	Some College	Some College (percent)	Associate Degree	Associate Degree (percent)	Bachelor Degree	Bachelor Degree (percent)	Graduate/ Professional Degree	Graduate/ Professional Degree (percent)
Apache	9,250	29	7,940	24.9	2,093	6.6	1,868	5.9	848	2.7
Apache Alone	4,261	27.1	4,389	27.9	1,191	7.6	1,176	7.5	478	3
Chiricahua	352	41.3	163	19.1	88	10.3	72	8.5	46	5.4
Fort Sill Apache	16	14.2	23	20.4	13	11.5	26	23	16	14.2
Jicarilla Apache	544	35.2	420	27.2	93	6	102	6.6	56	3.6
Mescalero Apache	853	27.6	979	31.7	227	7.3	198	6.4	120	3.9
Oklahoma Apache	108	41.1	44	16.7	7	2.7	17	6.5	4	1.5
Payson Tonto Apache	31	63.3	3	6.1	0	0	2	4.1	0	0
San Carlos Apache	1,410	30.6	985	21.4	226	4.9	82	1.8	57	1.2
White Mountain Apache	1,648	29.7	896	16.2	239	4.3	181	3.3	37	0.7
Comanche	1,839	27.6	1,861	27.9	572	8.6	863	13	368	5.5
Kiowa	1,591	34.4	1,227	26.6	251	5.4	432	9.4	244	5.3
Kiowa Alone	1,503	34.4	1,154	26.4	251	5.8	391	9	204	4.7
Oklahoma Kiowa	88	34.8	72	28.5	0	0	41	16.2	40	15.8

Source: USCB 2007

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In 2000, mean household earnings and per capita income were comparable for all three factions of Native American populations with interest in the Texas Panhandle region. The Kiowa population had the highest mean household earnings of $40,090 as shown in Table 4.5.10-4. The Comanche population had the highest per capita income of $14,312 and the lowest mean household earnings of $38,959. The Apache had the lowest per capita income with $11,721 (USCB 2007).

Of the three Native American populations within the vicinity of Pantex, the Apache had the largest percentage of individuals below the poverty level in 2000 with 33.9 percent as compared to the Comanche population which had 19.8 percent of the total population living below the poverty level as shown in Table 4.5.10-4 (USCB 2007).

Table 4.5.10-4—Income and Poverty Level Estimates for Native American Populations within the Vicinity of or With Interest in Pantex, 2000

Pantex	Mean Household Earnings	Per Capita Income	Individuals Below the Poverty Level	Individuals Below the Poverty Level (percent)
Apache	$39,143	$11,721	18,732	33.9
Apache Alone	$44,627	$16,198	5,548	23.9
Chiricahua	$40,064	$16,656	210	18.9
Fort Sill Apache	$33,822	$15,390	53	24.4
Jicarilla Apache	$37,941	$11,414	852	28.7
Mescalero Apache	$40,469	$13,510	1,393	26.4
Oklahoma Apache	$28,329	$12,432	120	32.4
Payson Tonto Apache	$49,100	$6,306	22	16.8
San Carlos Apache	$28,285	$5,951	4,697	48.5
White Mountain Apache	$28,188	$6,268	5,787	47.6
Comanche	$38,959	$14,312	2,027	19.8
Kiowa	$40,490	$14,179	2,137	26.6
Kiowa Alone	$38,226	$13,836	2,062	27.2
Oklahoma Kiowa	$74,020	$19,928	75	16.7

Source: USCB 2007.

In 2000, the Apache had the largest average family size with 3.77 persons, followed by the Kiowa with 3.45 and the Comanche with 3.36 persons per family. The Apache had the greater number of occupied housing units which is consistent with their larger population as shown in Table 4.5.10-5 (USCB 2007).

Table 4.5.10-5—Housing Characteristics for Native American Populations within the Vicinity of or With Interest in Pantex, 2000

Pantex	Average Family Size	Housing Units	Occupied Housing Units	Owner Occupied Housing Units	Owner Occupied Housing Units (percent)	Renter Occupied Housing Units	Renter Occupied Housing Units (percent)
Apache	3.77	18,130	17,788	9,392	52.8	8,396	47.2
Apache Alone	3.37	9,058	8,865	4,085	46.1	4,780	53.9
Chiricahua	3.28	518	531	240	45.2	291	54.8
Fort Sill Apache	2.84	87	89	37	41.6	52	58.4
Jicarilla Apache	3.91	961	939	624	66.5	315	33.5
Mescalero Apache	3.49	1,854	1,785	1,005	56.3	780	43.7
Oklahoma Apache	3.66	106	91	36	39.6	55	60.4
Payson Tonto Apache	6.53	36	47	39	83	8	17
San Carlos Apache	4.49	2,421	2,369	1,430	60.4	939	39.6
White Mountain Apache	4.33	3,010	2,984	1,857	62.2	1,127	37.8
Comanche	3.36	3,834	3,737	1,979	53	1,758	47
Kiowa	3.45	2,454	2,404	1,102	45.8	1,302	54.2
Kiowa Alone	3.44	2,321	2,282	1,042	45.7	1,240	54.3
Oklahoma Kiowa	3.53	133	122	60	49.2	62	50.8

Source: USCB 2007.

4.5.11 Health and Safety

Most nuclear weapon parts that include radioactive materials are sealed, therefore, minimizing the likelihood of contamination of the weapons themselves, the workers, the public, and the environment. Some activities at Pantex however, do involve the release or the potential release of small amounts of radionuclides (Pantex 2006).

4.5.11.1 *Public Health*

4.5.11.1.1 Radiological

Releases of radionuclides to the environment from Pantex operations provide a source of radiation exposure to individuals in the vicinity of Pantex. During 2005, Pantex Plant’s environmental radiological monitoring program was conducted according to DOE Orders 450.1, “Environmental Protection Program,” and 5400.5, “Radiation Protection of the Public and the Environment.” The program involved measuring radioactivity in environmental samples in addition to calculating the potential radiological dose to the offsite public. The program monitored for the principal radionuclides associated with plant operations: tritium, thorium-232, uranium-234, uranium-238, and plutonium-239 in air, groundwater, drinking water, surface water, soil, flora, and fauna samples. The radionuclides thorium-232, uranium-234, uranium-238, and plutonium-239 emit primarily alpha particles. Tritium emits beta particles. Gamma radiation emissions from these radionuclides were also monitored and evaluated.

The exposure of members of the public to all DOE sources of radiation is limited by the DOE to levels that shall not cause, in a year, an effective dose equivalent greater than 100 millirem. Demonstration of compliance with this limit is documented by a combination of measurements and calculations including the comparison of concentrations of radioactive material in air and water to DCGs listed in Chapter III of DOE Order 5400.5. The DOE provides a level of protection for persons consuming water from a public drinking water supply equivalent to the drinking water criteria in 40 CFR 141 by limiting the effective dose equivalent in a year to 4 millirem. Current Pantex policy does not allow the discharge of radioactive material into liquid effluent, thus eliminating any future potential impact to groundwater from that source. Compliance with the aforementioned criterion is accomplished by comparing measured concentrations of radionuclides in drinking water to 4 percent of the DCG values for ingested water. The DOE further limits emissions of radionuclides to the ambient air from DOE facilities to those amounts that would not cause any member of the public to receive, in any year, an effective dose equivalent of 10 millirem per year. This limit is equivalent to the limit for emissions of radionuclides other than radon to this pathway established by the EPA at 40 CFR 61.92.

Compliance with the dose limit specified in 40 CFR 61.92 (and hence that for the air pathway specified in DOE Order 5400.5) is demonstrated by calculating the effective dose equivalent received by the MEI member of the general public. This individual is a person who resides near Pantex Plant, and who would receive, based on theoretical assumptions about lifestyle that maximize exposure to radiological emissions, the highest effective dose equivalent from Plant operations. Calculations are performed using the EPA's CAP88-PC model (EPA 1992).

The dose received by the MEI and the collective population dose are tabulated in Table 4.5.11-1. Because there were no releases from Pantex Plant to the water pathway or any other pathway, the indicated dose represents that for the *air* pathway as well as *all* pathways. Based on the 2005 operational data, Pantex caused a dose to the MEI of 4.28×10^{-9} millirem per year. This dose is 4.28×10^{-9} percent of the DOE public dose limit for all pathways. This dose is significantly below the U.S. EPA maximum permissible exposure limit to the public (and the DOE "air pathway" limit) of 10 millirem per year. The monitoring and analysis results demonstrate that no adverse effects occurred from Plant operations in 2005.

Based upon the same CAP88-PC modeling results, the collective population dose received by those living within 50 miles of Pantex Plant would have been 3.07×10^{-8} person-rem per year in 2005. For comparison purposes, the estimated background radiation dose to the population within 50-miles of Pantex was calculated to be 29,600 person-rem (Pantex 2006).

Pantex workers receive the same dose as the general public from background radiation, but they also may receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at Pantex from operations in 2005 are presented in Table 4.5.11.–2. These doses fall within the radiological regulatory limits of 10 CFR 835. Using a risk estimator of 6×10^{-4} LCFs per rem among workers (see Appendix C), the number of projected fatal cancers among Pantex workers from normal operations in 2005 is 0.03.

Table 4.5.11–1—Radiation Doses to the Public from Normal Pantex Operations in 2004 (Total Effective Dose Equivalent)

Members Of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Offsite MEI (millirem)	10	4.28×10^{-9}	4	0	100	4.28×10^{-9}
Population within 50 miles[b] (person-rem)	None	3.07×10^{-8}	None	0	None	3.07×10^{-8}

Source: Pantex 2006.

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-millirem per year limit from airborne emissions is required by the *Clean Air Act* (40 CFR 61) and the 4-millirem per year limit is required by the *Safe Drinking Water Act* (40 CFR 141). For this EIS, the 4- millirem per year value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 millirem per year is the limit from all pathways combined. If the potential collective dose to the offsite population exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.

[b] 50-mile population is approximately 334,000 based on 2000 census data.

Table 4.5.11–2—Radiation Doses to Workers From Normal Pantex Operations in 2005 (Total Effective Dose Equivalent)

Occupational Personnel	Standard	Actual
Average radiation worker dose (millirem)	5,000[a]	132
Collective radiation worker dose[b] (person-rem)	None	44.2

Source: Pantex 2006.

[a] DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 millirem per year(DOE 1999e); the site must make reasonable attempts to maintain individual worker doses below this level.

[b] There were 334 workers with measurable doses in 2001.

4.5.11.1.2 Nonradiological

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Pantex workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals.

Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at Pantex via inhalation of air containing hazardous chemicals released to the atmosphere by Pantex operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Nonradiological ambient air monitoring was conducted at a single location designated in Texas Natural Resources Conservation Commission (TNRCC) Hazardous Waste Permit HW-50284. The maximum measurement of hydrogen fluoride at this air monitoring site was 3.9 percent of the TNRCC Effects Screening Level (ESL) for hydrogen fluoride. The maximum measurement for any VOC was 87.5 percent of its ESL. This VOC (hexachlorobutadiene) was measured on a day when thermal treatment (burning) was not being conducted at the Burning Ground. The maximum concentration of respirable particulate matter measured at the site designated in HW-50284 was 78.9 percent of the NAAQS, 24-hour average concentration (150 micrograms per cubic meter).

4.5.12 Transportation

As shown in Figure 4.5.12-1 Pantex is in the northern Texas panhandle approximately 17 miles northeast of Amarillo, Texas. I-40 provides the main east-west route in the region. I-27 connects Amarillo with locations to the south as far as Lubbock, which is 124 miles away. Highway 87 provides access to and from the north. Truck shipments to Pantex from the east would arrive on I-40, exiting at FM 2373. The shipping gate is off FM 2373.

Access to the site is provided by the Texas Farm-to-Market roads bounding the site on the north, east, and west and by U.S. 60, one mile to the south. I-40 and I-27 provide access to the interstate highway system. Additionally, 47 miles of roads exist within Pantex boundaries.

Roads within Pantex are classified as primary, secondary, and tertiary roadways. Primary roads are the main distribution arteries for all onsite and offsite traffic. Secondary roads are collector roadways that supplement the primary roads. Primary and secondary roads are paved, two-lane roadways. Tertiary roads are generally single-lane roads, but some heavily traveled tertiary roads are two lanes (DOE 1996c).

4.5.12.1 *Aircraft and Railroad Operations*

The Amarillo International Airport is located approximately 7.5 miles southwest of Pantex Plant. The airport is primarily used for commercial aviation and is equipped for international commerce. Pantex Plant leases a small facility at the airport for its own transportation use. The management and operations (M&O) contractor provides the necessary ground transportation.

A major rail center for the Burlington Northern Santa Fe Railroad, formerly known as the Atchison, Topeka, and Santa Fe Railroad, is located in Amarillo, Texas. The railroad passes along the southernmost portion of the TTU property at Pantex Plant Site. A railroad spur which extended through the TTU property into Pantex Plant from the southwest was removed in 2006. (DOE 1996b).

4.5.12.2 *Transportation Accidents*

Motor vehicle accidents in Carson County and nearby counties are reported in Table 4.5.12-1. In 2001, there were 31 motor vehicle accidents in Armstrong, Carson, Potter, and Randall Counties resulting in 37 fatalities.

Table 4.5.12-1—Texas Traffic Accidents in Nearby Counties, 2001

County	Total Vehicle Accidents	Interstate Accidents	Fatalities
Armstrong	1	1	1
Carson	4	1	7
Potter	16	2	18
Randall	10	1	11

Source: TXDPS 2001.

4.5.13 Waste Management

The types of wastes generated at Pantex Plant include hazardous wastes, regulated under RCRA, universal waste, non-hazardous wastes, wastes regulated under TSCA, LLW, MLLW, and sanitary waste.

4.5.13.1 *Low-Level Waste*

Compactable solid LLW is processed at the LLW compactor and stored along with non-compactable materials for shipment to NTS, where most Pantex LLW is disposed of, or to a commercial disposal facility. Radioactively contaminated classified weapons components are sent to the classified LLW repository at NTS. Soil contaminated with depleted uranium has been disposed of at a commercial facility, and the possibility for disposal of other LLW at commercial facilities is being pursued where technically and economically advisable (DOE 1996d).

4.5.13.2 *Mixed Low-Level Waste*

Most Pantex mixed waste consists of paper products contaminated with solvents and low-level radionuclides, and inorganic debris (including metals) contaminated with low levels of radionuclides. Mixed waste is disposed of offsite. Pantex treats mixed LLW onsite in two facilities: Building 16-18 and the Burning Ground.

Building 16-18 is permitted for the treatment and processing of mixed LLW and hazardous waste in containers. The Burning Ground is permitted to treat explosives and explosive-contaminated waste by open burning. In some cases, a large volume reduction is attained by this treatment, and some wastes are rendered nonhazardous due to elimination of the reactivity hazard.

DOE decided to construct a Hazardous Waste Treatment and Processing Facility (HWTPF, Building 16-18) in its ROD for the *Final Environmental Impact Statement for the Continued Operation of Pantex and Associated Storage of Nuclear Weapon Components* (62 FR 3880; January 27, 1997). DOE completed construction and initiated operations of the HWTPF in FY2000 (DOE 2001a). Building 16-18 is assuming more of the treatment and processing as Building 11-9S no longer exists. Operations currently consist of segregating and downgrading production line generated waste, destruction of classified and sensitive matter, evaporation of tritiated water, waste compaction, and segregation of scintillation vials into solid and liquid waste streams. There is also the capability to solidify liquids and to rinse drums for reuse, should the need arise.

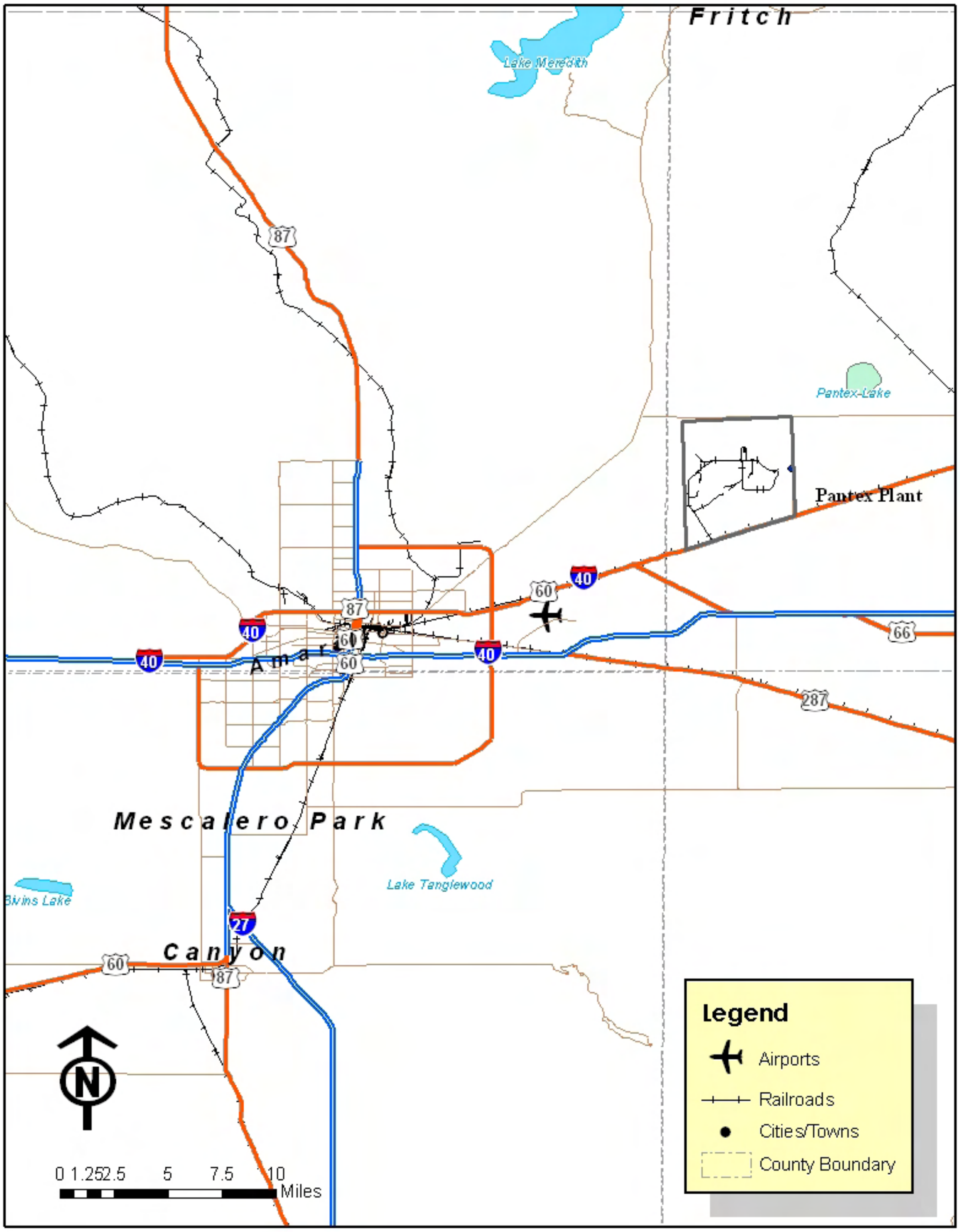


Figure 4.5.12-1—Roads in the Vicinity of Pantex

4.5.13.3 *Hazardous Waste*

During 2005, Pantex generated 711 cubic yards of hazardous waste. Typical hazardous wastes generated at Pantex Plant included explosives-contaminated solids, spent organic solvents, and solids contaminated with spent organic solvents, metals, and/or explosives. Before onsite processing and/or shipment to commercial facilities, hazardous wastes were managed in satellite accumulation areas, less than 90-day waste accumulation sites, or RCRA permitted authorized waste management units. Some hazardous wastes, such as explosives, were processed onsite before the process residue was shipped offsite for final treatment and disposal. During the year, environmental restoration projects and deactivation and decommissioning of excess facilities contributed 1.9 percent of the total hazardous waste generated. Hazardous wastes and residues from hazardous waste processing are shipped to commercial facilities authorized for final treatment and disposal or, as applicable, recycling (Pantex 2006).

4.5.13.4 *Other Wastes*

During 2005, Pantex generated 6,375 cubic yards of non-hazardous waste. Non-hazardous wastes generated at Pantex were characterized as either Class 1 non-hazardous industrial solid or Class 2 non-hazardous industrial solid wastes, as defined by Title 30 of the Texas Administrative Code. Class 1 non-hazardous wastes generated at Pantex were managed in a similar manner as hazardous waste, including shipment to offsite treatment and/or disposal facilities. Some Class 2 non-hazardous wastes (inert and insoluble materials such as bricks, concrete, glass, dirt, and certain plastics and rubber items that are not readily degradable) were disposed of in an onsite Class 2 non-hazardous waste landfill. Other Class 2 nonhazardous wastes, generally liquids, were shipped to commercial facilities for treatment and disposal (Pantex 2006).

The Pantex Plant environmental restoration projects, deactivation and decommissioning of excess facilities and construction projects contributed 82.4 percent of the total non-hazardous waste generated, during 2005. In addition, during the year, Pantex generated 945 cubic yards of sanitary wastes (cafeteria waste and general office trash). Sanitary wastes were also characterized as Class 2 non-hazardous wastes and disposed of at authorized offsite landfills (Pantex 2006).

During 2005, Pantex generated 2,036 cubic yards of wastes regulated by the TSCA. These wastes include asbestos, asbestos-containing material, and materials containing or contaminated by PCBs. During the year, environmental restoration projects and deactivation and decommissioning of excess facilities contributed 99.5 percent of the total TSCA waste generated. All TSCA wastes were shipped offsite for final treatment and disposal (Pantex 2006).

During 2005, Pantex generated 31 cubic yards of waste that were managed as universal wastes. Universal wastes are defined as hazardous wastes that are subject to alternative management standards in lieu of regulation, except as provided in applicable sections of the Texas Administrative Code. Universal wastes include batteries, pesticides, paint and paint-related waste, and fluorescent lamps. During the year, deactivation and decommissioning of excess facilities and construction projects contributed 12.2 percent of the total universal waste generated. These wastes are shipped offsite for final treatment, disposal, or, as applicable, recycling (Pantex 2006).

Pantex generated 97 cubic yards of low-level radioactive waste, during 2005. The majority of the low-level radioactive wastes were generated by weapons-related activities. During the year, deactivation and decommissioning of excess facilities and construction projects activities contributed 0.3 percent of the total low-level radioactive waste generated (Pantex 2006).

Assembly and disassembly of weapons also results in some wastes that include both radioactive and hazardous constituents, which are referred to as "mixed waste." The hazardous portion of the mixed waste is regulated by the TCEQ pursuant to RCRA regulations. The radioactive portion is regulated under the *Atomic Energy Act* (Pantex 2006).

During 2005, Pantex generated 1.8 cubic yards of mixed waste. Most mixed wastes generated at Pantex consist of paper products contaminated with solvents and low-levels of radionuclides, and inorganic debris (including scrap metals) contaminated with low-levels of radionuclides. During the year, deactivation and decommissioning of excess facilities contributed 5.4 percent of the total mixed waste generated (Pantex 2006).

4.5.13.5 *Waste Management Volumes*

Wastes generated from the operation, maintenance, and environmental cleanup of Pantex in calendar year 2005 are summarized in Table 4.5.13-1. Overall, the amount of waste generated in 2005 increased 12.6 percent from 2004. This is due primarily to an increase in the generation of TSCA wastes from deactivation and decommissioning of excess facilities and construction projects.

4.5.13.6 *Waste Management Facilities*

Wastes are collected from various generator sites in Zone 12 South at Pantex Plant and staged at Building 1242 for sorting and segregating before they are transferred to various waste management facilities. Other generator sites throughout Pantex Plant move waste directly to the 117N storage pad or Building 16-18 (DOE 1996c). Given below is a brief summary of the current and proposed management facilities for Pantex Plant waste.

Table 4.5.13–1—Waste Volumes Generated at Pantex (yd^3)

Waste Type	1993	2003	2004	2005	Percent Change from 1993	Percent Change from 2004
Non-hazardoux Waste	14,237	14,208.3	6,050	6,374.5	(55.2)	5.4
Sanitary Waste	800.5	988.8	1,061	944.9	18.04	(10.9)
Hazardous Waste	483.8	8,798.9	337.6	711	37.06	110.6
Low-Level Waste	375.4	75.8	95.6	96.8	(74.2)	1.2
Mixed Waste	49	0.8	3.3	1.8	(96.3)	(44.6)
TSCA Waste	147.7	542.9	1,481.8	2,036.1	1,278.8	37.4
Universal Waste[a]	-	31.9	24	30.7	-	27.7
Total	**18,086.4**	**26,650.4**	**11,057.3**	**12,200.8**	**(36.6)**	**12.6**

Source: Pantex 2006.
[a] In 2001, Pantex began managing some hazardous Waste under the Universal Waste Rules.

Four facilities (117N Pad, 117A, 117B, and 16-18) are used for storing waste in Zone 11. The 117N Pad is an above-grade permitted storage pad with two sheds. This facility is used to store LLMW, hazardous waste, LLW, and other wastes and materials. Units 117A and B are permitted storage pads adjacent to the 117N Pad and are used for storage of wastes on a single, above-grade concrete pad. Building 16-18 is used for the storage of hazardous waste, LLMW, LLW, and other wastes and materials. The north portion of this building is also used to repackage and stage waste for shipment (DOE 1996c).

In Zone 4, 4 HW magazines, 1 LLW magazine, 13 hazardous waste Conex boxes, and 20 LLW Conex boxes are available for storage of wastes. The four hazardous waste magazines are used for storage of liquid and solid MLLW and hazardous waste. Containers of LLW are periodically moved from storage areas and transported to NTS for disposal. The Conex boxes are large steel containers with a capacity of about 94 cubic yards. The 13 hazardous waste Conex boxes have a permitted storage capacity of 4,467 drums and a total operating capacity of 946 containers. Twenty Conex boxes are used for storage of LLW until it is shipped offsite (DOE 1996c).

4.6 SANDIA NATIONAL LABORATORIES/NEW MEXICO

Sandia National Laboratories/New Mexico (SNL/NM) was established as a nuclear weapons design laboratory in 1949. Its facilities are located in Albuquerque, NM; Amarillo, TX; Carlsbad, NM; Kauai, HI; Las Vegas, NV; Livermore, CA; and Tonopah, NV. The facilities discussed in this section refers only to the main Albuquerque site, which is located on approximately 2,935 acres of DOE property on Kirtland Air Force Base (KAFB) (Figure 4.6-1). An additional 15,000 acres are provided to DOE/NNSA through various agreements, land use permits, and leases from the USAF, the USFS, and the BLM to conduct operations.

The principal NNSA missions at SNL/NM are to conduct system engineering of nuclear weapons; design and develop non-nuclear components; conduct field and laboratory non-nuclear testing; conduct research and development in support of the nuclear weapon non-nuclear design; manufacture a limited number of non-nuclear weapon components; provide safety and reliability assessments of the stockpile; and manufacture neutron generators for the stockpile.

4.6.1 Land Use

4.6.1.1 *Onsite Land Uses*

SNL/NM is located approximately 7 miles southeast of downtown Albuquerque, NM (Figure 4.6-1). There are no prime farmlands on SNL/NM (DOE 1999c).

There are five SNL/NM technical areas (TA) which cover approximately 2,560 acres of land within the boundary of KAFB. TAs-I, -II, and -IV encompass approximately 645 acres. TA-III encompasses approximately 1,890 acres, and TA-V encompasses approximately 25 acres (DOE 2003).

The USAF and DOE are the principal land users within KAFB, occupying over 90 percent of the land. DOE owns only a small portion of the land it needs and is required to conduct many of its activities under permit on land owned or withdrawn by the USAF. SNL/NM facilities and operations make up a majority of DOE's land use requirements on KAFB. Other DOE-funded activities make up the remainder (DOE 1996b, DOE 2006a).

The military living quarters on KAFB is the most heavily developed area on the base and is located adjacent to TA-I. KAFB continues to share lands and infrastructure with several entities, including DOE and SNL/NM. KAFB comprises approximately 51,560 acres of land and includes lands owned by the DOE, DoD, and portions of the Cibola National Forest withdrawn for use by the USAF and DOE (SNL/NM 2004). Most of the land is under the control of the USAF which includes land donated to KAFB by the City of Albuquerque (DOE 1996b, DOE 2006a).

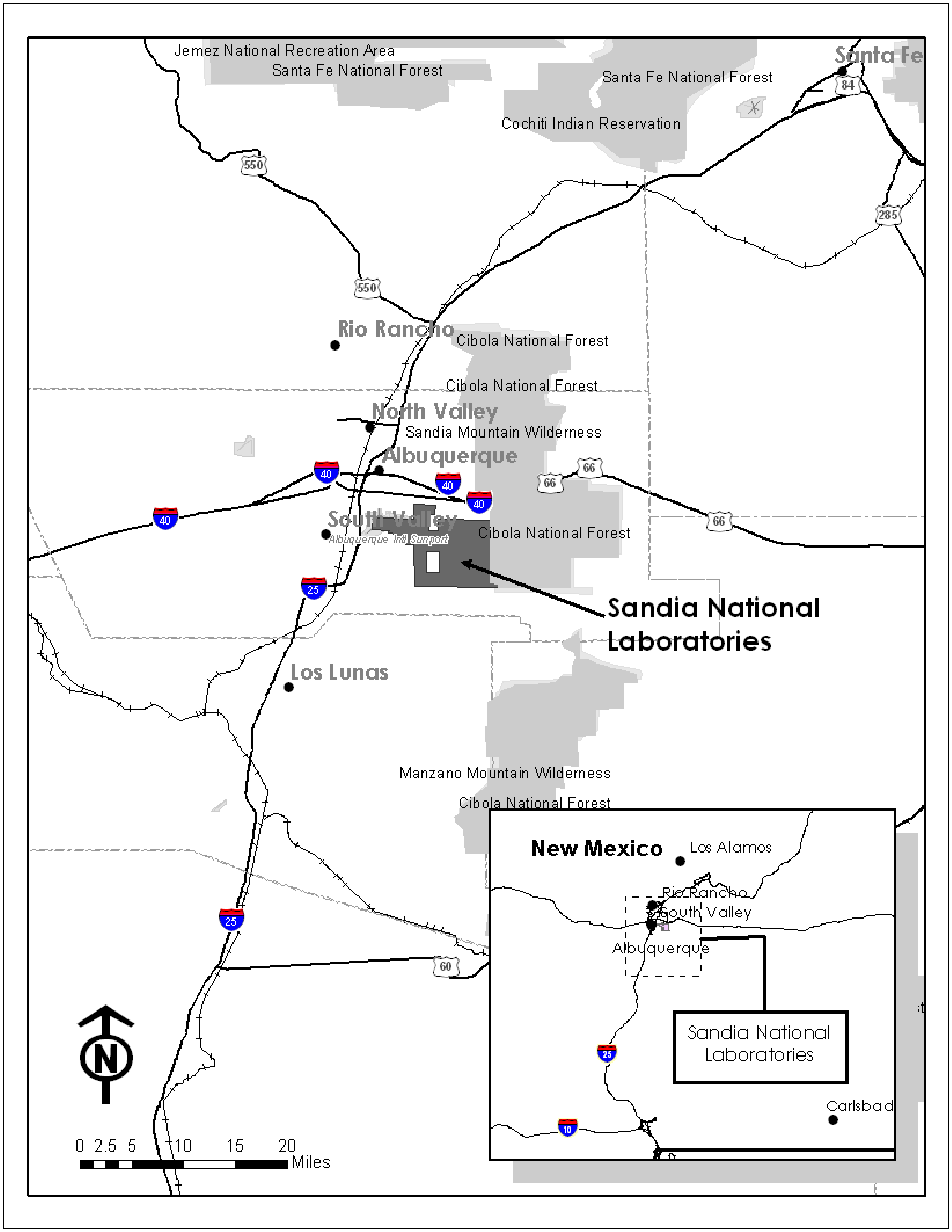


Figure 4.6-1—Location of SNL/NM

4.6.1.2 *Surrounding Land Uses*

Except for vacant land on both sides of Tijeras Canyon east of TA I and some unmanned utility facilities, the land north of SNL/NM is part of the urbanized city of Albuquerque. The urban land use consists of a mixture of residential, commercial, industrial, institutional, and various supporting public uses. The closest residence to the KAFB boundary is approximately 20 feet to the north. Commercial uses are primarily concentrated north of the site along Central Avenue and Gibson Boulevard. SNL/NM does not contain any public recreation facilities (DOE 1996b).

4.6.2 Visual Resources

The surrounding visual characteristics of SNL/NM consist of mostly flat, gently sloping grassland to the west and mountainous terrain to the east. Key landforms that dominate views in the general area include the Four Hills formation, the Manzanita Mountains, and the Manzano Mountains further south. From areas of Albuquerque nearest KAFB, views to the east and southeast are limited by the Four Hills formation and surrounding foothills of the Manzano Area. Views to the south partially consist of KAFB facilities, the Albuquerque International Sunport, and open rangeland. In general, the terrain features associated with the western portion of KAFB are not particularly distinctive. The eastern half, however, exhibits greater visual variety due to its mountain and canyon topography. Most SNL/NM facilities are well within the KAFB boundary and away from public view. Because of their location and the surrounding terrain characteristics, most facilities are not visible from roads and areas with public access (SNL/NM 2006).

Development on KAFB is the most apparent alteration affecting visual quality. Development is most apparent within the TAs. TA-I, TA-II, and TA-V are the most densely developed. TA-III and TA-IV contain more open space; however, development in these areas is still apparent. In the 1999 SNL/NM SWEIS, SNL/NM initiated Campus Design Guidelines which contain a set of principles and guidelines that provide a framework for the physical development and redevelopment of SNL/NM sites (SNL/NM 2006).

4.6.3 Site Infrastructure

Site infrastructure available at SNL/NM is used to support the current missions at SNL/NM. To support these missions an infrastructure exists as shown in Table 4.6.3-1.

4.6.3.1 *Electricity*

Since the release of the *1999 SNL/NM SWEIS* (DOE 1999c) electricity usage has increased from 198,000 MWh to 207,672 MWh. This usage is approximately 28 percent of system capacity (DOE 2006a).

4.6.3.2 *Water*

Water consumption projection for 2008, which include new facilities, shows water use increasing to 555.3 million gallons per year. This is an 11 percent increase over the water consumption under the *1999 SNL/NM SWEIS.* The combined SNL/NM projected water use total plus other KAFB water total (for baseline year 1996) of 1.3 billion gallons per year is still below, or 65 percent of the *1999 SNL/NM SWEIS* KAFB water infrastructure capacity of 2 billion gallons per year (DOE 2006a).

Table 4.6.3-1—Baseline Characteristics for SNL/NM and KAFB Site

Characteristics	Current Value
Land	
Area (acres)	2,935
Roads (miles)	65
Railroads (miles)	4
Electrical	
Available capacity (MWh)	735,840
Energy consumption (MWh)	207,672
Natural Gas	
Available Capacity (million yd^3)	8.5
Consumption (yd^3)	55,555
Water	
Treated Water Usage (MGD)	1.44
Sanitary Sewer System	
System Capacity (MGD)	2.33
Average Daily Flow (MGD)	1

Source: DOE 1999c, SNL/NM 2004, DOE 2003a, DOE 2006a.
EOA = Expanded Operations Alternative
KAFB = Kirtland Air Force Base
yd^3 = cubic yards
M = million
MGD = million gallons per day
MWh = megawatt-hours
SNL/NM = Sandia National Laboratories/New Mexico

4.6.3.3 *Natural Gas*

Natural gas usage has increased over the level used in the *1999 SNL/NM SWEIS* analysis. The available capacity is 8.5 million cubic yards while consumption is 55,555 cubic yards. This represents 6.5 percent of natural gas capacity.

4.6.4 Air Quality and Noise

4.6.4.1 *Air Quality*

4.6.4.1.1 Meteorology and Climatology

Large diurnal temperature ranges, summer monsoons, and frequent drying winds are characteristic of the regional climate in the Albuquerque Basin and Sandia and Manzano Mountains. Temperatures are typical of mid-latitude dry continental climates with summer high temperatures in the basin in the 90s°F and inter high temperatures around 50°F. Daily low temperatures range from around 60s°F in the summer to the low 20s°F in the winter. The dry continental climate also produces low average humidities in the late spring and summer prior to the onset of the monsoon season. Daytime relative humidities can be between 10 and 20 percent in the spring and early summer, with an average humidity near 30 percent. Average winter relative humidities are approximately 50 percent (SNL/NM 2006).

Precipitation varies across the region with many locations in the higher elevations of the mountains receiving twice the annual rainfall of locations in the Albuquerque Basin. Most precipitation falls between July and October, and mainly in the form of brief heavy rain showers. Average annual precipitation based on 10 years of data collected between 1995 and 2004 is around 8.5 inches at SNL/NM with 10.9 inches in the lower foothills. Annual precipitation recorded at the NWS cooperative stations in mountain elevations varies between 10 and 23 inches. The winter season in the Albuquerque Basin and around SNL/NM is generally dry with an average of less than 1.5 inches of precipitation falling between December and February (SNL/NM 2006).

While the regional climate is described by the atmospheric state variables of temperature and humidity, site-specific meteorology at SNL/NM is influenced by the proximity to topographic features such as mountains, canyons, and arroyos. These features influence local wind patterns across the site; canyons and arroyos tend to channel or funnel wind, whereas mountains create an upslope-downslope diurnal pattern to wind flows. Winds tend to blow toward the mountains or up the Rio Grande Valley during the day and nocturnal winds tend to blow down the mountain towards the Rio Grande Valley. These topographically induced wind flows can be enhanced or negated by weather systems that move across the southwest part of the U.S. The strongest winds occur in the spring when monthly wind speeds average 10.3 miles per hour. Wind gusts can commonly reach 50 miles per hour (SNL/NM 2006).

Average Annual values for wind speed, temperature, and precipitation are shown in Table 4.6.4-1.

Table 4.6.4-1—Average Annual Wind Speed, Temperature, and Precipitation Minimum and Maximum Values for SNL/NM

Parameter (Average Annual)	Minimum	Maximum
Wind Speed (m/sec)	11	12
Temperature (°F)	57	58
Precipitation (in)	11	12

Source: SNL/NM 2006.

4.6.4.1.2 Ambient Air Quality

Bernalillo County has been designated as a maintenance area under the CAA for carbon monoxide emissions and is in attainment for other federally regulated pollutants. The New Mexico Administrative Code (NMAC), Title 20, Part 11.04, (20 NMAC 11.04), entitled General Conformity, implements Section 176(c) of the CAA, as amended (42 U.S.C 7401 et seq.), and regulations under 40 CFR 51, Subpart W, with respect to conformity of general Federal action in Bernalillo County. 20 NMAC Part 11.04.11.1.2, paragraph B, establishes the emission threshold of 100 tons per year of carbon monoxide at SNL/NM that would trigger the requirement to conduct a conformity analysis (DOE 2006a).

Depending on emission levels, modification to existing sources or construction of new sources emitting carbon monoxide may require a general or transportation conformity analysis as well as additional levels of controls to comply with the NAAQS. In addition, modification to existing sources or construction of new sources emitting the other criteria pollutants (sulfur dioxide, nitrogen dioxide, ozone, PM_{10}, and lead) for which a pre-construction permit must be obtained are required to comply with the NAAQS (DOE 2003).

NESHAP compliance support is provided to all SNL/NM source owners subject to radionuclide air emissions regulations. The EPA regulates radionuclide air emissions in accordance with 40 CFR 61, Subpart H. Dose is calculated using the CAP-88 computer code. NESHAP regulations stipulate that direct stack or diffuse monitoring is only required if a facility has the potential to produce an effective dose equivalent to the MEI of greater than 0.1 millirem per. Currently there are no facilities with this potential, and therefore, no stack monitoring is required at SNL/NM. However, while not required by regulation, stack monitoring and calculations based on measured parameters are performed as a best management practice at several facilities. All emissions based on measurements (i.e., continuous monitoring, periodic monitoring, and calculations based on measured parameters) are used to calculate the doses (DOE 2003).

Nonradiological Air Emissions

There were no exceedences of the criteria pollutant standards in 2005 (Table 4.6.4-2). The highest daily PM_{10} loading on the site was 53.9 micrograms per cubic meter. The annual PM concentrations for 2005 are similar to or slightly higher than the results for 2004. Dry conditions in the area contributed to an increase in monthly averages during the later part of 2005 as compared to reported values in 2004 (SNL/NM 2006).

Concentrations of $PM_{2.5}$ were highest in the summer months being most likely the result of wildland fire smoke transported from areas outside of SNL/NM. Detected concentrations of VOCs were multiple orders of magnitude below the Threshold Limit Values (TLV). The TLV defines the reasonable level to which a worker can be exposed without adverse health effects. Table 4.6.4-2 compares the criteria pollutant concentrations measured for the 2004 CPMS with those reported in the 2005 SNL/NM ASER (SNL/NM 2006).

Radiological Air Emissions

SNL/NM currently has 15 potential NESHAP facilities that may be defined as either point or diffuse emissions sources. Table 4.6.4-3 lists the radionuclides and the total reported emissions (in curies) from each SNL/NM NESHAP source in 2004. Of the 15 sources, 14 were point sources and one was a diffuse source (landfill). Two of the 15 facilities reported no emissions in 2004. The 15 SNL/NM NESHAP facilities are illustrated in Figure 4.6.4-1.

Table 4.6.4-2—Criteria Pollutant Results as Compared to Regulatory Standards, 2005

Criteria Pollutant	Averaging Time	Unit	NMAAQS Standard	NAAQS Standard	Maximum or Measured Concentrations
Carbon Monoxide	1 hour 8 hours	ppm ppm	13.1 8.7	35 9	2.73 1.65
Nitrogen Dioxide	24 hours Annual	ppm ppm	0.10 0.05	-0.053	0.041 0.013
Sulfur Dioxide§	3 hours 24 hours Annual	ppm ppm ppm	- 0.10 0.02	0.50 0.14 0.03	0.054 0.005 <0.001
Ozone	1 hour 8 hour	ppm ppm	0.12	0.12 0.08	0.092 0.078[a]
PM_{10}	24 hours Annual	μg/m3 μg/m3	--	150 Revoked[c]	54[b] 12.1
$PM_{2.5}$	24 hours Annual	μg/m3 μg/m3	--	35 15.0	19.8[d] 8.5
Lead	30 days Any quarter	μg/m3 μg/m3	- 1.5	- 1.5	0.0040 0.0020

Source: SNL/NM 2006.
SWEIS = Site-Wide Environmental Impact Statement
CPMS = Criteria Pollutant Monitoring Station
NMAAQS = New Mexico Ambient Air Quality Standards
NA = not applicable
NAAQS = National Ambient Air Quality Standards
ppm = parts per million
PM_{10} = Particulate matter 10 microns in diameter
$PM_{2.5}$ = Particulate matter 2.5 microns in diameter
$\mu g/m^3$ = micrograms per cubic meter
§Standards are defined in ug/m3 and have been converted to ppm.
[a]Reported as the fourth highest average for the year – per regulatory standards.
[b]Reported as the 99th percentile value – per regulatory standards
[c] Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the agency revoked the annual PM_{10} standard in 2006 (effective December 17, 2006).
[d]Reported as the 98th percentile value – per regulatory standards

Table 4.6.4-3—Summary of Radionuclide Releases from the 15 NESHAP Sources in 2004

TA	Facility Name	Monitoring Method	Used in Dose Calculation	Radionuclide	Reported Release (Ci/yr)
I	Sandia Tomography and Radionuclide Transport (START) Laboratory	Calculation	No	^{60}Co ^{15}Cs	2.5E-08 5.0E-09
I	Radiation Laboratory	Calculation	No	^{3}H ^{13}N ^{41}Ar	1.0E-05 1.0E-06 1.0E-00
I	Calibration Laboratory	Calculation	No	^{3}H	6.9E-05
I	Neutron Generator (NGF) TANDEM Accelerator Metal Tritide Shelf-Life Laboratory	Continuous Calculation Calculation	Yes No No	^{5}H ^{5}H ^{5}H	0.11 1.0E-05 5.0E-09
I	Cleaning and Contamination Control Laboratory (CCCL)	Calculation	No	^{14}C	2.7E-04
II	Explosive Components Facility (ECF)	Calculation	No	^{3}H	8.4E-04

Table 4.6.4-3—Summary of Radionuclide Releases from the 15 NESHAP Sources in 2004 (continued)

TA	Facility Name	Monitoring Method	Used in Dose Calculation	Radionuclide	Reported Release (Ci/yr)
II	Mixed Waste Landfill (MWL)	Periodic	Yes	^{3}H	0.09
III	Radioactive & Mixed Waste Management Facility (RMWMF)	Continuous	Yes	^{5}H ^{241}Am ^{90}Sr ^{15}Cs	
IV	HERMES III (at the Simulation Technology Laboratory)	Periodic	No	^{13}N ^{15}O	1.3E-03 1.3E-04
IV	Z-Facility (Accelerator)	Calculation	No	^{3}H ^{238}U ^{234}U ^{235}U	1.6E-07 2.0E-07 9.2E-09 2.1E-07
V	Auxillary Hot Cell Facility (HCF)	Periodic	Yes	N/A	N/A
V	Annular Core Research Reactor	Periodic	Yes	^{41}Ar	4.5
V	Sandia Pulsed Reactor	Periodic	Yes	N/A	N/A

Source: SNL/NM, 2006.
Note: Monitoring Method: Periodic = Based on periodic measurements; Calculation = Calculated from known parameters; Continuous = Based on continuous air monitoring results
HERMES III = High Energy Radiation Megavolt Electron Source III
Ci/yr = curies per year
TA = Technical Area
N/A = not available

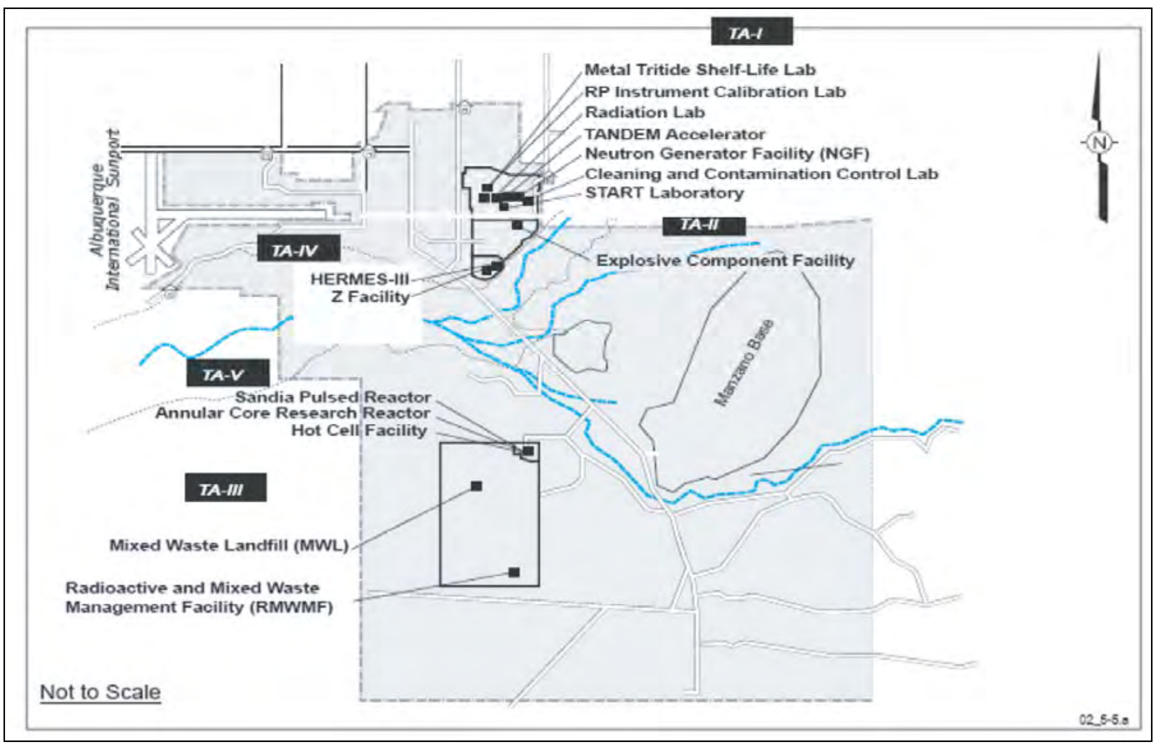


Figure 4.6.4-1—Locations of the 15 Facilities at SNL/NM that Provided Radionuclide Release Inventories in 2004

4.6.4.2 *Noise*

Noise levels remain within levels characteristic of a light industrial setting in the range of 50 and 70 dBA. Construction activities would generate noise produced by heavy construction equipment, trucks, and power tools. In addition, traffic and construction noise is expected to increase during construction onsite and along offsite local and regional transportation routes used to bring construction material and workers to the site. These construction noise levels would contribute to the ambient background noise levels for the duration of construction, after which ambient background noise levels would return to pre-construction levels. Table 4.6.4-5 presents peak attenuated noise levels expected from operation of construction equipment including peak noise levels at the source and at distances of 50, 100, 200, and 400 feet.

Table 4.6.4-5—Peak Attenuated Noise Levels (in decibels [dBA]) Expected from Operation of Construction Equipment

Source	Peak Noise Level	Distance from Source			
		50 ft	100 ft	200 ft	400 ft
Heavy trucks	95	84-89	78-83	72-77	66-71
Dump trucks	108	88	82	76	70
Concrete mixer	108	85	79	73	67
Jackhammer	108	88	82	76	70
Scraper	93	80-89	74-82	68-77	60-71
Bulldozer	107	87-102	81-96	75-90	69-84
Generator	96	76	70	64	58
Crane	104	75-88	69-82	63-76	55-70
Loader	104	73-86	67-80	61-74	55-68
Grader	108	88-91	82-85	76-79	70-73
Dragline	105	85	79	73	67
Pile driver	105	95	89	83	77
Forklift	100	95	89	83	77

Source: DOE 2000c.

4.6.5 Water Resources

4.6.5.1 *Surface Water*

4.6.5.1.1 Surface Water Quality

Surface discharges are releases of water and water-based compounds made to roads, open areas, or impoundments. Past sampling results from 1998 and 1999 have shown a presence of metals such as zinc, magnesium, and iron elevated above the benchmark values (SNL/NM 2001a). No unusual characteristics were observed in 2001, 2002, and 2003 (SNL/NM 2002a, 2003, 2004). No monitoring was required in 2000 (SNL/NM 2001b). Monitoring results in 2004 identified elevated levels of total suspended solids (TSS) and magnesium (SNL/NM 2006). Albuquerque's semiarid climate with sparse vegetative cover and high erosion rates naturally produce high TSS levels. SNL/NM has reduced TSS levels in developed areas through best management practices, such as retention and detention ponds, landscaping conducive to infiltration, and lining of storm drain channels for erosion reduction. All monitoring points show elevated levels of magnesium even though they are separated by several miles and collect runoff from several different drainage areas. The presence of zinc, magnesium, and iron is likely due to natural conditions associated with rocks and soils derived from the igneous/metamorphic complex of the Manzanita Mountains.

The 1999 SNL/NM SWEIS identified oil and grease runoff and increased frequency of outdoor testing to be sources of contaminants of concern (DOE 1999c). No levels of water quality constituents exceeded the projections identified in the 1999 SNL/NM SWEIS (DOE 1999c).

Extended drought conditions have resulted in reduced surface water flows. Surface water flows peaked in 2004 due to near normal levels of precipitation (SNL/NM 2006).

4.6.5.1.2 Surface Water Rights and Permits

New Mexico is in the process of obtaining the authority to regulate discharges under NPDES with the goal of obtaining this authority by 2008. Until that time, EPA Region VI is the current permitting authority. New Mexico has enacted 20 6.4 NMAC "Standards for Interstate and Intrastate Surface Waters" to protect the quality of surface waters in the State. Due to the hydrologic conditions at SNL/NM, Sandia Corporation does not specifically monitor for compliance with these standards. SNL/NM does not compare analytical results from NPDES sampling with the stream standards. Some constituents of concern in New Mexico's Stream Standards that are not on the NPDES analyte list have been added to SNL/NM's analyte list to confirm compliance (SNL/NM 2006).

4.6.5.2 *Groundwater*

The groundwater beneath the SNL/NM and adjacent areas is the source of drinking water for SNL/NM, KAFB, adjacent portions of the Albuquerque, and the Pueblo of Isleta. All known groundwater contamination is the result of past activities. No current or planned future activities are expected to adversely impact groundwater quality. Investigations or remediation of these sites is ongoing (SNL/NM 2006). Figure 4.6.5-1 displays a conceptual diagram of the groundwater system underlying SNL/NM.

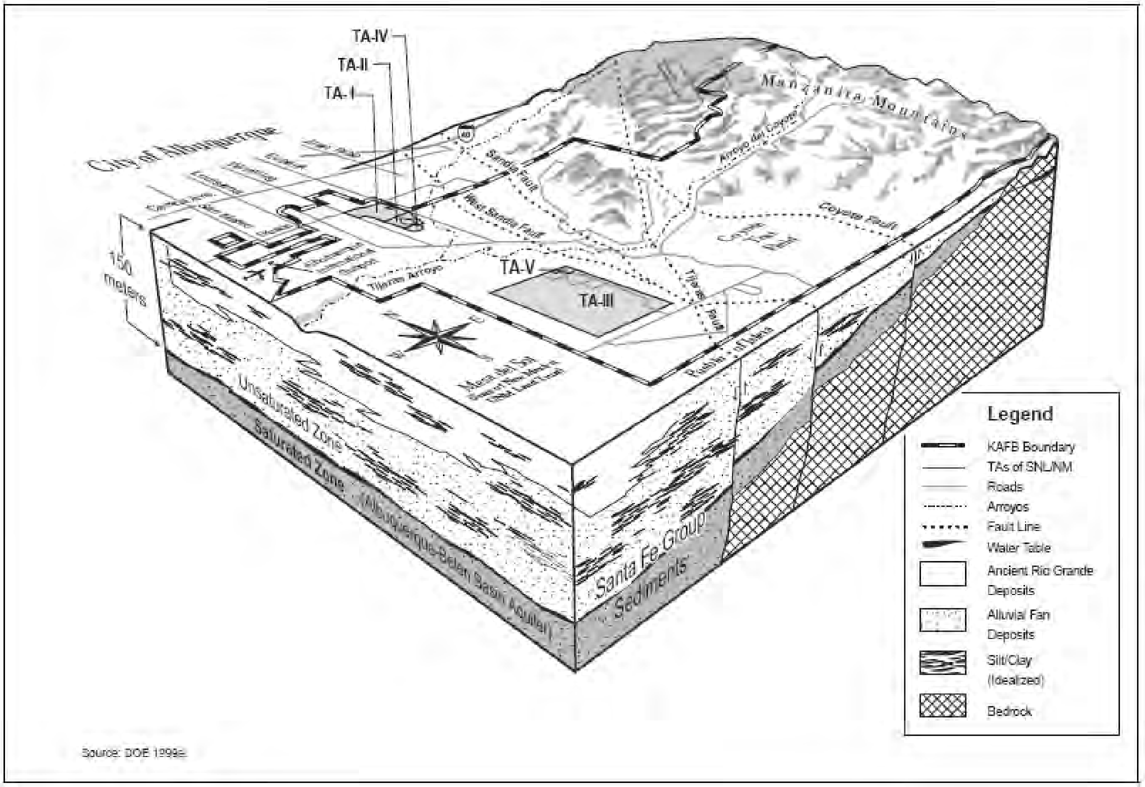


Figure 4.6.5-1—Conceptual Diagram of the Underlying Groundwater System at SNL/NM

4.6.5.2.1 Groundwater Quality

The EPA regulates drinking water constituents by setting MCLs. The New Mexico Water Quality Control Commission regulates drinking water constituents by establishing maximum allowable concentrations (MACs). During August 2005, annual sampling of groundwater was conducted by the Groundwater Protection Program (GWPP) Groundwater Surveillance Task. Samples were collected from 14 wells. Groundwater surveillance samples for the GWPP were analyzed for the following parameters:

- VOCs,
- dissolved metals (except for mercury),
- selected radionuclides,
- gross alpha & beta activity,
- major ions including nitrate,
- alkalinity/total phenols,
- total halogenated organics (TOX), and
- gamma spectroscopy

No groundwater samples exceeded MCLs for VOCs. Only bromoform and carbon disulfide were detected at quantifiable values above the reporting limits. No groundwater samples exceeded established MCLs for any of the non-metallic inorganic constituent analytes. Of the metals, only manganese and iron exceeded their established MACs for aesthetic purposes at CTF-MW2 (manganese and iron) and Eubank-1 (iron). No groundwater samples were found to exceed the MCLs for radionuclide activity (SNL/NM 2006).

4.6.5.2.2 Groundwater Availability, Use, and Rights

Most of the City of Albuquerque's water supply wells are located on the east side of the Rio Grande. As a result of groundwater withdrawal, the water table has dropped by as much as 141 feet (Thorn et al. 1993).

Potable water to KAFB and SNL/NM facilities is supplied by on-site production from 10 wells. In 2005, KAFB pumped approximately 1.13 billion gallons of groundwater (SNL/NM 2005). Groundwater withdrawals from KAFB and the City of Albuquerque wells at the north end of KAFB have created a trough-like depression in the water table causing flow to be diverted northeast in the direction of the well fields (SNL/NM 2006).

4.6.6 Geology and Soils

The regional geologic setting in which SNL/NM and KAFB are situated has been subjected to relatively recent episodes of basaltic volcanism and ongoing regional rifting (crustal extension). The Rio Grande rift has formed a series of connected down-dropped basins in which vast amounts of sediments have been deposited. The Rio Grande rift extends for about 450 miles from Leadville, Colorado to northern New Mexico (SNL/NM 2006).

4.6.6.1 *Geology*

SNL/NM is in the eastern portion of the 30-mi-wide Albuquerque-Belen Basin, about midway along its north-south trending length of about 100 miles. The Albuquerque Basin is one of several north-south trending sediment-filled basins formed by the Rio Grande rift. On the east, uplifted fault blocks, manifested by the Sandia, Manzanita, and Manzano Mountains bound the basin. The western and northern sides of the Basin are bound by the Lucero Uplift to the west; the Rio Puerco fault belt to the northwest, and the Nacimiento Uplift to the north. There is relatively little topographic relief along the Rio Puerco fault belt on the northwestern side of the basin. Two south-flowing rivers drain the basin: the Rio Puerco to the west and the Rio Grande to the east (SNL/NM 2006).

4.6.6.2 *Soils*

Soils at SNL/NM are derived primarily from eroded bedrock in the Manzanita Mountains that was transported downslope by water. Soil layers formed by these sediments tend to be discontinuous. The chemical composition of these soils reflect the composition of the source bedrock, and soils at SNL/NM frequently have high naturally occurring (background) concentrations of the metals arsenic, beryllium, and manganese (DOE 1999c).

As a result of past SNL/NM activities, soil contamination exists or may exist at a number of locations at KAFB, although most sites are less than 1 acre in size. Cleanup of these contaminated sites is regulated under RCRA. SNL/NM investigates and remediates these sites through the ER Project. A large cleanup under the ER Project was the excavation of the Chemical Waste Landfill (CWL). This project began September 30, 1998, and was completed in February 2002. During this time over 52,000 cubic yards of soil and debris were excavated and most were disposed of at the Corrective Action Management Unit (CAMU), adjacent to the CWL, for treatment and/or placement in the containment cell for long-term management. Approximately 70 cubic yards of soil were disposed off site due to radiological activity above CAMU acceptance criteria. Additionally, a minor amount of soil contaminated with PCB compounds was disposed of offsite after the CAMU stopped accepting waste. Backfilling of the CWL to four feet below ground surface was completed in February 2004. Clean-up activities in the site operational boundary area adjacent to the CWL were completed in February 2004 and closure activities continued in 2005. Removal of waste from the CWL, backfilling and capping of the CWL with clean material, and deposition of CWL waste in the CAMU, which has a containment cell design, has resulted in improved soil conditions at SNL/NM since the 1999 SNL/NM SWEIS (DOE 2006a).

Soil contamination also exists at some active SNL/NM outdoor test facilities. In the past decade, environmental controls on testing have reduced the concentrations or extent of additional soil contamination. The ER Project addresses soil contamination resulting from past testing (DOE 1996c). Most of the soil contamination at these active sites is shallow surface contamination stemming from the explosion, destruction, or burning of tested devices containing hazardous material. The primary contaminants at these active sites are depleted uranium and lead (SNL/NM 2005).

SNL/NM actively performs environmental soil monitoring on and near KAFB to confirm the effectiveness of control systems in place at the various TAs. In 2004, soil samples were collected from a total of 51 locations (30 on-site, 15 perimeter, and six off-site locations). A soil sample was not collected at one on-site location (32E) due to human error. Samples are analyzed for common radionuclides and metals, with analytical results compared to naturally occurring concentrations. For 2004, soil monitoring for radiological parameters results identified all soil locations as Priority-4 (consistent with off-site values and no increasing trends (SNL/NM 2005).

Due to the drought, many of the soil samples collected had such low soil moisture content that meaningful tritium in soil moisture measurements were frequently not possible. Tritium is not a significant indicator radionuclide for operations at SNL/NM and the low soil moisture in the area will always make low activity assay difficult. In 2004, it was decided to not sample for tritium in soil (SNL/NM 2005).

4.6.6.3 *Seismology*

Albuquerque is in a region expected to experience moderate earthquakes that could result in damage to buildings, depending on the quality of construction. Since the 1999 SNL/NM SWEIS, three earthquakes have occurred within a 100 mile radius of Albuquerque. The epicenter of the closest earthquake was 52 miles west of Albuquerque, had a Richter scale magnitude of 3.0, and occurred in May 2004. The other two earthquakes were of magnitude 2.4 and 3.5 and occurred 81 and 54 miles south of Albuquerque, respectively. In the Albuquerque area, the largest magnitude earthquake of the century, a recorded magnitude 4.7, occurred on January 4, 1971. SNL/NM buildings did not receive any appreciable damage from this event.

Several major faults are located on KAFB. The Tijeras fault, which has been traced as far north as Madrid, New Mexico, trends southwesterly through Tijeras Canyon and across KAFB. The Tijeras Canyon was formed by preferential erosion along the fault. The system of faults connecting with the Tijeras fault on KAFB is collectively referred to as the Tijeras fault complex (SNL/NM 2006). Figure 4.6.6-1 displays regional faults at SNL/NM.

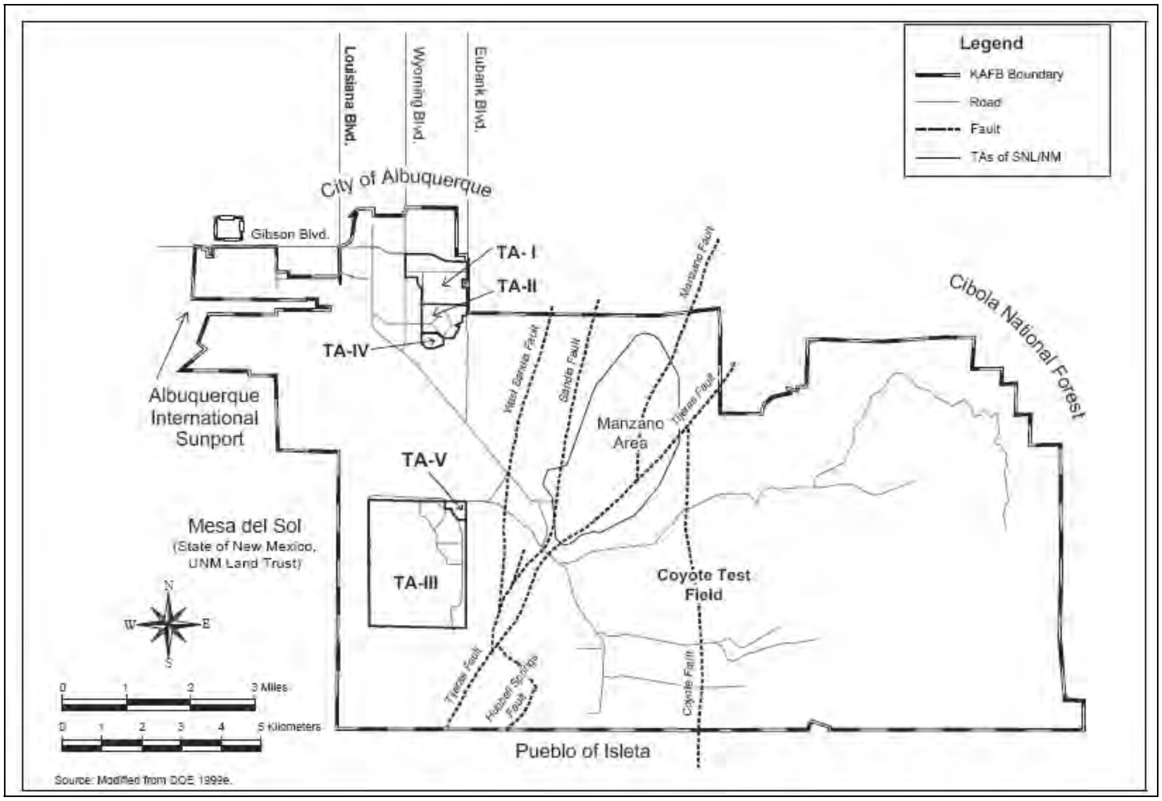


Figure 4.6.6-1—Regional Faults at KAFB

The Tijeras fault complex marks a distinct geologic boundary between the uplifted blocks on the east and the sediment-filled basin to the west. This geologic boundary also forms a boundary between the two major groundwater regimes at KAFB. The Sandia fault is thought to be the primary boundary between the Sandia Mountains and the Albuquerque Basin. The Sandia fault converges with the Tijeras fault and the Hubbell Springs fault. Both the Sandia fault and Hubbell Springs fault are north-south trending, down-to-the-west, en-echelon normal faults, which are Tertiary in age (Lozinsky and Tedford 1991, Woodward 1982, Kelley and Northrup 1977) (SNL/NM 2006).

4.6.7 Biological Resources

This section describes ecological resources at SNL/NM including terrestrial and aquatic resources, T&E species, and floodplains and wetlands.

4.6.7.1 *Terrestrial Resources*

There are four major habitat types at the SNL/NM site: grassland, woodland, riparian, and altered. Much of the unaltered habitats receive minimal disturbance from site operations. Figure 4.6.7-1 displays vegetation types at SNL/NM.

Altered habitat at SNL/NM and KAFB includes buildings and the areas surrounding buildings, field testing areas, training areas, a golf course, residential areas, roadways, utilities, runways, and taxiways. The vegetation in this habitat type varies greatly, including bare ground and manicured landscapes, but the bulk of this habitat is comprised of non-native, weedy species of plants. Increasingly, efforts are underway to reseed altered areas with native plant species to assist the natural revegetation process (SNL/NM 2004).

Each of the major habitat types within the KAFB boundary supports a variety of wildlife species. Bird communities are particularly dynamic; some resident bird species remain on-site throughout the year, and many migratory bird species frequent SNL/NM. Some common wildlife species at

SNL/NM include coyote (*Canis latrans*), deer mouse (*Peromyscus leucopus*), rock squirrel (*Spermophilus variegates*), common raven (*Corvus corax*), American robin (*Turdus migratorius*), and the house finch (*Carpodacus mexicanus*) (SNL/NM 2004).

4.6.7.2 *Floodplains and Wetlands*

4.6.7.2.1 Wetlands

Six wetlands have been identified on KAFB that are associated with natural springs and are cumulatively less than one acre (DOE 1999c). Coyote Springs is the largest natural wetland onsite and consists of four separate seep areas. Two of the wetlands, Sol se Mete and Burn Site Springs, are in the canyons of the Withdrawn Area. Species characteristic of these wetlands include wire rush, three-square, Torrey rush, and cattail (USACE 1995). Only the Burn Site Spring is on land used by SNL/NM.

4.6.7.2.2 Floodplains

Floods and runoff occur most commonly during the summer thunderstorm season (July through September) when approximately 50 percent of the average annual rainfall occurs. Snow in the Manzanita Mountains can produce local runoff that rarely reaches the lower portions of the arroyos or the Rio Grande. The 100 and 500-year floodplains are narrow and confined to existing drainage channels and several low-lying streets and vacant areas (DOE 1999c).

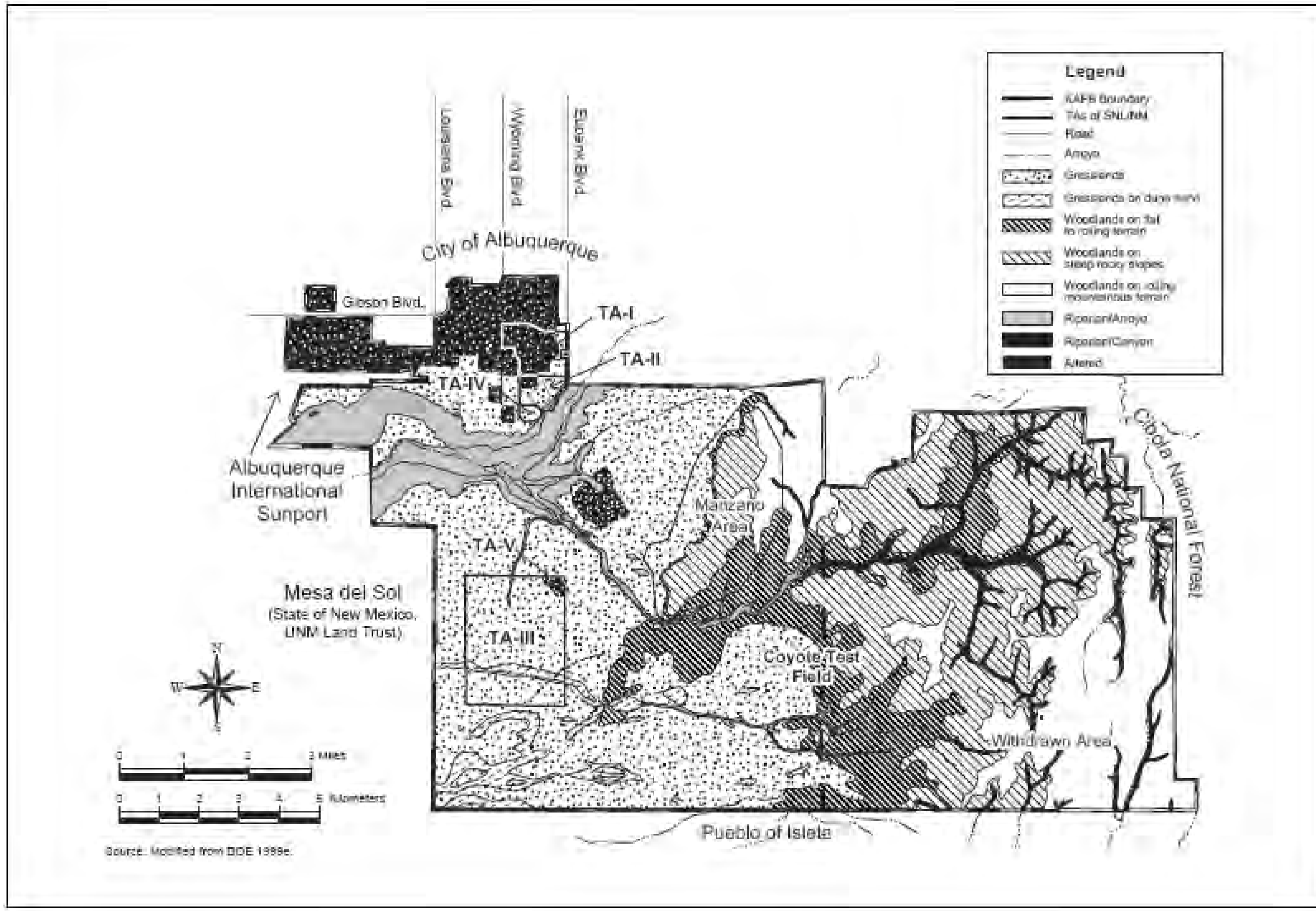


Figure 4.6.7-1—Vegetation Types at SNL/NM

4.6.7.3 *Aquatic Resources*

Five small unnamed springs occur around the Four Hills. Three support wetland vegetation and the other 2 are rock seeps and do not support wetland vegetation, but may provide surface water to wildlife (SNL/NM 2004). Natural spring-fed wetlands form a minor component of the riparian habitat on KAFB and are cumulatively less than 1 acre in size. The USFS manages a tank that collects water for wildlife at this spring and Sol se Mete Spring. The USAF administers constructed ponds on KAFB Tijeras Arroyo Golf Course and a constructed lake, Christian Lake, in the southern part of KAFB (DOE 1999c).

4.6.7.4 *Threatened, Endangered and Sensitive Species*

Fifteen threatened, endangered and other species of concern were identified as potentially occurring in Bernalillo County (USFWS 2005). Of the 15, 4 of these species (Table 4.6.7-1) have been documented on KAFB (SNL/NM 2006).

Table 4.6.7-1—Threatened and Endangered Species Potentially Occurring at KAFB

Species	Scientific Name	Federal Status	State Status	Observed at KAFB
Mammals				
Spotted Bat	*Euderma maculatum*		Threatened	
New Mexican Jumping Mouse	*Zapus hudsonius luteus*		Threatened	
Fish				
Rio Grande Silvery Minnow	*Hybognathus amarus*	Endangered	Endangered	
Birds				
Common Black Hawk	*Buteogallus anthracinus anthracinus*		Threatened	
American Peregrine Falcon	*Falco peregrinus anatum*		Threatened	Yes
Mexican Spotted Owl	*Strix accidentalis lucida*	Threatened		
White-eared Hummingbird	*Hylocharis leucotis borealis*		Threatened	
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	Endangered	
Whooping Crane	*Grus Americana*	Endangered	Endangered	
Bell's Vireo	*Vireo bellii*		Threatened	Yes
Gray Vireo	*Vireo vicinior*		Threatened	Yes
Baird's Sparrow	*Ammodramus bairdii*		Threatened	Yes
Neotropic Cormorant	*Phalacrocorax brasilianus*		Threatened	
Yellow-billed Cuckoo	*Coccyzus Americanus*	Candidate		

Source: SNL/NM 2006.

Of the state-listed threatened and endangered wildlife species, only the gray vireo is known to regularly breed on site. The American peregrine falcon is listed as a species of concern by the USFWS (USFWS 2005). No nesting of this species has been observed, and only a small amount of American peregrine falcon nesting habitat exists on KAFB (SNL/NM 2004).

No plant species currently listed as threatened or endangered are known to occur at KAFB. The Santa Fe milkvetch (*Astragalus feensis*) has been observed at the SNL/NM site and is listed in the New Mexico Rare Plants List (New Mexico Rare Plant Technical Council 2005, SNL/NM 2004).

4.6.7.5 *Biological Monitoring and Abatement Programs*

Ecological monitoring of selected biota, including small mammals, birds, reptiles, amphibians, and vegetation, is conducted annually by SNL/NM. Baseline measurements are collected on potential contaminant loads in species as well species density and composition. In 1997, data were collected at two sites: TA-II and a site at the southeastern end of the perimeter fence separating the Pueblo of Isleta and KAFB. Analysis of samples of seven small mammals from these sites did not show any significant radionuclide or metal contamination (SNL/NM 1997u).

SNL/NM completed an ecological risk assessment validation study (DOE 1999c). This study was conducted for the SNL/NM ER project to provide site-specific data in support of the ecological risk assessment currently being used to evaluate potential risks to natural populations at contaminated sites. The field work for this study included both biomonitoring and quantitative surveys of key populations at potential ecological risk. Biomonitoring consisted of the collection of soil, plant, invertebrate, and small mammal samples from four ER Project sites and the analysis of these samples to determine the concentrations of 18 selected inorganic analytes. No significant effects to small mammal communities were found at any of the sites. A report presenting the results of these studies is currently in preparation. The study objectives recommended by the U.S. Department of Interior (DOI) will be considered in ongoing study objectives (DOE 1999c).

4.6.8 Cultural Resources

4.6.8.1 *Prehistoric Resources*

Archaeological surveys of 100 percent of the area within the 5 DOE-owned TAs were conducted in the 1990s, thus no new surveys have been conducted since the 1999 SNL/NM SWEIS. In addition, portions of these technical areas had been surveyed for specific projects. There are no known archaeological sites within these five TAs (SNL/NM 2004).

Extensive archaeological surveys have been conducted of the remainder of KAFB since the 1999 SNL/NM SWEIS. The areas surveyed include all USFS-owned lands withdrawn to USAF and DOE, all BLM-owned lands withdrawn to USAF, and all USAF-owned lands. The TAs, the main facility and housing of the base, and some ER Project sites were the only areas excluded. These surveys were much more comprehensive than those conducted before the 1999 SNL/NM SWEIS. Table 4.6.8-1 compares the current knowledge about known archaeological sites with the information presented in the 1999 SNL/NM SWEIS.

The types of archaeological sites identified on KAFB have remained consistent with those known at the time of the 1999 SNL/NM SWEIS. The number and density of sites have increased overall due to the comprehensive nature of the recent surveys. The patterns of geomorphic and topographic distribution of archaeological sites have changed somewhat since the 1999 SNL/NM SWEIS. While prehistoric and historic sites are still clustered in 4 major areas, as shown in the 1999 SNL/NM SWEIS (DOE 1999c), the clusters now have slightly wider boundaries (SNL/NM 2004). The cluster at the headwaters of Arroyo del Coyote is the same. The cluster at the Joint Operating Agreement Area has expanded into the southern portion of the Cask Testing Facility (CTF). The cluster located along Tijeras Arroyo has extended slightly to the west.

4.6.8.2 *Historic Resources*

Information on architectural properties was limited at the time of the 1999 SNL/NM SWEIS (DOE 1999c). Based on a consultation completed with the NM SHPO in 2005, 11 buildings are eligible in TA-I (1 of which has been documented and demolished), 64 are not currently eligible, and the remainder have not been evaluated. In the diamond-shaped area that was originally identified as TA-II, the entire TA was determined to be eligible as a district, with three buildings individually eligible and 32 buildings contributing to the district eligibility. SNL/NM conducted extensive documentation of the buildings and the buildings were all demolished (SNL/NM 2004).

Table 4.6.8-1—Known Prehistoric and Historic Archaeological Sites by Land Owner

Land Owner	Number of Archaeological Sites			
	All Known Sites		NRHP Eligible or Potentially Eligible Sites	
	1999 SNL/NM SWEIS	Current	1999 SNL/NM SWEIS	Current
DOE	0	0	0	0
USAF (includes BLM withdrawn areas)	130	267	86	168
USFS, Withdrawn to DOE	41	48	35	42
USFS, Withdrawn to USAF	110	183	68	142
Leased to DOE by State of New Mexico	3	3	3	3
Leased to DOE by Pueblo of Isleta	0	1	0	1
TOTALS	**284**	**502**	**192**	**356**

Source: DOE 1999c, KAFB 2004.
BLM = Bureau of Land Management
DOE = Department of Energy
NRHP = National Register of Historic Places
SNL/NM = Sandia National Laboratories/New Mexico
SWEIS = Site-Wide Environmental Impact Statement
USAF = United States Air Force
USFS = United States Forest Service

Architectural inventories of buildings and structures within the five technical areas have been undertaken since the SWEIS, focusing on those buildings that reach the 50-year age criterion. Eighty-one buildings in TA-I have been recorded since the 1999 SNL/NM SWEIS and some of them evaluated; 2 are eligible for the NRHP (one of which has been extensively documented and demolished), 22 are not eligible, 6 are of historical interest, and the remaining buildings have not been evaluated. Within the new TA-II boundaries, only one building has been evaluated and it is not eligible. Within TA-III, 77 buildings or structures have been evaluated and found not eligible for listing on the NRHP. Eligible properties in TA-III include the Sled Track (the track and six buildings), Centrifuge Complex (two centrifuge facilities and two support structures), Mechanical Shock Facility (one building), Vibration Acoustics and Mass Properties Lab, and Water Impact Facility (building, tower, and associated structures). Four buildings in TA-IV have been evaluated for NRHP-listing; 3 are not eligible and 1 is eligible. At TA-V only 1 building has been evaluated and it is not eligible (SNL/NM 2004; DOE 2003).

SNL/NM facilities that are located outside of the technical areas and have been evaluated for NRHP-eligibility include the ACF Complex and the Lurance Canyon Burn Site. Both of these facilities are located within the CTF on USFS-owned land withdrawn to DOE. At the ACF Complex, 16 buildings have been determined not eligible. Three buildings and the aerial cables themselves have been determined eligible. Fifteen buildings at the Burn Site, slated for demolition, were evaluated and determined not eligible (Ullrich 2006). The SNL/NM facilities at Thunder Range have been evaluated and none of them are eligible. Building 9972, the Radar Cross Section Facility, has been evaluated and was determined eligible. Building S9800B (firing pit) was found eligible and has been documented and demolished and Building 9990 has been found eligible (documentation is currently underway).

4.6.8.3 *Native American Resources*

A Traditional Cultural Property (TCP) is a place or object that is significantly associated with the cultural practices and beliefs that are rooted in a community's history and are important in maintaining the cultural identity of the community. Consultations with Tribes were conducted during preparation of the SWEIS; no specific TCPs were identified at that time. Since then, some project-specific consultations have occurred; however, there are still no specific TCPs identified for KAFB (KAFB 2006).

4.6.9 Socioeconomic Resources

Socioeconomic characteristics addressed at SNL/NM include employment, regional economy, and population, housing, and community services. Socioeconomic characteristics are presented for a ROI. The ROI was identified based on the distribution of residences for current SNL/NM employees. The ROI is defined as those counties where approximately 90 percent of the workforce lives.

SNL/NM is located in Bernalillo County, New Mexico. Statistics for socioeconomic characteristics are presented for the ROI, a region consisting of Bernalillo, Sandoval, Torrance, and Valencia Counties. Figure 4.6.9-1 presents a map of the counties composing the SNL/NM ROI.

4.6.9.1 *Employment and Income*

Labor force statistics are summarized in Table 4.6.9-1. The civilian labor force of the ROI grew by approximately 6 percent from 370,858 in 2000 to 391,884 in 2005. The overall ROI employment experienced a growth rate of nearly 5 percent with 355,580 in 2000 to 372,371 in 2005 (BLS 2007).

The ROI unemployment rate was 5 percent in 2005 and 4.1 percent in 2000. In 2005, unemployment rates within the ROI ranged from a low of 4.8 percent in Bernalillo County to a high of 5.5 percent in Valencia County. The unemployment rate in New Mexico in 2005 was 5.3 percent (BLS 2007).

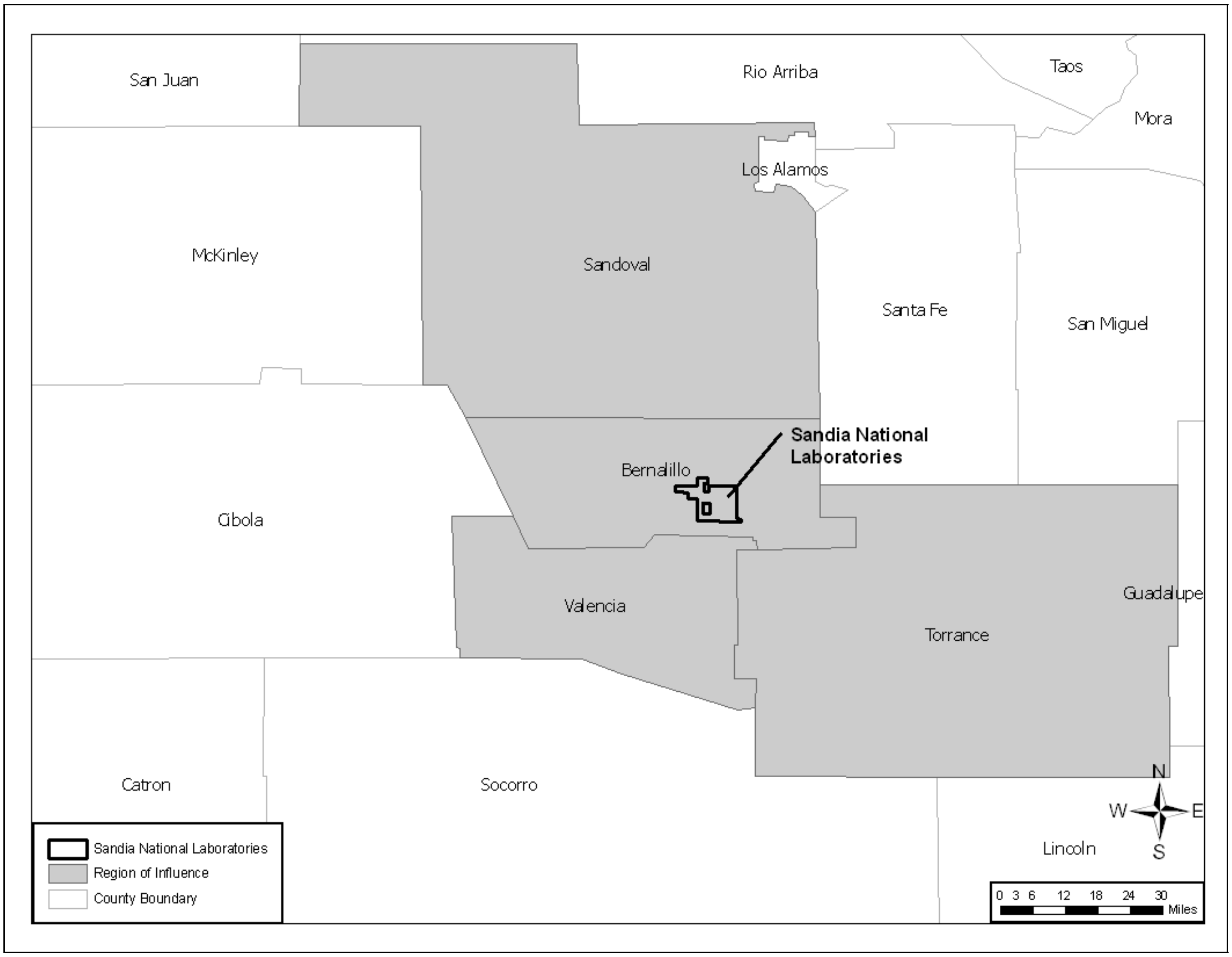


Figure 4.6.9-1—Region of Influence for Socioeconomic Impacts at SNL/NM

Table 4.6.9-1—Labor Force Statistics for ROI and New Mexico

	ROI		**New Mexico**	
	2000	**2005**	**2000**	**2005**
Civilian Labor Force	370,858	391,884	852,293	915,489
Employment	355,580	372,371	810,024	867,317
Unemployment	15,278	19,513	42,269	48,172
Unemployment Rate (percent)	4.1	5.0	5.0	5.3

Source: BLS 2007.

Income information for the SNL/NM ROI is provided in Table 4.6.9-2. Torrance is at the low end of the ROI with a median household income in 2004 of $30,347 and a per capita income of $21,111. Bernalillo had a median household income of $43,047 and a per capita income of $31,441 (BEA 2007).

Table 4.6.9-2—Income Information for the SNL/NM ROI, 2004

	Per capita income (dollars)	Median household income (dollars)
Bernalillo	31,441	43,047
Sandoval	26,418	47,745
Torrance	21,111	30,347
Valencia	23,311	36,955
New Mexico	26,679	37,838

Source: BEA 2007.

4.6.9.2 *Population and Housing*

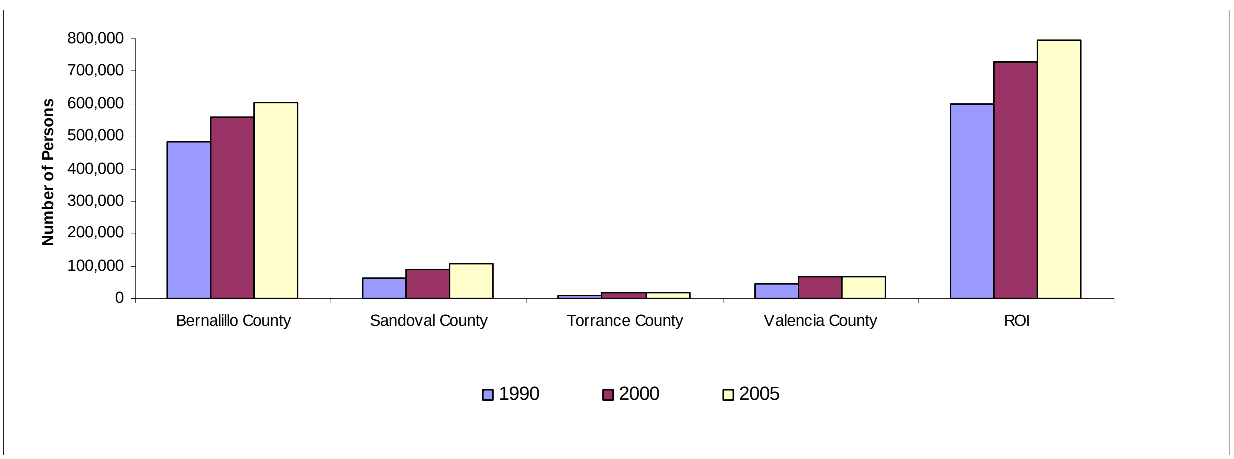
The ROI is used to analyze the primary economic impacts on population and housing. Table 4.6.9-3 presents historic and projected population in the ROI and the state.

Table 4.6.9-3—Historic and Projected Population

County	1990	2000	2005	2010	2020
Bernalillo County	480,577	556,678	603,783	631,839	698,832
Sandoval County	63,319	89,908	107,146	126,294	162,409
Torrance County	10,285	16,911	17,456	21,690	24,979
Valencia County	45,235	66,152	69,132	86,708	108,064
ROI	599,416	729,649	797,517	866,531	994,284
New Mexico	1,515,069	1,819,046	1,925,985	2,112,986	2,383,116

Source: USCB 2007.

Between 1990 and 2000, the ROI population increased 22 percent from 599,416 in 1990 to 729,649 in 2000. From 2000 to 2005, the population of the ROI increased 9 percent to 797,517 in 2005. Sandoval County experienced the largest population growth within the ROI between 2000 and 2005 with an increase of 19 percent (USCB 2007). Figure 4.6.9-2 presents the trends in population within the SNL/NM ROI.



Source: USCB 2007.

Figure 4.6.9-2—Trends in Population for the SNL/NM ROI, 1990-2005

Table 4.6.9-4 lists the total number of housing units and vacancy rates in the ROI. In 2000, the total number of housing units in the ROI was 305,840 with 281,052 occupied (92 percent). There were 190,981 owner-occupied housing units and 90,071 rental units. The median value of owner-occupied units in Bernalillo County was the greatest of the counties in the SNL/NM ROI ($128,300). The vacancy rate was the lowest in Bernalillo County (7.6 percent) and the highest in Torrance County (17 percent) (USCB 2007).

Table 4.6.9-4—Housing in the SNL/NM ROI, 2000

	Total Units	Occupied housing Units	Owner Occupied Units	Renter Occupied Units	Vacant units	Vacancy Rate (percent)	Median value of Owner Occupied Units (dollars)
Bernalillo County	239,074	220,936	140,634	80,302	18,138	7.6	128,300
Sandoval County	34,866	31,411	26,257	5,154	3,455	9.9	115,400
Torrance County	7,257	6,024	5,055	969	1,233	17.0	82,800
Valencia County	24,643	22,681	19,035	3,646	1,962	8.0	108,300
ROI	305,840	281,052	190,981	90,071	24,788	8.1	123,328

Source: USCB 2007.

4.6.9.3 *Community Services*

Community services analyzed in the ROI include public schools, law enforcement, fire suppression and medical services. There are 10 school districts with 256 schools serving the SNL/NM ROI. Educational services are provided for approximately 131,095 students by an estimated 8,642 teachers for the 2005 to 2006 school year (IES 2006a). The student-to-teacher ratio in these school districts ranges from a high of 16:1 in the Los Lunas School District in Valencia County to a low of 11:1 in the Jemez Valley School District, in Sandoval County. The student-to-teacher ratio in the ROI was 15:1 (IES 2006a).

The counties within the ROI employ approximately 8,008 firefighters and law enforcement officers. There are 10 hospitals that serve residents of the ROI with the majority located in Bernalillo County. These hospitals have a total bed capacity of 1,456 (ESRI 2007).

4.6.10 Environmental Justice

The potentially affected area considered for environmental justice analysis is the area within a 50-mile radius of SNL/NM. Figure 4.6.10-1 shows counties potentially at risk from the current missions performed at SNL/NM. There are seven counties included in the potentially affected area. Table 4.6.10-1 provides the demographic profile of the potentially affected area using data obtained from the 2000 Census.

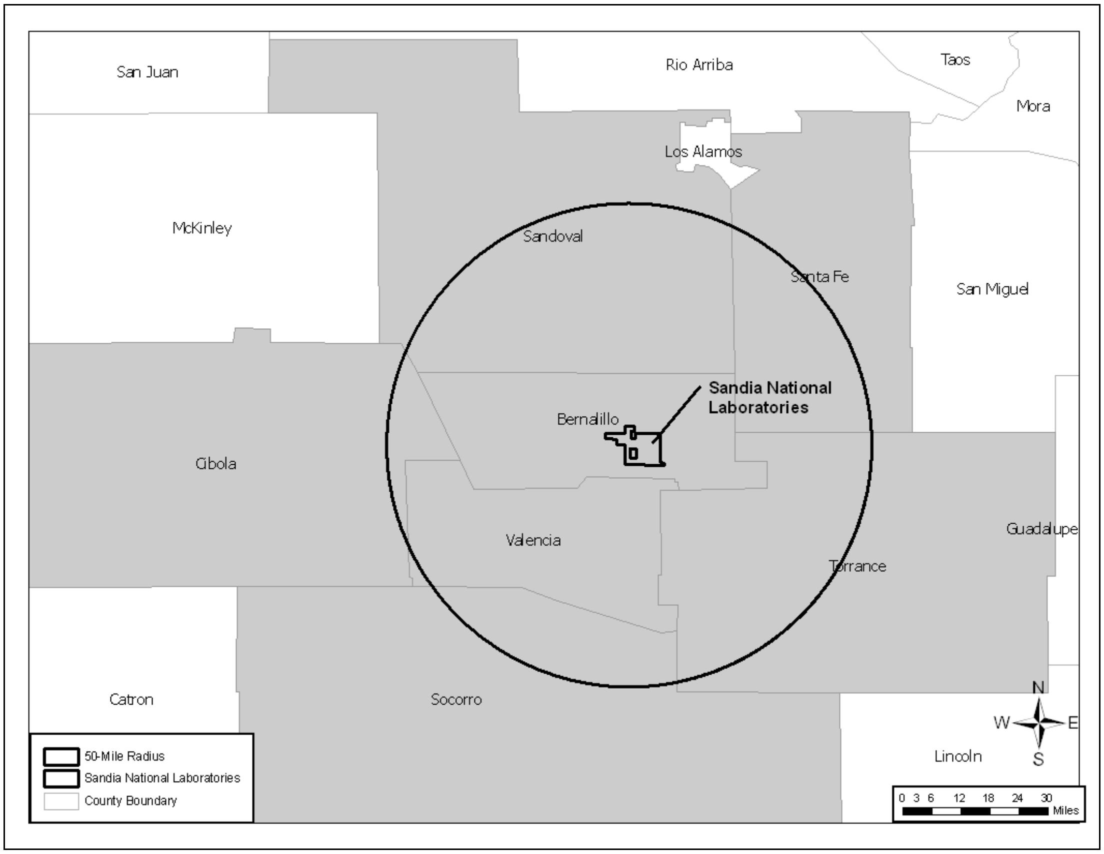


Figure 4.6.10-1—Potentially Affected Counties Surrounding SNL/NM Environmental Justice

In 2000, persons self-designated as minority individuals in the potentially affected area comprised 59.3 percent of the total population. Hispanic residents are the largest group within the minority population. As a percentage of the total resident population in 2000, New Mexico had a minority population of 55 percent and the U.S. had a minority population of 30.9 percent (USCB 2007).

Table 4.6.10-1—Demographic Profile of the Potentially Affected Area Surrounding SNL/NM, 2000

Population Group	Population	Percent
Minority	**535,543**	**59.3**
Hispanic alone	274,020	30.4
Black or African American	19,241	2.1
American Indian and Alaska Native	54,438	6.0
Asian	16,221	1.8
Native Hawaiian and Other Pacific Islander	4,759	0.5
Some other race	130,997	14.5
Two or more races	35,867	4.0
White alone	**367,071**	**40.7**
Total Population	**902,614**	**100.0**

Source: USCB 2007.

Census tracts with minority populations exceeding 50 percent were considered minority census tracts. Based on 2000 census data, Figure 4.6.10-2 shows minority census tracts within the 50-mile radius where more than 50 percent of the census tract population is minority.

Census tracts were considered low-income census tracts if the percentage of the populations living below the poverty threshold exceeded 50 percent (CEQ 1997). Based on 2000 Census data, Figure 4.6.10-3 shows low-income census tracts within the 50-mile radius where more than 50 percent of the census tracts population is living below the Federal poverty threshold.

According to 2000 census data, approximately 126,580 individuals residing within census tracts in the 50-mile radius of SNL/NM were identified as living below the Federal poverty threshold, which represents approximately 14 percent of the population within the 50-mile radius. There was one census tract located in Cibola County with populations greater than 50 percent identified as living below the Federal poverty threshold. In 2000, 18.4 percent of individuals for whom poverty status is determined were below the poverty level in New Mexico and 12.4 percent in the U.S. (USCB 2007).

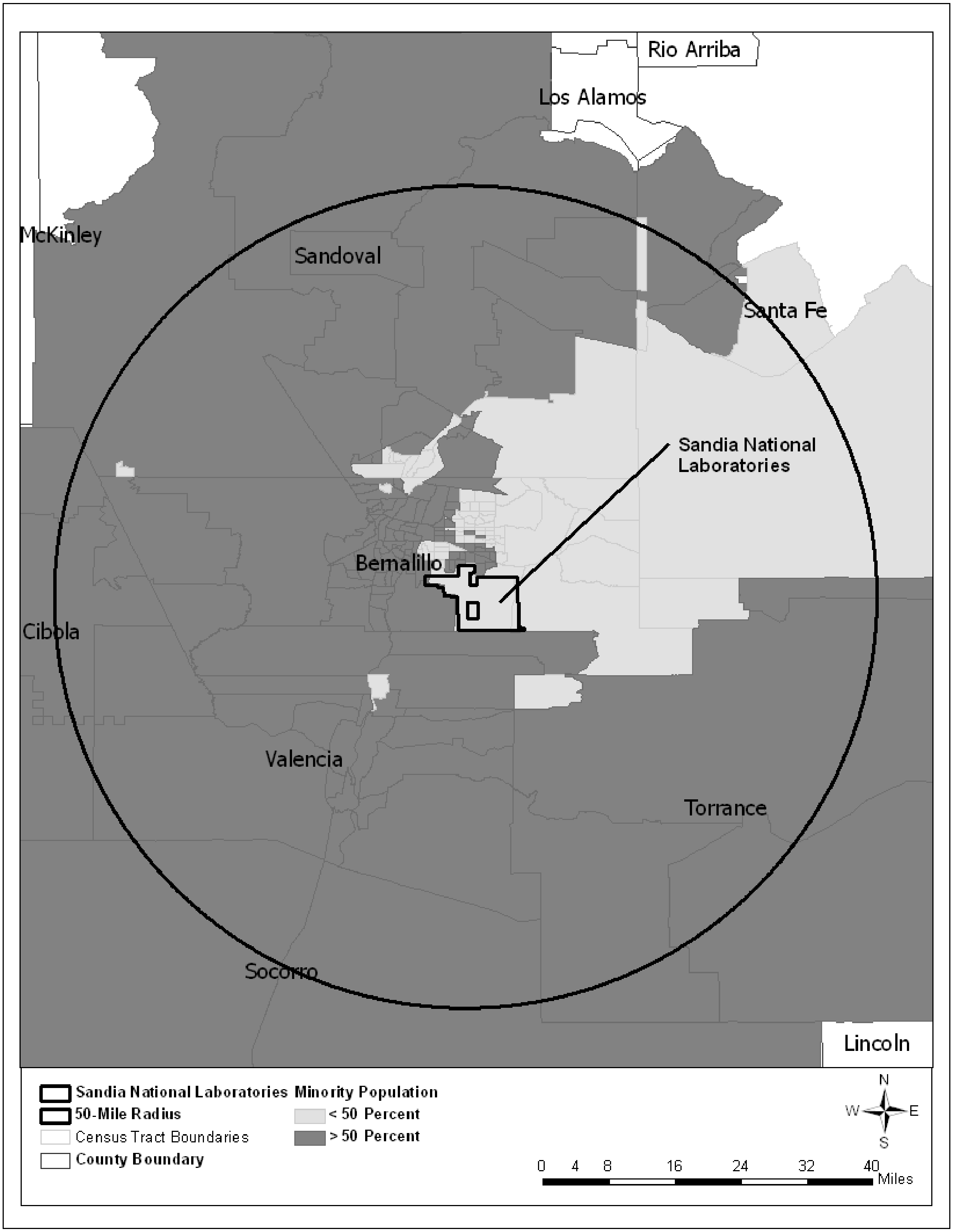


Figure 4.6.10-2—Minority Population – Census Tracts with More than 50 Percent Minority Population in a 50-Mile Radius of SNL/NM

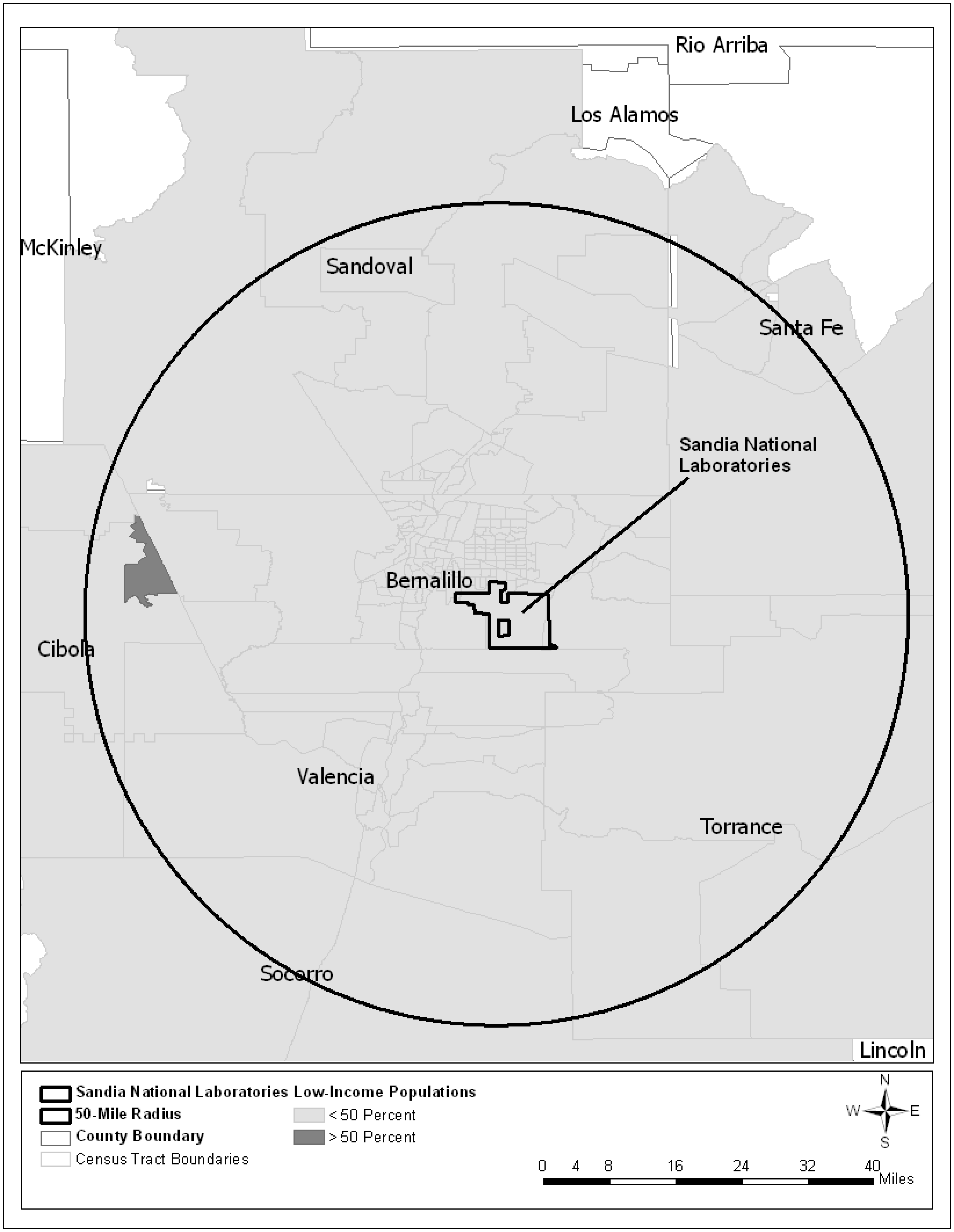
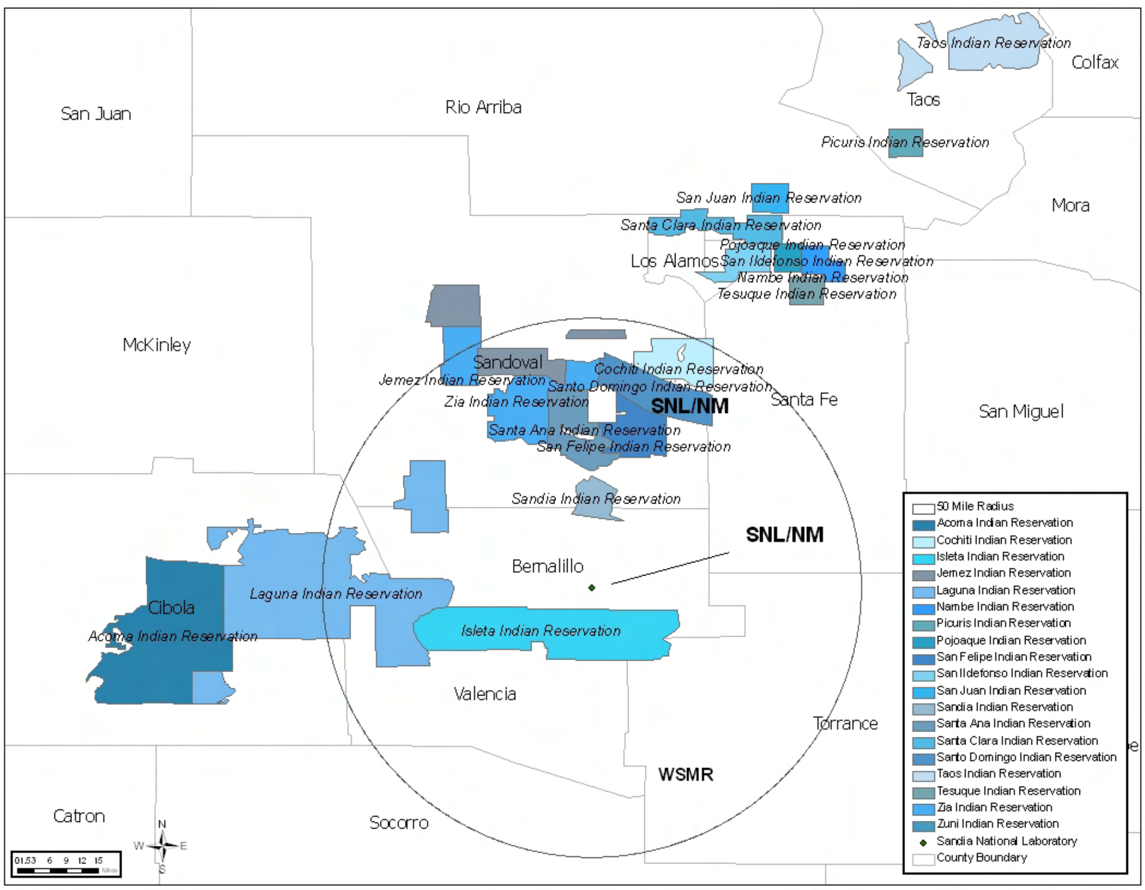


Figure 4.6.10-3—Low-Income Population – Census Tracts with More than 50 Percent Low-Income Population in a 50-Mile Radius of SNL/NM

4.6.10.1 *Characteristics of Native American Populations within the Vicinity of or with Interest in SNL/NM Activities/Operations*

As discussed in Sections 4.6.8.3, Native American groups which are known to have used or have interest in the lands surrounding SNL/NM are the New Mexican Pueblo Indians which are shown in Figure 4.6.10-4 and listed below:

- Acoma
- Cochiti
- Jemez
- Laguna
- Nambe
- Picuris
- Pojoaque
- San Felipe
- San Ildefonso
- San Juan
- Sandia
- Santa Ana
- Santa Clara
- Santo Domingo
- Taos
- Tesuque
- Zia
- Zuni



Source: ESRI 2007.

Figure 4.6.10-4—Location of New Mexico Indian Pueblo Reservations

The 2000 U.S. Census Bureau was used to obtain characteristics, including population, employment, educational attainment, income, poverty level, average family size, and housing

characteristics for all population subcategories associated with the ones mentioned above. The results of this analysis are provided in the following section.

As shown in Table 4.6.10-2, the Zuni had the highest of the Native American populations with 9,311 and Pojoaque with the least at 209. The Picuris have the largest percentage of their population as members of the civilian labor force at 74.8 percent and the San Felipe with the smallest percentage of their population as members of the civilian labor force with 31.5 percent. The Zuni had the highest unemployment rate at 11.8 percent and the Santa Clara with the lowest unemployment rate at 3.2 percent (USCB 2000).

Of those individuals over 25 with some form of education, the largest constituency of all the New Mexico Pueblo populations had received a high school diploma as shown in Table 4.6.10-3. A comparable percentage of individuals had attended some college and slightly lesser percentages of these populations had received degrees from institutions of higher learning (Associate, Bachelor, or Graduate/Professional) (USCB 2000).

Table 4.6.10-2—Population and Employment Estimates for Native American Populations within the Vicinity of or With Interest in SNL/NM, 2000

SNL/NM	Population	Civilian Labor Force	Civilian Labor Force (percent)	Employed	Employed (percent)	Unemployed	Unemployed (percent)
Pueblo	59,621	24,527	58.1	21,130	50.1	3,397	8
Acoma	4,298	1,792	60.1	1,548	51.9	244	8.2
Cochiti	913	409	60.9	357	53.1	52	7.7
Isleta	3,685	1,602	58.8	1,474	54.1	128	4.7
Jemez	2,705	1,057	56.8	875	47	182	9.8
Laguna	6,346	2,682	59.4	2,375	52.6	307	6.8
Nambe	558	200	56.3	184	51.8	16	4.5
Picuris	338	178	74.8	168	70.6	10	4.2
Pojoaque	209	53	48.6	53	48.6	0	0
San Felipe	2,756	579	31.5	428	23.2	151	8.2
San Ildefonso	539	269	70.1	234	60.9	35	9.1
San Juan Pueblo	1,438	639	64.7	579	58.7	60	6.1
Sandia	353	186	70.7	176	66.9	10	3.8
Santa Ana	623	276	62	257	57.8	19	4.3
Santa Clara	1,057	437	55.8	412	52.6	25	3.2
Santo Domingo	4,216	1,363	49	1,117	40.2	246	8.8
Taos	1,877	993	66.9	875	58.9	118	7.9
Tesuque	511	214	62.2	197	57.3	17	4.9
Zia	900	398	61.3	353	54.4	45	6.9
Zuni	9,311	3,571	54.9	2,802	43.1	769	11.8

Source: USCB 2000.

Table 4.6.10-3—Level of Educational Attainment by Native American Populations within the Vicinity of or With Interest in SNL/NM, 2000

SNL/NM	Highschool Graduate	Highschool Graduate (percent)	Some College	Some College (percent)	Associate Degree	Associate Degree (percent)	Bachelor Degree	Bachelor Degree (percent)	Graduate/ Professional Degree	Graduate/ Professional Degree (percent)
Pueblo	11,039	33.4	8,628	26.1	2,362	7.1	2,279	6.9	909	2.8
Acoma	943	40.9	540	23.4	161	7	116	5	52	2.3
Cochiti	161	30.3	186	35	54	10.2	27	5.1	27	5.1
Isleta	848	38	559	25.1	115	5.2	170	7.6	63	2.8
Jemez	525	37.7	340	24.4	77	5.5	108	7.8	19	1.4
Laguna	1,124	31.9	1,004	28.5	385	10.9	343	9.7	96	2.7
Nambe	76	29	75	28.6	33	12.6	23	8.8	2	0.8
Picuris	38	19.2	110	55.6	2	1	26	13.1	4	2
Pojoaque	27	34.6	24	30.8	4	5.1	3	3.8	3	3.8
San Felipe	661	46.4	169	11.9	44	3.1	39	2.7	22	1.5
San Ildefonso	117	37.9	100	32.4	23	7.4	40	12.9	3	1
San Juan Pueblo	223	27.4	272	33.5	82	10.1	61	7.5	6	0.7
Sandia	44	21.4	41	19.9	64	31.1	15	7.3	26	12.6
Santa Ana	147	41.8	98	27.8	26	7.4	19	5.4	8	2.3
Santa Clara	235	36	171	26.2	50	7.7	69	10.6	21	3.2
Santo Domingo	897	42	377	17.6	48	2.2	64	3	67	3.1
Taos	378	31.6	367	30.6	100	8.3	112	9.3	39	3.3
Tesuque	104	37.3	89	31.9	5	1.8	22	7.9	8	2.9
Zia	174	34.7	125	24.9	37	7.4	23	4.6	7	1.4
Zuni	1,547	31.5	1,189	24.2	346	7	198	4	52	1.1

Source: USCB 2000.

In 2000, the mean household earnings and per capita income were comparable for all New Mexico Pueblo populations. The San Felipe Pueblo had the highest mean household earnings with $45,444 as shown in Table 4.6.10-4. The Isleta Pueblo had the highest per capita income with $17,030. The Zuni population had the lowest mean household earnings with $30,258 and the lowest per capita income with $7,837 (USCB 2000).

Of all the New Mexico pueblo populations, the Santo Domingo had the largest percentage of individuals below the poverty level in 2000 with 36.8 percent as compared to the Santa Ana population which had 7.4 percent of the total population living below the poverty level as shown in Table 4.6.10-4 (USCB 2000).

Table 4.6.10-4—Income and Poverty Level Estimates for Native American Populations within the Vicinity of or With Interest in SNL/NM, 2000

SNL/NM	Mean Household Earnings	Per Capita Income	Individuals Below the Poverty Level	Individuals Below the Poverty Level (percent)
Pueblo	$35,886	$10,798	17,030	29.1
Acoma	$37,498	$9,584	1,067	25.3
Cochiti	$32,245	$10,095	227	25.2
Isleta	$39,314	$17,106	743	20.5
Jemez	$31,431	$8,897	727	27.2
Laguna	$35,535	$11,099	1,476	24
Nambe	$31,319	$8,718	127	23
Picuris	$45,403	$14,370	57	16.9
Pojoaque	$33,720	$8,719	68	32.5
San Felipe	$45,444	$8,514	952	34.7
San Ildefonso	$31,154	$11,095	129	23.9
San Juan Pueblo	$35,950	$11,519	365	25.8
Sandia	$41,347	$14,414	53	15
Santa Ana	$39,011	$10,527	46	7.4
Santa Clara	$32,255	$10,483	288	27.4
Santo Domingo	$33,080	$8,228	1,537	36.8
Taos	$34,456	$12,022	492	26.9
Tesuque	$35,240	$12,001	93	18.2
Zia	$35,999	$9,693	125	14.7
Zuni	$30,258	$7,837	4,041	44

Source: USCB 2000.

In 2000, the Santo Domingo had the largest average family size with 5.22 persons compared to the Tesuque who had the smallest average family size with 2.96 persons per family. The Zuni had the greater number of occupied housing units which is consistent with their larger population Table 4.6.10-5 (USCB 2000).

Table 4.6.10-5—Housing Characteristics for Native American Populations within the Vicinity of or With Interest in SNL/NM, 2000

SNL/NM	Average Family Size	Housing Units	Occupied Housing Units	Owner Occupied Housing Units	Owner Occupied Housing Units (percent)	Renter Occupied Housing Units	Renter Occupied Housing Units (percent)
Pueblo	3.89	17,328	17,084	11,578	67.8	5,506	32.2
Acoma	4.18	1,089	1,076	783	72.8	293	27.2
Cochiti	4.38	267	284	170	59.9	114	40.1
Isleta	3.37	1,361	1,355	1,045	77.1	310	22.9
Jemez	4.05	699	701	538	76.7	163	23.3
Laguna	3.6	1,953	1,894	1,171	61.8	723	38.2
Nambe	3.22	202	194	165	85.1	29	14.9
Picuris	3.39	117	108	84	77.8	24	22.2
Pojoaque	3.31	83	85	50	58.8	35	41.2
San Felipe	5.44	517	521	470	90.2	51	9.8
San Ildefonso	3.05	218	205	156	76.1	49	23.9
San Juan Pueblo	3.39	472	468	289	61.8	179	38.2
Sandia	3.31	138	128	108	84.4	20	15.6
Santa Ana	5.1	150	162	144	88.9	18	11.1
Santa Clara	3.29	409	404	357	88.4	47	11.6
Santo Domingo	5.22	859	889	575	64.7	314	35.3
Taos	3.17	752	733	563	76.8	170	23.2
Tesuque	2.96	171	161	139	86.3	22	13.7
Zia	3.64	255	234	181	77.4	53	22.6
Zuni	4.22	2,334	2,293	1,558	67.9	735	32.1

Source: USCB 2000.

4.6.11 Health and Safety

Current activities associated with routine operations at SNL/NM have the potential to affect worker and public health. The following discussion characterizes the human health impacts from current releases of radioactive and nonradioactive materials at SNL/NM. It is against this baseline that the potential incremental and cumulative impacts associated with the alternatives are compared and evaluated.

4.6.11.1 *Public Health*

4.6.11.1.1 Radiological

Releases of radionuclides to the environment from SNL/NM operations provide a source of radiation exposure to individuals in the vicinity of SNL/NM. During 2005, SNL/NM's environmental radiological monitoring program was conducted according to DOE Orders 450.1, “Environmental Protection Program,”1 and 5400.5, “Radiation Protection of the Public and the Environment.” The program involved measuring radioactivity in environmental samples in addition to calculating the potential radiological dose to the offsite public.

Radiological and nonradiological hazardous materials released from SNL/NM facilities reach the environment and people through different transport pathways. Of the transport pathways that could potentially impact human health, only the air exposure pathway from air emissions provides a complete exposure pathway. Soils, groundwater, and surface water exposure do not provide complete exposure pathways and are not expected to lead to radiological or nonradiological exposure to public receptors. Section 4.6.4.1 identifies the facilities at SNL/NM that emit radiological emissions, and quantifies the amounts of each radionuclide released.

The exposure of members of the public to all DOE sources of radiation is limited by the DOE to levels that shall not cause, in a year, an effective dose equivalent greater than 100 millirem. Demonstration of compliance with this limit is documented by a combination of measurements and calculations including the comparison of concentrations of radioactive material in air and water to derived concentration guides (DCGs) listed in Chapter III of DOE Order 5400.5. The DOE provides a level of protection for persons consuming water from a public drinking water supply equivalent to the drinking water criteria in 40 CFR 141 by limiting the effective dose equivalent in a year to 4 millirem. Compliance with the aforementioned criterion is accomplished by comparing measured concentrations of radionuclides in drinking water to 4 percent of the DCG values for ingested water. The DOE further limits emissions of radionuclides to the ambient air from DOE facilities to those amounts that would not cause any member of the public to receive, in any year, an effective dose equivalent of 10 millirem per year. This limit is equivalent to the limit for emissions of radionuclides other than radon to this pathway established by the EPA at 40 CFR 61.92.

Compliance with the dose limit specified in 40 CFR 61.92 (and hence that for the air pathway specified in DOE Order 5400.5) is demonstrated by calculating the effective dose equivalent received by the maximally exposed individual member of the general public. This individual is a person who resides near SNL/NM, and who would receive, based on theoretical assumptions about lifestyle that maximize exposure to radiological emissions, the highest effective dose equivalent from SNL/NM operations. Calculations are performed using the EPA's CAP88-PC model (EPA 1992).

The dose received by the MEI and the collective population dose are tabulated in Table 4.6.11-1. Based on the 2005 operational data, SNL/NM emitted a dose to the maximally exposed member of the general public of 0.00082 millirem per year (SNL/NM 2006). This dose is less than 1 percent of the DOE public dose limit for all pathways and less than 1 percent of the EPA maximum permissible exposure limit to the public (and the DOE "air pathway" limit) of 10 millirem per year. The monitoring and analysis results demonstrate that no adverse effects occurred from SNL/NM operations in 2005. SNL/NM met all NESHAP compliance requirements in 2005 (SNL/NM 2006).

The 2005 collected dose for the collective regional population (793,740 estimated to be living within 50-mile radius of SNL/NM) is 1.7 x 10^{-4}. For perspective, the annual radiation dose from natural background radiation is approximately 360 millirem per year (SNL/NM 2006).

Table 4.6.11–1—Radiological Dose Reporting, 2005

Pathway	Dose to MEI (mrem)	Percent of DOE 100-mrem/yr Limit	Estimated Population Dose with 50 miles (person-rem)	Population within 50 mile radius of site	Estimated Background Radiation Population Dose (mrem)
Air	8.2×10^{-4}	0.001 percent	1.7×10^{-4}	793,740	-
Water	0	0	0	0	-
Other Pathways	0	0	0	0	-
All	8.2×10^{-4}	0.001 percent	1.7×10^{-4}	793,740	2.9×10^{5}

Source: SNL/NM 2006.
mrem=millirem
mrem/yr=millirem per year

SNL/NM operations are required to be in compliance with the DOE and OSHA requirements for worker health and safety. DOE Environment, Safety, and Health (ES&H) programs regulate the work environment and seek to minimize the likelihood of work-related exposures, illnesses, and injuries. In addition, SNL/NM's Occupational Radiation Protection Program complies with 10 CFR 835, *Occupational Radiation Protection*, and DOE-N-441.1, *Radiological Protection for DOE Activities*, which provide requirements for protection of onsite workers and visitors.

Table 4.6.11-2 lists the average, maximum and collective effective dose equivalent to workers for the years 1999 through 2003. Table 4.6.11-3 identifies the nonfatal injury/illness case rates and lost workday case rates for Sandia Corporation employees from 1999 through 2003. The doses and rates for this period have remained relatively constant, indicative of a stable occupational health and safety environment. In 2005, the collective dose to workers was 8.5 person-rem.

Table 4.6.11-2—Average, Maximally Exposed Individual (MEI) and Collective Radiation-Badged Worker Doses

Parameter	Calendar Year				
	1999	2000	2001	2002	2003
Average dose to workers (mrem/yr)	68	84	50	45	43
Dose to MEI (mrem/yr)	603	720	472	425	417
Collective dose to workers (person-rem/yr)	7.34	7.81	5.30	4.95	10.49

Source: SNL/NM 2006.
mrem/yr=millirem per year

Table 4.6.11-3—Comparison of Nonfatal Injury/Illness and Lost Work Day Case Rates

Parameter	Calendar Year				
	1999	2000	2001	2002	2003
Nonfatal Occupational Injury/Illness Rates (per 100 workers/year [per 200,000 hours])	3.5	3.6	4.2	3.3	3.6
Lost Work Day Case Rates (per 100 workers/year [per 200,000 hours])	1.5	1.4	1.3	1.8	1.3

Source: SNL/NM 2006.

4.6.11.1.2 Nonradiological

Nonradiological chemical air pollutants are released from SNL/NM facilities that house chemistry laboratories or chemical operations. Air samples collected near known chemical emission sources are the highest expected chemical air pollutant levels from current SNL/NM operations. Due to dilution and dispersion, lower levels of these air pollutants would occur at locations offsite and further away from the sources. The maximum ambient concentrations of VOCs measured by monitoring stations onsite at SNL/NM are below safety levels established for workers in industrial areas. Although there are no SNL/NM-operated monitoring stations offsite, it is possible to make the assessment that concentrations decrease with distance from the source and, therefore, are also below health-risk levels for impacts to public health

Small amounts of nonradiological chemical contamination, which have been caused by past SNL/NM operations, have been identified in other environmental resources (such as groundwater and soils subsurface). Chemicals existing in the environment have the potential to reach members of the public through these different transport pathways. Environmental sampling programs involving resources such as groundwater, soils, and surface water, are designed to monitor and assess the potential for public exposure to these pollutants through these different media. Evaluations of groundwater, soils, and surface water information indicate that the public is not in contact with these areas of contamination within SNL/NM site boundaries and that the contamination is not being transported offsite (DOE 1999c). Nonradiological chemical air emission values were reviewed in the 2006 SNL/NM SA. Because the emissions had not changed significantly from the results presented above, the concentrations of VOCs remain below health-risk levels (SNL/NM 2006).

4.6.12 Transportation

Figure 4.6.12-1 shows major transportation routes in vicinity of SNL/NM. Nearly all of SNL/NM activities are conducted within the boundaries of KAFB. Three principal entrances of KAFB, the Wyoming, Gibson, and Eubank Gates, provide access to SNL/NM. Additional entrances are located at the Truman/Gibson and Carlisle/Gibson intersections. Average weekday traffic volume (two-way) on Wyoming Boulevard south of the Gibson Boulevard intersection is 16,211 vehicles per day. Traffic entering the intersection of G Avenue and 20th Street from the east (traveling from the direction of the Eubank gate) is 20,066 average weekday traffic volume (DOE 2006a).

Traffic in the KAFB vicinity is predominantly associated with USAF operations. In addition to Air Force and SNL/NM activities, other Federal agencies conduct operations at KAFB including the Department of Homeland Security, the Defense Threat Reduction Agency (DTRA), and the USGS. Traffic volumes for SNL/NM-affiliated activities are based on estimates derived from various traffic studies. The average estimated daily SNL/NM-affiliated traffic flow at KAFB's main access points are provided in Table 4.6.12-1.

Table 4.6.12-1—Daily Gate Traffic Estimates for SNL/NM Activities at KAFB

Study Year	Gibson Gate	Wyoming Gate	Eubank Gate	Total
1982	16,700	17,800	10,000	44,500
1993	21,160	21,700	12,200	55,060
1995	22,523	19,835	14,788	57,146
2004	15,255	16,075	19,636	50,966

Source: SNL/NM 2004.

4.6.12.1 *Aircraft Operations*

Access to passenger and air freight services for shipments to or from SNL/NM is possible by traversing between SNL/NM and the Albuquerque International Sunport. KAFB and the Sunport share runways, and it is possible to travel between KAFB and SNL/NM without exiting the Air Force base. Commercial air freight services, such as Menlo Worldwide or DHL Worldwide are available at the Sunport. The NNSA Office of Secure Transportation Aviation Operations Branch (AOB), also located at the Sunport, supports DOE programs and operations. All inbound and outbound KAFB shipments via AOB are considered to be DOE air transport shipments.

4.6.12.2 *Transportation Accidents*

In a lessons learned report documenting motor vehicle accidents (MVAs) during the period of January 1997 to May 2002, 50 MVAs were reported at SNL/NM-controlled facilities (SNL/NM 2002). Online record searches for the five-year period spanning CY1999 through 2003 found 22 MVAs at SNL/NM. The sources used were the Occurrence Reporting and Processing System (ORPS) and the Human Resources (HR) Queries database.

It should be noted that the lessons learned documents includes MVAs at the TTR; however it is believed that the 22 MVAs for the CY1999 to CY2003 period does not provide a complete list of MVAs at SNL/NM. The ORPS only lists those accidents that meet certain criteria including property damage over a certain dollar amount and environmental impacts due to MVAs. The HR Queries emphasizes injuries to SNL/NM employees, at times not accounting for subcontractor MVAs.

Motor vehicle accidents in Bernalillo County and nearby counties are reported in Table 4.6.12-2. In 2005, there were 28,360 motor vehicle accidents in Bernalillo, Sandoval, Santa Fe, Torrance, and Valencia Counties resulting in 162 fatalities.

Table 4.6.12-2—New Mexico Traffic Accidents in Bernalillo and Nearby Counties, 2005

County	Total Accidents	Fatalities	Injuries
Bernalillo	20,917	78	9,650
Sandoval	1,953	24	1,161
Santa Fe	4,217	33	2,323
Torrance	281	13	172
Valencia	992	14	592
New Mexico	49,023	488	24,001

Source: NMDOT 2006.

4.6.13 Waste Management

The method of screening for waste generation is to compare the types and quantities of waste generated and projected to be generated by SNL/NM operations (excluding ER Project and decommissioning activities) with the waste generation analysis reported as the EOA in the 1999 SNL/NM SWEIS. Projection methodology is explained when the projections are discussed in the following subsections.

4.6.13.1 *Low-Level Waste*

SNL/NM continues to generate LLW and MLLW in its ongoing operations. TRU and mixed TRU wastes are not generated by current operations and are not expected to be generated by the new facilities that are expected to be operational by 2008. However, these wastes are still actively managed at the Radioactive and Mixed Waste Management Facility (RMWMF) while awaiting shipment to offsite disposal facilities.

The quantities of LLW generated in 1999, 2000, and 2001 exceeded the quantity projected under the EOA in the 1999 SNL/NM SWEIS. The quantities generated in 2002, 2003, and 2004 were well under the SWEIS quantity. The projections for 2005 through 2008 were based on the average amounts generated from 1999 through 2004 and adjusted for the expected activity increases or decreases at SNL/NM facilities. The quantities projected for 2005 through 2008 are about 96 percent of the SWEIS quantity (TtNUS 2006).

4.6.13.2 *Mixed Low-Level Waste*

The annual generation of MLLW from 1999 through 2004 did not exceed the 1999 SNL/NM SWEIS bounding quantity. For 2005 through 2008, the annual generation is projected to be less than that generated in 2004 and would remain steady at about 118 cubic feet (1,838 kilograms, using an average density of 1,586 pounds per cubic yard [DOE 1999c]), which is about 37 percent of the SWEIS quantity (TtNUS 2006). Since the quantities projected for 2005 through 2008 are less than the amount projected in the 1999 SNL/NM SWEIS, the 1999 SNL/NM SWEIS impacts analysis is considered sufficient for LLMW.

4.6.13.3 *Hazardous Waste*

The 1999 SNL/NM SWEIS analysis projected the annual maximum quantity of hazardous waste generated at SNL/NM operating facilities to be 206,163 pounds. As presented in Table 4.6.13-1, SNL/NM has generated less than that amount each year except in 2003. Hazardous waste generation for 2005 through 2008 was projected based on the average generation during the period from 1999 through 2004 and adjusted for increasing and decreasing activity levels at the selected facilities and the new facilities. For 2005-2008, the annual generation is projected to be highest in 2007 and 2008, at 122,687 pounds, which is about 60 percent of the SWEIS EOA quantity (TtNUS 2006). Since the quantities projected for 2005-2008 are less than the amount projected in the 1999 SNL/NM SWEIS, the impacts analysis of the 1999 SNL/NM SWEIS is considered sufficient for hazardous waste.

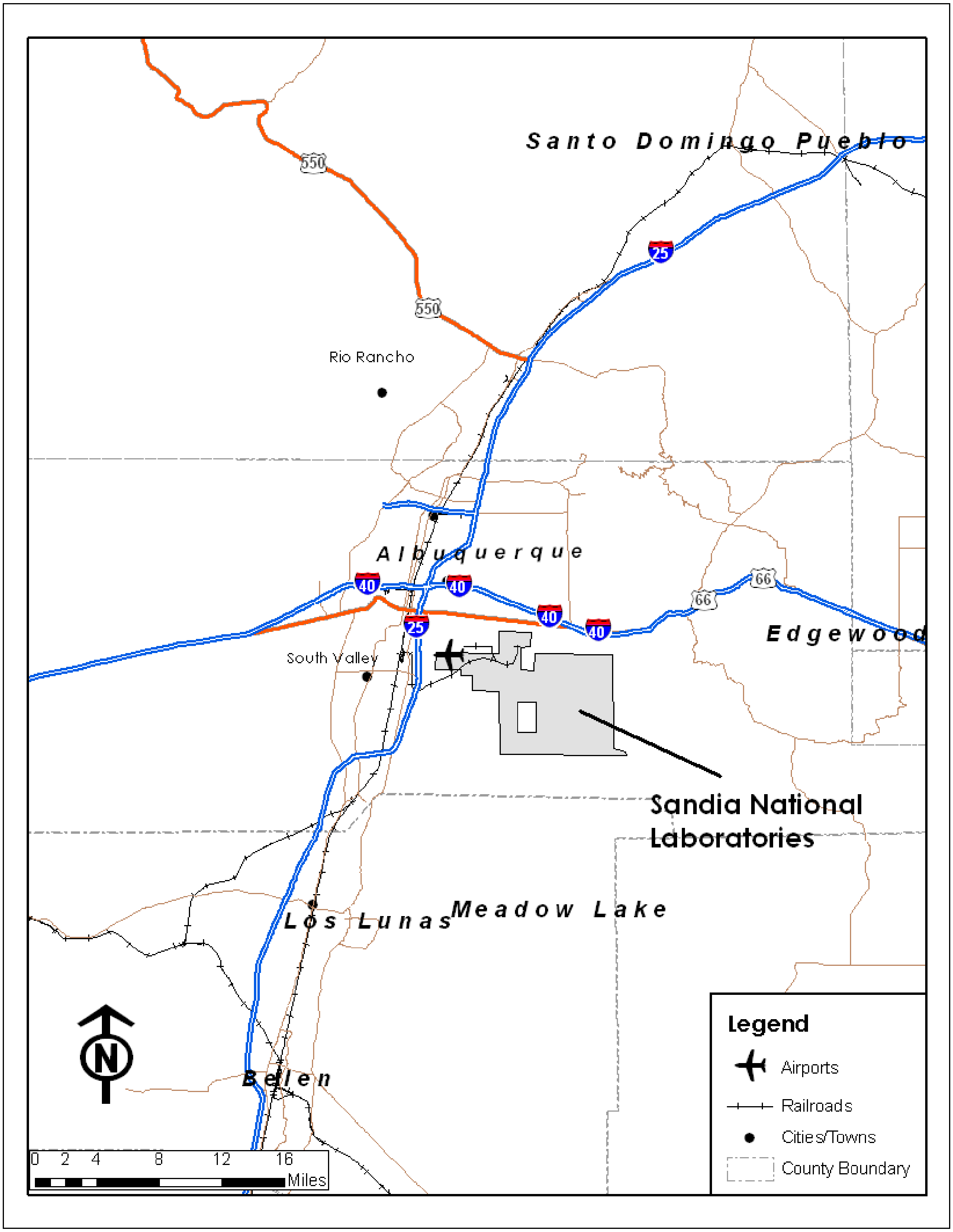


Figure 4.6.12-1—Major Roads at SNL/NM

4.6.13.4 *Non-hazardous Waste*

Non-hazardous chemical waste is generated at SNL/NM through ongoing operations and ER Project activities. This waste stream is composed of non-regulated waste that is processed at the Hazardous Waste Management Faciltiy (HWMF). The 1999 SNL/NM SWEIS stated that 275,824 pounds would be generated by ER Project activities and that the maximum quantity generated by operations would be 203,464 pounds. The 2004 quantity generated by ER Project activities and operations (separate quantities were not available) was 428,298 pounds (SNL/NM 2006). NNSA expects this amount to decrease as the ER Project is completed.

4.6.13.5 *Waste Generation Capacities*

Table 4.6.13-1 presents the waste generation quantities for 2005. It also lists the maximum annual quantity of waste presented in the 1999 SNL/NM SWEIS for the EOA (i.e., bounding quantity) for LLW, MLLW, TRU, mixed TRU, hazardous, municipal solid wastes, and wastewater. The 1999 SNL/NM SWEIS EOA quantities did not account for ER Project wastes and wastes resulting from D&D activities; therefore, ER project waste quantities are not reflected in Table 4.6.13-1.

4.6.13.6 *Waste Generation Facilities*

Waste at SNL/NM is processed at 5 facilities: the, the Thermal Treatment Facility (TTF), the HWMF, the RMWMF, the Manzano Storage Bunkers (MSB), and the Solid Waste Transfer Facility (SWTF). Waste generated and shipped by the HWMF in 2005 is shown in Table 4.6.13-1.

Table 4.6.13-1—Waste Generated and Shipped By the HWMF in 2005

Waste Categories Handled at the HWMF	2005 Waste Shipped
RCRA Waste	**pounds**
Hazardous Waste	230,032
Hazardous Waste (generated by ER Project)	981,235
Hazardous Waste (recycled)	10,901
Total	**1,222,168**
TSCA	
Asbestos	380,609
PCB (recycled NR)	10,624
PCB (incin NR)	4,862
PCB (incin RCRA)	2,066
Total	**398,161**
Biohazardous	
Infectious Waste	1,538
Other	
NR Waste (minus asbestos, PCB, subtitle D, ER, recycled)	698,434
Non-hazardous Solid Waste (RCRA Subtitle D)	24,552
Non-RCRA (generated by ER Project)	81,292
Used Oil	83,373
Other (recycled)	162,279
Total	**1,049,930**
Total Waste and Recyclables Shipped	**2,671,797**

Source: SNL/NM 2006.
lb = pounds

4.7 WHITE SANDS MISSILE RANGE

WSMR is a unique tri-service facility for test, evaluation, research, and assessment of military systems and commercial products located in south-central New Mexico (Figure 4.7-1). WSMR offers a broad assortment of testing capabilities and infrastructure, from management of the largest open-air/over-land missile range in the hemisphere to environmental testing chambers and computer modeling laboratories. WSMR is part of the Developmental Test Command (DTC), which reports to the United States Army Test and Evaluation Command.

The WSMR possesses extensive capabilities and infrastructure used by the Army, Navy, Air Force, NASA and other government agencies as well as universities, private industry and foreign militaries. No NNSA activities currently take place on the WSMR.

4.7.1 Land Use

4.7.1.1 *Onsite Land Uses*

WSMR lies within the Mexican Highland section of the Basin and Range Physiographic Province (Hawley 1986). This region is typified by alternating north-south aligned mountain ranges separated by expanses of sediment-filled basins (Peterson 1981, Hawley 1986).

Consistent with the regional basin and range topography, the overall landscape of WSMR consists of two large basins, the Jornada del Muerto and the Tularosa, which are separated mainly by the San Andres Mountains (Figure 4.7.1-1). There are no prime farmlands on WSMR (NRCS 2002).

Defense Threat Reduction Agency (DTRA) test beds lie within the Jornada del Muerto Basin, northern portions of the San Andres Mountains, and an area on the western side of the Oscura mountains. The Permanent High Explosive Test Site (PHETS) lies on a nearly level alluvial plain in the northern Jornada del Muerto Basin. It is located in Socorro County approximately 13 miles south of Stallion Range Center in the northwest corner of WSMR. PHETS is the largest of the DTRA test sites and has an overall area of approximately 22,400 acres; however, most test activities at PHETS take place in three test beds that cover a smaller area of approximately 5,246 acres. PHETS is used for HE events and tests to evaluate the effectiveness of various weapon systems against hardened targets.

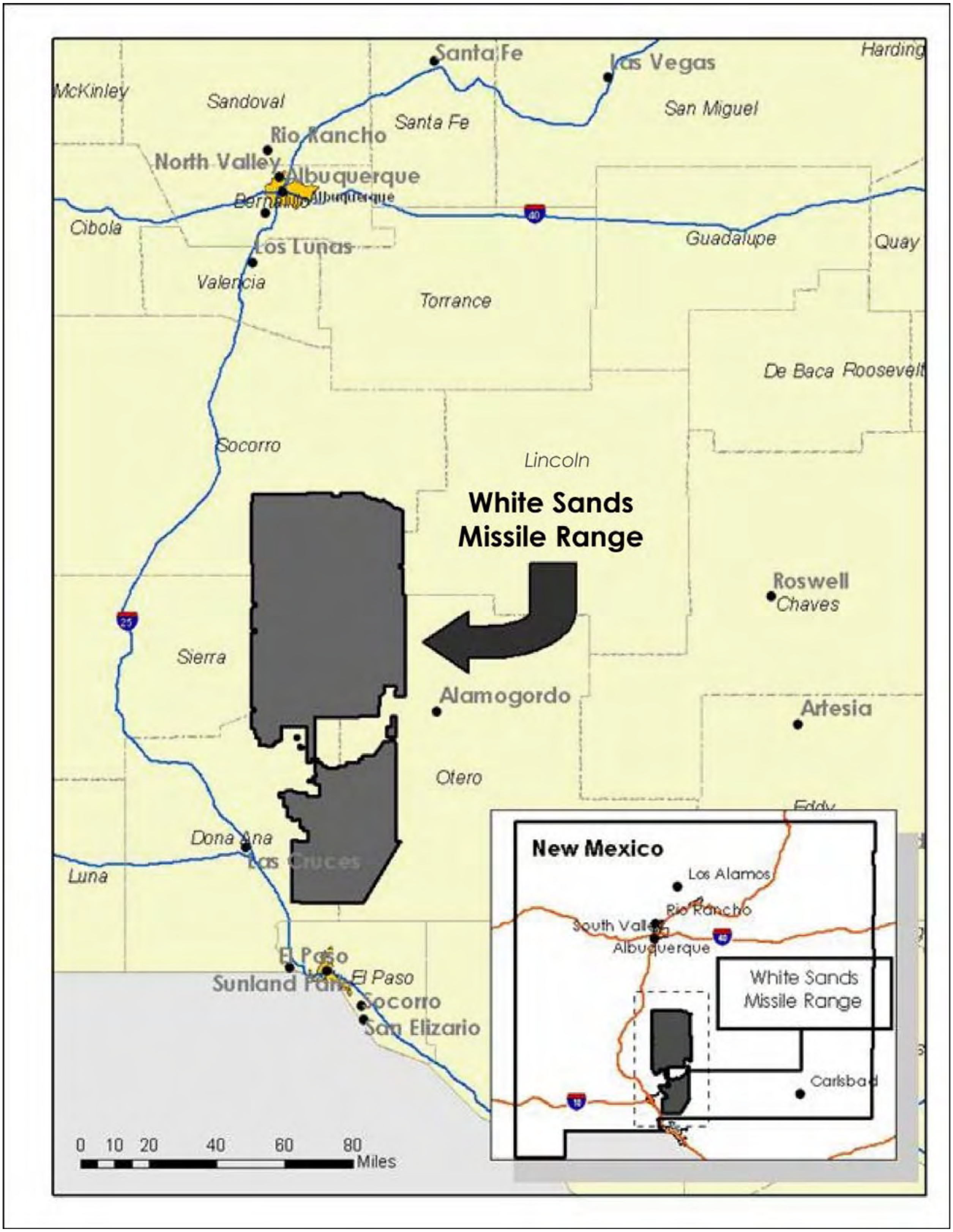
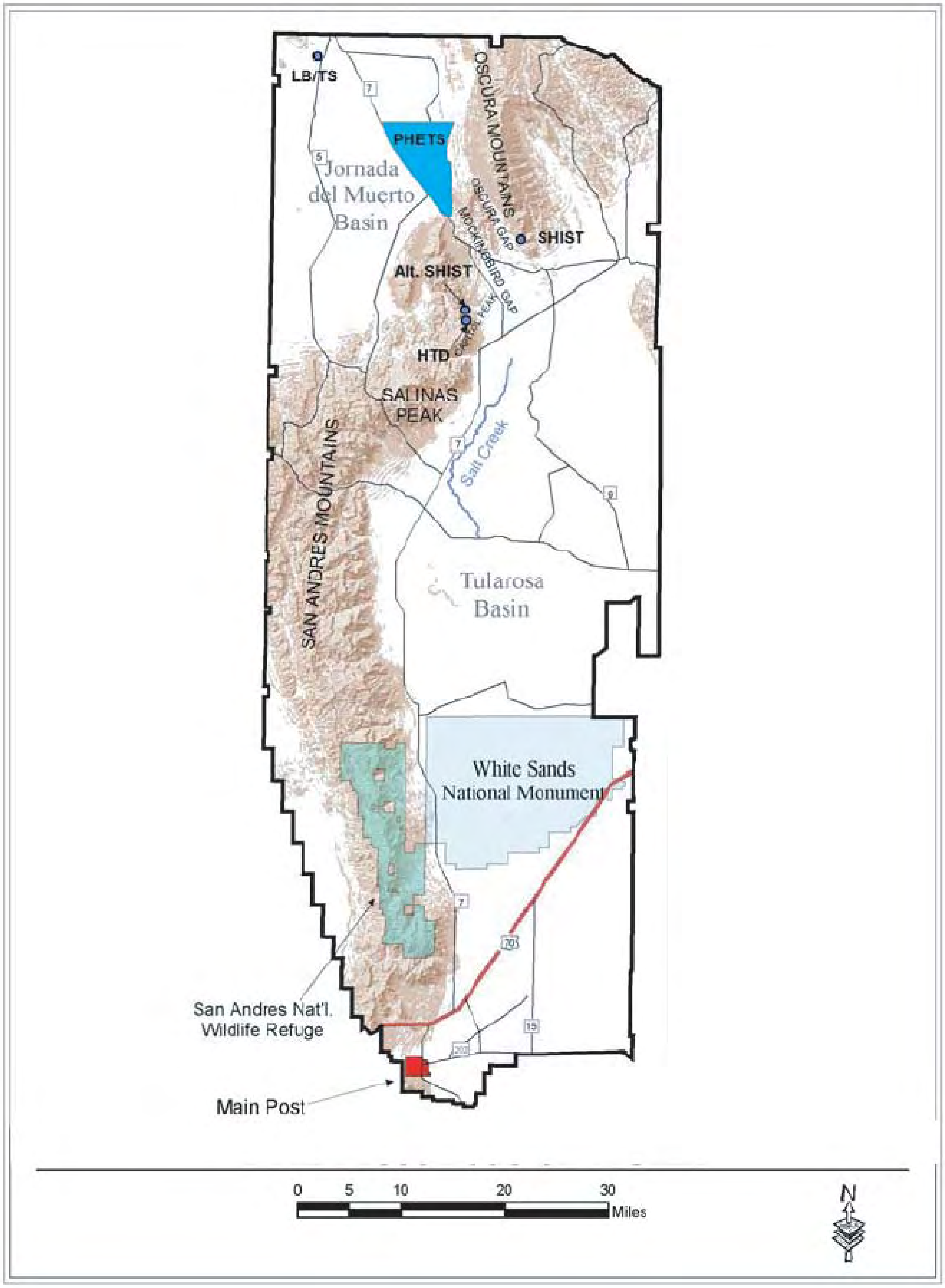


Figure 4.7.1-1—Map of White Sands Missile Range



Source: DTRA 2007.

Figure 4.7.1-1—Map of White Sands Missile Range showing Defense Threat Reduction Agency Test Beds

The Large Blast Thermal Simulator (LB/TS) is also located in the northern portion of the Jornada del Muerto Basin approximately 2.1 miles southwest of the Stallion Range Center, 12 miles northwest of PHETS, and 2.2 miles south of the nearest WSMR boundary. The site covers approximately 50 acres, with the nearest mountains approximately 17 miles to the east. LB/TS contains a large building complex and parking areas. LB/TS is an enclosed facility used to evaluate the survivability and vulnerability of full-scale military and other equipment subjected to the air blast and thermal conditions of an enemy's simulated nuclear explosion.

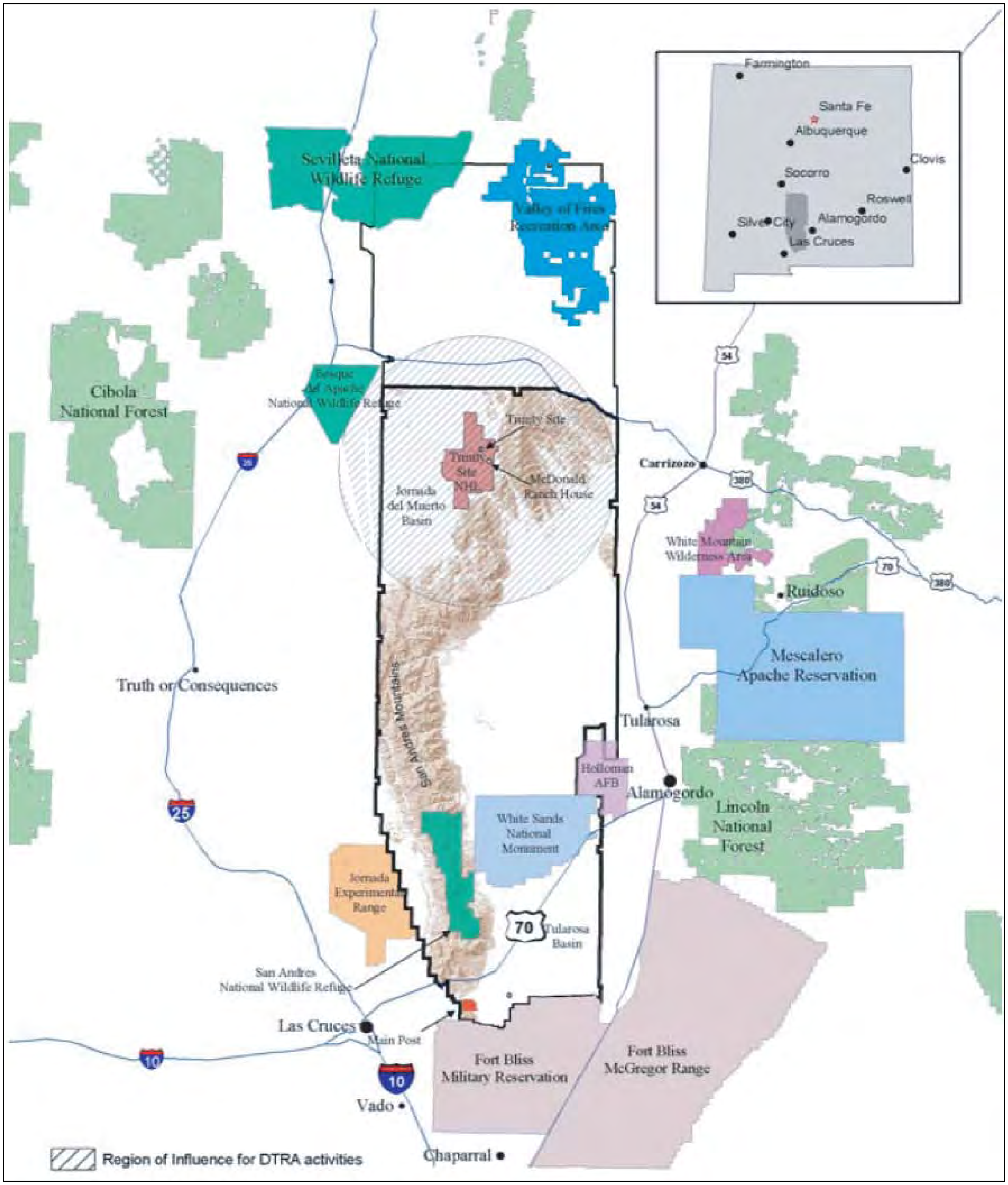
The Seismic Hardrock In Situ Test site (SHIST) site is located in Sierra County approximately 14 miles southeast of PHETS, and covers a 17 acre area. This site has been used in support of bedrock penetration testing. The Oscura Mountains and adjoining Chupadera Mesa cover the northeast corner of WSMR (Figure 4.7.1-1). The Chupadera Mesa extends beyond WSMR boundaries into the Northern Extension. (The Northern Extension is an area outside of WSMR boundaries that can be used for certain non-explosive testing activities under pre-existing agreements with the landowners.) SHIST is used principally for bedrock (e.g., granite, diabase, shale, or limestone) penetration tests using various warhead types.

4.7.1.2 *Surrounding Land Uses*

Figure 4.7.1-2 displays the surrounding land use in the vicinity of the WSMR. Bordering WSMR to the west is the Jornada Experimental Range (JER) and the Jornada Long Term Ecological Research Site operated by the U.S. Department of Agriculture (USDA). Bosque Del Apache National Wildlife Refuge is located near the northwest corner of WSMR and Sevilleta National Wildlife Refuge is located north of Socorro overlapping the North Extension Area.

The bulk of BLM lands adjacent to WSMR come under the jurisdiction of Las Cruces Field Office. Managed by the BLM, Aguirre Springs Recreation Area is located west of the Main Post on the eastern aspect of the Organ Mountains and Dripping Springs Preserve is located at the base of the Organ Mountains east of Las Cruces. Formerly part of the privately owned Cox Ranch, Dripping Springs is now a historical feature of the Organ Mountains Recreation Area. The Preserve abuts Fort Bliss lands on the east side of the Organ Mountains, but is little affected by the activities of WSMR despite its close proximity. Several private ranches and farms are also adjacent to or a short distance from WSMR.

The Valley of Fires Recreation Area, managed by the BLM Roswell Field Office, is located 3 miles from Carrizozo and contains one of the youngest lava fields in the continental U.S. (approximately 10,000 years old); these lava flows extend into the eastern part of the WSMR called the "Malpais". The Mescalero Apache Reservation encompasses parts of the Sacramento and White Mountains to the east of WSMR.



Source: DTRA 2007.

Figure 4.7.1-2—Land Use in the Vicinity of White Sands Missile Range

4.7.2 Visual Resources

Scenic desert landscapes with rugged topography are typical at WSMR. Also, high mountains with sheer rock faces contrast with broad, flat basins to create much visual appeal. Nearby White Sands National Monument is a beautiful expanse of white gypsum sand dunes whose sand supply is derived from Lake Lucero, a largely barren playa lakebed. However, most of the WSMR landscape is not readily viewable by the general public due to access restrictions.

PHETS is part of a larger area that has been used for high explosive tests, bombing, and missile impacts since the creation of WSMR in the 1940s. PHETS is located within the Jornada del Muerto Basin. It is a remote area with a stark and expansive landscape; viewed from the Jornada del Muerto Basin, the Oscura and San Andres Mountains create a scenic backdrop to the east.

PHETS is located within the boundaries of a 49,360 acre portion of WSMR designated as the Trinity Site National Historic Landmark (Trinity NHL). PHETS test beds and infrastructure can be seen from the Trinity NHL monument, which is open to visitors two days each year.

PHETS and the surrounding area have an overall disturbed appearance as a result of extensive historic use. Active disturbance at PHETS is limited to three primary test beds containing nonpermanent single and multiple story test structures, test support equipment, berms, and an established road network. Berms and other light-colored bare soil areas are visually prominent against a background of natural vegetation. An administrative complex is located at the intersection of Range Roads 7 and 20. Located near PHETS are several impact areas including Stallion WIT, 649 WIT, and the Northeast Center Impact Area. . Many test programs launch missiles from the southern portion of WSMR into these northern impact areas. As a result of continuous mechanical ground-clearing activities, the impact areas have a disturbed appearance.

SHIST (Seismic Hard rock In-Situ Source Test) and Alt. SHIST have been used for projectile penetration testing since the early 1990s. Earth-moving activities associated with projectile recovery have noticeably altered the appearance of the land surface. Fresh rock and bare soil areas contrast sharply with vegetated areas. Evidence of historic and on-going DoD activities is visible from access roads to both sites. The immediate area surrounding various test beds has been altered from historic use and contains support roads, target bunkers, and tunnels. The Hard Target Defeat (HTD) test beds are located in Capitol Peak area, a relatively remote mountain setting. The excavation of target tunnels and the resultant large spoil piles have altered the landscape. In addition, construction of a road network, several staging areas for equipment and temporary buildings have altered the appearance of the landscape. The lower part of Capitol Canyon can be partially seen from Range Road 7 about 5 miles distant.

However, other than the access road, there are no routinely utilized facilities from which the project area can be viewed. This site is beyond the visual range of visitors to WSMR. The LB/TS is a 50-acre complex located in a remote basin-floor desert-shrub land setting. The site includes a one-story reinforced-concrete administration and control building, several other large buildings related to facility operation, and a roughly 820 foot long semicircular shock tube surrounded by 8-foot earthen berms. The LB/TS can be glimpsed from Stallion Range Center and Range

Road 7, both about 2.1 miles distant. A 7-foot chain link security fence encloses the large building complex and parking areas.

Although there are no BLM Visual Resource Contrast ratings for WSMR, undeveloped lands within WSMR generally meet the characteristics of Classes II and III, which are described in Table 4.7.2-1.

Table 4.7.2-1—BLM Visual Resource Management Rating System

Class	Objective
Class I	To preserve the existing character of the landscape, the level of change to the characteristic landscape should be very low and must not attract attention.
Class II	To retain the existing character of the landscape, the level of change to the characteristic landscape should be low.
Class III	To partially retain the existing character of the landscape, the level of change to the characteristic landscape should be moderate.
Class IV	To provide for management activities which require major modification of the existing character of the landscape, the level of change to the characteristic landscape can be high.

Source: BLM 1980.

4.7.3 Site Infrastructure

Electricity is provided to WSMR from several commercial sources, with El Paso Electric Company supplying 92 percent of the 92,121 MWh consumed during the 1999 fiscal year. The local power grid connects many frequently used sites across WSMR. Approximately 300 portable diesel generators, with an output from 10-700 kVA, are provided by WSMR to supply power at remote sites. The Information Operation Directorate is responsible for communication support to WSMR, including distribution, maintenance, and scheduling. Off-range telephone services are provided by Qwest Communications. Cellular phones and/or radios are required for personnel traveling north of U.S. Highway 70 on WSMR (DTRA 2007).

The PHETS Administrative Park is served for electricity, water, and heating; LB/TS, SHIST, Alt. SHIST, and HTD are not. Water for PHETS is obtained from the Stallion Range Center water system and delivered to a storage tank at the Administrative Park via tank truck. Many of the bunkers and support buildings on the PHETS test beds are hardwired for power. Heating is provided through refillable propane tanks (DTRA 2007).

4.7.4 Air Quality and Noise

4.7.4.1 *Air Quality*

4.7.4.1.1 Meteorology and Climatology

The climate at WSMR is a hot summer and mild fall, winter, and spring. WSMR temperatures are generally mild and influenced by elevation (U.S. Army 2002a). The warmest WSMR temperatures are reached in July and average highs are about 93°F. The lowest temperatures are reached in January and average low temperatures in January range from 21-34°F. Summertime temperatures often exceed 100ºF and wintertime nighttime temperatures often drop below freezing. Mean annual temperature at the WSMR Main Post (elevation 4,250 feet) was reported as 62°F (U.S. Army 2002a). Higher elevations are typically cooler on average. In general, temperature drops about 5°F for every 1,000 foot rise in elevation (Dick-Peddie 1993). Average temperatures recorded at two WSMR surface meteorological stations (the Surface Atmosphere Measuring System) during July 2000 illustrate the effect of elevation on temperature. The average July temperature at an elevation of 4,005 feet was 83°F, with a maximum of 104°F; whereas during the same timeframe the average temperature at Salinas Peak, at an elevation of 8,941 feet, was 64°F, with a maximum of 81°F (U.S. Army 2002a).

Approximately 60 percent of the total annual rainfall occurs during the summer "monsoon" season, and most of the remaining portion during the winter and spring months. Mean annual precipitation in the basins is less than 10 inches, increasing to approximately 16 inches at higher mountain elevations (U.S. Army 2002a). Strong westerly winds frequently occur from late February through early May, and these inhibit movement into the area of precipitation from the Gulf of Mexico. The spring winds sometimes raise large amounts of dust and sand from the soil surface in areas with sparse vegetation, causing occasional severe dust storms. Dust storms occur most frequently in March and April, and more rarely in other months (Eschrich 1992). During the year, the prevailing wind direction varies from north to south to west. From June to October the prevailing winds are usually from the south, but they can vary and be from the north or the west (U.S. Army 2002a).

4.7.4.1.2 Ambient Air Quality

The location and topography of WSMR generally promote conditions that do not concentrate manmade pollutants. The natural setting of the range, however, is conducive to generation of airborne dust during high winds. The NMED and the U.S. EPA through Air Quality Control Regions (AQCR) regulate air quality of New Mexico. WSMR is situated mostly within AQCR 153, although the northern end (Socorro County) is in AQCR 156. Pollutants that are monitored using the AQCR include carbon monoxide, ozone, nitrogen dioxide, sulfur dioxide, respirable particulate matter, and lead. WSMR is located in areas that are considered to be in attainment of NAAQS (WSMR 2001). Equipment covered by this section includes certain listed stationary sources that emit more than 100 tons per year of any regulated pollutant, or other stationary sources that emit more than 250 tons per year.

Nonradiological Air Emissions

Airborne dust is a persistent problem throughout WSMR, including the DTRA test beds. Strong westerly winds are typical in the spring (March through early May) producing dust storms prior to the onset of the rainy season. Intact soils and vegetation generally promote better air quality; however, if vegetation is removed and soil exposed, wind erosion often leads to substantial amounts of airborne dust. Likewise, the arid to semiarid climate in the region results in less plant cover and thus tends to exacerbate wind erosion and dust generation.

Manmade pollution sources occur throughout WSMR but are mainly concentrated in the Main Post region where activity levels are highest. The main continuous source of manmade air pollution on WSMR is from vehicle emissions, including automobiles, missiles, aircraft, and ground targets. Dust generated from vehicular traffic on dirt and gravel roads is a common problem everywhere on WSMR. Specific to the north part of the range, a concrete batch plant and a propane boiler at PHETS generate airborne particulate matter and hydrocarbon emissions that require permitting under Title V of the *Clean Air Act*. The concrete batch plant and the propane boiler are included in the WSMR Title V air quality permit (DTRA 2007).

Radiological Air Emissions

High voltage radar equipment is a common source of x-rays on WSMR but proper shielding reduces this hazard to all site personnel. Trinity Site, the location of the first atomic bomb detonation in 1945, is within PHETS and continues to produce low levels of ionizing radiation (approximately 0.5 millirem during a one-hour visit). Non-ionizing radiation refers to lower energy electromagnetic radiation, mostly in microwave and thermal wavelengths. Potential sources of non-ionizing radiation include lasers and radars. Lasers emit high-intensity light and are used for tracking and sighting purposes. Radar units produce microwave (heat) radiation in addition to x-ray (ionizing) radiation. The regulatory limit for hazardous human exposure is expressed by power density (mW/cm2). It can be as low as 1 mW per centimeters squared or as high as 10 mW per centimeters squared, depending on the frequency. Sources of ionizing radiation previously used in program activities include instrumentation fielded for large-scale explosive testing and the testing of chemical agent detectors. Sources of non-ionizing radiation previously used by DTRA activities include laser guidance and tracking systems, radar guidance and tracking systems, site illumination, communication, and electro-optical countermeasures.

Radiation safety issues are the responsibility of the WSMR Environment and Safety Directorate, Radiation Protection Division, which ensures compliance with rules and regulations outlined by the U.S. Nuclear Regulatory Commission and Army Regulation 11-9 (1999). These regulations focus on establishing policies and procedures for the use, licensing, disposal, transportation, safety design, and inventory control of ionizing and non-ionizing radiation sources. Radiation exposure standards, dosimetry (measurements of radiation doses) and accident reporting instructions are also addressed. For a more detailed description of radiation sources on WSMR refer to the WSMR RW-EIS (DTRA 2007).

4.7.4.2 *Noise*

Major sources of noise at WSMR include missile launches, sonic booms, ordnance explosions, low-altitude military jet traffic, aircraft drone overflights, gunfire, military helicopters, and general vehicle traffic. Typical noise sources for DTRA activities include background noises from vehicles, aircrafts, and other equipment. Intermittent noises from weapons tests include high explosive discharges, bomb impacts, and various munitions delivery systems (DTRA 2007).

Traffic along established roads and other human activity add to background noise levels in accessible areas of WSMR. The average automobile traveling at 30-60 miles per hour produces 60-75 dBA at a distance of 50 feet, which is considered representative of vehicle-generated noise throughout the area (DTRA 2007).

4.7.5 Water Resources

Three regional watersheds are located within WSMR boundaries: the Jornada del Muerto, Tularosa Valley, and Jornada Draw basins. All three watersheds are closed basins. (Closed basins have no drainage outlet for surface water flow, and essentially all surface water is lost to evaporation.) The Jornada del Muerto Basin is located in the northwest portion of WSMR, and drains a 1,893 square mile area, almost half of which is located within WSMR. The highest elevation points and headwaters of this basin system include portions of the San Andres Mountains, Mockingbird Mountains, Little Burro Mountains, Oscura Mountains, and Chupadera Mesa (WSMR 2001). The Tularosa Valley watershed (basin) drains most of the WSMR land area (6,604 square miles). More than a third of the Tularosa Valley basin is located within the boundary of WSMR.

The highest topographic relief of this watershed includes portions of the San Andres and Sacramento mountains. Water from the mountain front recharges the basin ground water, which is then lost to evaporation at Lake Lucero, the lowest portion of this closed basin system (WSMR 2001). Only a narrow portion of the Jornada Draw watershed is located within WSMR. It drains 1,268 square miles, and the San Andres Mountains form the highest elevation within this basin (WSMR 2001).

4.7.5.1 *Surface Water*

Surface water resources within WSMR are limited due to low rainfall, high evaporation rates (due to high temperature and low humidity), and high soil infiltration properties. Most streams, lakes, and rainwater catchments are ephemeral (not permanent) and are dependent on runoff from relatively infrequent precipitation events typical of the region. Surface water generally occurs as overland flow from occasional intense thunderstorms during summer, accumulating in natural or manmade depressions. The gently sloping topography and the tendency for water to evaporate quickly and rapidly percolate into underlying sandy alluvium promote relatively low runoff amounts at PHETS and LB/TS. Test beds in the more mountainous locations (SHIST, Alt. SHIST, and HTD) experience greater surface flow during the more intense precipitation events. Surface water resources within WSMR are limited and water quality ranges from fresh to brine. Surface water quality is variable and is measured as the concentration of dissolved minerals in the water, termed total dissolved solids (TDS).

4.7.5.1.1 Surface Water Quality

Surface water quality in ephemeral water bodies ranges from fresh to brine, and can become more highly concentrated with TDS over time due to evaporation. The northern Jornada del Muerto Basin has poorly defined and integrated surface water drainage, except within bedrock outcrops along the basin margins where water flows toward the basin center (Weir 1965). Surface flow within this watershed is intermittent and depends on precipitation levels. Weir (1965) conducted the most comprehensive evaluation of water sources in the Jornada del Muerto Basin but no perennial springs or surface water sources were reported.

There are many ephemeral lakes (playas) in the Jornada del Muerto Basin, and these provide seasonal water sources for wildlife. The northern Tularosa Valley watershed has a better-integrated and defined drainage pattern than the Jornada del Muerto Basin (WSMR 2001). The majority of runoff from the San Andres Mountains drains into the Tularosa Basin through approximately 14 large canyons (Kottlowski et al., 1956). Streambeds in the mountains have a rectangular drainage pattern, with major canyons formed perpendicular and tributary canyons formed parallel to the strike of the beds of sedimentary rocks (Kottlowski et al., 1956).

Perennial surface water bodies on WSMR are essentially limited to the Tularosa Basin, and Salt Creek is the only major perennial stream. Salt Creek is located in the northwestern portion of the basin and flows from north to south. Stream flow measured (since 1995) at the USGS gauging station on Salt Creek, located at RR316, showed a monthly mean high of 2.7 cubic feet per second and a low of 0.67 cubic feet per second (USGS 2008a). Daily flows fluctuate relative to the precipitation received. The mean daily flows for the same period of record show highs of 13 cubic feet per second and lows of 0.25 cubic feet per second (USGS 2008a). The source of its water is brackish to saline shallow ground water flowing through the underlying alluvium. The stream flow eventually disappears into the ground or empties into the playas north of Lake Lucero.

Lake Lucero is located in the southwestern portion of the basin, and it contains saline to brine water most of the time. Flow rate depends on precipitation runoff events and can quickly change. Stream flow measured (since 1995) at the USGS gauging station on Salt Creek, located at RR 316, showed a high of 88 cubic feet per second and a low of zero (WSMR 2001). The water in Salt Creek has high concentrations of TDS and is classified as saline, and water quality has been shown to depend on location and flow rate at time of collection (WSMR 2001). There are several perennial ponds associated with Mound Springs and Malpais Spring, with Malpais Spring providing sufficient water to form a wetland. Several earthen water catchments, probably abandoned ranching-era stock tanks, are found at PHETS. Storm water runoff from PHETS drains westward across a broad alluvial plain and into ephemeral playa lakes in the central part of the Jornada del Muerto Basin.

Perennial and ephemeral seeps and springs occur throughout the San Andres and Oscura mountains. Capitol Peak and Alt. SHIST sites are located in the San Andres Mountains, and SHIST site is located approximately 4.7 miles to the northeast in the Oscura Mountains. The closest major spring to Capitol Peak and Alt. SHIST is Russell Spring, which is located approximately 3.7 miles to the south-southwest in Thrugood Canyon south of Capitol Peak. Wildlife watering units, which are mostly former ranch stock tanks, also periodically hold water. The watering unit at the old Burris Ranch in Burris Valley is located approximately 1.5 miles west of both Capitol Canyon and Alt. SHIST sites. The closest major spring to SHIST site is Kidd and Duffy Spring, located about 3 miles to the north-northeast of the test bed. Unlike for the springs in the Tularosa Basin that are potential habitat for the White Sands pupfish, there are little data available on the water quality of mountain springs (WSMR 2001). All three sites drain toward the Tularosa Basin.

4.7.5.2 *Groundwater*

Groundwater on WSMR can occur in all lithologic units, ranging from Precambrian to Quaternary in age. Large amounts of water are contained in the Tertiary to Quaternary unconsolidated basin-fill and alluvial deposits in the Tularosa and Jornada del Muerto basins; these locally yield large amounts of water to wells and springs (Roybal 1991). However, most of this water contains high concentrations of TDS and is of poor quality (Orr and Myers 1986, Roybal 1991, Weir 1965). Rocks of Permian and Cretaceous ages yield small to moderate amounts of water from joints and fractures in a few localities (Weir 1965).

4.7.5.2.1 Groundwater Quality

The chemical quality of groundwater in the northern part of WSMR is mostly poor because of the high concentrations of TDS, particularly sulfate, chloride, and sometimes nitrate (Weir 1965). Small amounts of water of good to fair quality are present in wells and springs at a handful of localities (Weir 1965); and ground water containing less than 1,000 milligrams per liter TDS has been reported at points of recharge high in alluvial fans next to the mountain fronts (WSMR 2001). However, TDS concentrations in most WSMR groundwater exceeds 1,000 milligrams per liter; more than 85 percent of ground water in the Tularosa Basin may contain TDS exceeding 3,000 milligrams per liter (Orr and Myers 1986), and TDS concentrations as high as 177,000 milligrams per liter have been reported (WSMR 2001).

Groundwater monitoring wells were drilled at PHETS in 2000 and 2001 to evaluate possible testing-related cumulative impacts (U.S. Army 2002a). Chemical quality data reported in the literature for water from historic wells (Roybal 1991, Weir 1965) indicated that ground water throughout PHETS is non-potable and brackish (1,000-10,000 milligrams per liter TDS). The Federal government regulates TDS concentrations in drinking water, and the secondary MCL for TDS in drinking water is 500 milligrams per liter (EPA 1986). Chemical quality data from historic wells in the area show that TDS concentrations, e.g. 3,310; 3,520; and 3,700 milligrams per liter (Weir 1965, Roybal 1991) exceeded the Federal drinking water standard. In addition, sulfate concentrations in water from these wells ranged from approximately 2,200 to 2,500 milligrams per liter. These concentrations were far higher than the 250 milligrams per liter allowed by Federal drinking water regulations (EPA 1986). In addition to TDS, high concentrations of sulfate make groundwater in the region non-potable. The high concentration of dissolved solids and sulfate in the groundwater in this region are a result of naturally occurring minerals that exist in the subsurface.

Non-potable water for construction, project activities, or personnel use is trucked in from outside sources, usually from wells at Stallion Range Center. Potable water for DTRA and other actions occurring in the area would come from the desalinization plant at Stallion Range Center. Sulfate, nitrate, and TDS content closely match historic well data for the area (Weir 1965, Roybal 1991). The chemical simulant triethyl phosphate (TEP) used in previous collateral damage tests (U.S. Army 2002b) was not detected in any of the samples. In addition, annual sampling and analysis of ground water at this test bed is planned to detect adverse trends in ground water quality (U.S. Army 2002b).

4.7.5.2.2 Groundwater Availability

The major source of recharge to the groundwater system occurs in areas adjacent to the mountain ranges. Runoff resulting from snowmelt or rainfall on relatively impermeable mountainous watersheds infiltrates the relatively permeable alluvial basin-fill deposits and recharges the groundwater system (Roybal 1991). Any discharge from the groundwater system occurs from evaporation, evapotranspiration, wells, springs, seeps, and Salt Creek (WSMR 2001). The sediments in the Tularosa and Jornada del Muerto basins contain large amounts of water; however, almost all of this water is highly saline and poor quality.

Groundwater at SHIST site is transitory and effectively limited by the shallow bedrock contact in the area. Alluvial cover within the SHIST boundaries reaches approximately 49 feet. Groundwater is expected to accumulate in the alluvium atop the bedrock following significant rainfall events but does not persist for long. In this area any subsurface water would flow southeastward into the Tularosa Basin (Weir 1965). The Mockingbird Gap well is nearest to SHIST, with a reported depth to water of 75 feet (Weir 1965). Alt. SHIST, located in the foothills north of Capitol Peak, is situated on granite bedrock covered by a veneer of alluvium in places. There are seismic boreholes drilled for past tests, but no water wells in the immediate vicinity. Burris Well, located approximately 1 mile west of Alt. SHIST, was drilled in valley-fill alluvium and has a reported water table depth of 36 feet and dissolved solids concentration of 1,290 milligrams per liter (Weir 1965). In the HTD test bed area, depth to water from wells in the region, within approximately 9 miles, ranges from 20-138 feet. Any subsurface water would drain towards the Tularosa Basin.

4.7.6 Geology and Soils

4.7.6.1 *Geology*

Geology and soil resources vary considerably on WSMR. The Jornada del Muerto Basin was formed by a syncline (a down-warped region of the earth's crust) and subsequently filled by a thick sequence of Santa Fe Group (Tertiary-Quaternary) and Late Quaternary sediments. These deposits were formed by a combination of geologic processes: alluvial (by moving water), lacustrine (in lakes), and eolian (wind-generated). The materials are comprised of interbedded sands, silts, and clays. In addition, alluvial fan deposits slope westward from the nearby Mockingbird Gap Hills and Oscura Mountains and taper into the basin. Throughout much of the basin there are low-lying dunes and sheet deposits of gypsum and quartz sands that were formed by wind activity in the Late Holocene. Evidence of playas and lake plains (vegetated former lake bed surfaces [Peterson 1981]), consisting of mostly silt deposits, is also visible in the basin.

The San Andres is a fault-block mountain range dissected by numerous north-south-trending faults throughout the area. Rocks in this region range from Precambrian granite to Permian-Pennsylvanian Panther Seep Formation (DTRA 2007). Quaternary alluvium occurs in the bottoms of canyons and valleys between bedrock outcrops. The upper boundary of the HTD test beds on the flanks of Capitol Peak occurs at the contact between granite and a sequence of generally darker, cliff forming Paleozoic rocks (DTRA 2007). The west side of Capitol Canyon consists of a section of Pennsylvanian Lead Camp Limestone. These rocks form massive cliffs and contain beds of chert and shale. Capitol Peak (and the HTD test beds) lies within the Salinas Peak mining district and contains scattered small mineral deposits. A shallow pit near Capitol Peak had low assays reported (DTRA 2007).

4.7.6.2 *Soils*

The soils from the middle to the western edge of the Jornada del Muerto Basin are mapped as Onite-Bluepoint-Wink and Yesum-Holloman associations (DTRA 2007). These soils are highly susceptible to erosion when subjected to disturbances. Coarser alluvial sediments make up the Marcial-Ubar, Berino-Doña Ana, and Nickel-Tencee associations (DTRA 2007), which occur closer to the San Andres and Oscura mountains.

The Nickel-Tencee soil association occurs extensively throughout the eastern margins of PHETS, mainly on alluvial fans derived from the nearby mountains (DTRA 2007). Soils within this association include gravelly fine sandy loam (Nickel) and very gravelly loam (Tencee). West of the Nickel-Tencee occurrence, the Berino-Dona Ana association (mostly sandy loams) is perhaps the most extensive soil-mapping unit within PHETS. Other soil-mapping units occurring at PHETS are Yesum-Holloman association, Lozier- Rock outcrop complex, and Gilland-Rock outcrop complex (DTRA 2007).

4.7.6.3 *Seismicity*

WSMR is located in the Rio Grande Rift, a region characterized by active movement along faults and earthquakes. Faulting and associated earthquakes continue today as the Rio Grande Rift continues to widen. In the WSMR area, expansion along the rift has resulted in major faults located at the eastern and western boundaries of the Tularosa Basin. Three of these major fault zones occur partly within WSMR boundaries (DTRA 2007).

Only two earthquakes greater than an intensity of III (on the Modified Mercalli Intensity Scale) have occurred within the boundaries of WSMR since 1869. Although only minor earthquakes have occurred within WSMR boundaries during historical times, based on the geological and seismological history of the area the possibility of a major earthquake exists (DTRA 2007).

In 2000 an analysis was conducted of the long history of recurrent movements along the major Quaternary (1.8 million years ago to present) faults that comprise the western Tularosa fault system. It was estimated that a major surface-rupturing earthquake ($M>6.5$), caused by reactivation of pre-existing faults, could affect WSMR about once every 2,000-4,000 years. However, because most Quaternary faults in the rift have long recurrence intervals (>50,000 to 250,000 years) and low movement rates, the risk of a major earthquake on WSMR is low. This is consistent with occurrence of primarily low- to moderate- magnitude ($M<6$) earthquakes that have been recorded or felt historically in New Mexico (DTRA 2007).

Although only minor earthquakes have occurred within WSMR boundaries during historical times, based on the geological and seismological history of the area the possibility of a major earthquake exists (DTRA 2007). Figure 4.7.6-1 displays a tectonic map of Southern New Mexico and Texas.

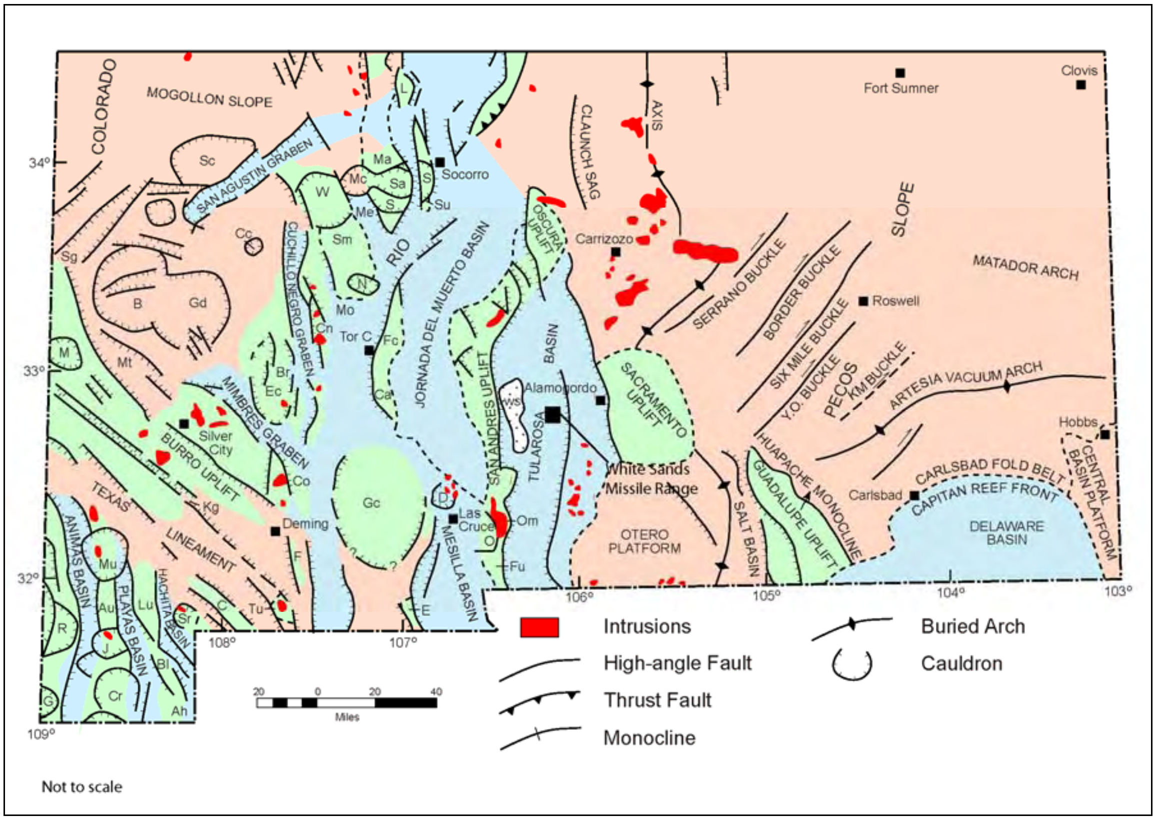


Figure 4.7.6-1—Tectonic Map of Southern New Mexico and Texas

4.7.7 Biological Resources

4.7.7.1 *Terrestrial Resources*

Variations in elevation and topography control much of the broad distribution of vegetation types on WSMR. Generally, increasing elevation equates to an increase in moisture availability and a decrease in temperature, which in turn influence the type of vegetation occurring in a given area. The lowland areas of the Tularosa and Jornada del Muerto basins have lower moisture availability, resulting in lowland scrublands and grasslands. Woodlands and coniferous forests occur in the higher elevations of the San Andres and Oscura mountains due to higher moisture availability. Figure 4.7.7-1 displays major vegetation types found on WSMR.

Seventy mammal species have been documented on WSMR (DTRA 2007). Large herbivores commonly found on WSMR include mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), and oryx (*Oryx gazella*). Predator species commonly found on WSMR include coyotes (*Canis latrans*), bobcats (*Lynx rufus*), mountain lions (*Felis concolor*) and badgers (*Taxidea taxus*). Small mammals occurring on WSMR include black-tailed jackrabbits (*Lepus californicus*), desert cottontails (*Sylvilagus auduboni*), and desert shrews (*Notiosorex crawfordi*). Rodents make up the most diverse order of mammals occurring on WSMR, consisting of five families: Sciuridae, Geomyidae, Heteromyidae, Muridae, and Erethizontidae (WSMR 2001).

Habitats within WSMR support nearly 300 documented avian species, many of which are seasonal or year-round residents (WSMR 2001). WSMR has resident populations of raptors, game birds, and songbirds. Raptor species common on WSMR include red-tailed hawks (*Buteo jamaicensis*), northern harriers (*Circus cyaneus*), and prairie falcons (*Falco mexicanus*). Game birds found on WSMR include Gambel's quail (*Callipepla gambellii*), scaled quail (*Callipepla squamata*), white-winged dove (*Zenaida asiatica*) and mourning dove (*Zenaida macroura*). Songbirds common to WSMR include American robins (*Turdus migratorius*), pyrrhuloxia (*Cardinalis sinuatus*), and horned larks (*Eremophila alpestris*).

WSMR has a wide assortment of reptiles mostly comprised of snake and lizard species. Three families of snakes are represented on the range: Leptotyphlopidae (blind snakes), Colubridae, and Viperidae (vipers). Two species of turtles, ornate box turtles (*Terrepene ornata*) and yellow mud turtles (*Kinosternon flavenscens*), also inhabit the range. Amphibian species are less abundant than reptiles. More common amphibian species include four species of Bufonidae (true toads) and three species of spade foot toads (Pelobatidae). One species of salamander, the tiger salamander (*Ambystoma tigrinum*), occurs on WSMR. This species can occur wherever suitable habitat, such as temporary rain pools and stock ponds, are available.

Common orders of insects found on WSMR include Coleoptera (beetles), Hemiptera (true bugs), Hymenoptera (ants, bees, and wasps), Lepidoptera (butterflies and moths), and Diptera (flies). Other common arthropod orders include Scholopenromorpha (centipedes), Pedipalpida (vinegaroons), Scorpionida (scorpions), and Araneida (spiders). Twenty- three species of land snails have been identified on WSMR, many of which occur in the San Andres Mountains (DRTA 2007).

4.7.7.2 *Floodplains and Wetlands*

4.7.7.2.1 Wetlands

Perennial surface water bodies on WSMR are essentially limited to the Tularosa Basin and Salt Creek is the only major perennial stream. Salt Creek is located in the northwestern portion of the basin and flows from north to south (Figure 4.7.7-2). The source of its water is brackish to saline shallow ground water flowing through the underlying alluvium.

The stream flow eventually disappears into the ground or empties into the playas north of Lake Lucero. Lake Lucero is located in the southwestern portion of the basin, and it contains saline to brine water most of the time. Flow rate depends on precipitation runoff events and can quickly change. Stream flow measured (since 1995) at the USGS gauging station on Salt Creek, located at RR 316, showed a high of 2,492 liters per second (88 cubic feet per second) and a low of zero (WSMR 2001). The water in Salt Creek has high concentrations of TDS and is classified as saline, and water quality has been shown to depend on location and flow rate at time of collection (WSMR 2001). There are several perennial ponds associated with Mound Springs and Malpais Spring (Figure 4.7.7-2), with Malpais Spring providing sufficient water to form a wetland.

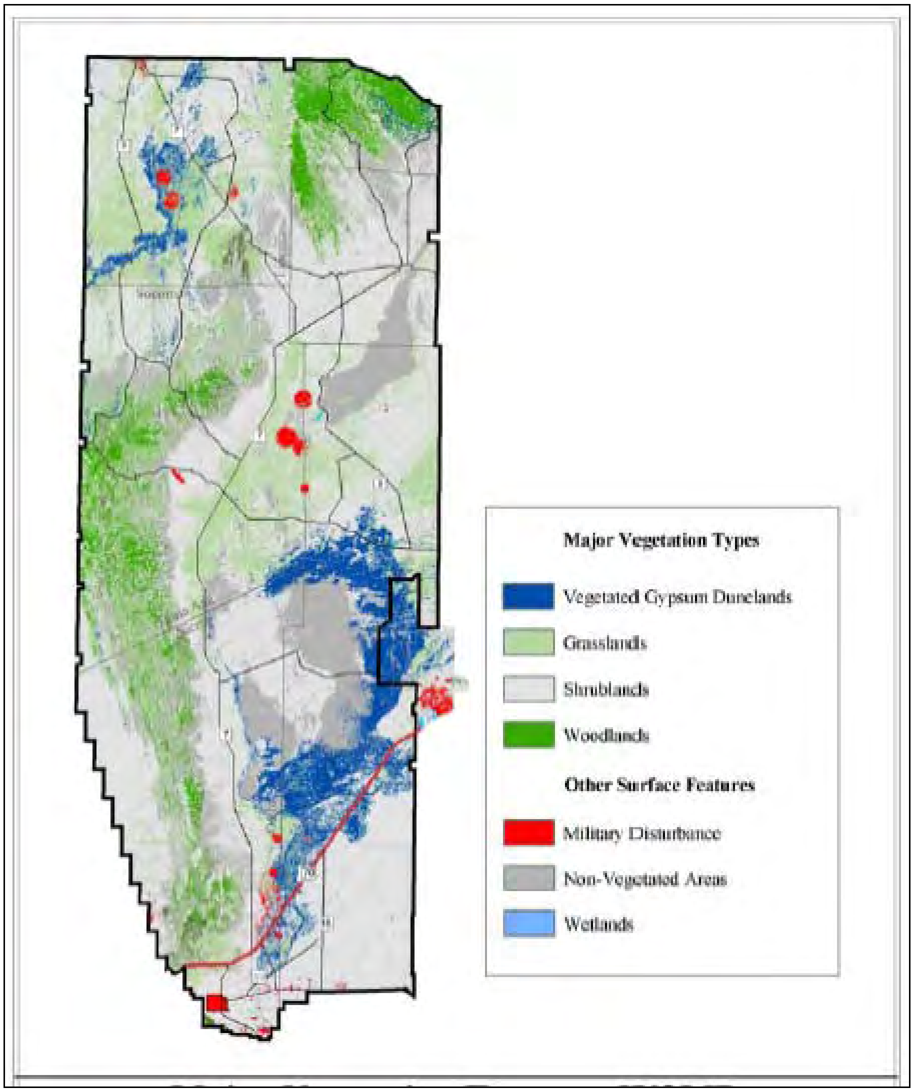


Figure 4.7.7-1—Major Vegetation Types on White Sands Missile Range

4.7.7.3 *Aquatic Resources*

There are no federally-designated Wild and Scenic Rivers onsite. The only fish species native to WSMR is the White Sands pupfish (*Cyprinidon tularosa*). This small fish is endemic to the Tularosa Basin, occurring in four separate habitats: Salt Creek, Malpais Spring, Mound Spring, and Lost River (Pittenger and Springer 1999). Within its limited habitat, populations are often dense, but their numbers can experience wide fluctuations due to natural climatic perturbations such as flood or drought. The White Sands pupfish is omnivorous, feeding mainly on aquatic insects and larvae, algae, and organic detritus (Propst and Pittenger 1994). Other fish species such as largemouth bass (*Micropterus salmoides*), mosquitofish (*Gambusia affinis*), goldfish (*Carassius auratus*), and sunfish (*Lepomis* spp.) have been introduced into springs, ponds and tanks (WSMR 2001).

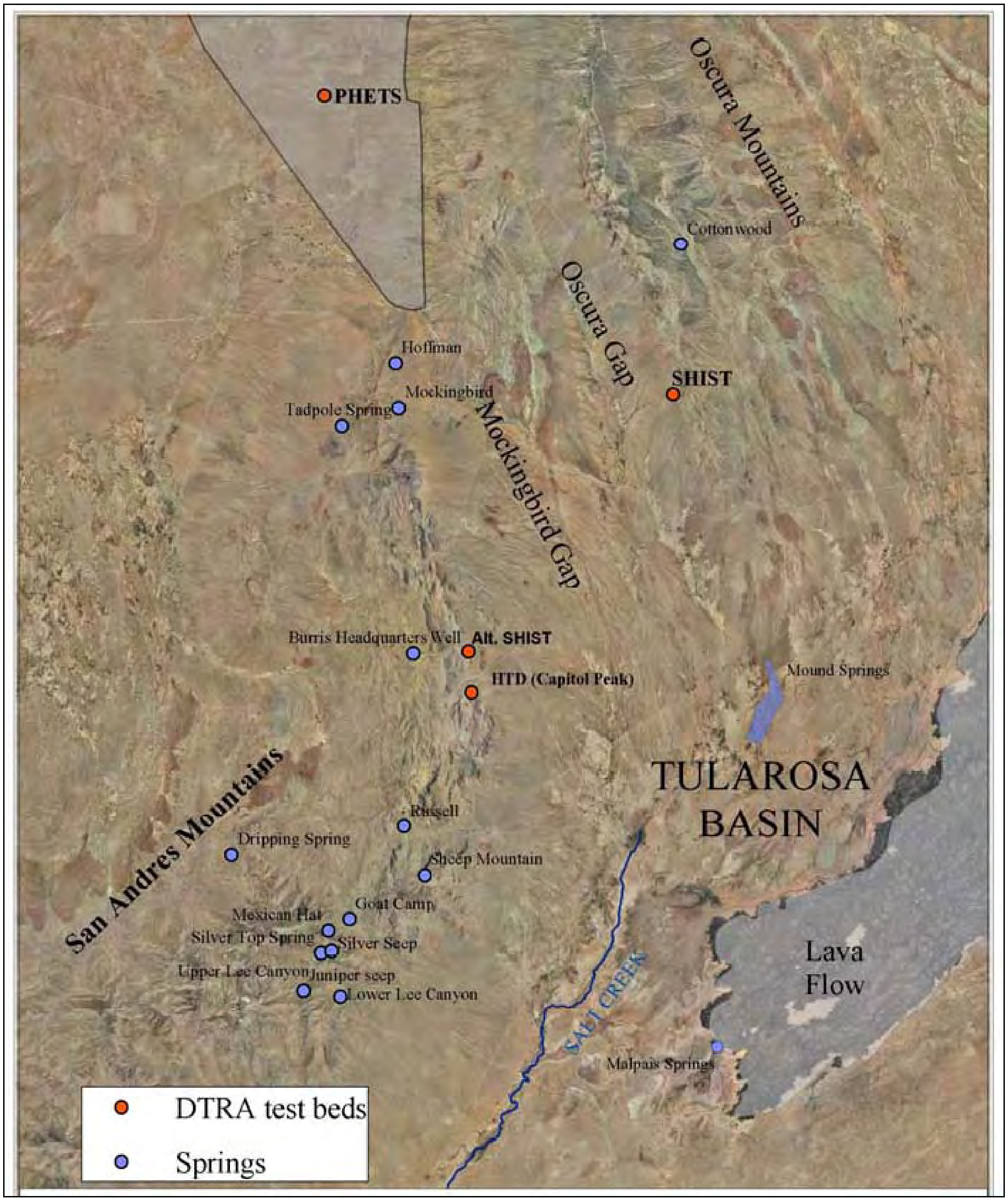


Figure 4.7.7-2—Springs Near Defense Threat Reduction Agency Test Beds on White Sands Missile Range

4.7.7.4 *Threatened, Endangered, or Sensitive Species*

Table 4.7.7-1 lists the species potentially occurring on WSMR which have Federal or State status.

Table 4.7.7-1—Federal and State Listed Species Potentially Occurring at WSMR

Species	Scientific Name	Federal Status	NM Status
American Peregrine Falcon	*Falco peregrinus anatum*		T
Northern aplomado Falcon	*Falco femoralis septentrionalis*	E	E
Baird's Sparrow	*Ammodramus bairdii*		T
Gray Vireo	*Vireo vicinior*		T
Lucifer Hummingbird	*Calothorax lucifer*		T
Violet-crowned Hummingbird	*Amazlia violiceps*		T
Desert Bighorn Sheep	*Ovis canadensis mexicano*		E
Oscura Mountains Chipmunk	*Tamias quadrivittatus oscuraensis*		T
Organ Mountain Colorado Chipmunk	*Tamias quadrivittatus australis*	SOC	T
Spotted Bat	*Euderma maculatum*		T
Todsen's pennyroyal	*Hedeoma todsenii*	E	E
Desert Night-blooming cereus	*Cereus greggii greggii*	SOC	E
Mescalero milkwort	*Polygala rimulicola mescalerorum*	SOC	E
Alamo beardtongue	*Penstemon alamosensis*	SOC	SOC
Organ Mountain evening primrose	*Oenothera organensis*	SOC	SOC
Mosquito plant	*Agastache cana*		NSOC
Cliff brittlebrush	*Apacheria chiricahuensis*		NSOC
Castetter's milkvetch	*Astragalus castetteri*		NSOC
Sandberg's pincushion cactus	*Escobaria sandbergii*		NSOC
Vasey's bitterweed	*Hymenoxys vaseyi*		NSOC
Lanceleaf beardtongue	*Penstemon ramosus*		NSOC
San Andres cross daisy	*Perityle staurophylla* var. *homoflora* and var. *staurophylla*		NSOC
Desert parsley	*Pseudocymopterus longiradiatus*		NSOC
Plank's catchfly	*Silene plankii*		NSOC
Claret cup cactus	*Echinocerrus triglochidiatus*		SOI
Tall prairie gentian	*Eustoma exaltatum*		SOI
Trans-Pecos sea lavender	*Limonium limbatum*		SOI
Club cholla	*Opuntia clavata*		SOI
Gramagrass cactus	*Pediocactus papyracanthus*		SOI
New Mexico scorpion weed	*Phacelia neomexicana*		SOI
Gypsumwort	*Pseudoclappia arenaria*		SOI
Hot Springs globemallow	*Sphaeralcea polychroma*		SOI

SOI: Species of Interest
SOC: Species of Concern
NSOC: Nominated as SOC
T: Threatened
E: Endangered
Source: DTRA 2007.

The desert bighorn sheep (*Ovis canadensis mexicano),* an endangered species for the State of New Mexico, is confined to steep and inaccessible areas of the San Andres Mountains.

The Oscura Mountains chipmunk, listed as threatened by the State, only occurs in the Oscura Mountains. Once considered a population of the Organ Mountains Colorado chipmunk, it has recently been described as a separate subspecies. Both subspecies are considered Threatened by the State of New Mexico (DTRA 2007).

The spotted bat is listed as threatened by the State of New Mexico and is considered a "probable species" on WSMR (DTRA 2007). Spotted bats have been observed in a variety of habitats, from riparian and pinyon-juniper woodlands to ponderosa pine and spruce-fir forests (DTRA 2007). In New Mexico, the species has been collected from the lower Rio Grande Valley near Las Cruces (elevation 3,936 feet) to near the peak of Mt. Taylor (elevation 10,594 feet), but most records are in or near wooded areas. This species prefers to roost in rock crevices in cliff faces (DTRA 2007).

T&E bird species that have been documented on WSMR include the northern aplomado falcon (*Falco femoralis septentrionalis*), American peregrine falcon (*Falco peregrinus anatu*m) and Baird's sparrow (*Ammodramus bairdii*). The northern aplomado falcon, an endangered species on Federal and State lists, is found in grasslands and shrublands at lower elevations from approximately 2,800-5,500 feet (DTRA 2007). Potential habitat for the aplomado falcon is shown in. This falcon prefers open terrain with scattered trees and low ground cover with a good supply of suitable nesting platforms, particularly mesquite and yuccas. WSMR represents the northern boundary of the historical range of the aplomado falcon. White Sands Environment and Safety Directorate and USFWS have classified two regions on WSMR as potentially suitable aplomado falcon habitat (WSMR 1997). These are limited to desert grasslands in the lower Three Rivers drainage, and in the Jornada del Muerto basin (WSMR 1997). A single transient aplomado falcon was sighted on WSMR at Rita Site and Black Site on 2 separate occasions in 1991 and 1992 (DTRA 2007).

The American peregrine falcon is listed as threatened by the State. This species breeds in mountainous areas and, in New Mexico, occurs mainly west of the eastern plains in migration. The peregrine falcon occurs on WSMR, mainly in the breeding months (March-August). These falcons have not been found to breed on WSMR, but transient individuals have been seen on WSMR at two locations: in 1995, in the mouth of Texas Canyon in the Organ Mountains; and in 1994 about 1.3 miles north of Malpais Springs on RR 9. There have also been several sightings on lands adjacent to WSMR (WSMR 2001). Baird's sparrow is listed as threatened by the State. In New Mexico, it has been found in a variety of habitats, ranging from desert grasslands in the south to prairies in the northeast, and in mountain meadows. This sparrow occurs in the eastern plains and southern lowlands during migration, mainly in autumn and is considered rare to uncommon (Hubbard 1978). Baird's sparrow occurs mainly in winter months (late October – February) at WSMR (DTRA 2007).

A total of 61 floral species having Federal or State status occur or potentially occur on WSMR. Most are restricted to mountainous habitat away from most WSMR testing activities. Todsen's pennyroyal (*Hedeoma todsenii*) is the only Federal endangered flora species documented on WSMR. Six populations have been found on high pinyon-juniper slopes on the western edge of the San Andres Mountains in the WSMR. These 2 parcels have been designated as critical habitat. There are 4 Federal listed floral species of concern occurring on WSMR, the desert night-blooming cereus (*Peniocereus greggii greggii*), Mescalero milkwort (*Polygala rimulicola mescalerorum*), Alamo beardtongue (*Penstemon alamosensis*), and Organ Mountain evening primrose (*Oenothera organensis*). Desert night-blooming cereus is widely distributed in gravelly soils of arroyos and lower piedmonts in the San Andres Mountains, while Mescalero milkwort and Alamo beardtongue are found at higher elevations on limestone slopes and cliffs. The Organ mountain evening primrose has been identified in riparian habitats only in the Organ Mountains.

There are 11 listed flora on WSMR that are nominated as species of concern (SOC) by the state of New Mexico. These species are mosquito plant (*Agastache cana*), cliff brittlebrush (*Apacheria chiricahuensis*), Castetter's milkvetch (*Astragalus castetteri*), Sandberg's pincushion cactus (*Escobaria sandbergii*), Vasey's bitterweed (*Hymenoxys vaseyi*), Organ Mountain evening primrose, Alamo beardtongue, lanceleaf beardtongue (*Penstemon ramosus*), San Andres cross daisy (*Perityle staurophylla* var. *homoflora* and var. *staurophylla*), desert parsley (*Pseudocymopterus longiradiatus*), and Plank's catchfly (*Silene plankii*). All of these species are found in mountainous habitat associated with canyons, woodlands, cliffs, boulders, and rocky outcrops.

In addition, 46 floral species have been designated by the White Sands Environment and Safety Directorate as WSMR species of interest (SOI). SOI species are plants that, while not afforded legal protection, White Sands Environment and Safety monitors for location and abundance based on four criteria including: 1) previous Federal or State listing; 2) rarity on WSMR; 3) species useful for land rehabilitation; and 4) species with spatially restricted habitat. The majority of WSMR SOI floral species occur in mountainous habitat on WSMR; only 8 SOI floral species occur on the basin floors. The eight SOIs occurring within the basins include claret cup cactus (*Echinocerrus triglochidiatus*); tall prairie gentian (*Eustoma exaltatum*); Trans-Pecos sea lavender (*Limonium limbatum*); club cholla (*Opuntia clavata*); gramagrass cactus (*Pediocactus papyracanthus);* New Mexico scorpion weed (*Phacelia neomexicana*); gypsumwort (*Pseudoclappia arenaria*); and Hot Springs globemallow (*Sphaeralcea polychroma*).

4.7.8 Cultural Resources

4.7.8.1 *Archaeological Resources*

Evidence in the material record suggests continued prehistoric human occupation of the WSMR region spanning approximately 11,000 years. As the environment gradually became drier and more extreme, humans inhabiting the area adapted by changing food procurement and living strategies.

According to the environmental assessment for LB/TS (McMullan and Gould 1988), 29 prehistoric archaeological sites were recorded in the Stallion area in a 1986 survey. Described as large areas with low artifact densities, no sites were located within the LB/TS project fence line. Within the Trinity NHL are two National Register-listed sites. Trinity Site was the test area for the first manmade nuclear detonation, and McDonald Ranch House is a historic homestead that was used to assemble the bomb which was used in the detonation.

Notable components include Ground Zero, the location of the first nuclear bomb detonation in 1945, the base camp that housed scientists and the support team, four instrumentation bunkers, three observation bunkers and the McDonald House. The site encompasses a total of approximately 36,413 acres. Over a dozen test-specific archaeological surveys have been conducted in the PHETS area. One hundred thirty-six archaeological sites have been recorded, both prehistoric and historic (U.S. Army 2002b).

Geery and Hoyt (1977) and Webb (1993) conducted archaeological surveys of the original SHIST Site. A large Archaic period site was recorded in the SHIST area and is currently fenced for protection. Another smaller prehistoric site was identified immediately outside the original SHIST Site in 2000 and other archaeological sites have been documented in the vicinity, but none that are directly affected by activities at SHIST Site. The site was recently expanded to the north following completion of an archaeological survey (U.S. Army 2002a).

Several cultural resource surveys have been conducted in and around the area encompassing Alt. SHIST (DTRA 2007). A number of Archaic period sites were recorded that may contain information significant to the prehistory of the area. One large site with components dating from Paleoindian through the Jornada Mogollon was also recorded and tested to determine potential for buried resources. The site did contain subsurface artifacts and is considered to be eligible for NRHP (Russel and Kirkpatrick 1997). An archaeological survey conducted in May 2001 recorded two sites (LA 132538 and LA 132539) along the dirt road leading into Mockingbird South from Range Road 7 and re-visited a previously recorded site (LA 51474) in the valley floor of the proposed test bed.

Previous archaeological projects in the Capitol Peak area have identified over 40 cultural resource sites. Most of these sites represent Archaic period occupation of the area, although some sites also exhibit Paleoindian and Formative period components. In addition, several historic period sites in the region have also been identified. An archaeological survey of 391 acres in the Capitol Peak project area was completed in May 2001 and four archaeological sites were recorded.

4.7.8.2 *Historic Resources*

The Trinity National Historic Landmark boundary overlaps much of the PHETS project area. Within the landmark are two National Register-listed sites: Trinity site and McDonald Ranch House. Trinity Site was the test area for the first manmade nuclear detonation. Notable components include Ground Zero, the location of the first nuclear bomb detonation in 1945, the base camp that housed scientists and the support team, four instrumentation bunkers, and three observation bunkers (DTRA 2007).

The site encompasses a total of approximately 36,413 acres. Located approximately 2.3 miles to the southeast of Trinity Site, McDonald Ranch House is a historic homestead that was used to assemble the bomb. Over a dozen test-specific archaeological surveys have been conducted in the PHETS area. One hundred thirty-six (136) archaeological sites have been recorded, both prehistoric and historic (DTRA 2007).Several cultural resource surveys have been conducted in and around the area encompassing Alt. SHIST. A number of Archaic period sites were recorded that may contain information significant to the prehistory of the area. One large site with components dating from Paleoindian through the Jornada Mogollon was also recorded and tested to determine potential for buried resources. The site did contain subsurface artifacts and is considered to be eligible for NRHP (DTRA 2007).

4.7.9 Socioeconomic Resources

Socioeconomic characteristics addressed at WSMR include employment, regional economy, and population, housing, and community services. Socioeconomic characteristics are presented for a ROI. The ROI was identified based on the distribution of residences for current WSMR employees. The ROI is defined as those counties where approximately 90 percent of the workforce lives.

The center for operations at WSMR is located in Dona Ana County, New Mexico. Statistics for socioeconomic characteristics are presented for the ROI, a region consisting of Dona Ana, Lincoln, Otero, Sierra, and Socorro Counties. Figure 4.7.9-1 presents a map of the counties composing the WSMR ROI.

4.7.9.1 *Employment and Income*

Labor force statistics are summarized in Table 4.7.9-1. The civilian labor force of the ROI grew by approximately 11 percent from 104,619 in 2000 to 115,604 in 2005. The overall ROI employment experienced a growth rate of 11 percent with 98,643 in 2000 to 109,164 in 2005 (BLS 2007).

The ROI unemployment rate was 5.6 percent in 2005 and 5.7 percent in 2000. In 2005, unemployment rates within the ROI ranged from a low of 4.6 percent in Lincoln and Otero Counties to a high of 5.8 percent in Dona Ana County. The unemployment rate in New Mexico in 2005 was 5.3 percent (BLS 2007).

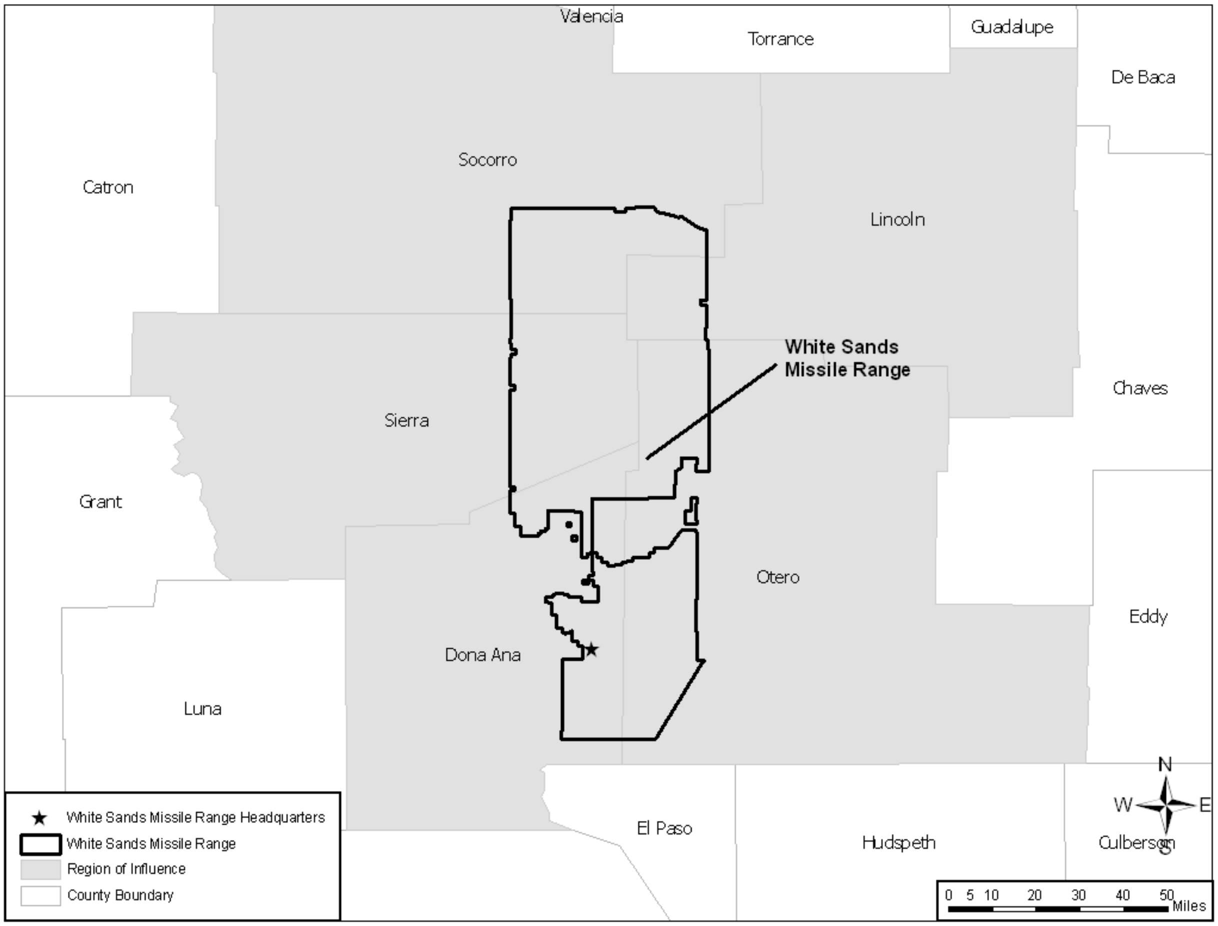


Figure 4.7.9-1—Region of Influence for Socioeconomic Impacts at WSMR

Table 4.7.9-1—Labor Force Statistics for ROI and New Mexico

	ROI		**New Mexico**	
	2000	**2005**	**2000**	**2005**
Civilian Labor Force	104,619	115,604	852,293	915,489
Employment	98,643	109,164	810,024	867,317
Unemployment	5,976	6,440	42,269	48,172
Unemployment Rate (percent)	5.7	5.6	5.0	5.3

Source: BLS 2007.

Income information for the WSMR ROI is provided in Table 4.7.9-2. Sierra County is at the low end of the ROI with a median household income in 2004 of $23,821 and a per capita income of $19,626. Lincoln County had the highest 2004 median household income in the ROI ($33,642). Dona Ana County had the highest 2004 per capita income in the ROI ($22,082) (BEA 2007).

Table 4.7.9-2—Income Information for the WSMR ROI, 2004

	Per capita income (dollars)	Median household income (dollars)
Dona Ana	22,082	30,740
Lincoln	21,974	33,642
Otero	20,588	32,400
Sierra	19,626	23,821
Socorro	20,452	26,622
New Mexico	26,679	37,838

Source: BEA 2007.

4.7.9.2 *Population and Housing*

The ROI is used to analyze the primary economic impacts on population and housing. Table 4.7.9-3 presents historic and projected population in the ROI and the state.

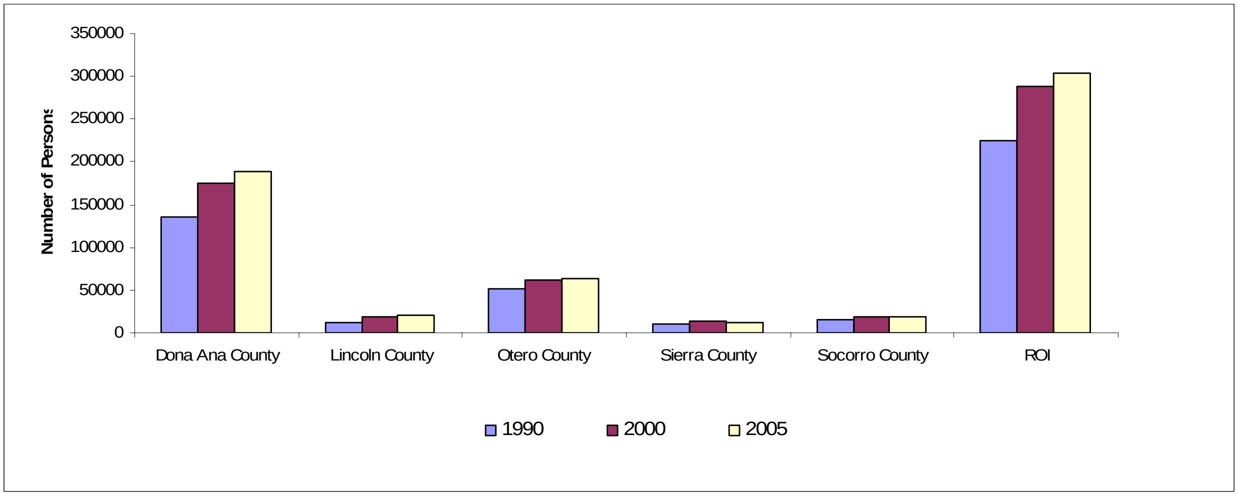
Table 4.7.9-3—Historic and Projected Population

Region	1990	2000	2005	2010	2020
Dona Ana County	135,510	174,682	189,306	218,523	255,057
Lincoln County	12,219	19,411	20,976	23,792	27,100
Otero County	51,928	62,298	63,128	67,018	70,508
Sierra County	9,912	13,270	12,777	16,723	19,857
Socorro County	14,764	18,078	18,194	21,421	24,493
ROI	224,333	287,739	304,381	347,477	397,015
New Mexico	1,515,069	1,819,046	1,925,985	2,112,986	2,383,116

Source: USCB 2007.

Between 1990 and 2000, the ROI population increased 28 percent from 224,333 in 1990 to 287,739 in 2000. From 2000 to 2005, the population of the ROI increased 6 percent to 304,381 in 2005. Dona Ana County experienced the largest population growth within the ROI between 2000 and 2005 with an increase of 8 percent while Sierra County experienced a decrease of 4 percent (USCB 2007). Figure 4.7.9-2 presents the trends in population within the WSMR ROI.

Table 4.7.9-4 lists the total number of housing units and vacancy rates in the ROI. In 2000, the total number of housing units in the ROI was 126,315 with 103,530 occupied (81.9 percent). There were 71,240 owner-occupied housing units and 32,290 rental units. The median value of owner-occupied units in Lincoln County was the greatest of the counties in the WSMR ROI ($108,400). The vacancy rate was the lowest in Dona Ana County (8.7 percent) and the highest in Lincoln County (46.4 percent) (USCB 2007).



Source: USCB 2007.

Figure 4.7.9-2 —Trends in Population for the WSMR ROI, 1990-2005

Table 4.7.9-4—Housing in the WSMR ROI, 2000

	Total Units	Occupied Housing Units	Owner Occupied Units	Renter Occupied Units	Vacant Units	Vacancy Rate (percent)	Median Value of Owner Occupied Units (dollars)
Dona Ana County	65,210	59,556	40,208	19,348	5,654	8.7	90,900
Lincoln County	15,298	8,202	6,336	1,866	7,096	46.4	108,400
Otero County	29,272	22,984	15,372	7,612	6,288	21.5	78,800
Sierra County	8,727	6,113	4,578	1,535	2,614	30.0	77,800
Socorro County	7,808	6,675	4,746	1,929	1,133	14.5	80,900
ROI	126,315	103,530	71,240	32,290	22,785	18.0	88,337

Source: USCB 2007.

4.7.9.3 *Community Services*

Community services analyzed in the ROI include public schools, law enforcement, fire suppression and medical services. There are 14 school districts with 127 schools serving the WSMR ROI. Educational services were provided for approximately 54,892 students by an estimated 3,690 teachers for the 2005 to 2006 school year (IES 2006a). The student-to-teacher ratio in these school districts ranged from a high of 16:1 in the Gadsden Independent School District in Dona Ana County to a low of 7:1 in the Hondo Valley Public School District in Lincoln County. The student-to-teacher ratio in the ROI was 15:1 (IES 2006a).

The counties within the ROI employ approximately 1,923 public safety workers (firefighters and law enforcement). There are eight hospitals that serve residents of the ROI with a total bed capacity of 650 (ESRI 2007).

4.7.10 Environmental Justice

The potentially affected area considered for environmental justice analysis is the area within a 50-mile radius of WSMR Headquarters. Figure 4.7.10-1 shows counties potentially at risk from the current missions performed at WSMR. There are five counties included in the potentially affected area. The environmental justice analysis uses WSMR Headquarters as the center of operations; therefore, the counties evaluated are different from those analyzed in the socioeconomic resources. Table 4.7.10-1 provides the demographic profile of the potentially affected area using data obtained from the 2000 Census.

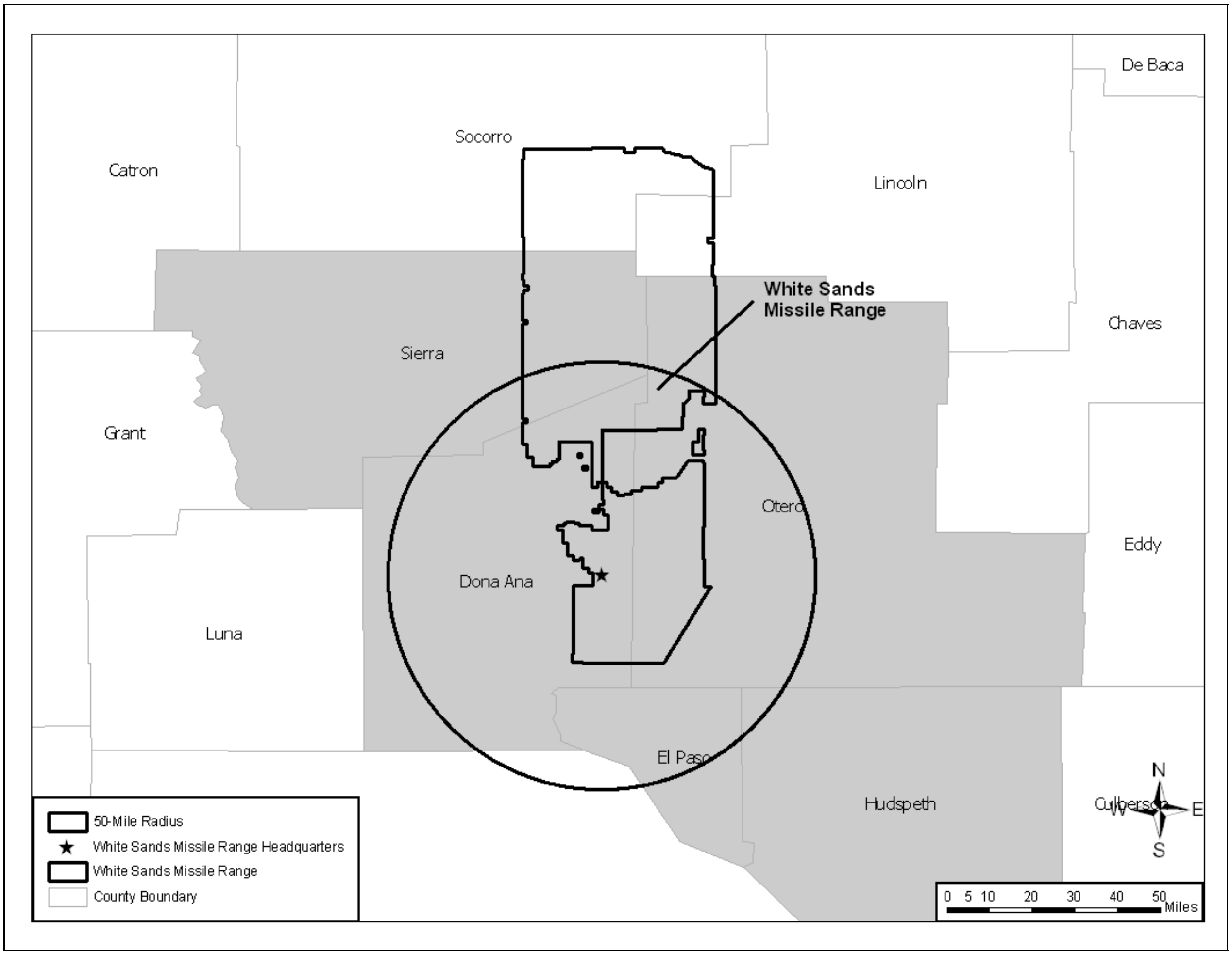


Figure 4.7.10-1—Potentially Affected Counties Surrounding WSMR for Environmental Justice ROI

Table 4.7.10-1—Demographic Profile of the Potentially Affected Area Surrounding WSMR, 2000

Population Group	Population	Percent
Minority	**733,069**	**75.5**
Hispanic alone	471,391	48.6
Black or African American	26,231	2.7
American Indian and Alaska Native	14,350	1.5
Asian	8,979	0.9
Native Hawaiian and Other Pacific Islander	901	0.1
Some other race	179,416	18.5
Two or more races	31,801	3.3
White alone	**237,636**	**24.5**
Total Population	**970,705**	**100.0**

Source: USCB 2007.

In 2000, persons self-designated as minority individuals in the potentially affected area comprised 75.5 percent of the total population. This minority population is composed largely of Hispanic residents. As a percentage of the total resident population in 2000, New Mexico had a minority population of 55 percent and the U.S. had a minority population of 30.9 percent (USCB 2007).

Census tracts with minority populations exceeding 50 percent were considered minority census tracts. Based on 2000 census data, Figure 4.7.10-2 shows minority census tracts within the 50-mile radius where more than 50 percent of the census tract population is designated minority.

Census tracts were considered low-income census tracts if the percentage of the populations living below the poverty threshold exceeded 50 percent. Based on 2000 Census data, Figure 4.7.10-3 shows low-income census tracts within the 50-mile radius where more than 50 percent of the census tracts population is living below the Federal poverty threshold.

According to 2000 census data, approximately 193,898 individuals residing within census tracts in the 50-mile radius of WSMR were identified as living below the Federal poverty threshold, which represents approximately 23 percent of the census tracts population within the 50-mile radius. There was one census tract located in Dona Ana County, New Mexico and nine census tracts in El Paso, Texas with populations greater than 50 percent identified as living below the Federal poverty threshold. In 2000, 18.4 percent of individuals for whom poverty status is determined were below the poverty level in New Mexico and 12.4 percent in the U.S. (USCB 2007).

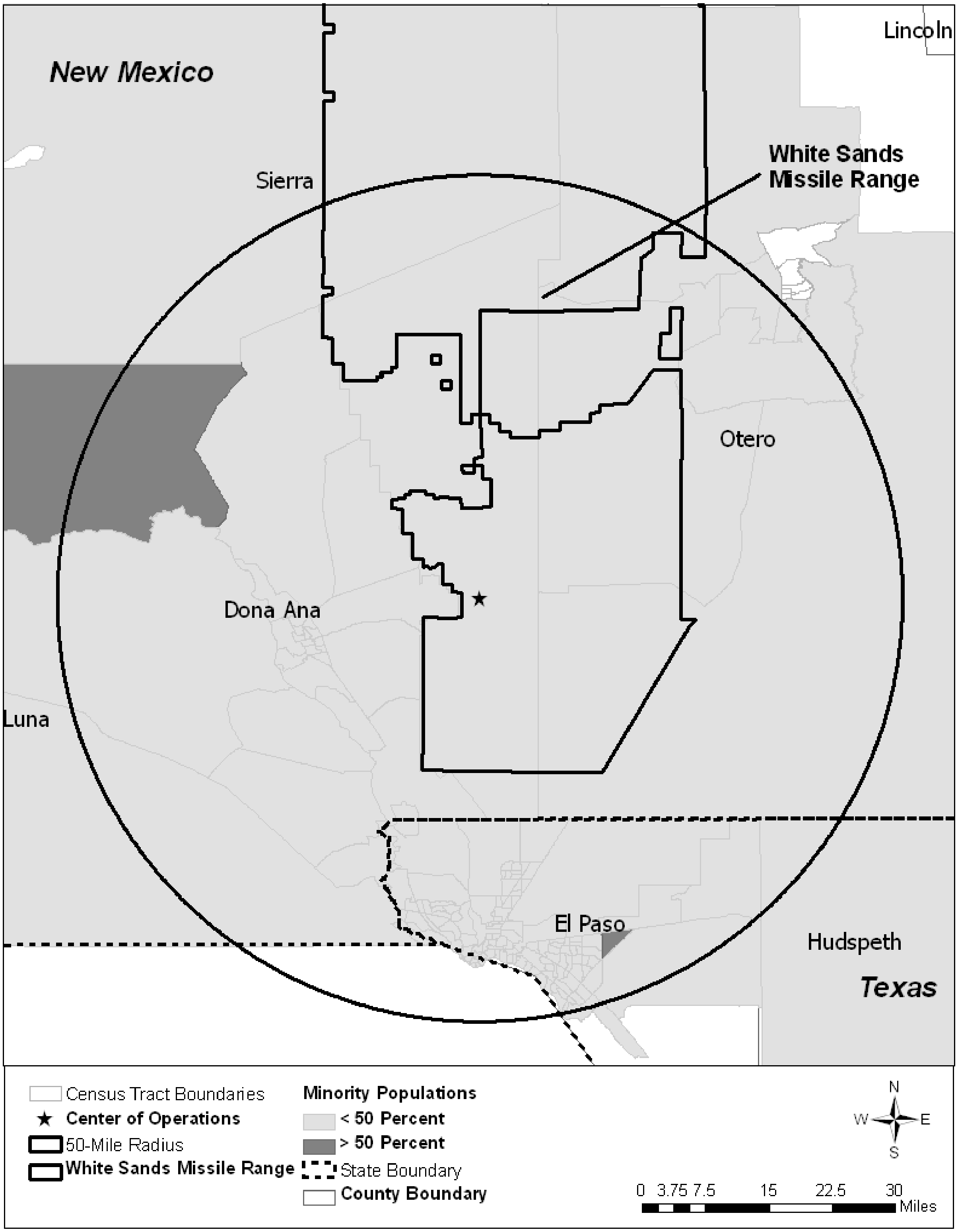


Figure 4.7.10-2—Minority Population—Census Tracts with More than 50 Percent Minority Population in a 50-Mile Radius of WSMR

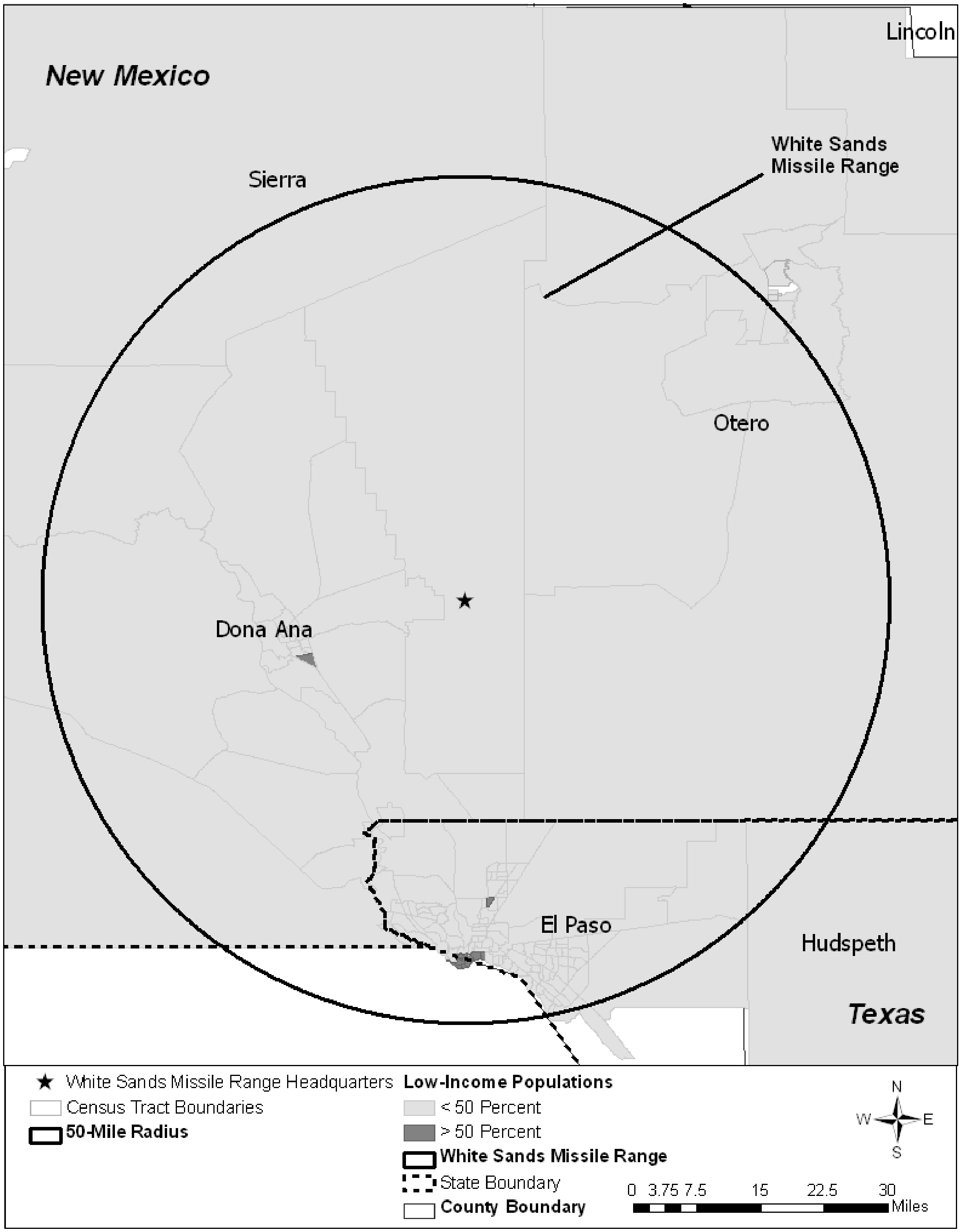
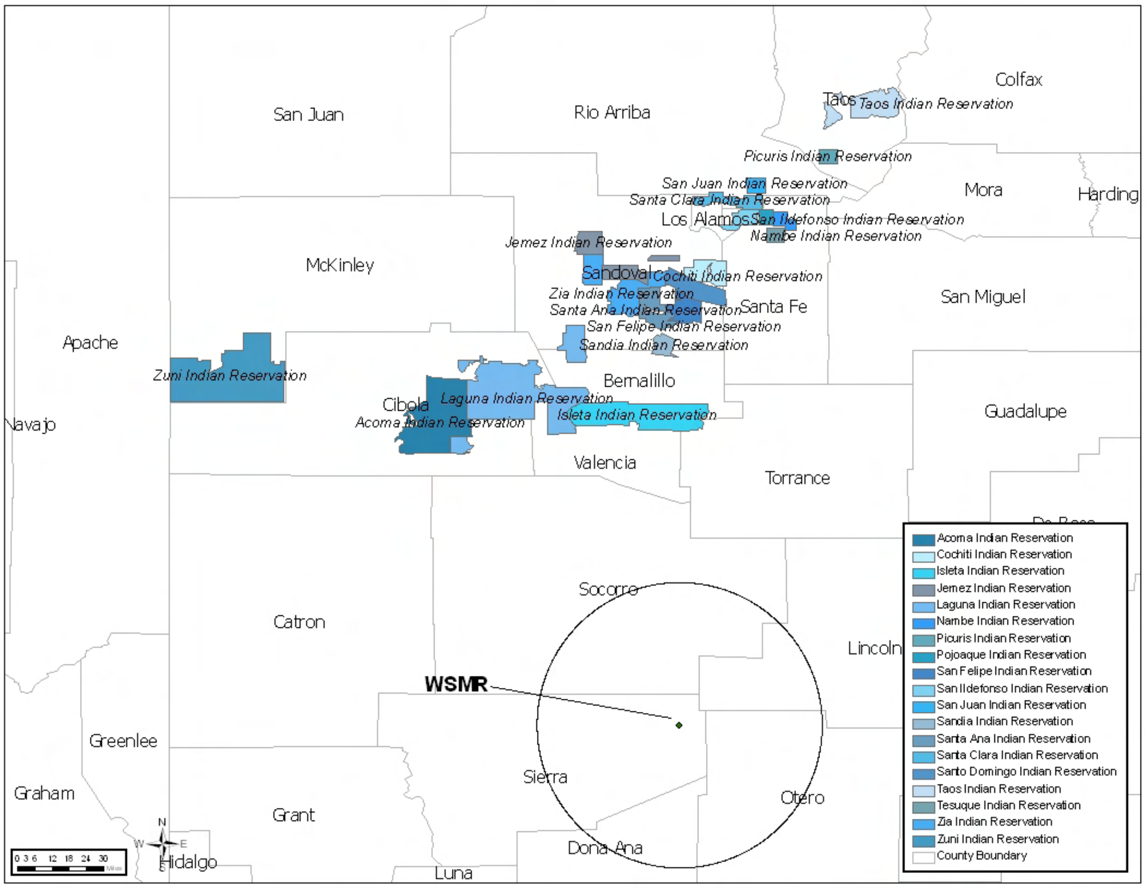


Figure 4.7.10-3—Low-Income Population—Census Tracts with More than 50 Percent Low-Income Population in a 50-Mile Radius of WSMR

4.7.10.1 *Characteristics of Native American Populations within the Vicinity of or with Interest in WSMR Activities/Operations*

As discussed in Sections 4.3.8.3, Native American groups which are known to have used or have interest in the lands surrounding WSMR are the New Mexican Pueblo Indians shown in Figure 4.7.10-4 and listed below:

- Acoma
- Cochiti
- Jemez
- Laguna
- Nambe
- Picuris
- Pojoaque
- San Felipe
- San Ildefonso
- San Juan
- Sandia
- Santa Ana
- Santa Clara
- Santo Domingo
- Taos
- Tesuque
- Zia
- Zuni



Source: ESRI 2007.

Figure 4.7.10-4—Location of New Mexico Indian Pueblo Reservations

The 2000 U.S. Census Bureau was used to obtain characteristics, including population, employment, educational attainment, income, poverty level, average family size, and housing

characteristics for all population subcategories associated with the ones mentioned above. The results of this analysis are provided in the following section.

As shown in Table 4.7.10-2, the Zuni had the largest of the Native American populations with 9,311 and Pojoaque the smallest with 209. The Picuris have the largest percentage of their population as members of the civilian labor force at 74.8 percent and the San Felipe with the smallest percentage of their population as members of the civilian labor force with 31.5 percent. The Zuni had the highest unemployment rate at 11.8 percent and the Santa Clara with the lowest unemployment rate at 3.2 percent (USCB 2007).

Of those individuals over 25 with some form of education, the largest constituency of all the New Mexico Pueblo populations had received a high school diploma as shown in Table 4.7.10-3. A comparable percentage of individuals had attended some college and slightly lesser percentages of these populations had received degrees from institutions of higher learning (Associate, Bachelor, or Graduate/Professional) (USCB 2007).

Table 4.7.10-2—Population and Employment Estimates for Native American Populations within the Vicinity of or With Interest in WSMR, 2000

WSMR	Population	Civilian Labor Force	Civilian Labor Force (percent)	Employed	Employed (percent)	Unemployed	Unemployed (percent)
Pueblo	59,621	24,527	58.1	21,130	50.1	3,397	8
Acoma	4,298	1,792	60.1	1,548	51.9	244	8.2
Cochiti	913	409	60.9	357	53.1	52	7.7
Isleta	3,685	1,602	58.8	1,474	54.1	128	4.7
Jemez	2,705	1,057	56.8	875	47	182	9.8
Laguna	6,346	2,682	59.4	2,375	52.6	307	6.8
Nambe	558	200	56.3	184	51.8	16	4.5
Picuris	338	178	74.8	168	70.6	10	4.2
Pojoaque	209	53	48.6	53	48.6	0	0
San Felipe	2,756	579	31.5	428	23.2	151	8.2
San Ildefonso	539	269	70.1	234	60.9	35	9.1
San Juan Pueblo	1,438	639	64.7	579	58.7	60	6.1
Sandia	353	186	70.7	176	66.9	10	3.8
Santa Ana	623	276	62	257	57.8	19	4.3
Santa Clara	1,057	437	55.8	412	52.6	25	3.2
Santo Domingo	4,216	1,363	49	1,117	40.2	246	8.8
Taos	1,877	993	66.9	875	58.9	118	7.9
Tesuque	511	214	62.2	197	57.3	17	4.9
Zia	900	398	61.3	353	54.4	45	6.9
Zuni	9,311	3,571	54.9	2,802	43.1	769	11.8

Source: USCB 2007.

Table 4.7.10-3—Level of Educational Attainment by Native American Populations within the Vicinity of or With Interest in WSMR, 2000

WSMR	High School Graduate	High School Graduate (percent)	Some College	Some College (percent)	Associate Degree	Associate Degree (percent)	Bachelor Degree	Bachelor Degree (percent)	Graduate/ Professional Degree	Graduate/ Professional Degree (percent)
Pueblo	11,039	33.4	8,628	26.1	2,362	7.1	2,279	6.9	909	2.8
Acoma	943	40.9	540	23.4	161	7	116	5	52	2.3
Cochiti	161	30.3	186	35	54	10.2	27	5.1	27	5.1
Isleta	848	38	559	25.1	115	5.2	170	7.6	63	2.8
Jemez	525	37.7	340	24.4	77	5.5	108	7.8	19	1.4
Laguna	1,124	31.9	1,004	28.5	385	10.9	343	9.7	96	2.7
Nambe	76	29	75	28.6	33	12.6	23	8.8	2	0.8
Picuris	38	19.2	110	55.6	2	1	26	13.1	4	2
Pojoaque	27	34.6	24	30.8	4	5.1	3	3.8	3	3.8
San Felipe	661	46.4	169	11.9	44	3.1	39	2.7	22	1.5
San Ildefonso	117	37.9	100	32.4	23	7.4	40	12.9	3	1
San Juan Pueblo	223	27.4	272	33.5	82	10.1	61	7.5	6	0.7
Sandia	44	21.4	41	19.9	64	31.1	15	7.3	26	12.6
Santa Ana	147	41.8	98	27.8	26	7.4	19	5.4	8	2.3
Santa Clara	235	36	171	26.2	50	7.7	69	10.6	21	3.2
Santo Domingo	897	42	377	17.6	48	2.2	64	3	67	3.1
Taos	378	31.6	367	30.6	100	8.3	112	9.3	39	3.3
Tesuque	104	37.3	89	31.9	5	1.8	22	7.9	8	2.9
Zia	174	34.7	125	24.9	37	7.4	23	4.6	7	1.4
Zuni	1,547	31.5	1,189	24.2	346	7	198	4	52	1.1

Source: USCB 2007.

In 2000, the mean household earnings and per capita income were comparable for all New Mexico Pueblo populations. The San Felipe Pueblo had the highest mean household earnings with $45,444 as shown in Table 4.7.10-4. The Isleta Pueblo had the highest per capita income with $17,106. The Zuni population had the lowest mean household earnings with $30,258 and the lowest per capita income with $7,837 (USCB 2007).

Of all the New Mexico pueblo populations, the Santo Domingo had the largest percentage of individuals below the poverty level in 2000 with 36.8 percent as compared to the Santa Ana population which had 7.4 percent of the total population living below the poverty level as shown in Table 4.7.10-4 (USCB 2007).

Table 4.7.10-4—Income and Poverty Level Estimates for Native American Populations within the Vicinity of or With Interest in WSMR, 2000

WSMR	Mean Household Earnings	Per Capita Income	Individuals Below the Poverty Level	Individuals Below the Poverty Level (percent)
Pueblo	$35,886	$10,798	17,030	29.1
Acoma	$37,498	$9,584	1,067	25.3
Cochiti	$32,245	$10,095	227	25.2
Isleta	$39,314	$17,106	743	20.5
Jemez	$31,431	$8,897	727	27.2
Laguna	$35,535	$11,099	1,476	24
Nambe	$31,319	$8,718	127	23
Picuris	$45,403	$14,370	57	16.9
Pojoaque	$33,720	$8,719	68	32.5
San Felipe	$45,444	$8,514	952	34.7
San Ildefonso	$31,154	$11,095	129	23.9
San Juan Pueblo	$35,950	$11,519	365	25.8
Sandia	$41,347	$14,414	53	15
Santa Ana	$39,011	$10,527	46	7.4
Santa Clara	$32,255	$10,483	288	27.4
Santo Domingo	$33,080	$8,228	1,537	36.8
Taos	$34,456	$12,022	492	26.9
Tesuque	$35,240	$12,001	93	18.2
Zia	$35,999	$9,693	125	14.7
Zuni	$30,258	$7,837	4,041	44

Source: USCB 2007.

In 2000, the San Felipe had the largest average family size with 5.44 persons, and the Tesuque had the smallest average family size with 2.96 persons per family. The Zuni had the greater number of occupied housing units which is consistent with their larger population Table 4.7.10-5 (USCB 2007).

Table 4.7.10-5—Housing Characteristics for Native American Populations within the Vicinity of or With Interest in WSMR, 2000

WSMR	Average Family Size	Housing Units	Occupied Housing Units	Owner Occupied Housing Units	Owner Occupied Housing Units (percent)	Renter Occupied Housing Units	Renter Occupied Housing Units (percent)
Pueblo	3.89	17,328	17,084	11,578	67.8	5,506	32.2
Acoma	4.18	1,089	1,076	783	72.8	293	27.2
Cochiti	4.38	267	284	170	59.9	114	40.1
Isleta	3.37	1,361	1,355	1,045	77.1	310	22.9
Jemez	4.05	699	701	538	76.7	163	23.3
Laguna	3.6	1,953	1,894	1,171	61.8	723	38.2
Nambe	3.22	202	194	165	85.1	29	14.9
Picuris	3.39	117	108	84	77.8	24	22.2
Pojoaque	3.31	83	85	50	58.8	35	41.2
San Felipe	5.44	517	521	470	90.2	51	9.8
San Ildefonso	3.05	218	205	156	76.1	49	23.9
San Juan Pueblo	3.39	472	468	289	61.8	179	38.2
Sandia	3.31	138	128	108	84.4	20	15.6
Santa Ana	5.1	150	162	144	88.9	18	11.1
Santa Clara	3.29	409	404	357	88.4	47	11.6
Santo Domingo	5.22	859	889	575	64.7	314	35.3
Taos	3.17	752	733	563	76.8	170	23.2
Tesuque	2.96	171	161	139	86.3	22	13.7
Zia	3.64	255	234	181	77.4	53	22.6
Zuni	4.22	2,334	2,293	1,558	67.9	735	32.1

Source: USCB 2007.

4.7.11 Health and Safety

4.7.11.1 *Public Health*

Potential hazards to human health and safety from activities at WSMR include non-ionizing radiation, ionizing radiation, high voltage equipment, noise, exposure to hazardous materials, and other site-specific characteristics such as the sun and biologics. General health and safety protocols for DTRA areas and facilities are addressed in various Federal, State, and WSMR guidelines, rules and regulations. Detailed standard operating procedures (SOPs) have been established to fulfill health and safety requirements.

Non-ionizing radiation refers to lower energy electromagnetic radiation, mostly in microwave and thermal wavelengths. Potential sources of non-ionizing radiation include lasers and radars. Lasers emit high-intensity light and are used for tracking and sighting purposes. Radar units produce microwave (heat) radiation in addition to x-ray (ionizing) radiation. The regulatory limit for hazardous human exposure is expressed by power density (mW per centimeter squared). It can be as low as 1 mW per centimeter squared or as high as 10 mW per centimeter squared, depending on the frequency. Sources of ionizing radiation previously used in program activities include instrumentation fielded for large-scale explosive testing and the testing of chemical agent detectors. Sources of non-ionizing radiation previously used by DTRA activities include laser guidance and tracking systems, radar guidance and tracking systems, site illumination, communication, and electro-optical countermeasures.

High voltage radar equipment is a common source of x-rays on WSMR but proper shielding reduces this hazard to all site personnel. Background ionizing radiation is generated from the decay of radioactive minerals in rocks (at WSMR and virtually everywhere) at the approximate rate of 55 millirem per year.

Trinity Site, the location of the first atomic bomb detonation in 1945, is within PHETS and continues to produce low levels of ionizing radiation (approximately 0.5 millirem during a one-hour visit). This amount is similar to what a person would receive flying in a jet airliner for one hour (DTRA 2007).

Exposure to noise can be a public health hazard, causing hearing impairment and undue psychological stress. Extreme noise environments include loud impulse noise events (where people are subjected to sudden loud noise, such as a closed-room detonation), or high noise levels over extended periods of time (such as from a riveting machine or pneumatic hammer operations). The loud impulsive events can especially have a severe effect on auditory capabilities and the health of the ear. WSMR activities require adherence to the OSHA Hearing Conservation Standard (29 CFR 1910.95), which protects workers from potentially hazardous occupational noise exposures. OSHA regulations establish a maximum noise level of 90 dBA for a continuous 8-hr exposure during a working day, and higher sound levels for shorter exposure times.

Additional potential health and safety concerns for workers on WSMR and in the DTRA areas include exposure to hazardous materials, exposure to explosive devices, unexploded ordnance (UXO). All personnel involved in testing activities are required by WSMR to receive UXO training.

Dehydration and heat stress are potential concerns, given the generally high temperatures in the region. Moreover, excessive exposure to the ultraviolet rays of the sun can result in sunburn and repeated exposure may produce skin damage and cause skin cancer. There is also a potential for contact with venomous snakes, insects, and thorny/spiny vegetation. Hantavirus Pulmonary Syndrome (HPS) may occur on WSMR, which causes disease in humans through contact with urine or droppings of deer mice (*Peromyscus maniculatus*) and other rodents. Rodents may nest in buildings and vehicles, creating an HPS hazard. West Nile virus, transmitted to humans by infected mosquitoes has also been detected on WSMR. On WSMR, mosquitoes may concentrate in areas such as wildlife watering ponds and springs, standing bodies of water, sewage outflows or water collecting in barrels (DTRA 2007).

4.7.12 Transportation

As shown in Figure 4.7.12-1, WSMR is bounded by U.S. Highway 380 to the north and U.S. Highway 54 to the east. U.S. Highway 70 crosses the southern portion of WSMR. No major access points exist along the western boundary of WSMR. An agreement with the State of New Mexico allows WSMR to establish off-range roadblocks on U.S. Highways 70 and 380 as a safety precaution during missile tests. Under the agreement, roadblocks may last no longer than 1 hr 15 minutes. U.S. Highway 70 is subject to an average of one roadblock per day, while U.S. Highway 380 experiences approximately one roadblock per month (DTRA 2007). U.S. Highway 70 provides Las Cruces and Alamogordo access to WSMR via Range Road 1. U.S. Highway 70 is in good condition with traffic volumes averaging approximately 8,740 vehicles per day (MDA 2002). Generally residents of WSMR require 21 minutes for a one way commute to the workplace. About 76.20 percent of the people commute to work alone in the car while 18.49 percent of the people carpool. More than 50 percent of the population has a commute of 15 minutes or less while approximately 15 percent of the population has a 45-59 minutes commute to their workplace.

An extensive road network connects most areas within WSMR, with the exception of less accessible areas in the San Andres and Oscura mountains. LB/TS is adjacent to Range Road 5 near Stallion Range Center and is easily accessible. Range Road 7 provides access to PHETS, and an extensive internal network of roads exists throughout the area. The size, surface, and condition of these roads vary; range roads 7, 20, and 13 are paved two-lane roads, and others are gravel or dirt. SHIST is a relatively isolated site and admittance is usually through the Aerial Cable Range. Access to HTD test beds at Capitol Peak and Alt. SHIST is provided through dirt and gravel roads intersecting Range Road 7.

WSMR controls a complex of 19 restricted areas. Any aircraft that have not been authorized and scheduled by the controlling agency are prohibited from entering active restricted airspace. During part of the day, WSMR may return some of the restricted airspace to FAA control for use by aircraft under a shared-use agreement between WSMR and the FAA. Missile firings, which include air-to-air, air-to-surface, surface-to-surface, and surface-to-air, are some of the major operations performed in the airspace. All areas are joint-use except R-5107B, which is in continuous use by WSMR and is not released back to the FAA. Many of the restricted areas are used extensively by Holloman AFB for advanced training missions (MDA 2002).

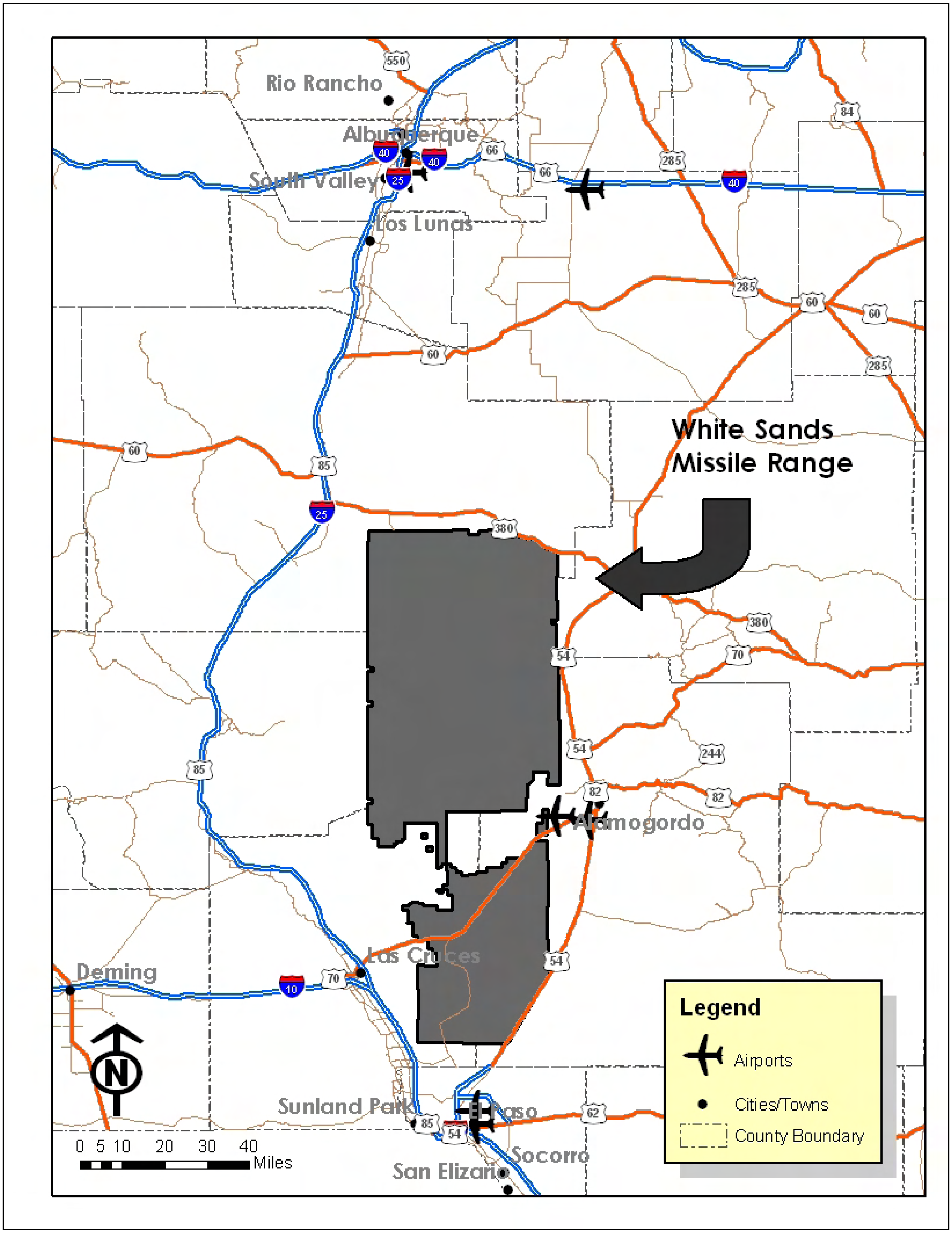


Figure 4.7.12-1—Roads in the Vicinity of White Sands Missile Range

4.7.13 Waste Management

Hazardous wastes produced by DTRA activities include a variety of liquid, solid and gaseous wastes. The generation, recovery, storage and disposal of hazardous wastes is regulated under the RCRA and the New Mexico Hazardous Waste Act (1985). Guidelines for the management and disposal of hazardous wastes generated by DTRA on WSMR are provided in WSMR Regulation 200-1. WSMR has developed an Environmental Disaster Plan as part of the WSMR Disaster Control Plan to prevent and/or control (i.e., minimize the impact) accidental discharges of oil and hazardous substances and includes all actions taken before, during, and after the spill event to reduce the probability of damage, minimize its effects and initiate recovery (DTRA 2007).

Sanitary sewage would be contained in an approved septic system which would periodically be emptied and disposed at an approved sewage treatment facility. Alumina dust discharged into the air is classified as simple dust and no fuels are or would be burned at the facility. The liquid nitrogen facility does not and would not produce hazardous by-products. Explosive charges are and would be used to rupture the diaphragms. No hazardous gasses, liquids, or solids would be used during testing. There is a satellite accumulation point on site for containment of waste and recyclable petroleum, oils, and lubricants generated by facility maintenance.

Hazardous materials at PHETS include HE, chemical and biological materials, construction products, and petroleum, oils, and lubricants. Waste products from DTRA that could potentially be defined as hazardous (e.g., spent or excess test materials, paints, glues, and petroleum, oils, and lubricants) would be analyzed for such determination. If the product is deemed hazardous it is and would be handled in accordance with WSMR Regulation 200-1. There is a satellite accumulation point in the PHETS Administration Park for collection of small amounts of petroleum, oils, and lubricants waste. Non- hazardous waste is and will be handled as solid waste or non-regulated waste.

No hazardous or toxic materials would be stored at SHIST or Alt. SHIST. Wastes potentially occurring at these sites include petroleum, oils, and lubricants products from vehicles and equipment that are and would be managed of at the PHETS satellite accumulation point.

Hazardous wastes produced by DTRA activities at HTD test beds include a variety of liquid, solid, and gaseous wastes. Petroleum, oils, and lubricants are the most widely used hazardous materials. Other products containing hazardous materials include batteries and cleaning solvents. Presently there is a satellite accumulation point set up at HTD to pick up petroleum, oils, and lubricants materials generated on site.

4.8 SAVANNAH RIVER SITE

SRS is located in south-central South Carolina and occupies an area of approximately 198,400 acres in Aiken, Barnwell, and Allendale Counties as shown in Figure 4.8-1. The site is approximately 15 miles southeast of Augusta, Georgia and 12 miles south of Aiken, South Carolina. With respect to activities supporting the nuclear weapons complex, SRS extracts tritium, and provides loading, unloading, and surveillance of tritium reservoirs. SRS does not maintain Category I/II quantities of SNM associated with weapons activities, but does maintain Category I/II quantities of SNM associated with other Department activities (e.g., environmental management).

4.8.1 Land Use

4.8.1.1 *Onsite Land Uses*

Currently, production and support facilities, infrastructure, research and development (R&D), and waste management facilities account for approximately 10 percent (approximately 19,000 acres) of land on the SRS (DOE 2002a). Of the remaining 90 percent (approximately 191,000 acres), approximately 70 percent is planted pine forest managed by the USFS under an interagency agreement with DOE (SRS 2006a). In 1972, the entire site was designated as a National Environmental Research Park (NERP) (DOE 2005d). About 15 percent of the soils at SRS are considered prime farmland (White and Gaines 2000).

The 19,000 acres of developed SRS land includes 5 non-operational nuclear production reactors, 2 chemical separations facilities (1 is operational and 1 is being deactivated), waste treatment, storage and disposal facilities (including two tank farms [F and H] and the Defense Waste Processing Facility), and various supporting facilities. In 2002, SRS began extensive decommissioning activities. Site D&D continued extensive operations through 2005 (SRS 2006c). The site was designed with a buffer zone that provides security and mitigates accidental exposure to the general public (SRS 2006c). A major new facility, the Salt Waste Processing Facility, is under construction, and construction of the Mixed Oxide (MOX) Fuel Fabrication Facility began in August 2007.

4.8.1.2 *Surrounding Land Uses*

SRS is approximately 12 miles south of Aiken, South Carolina, and 15 miles southeast of Augusta, Georgia. Aiken is the closest populated area to SRS. Land uses in areas surrounding SRS are varied and include residential, industrial, commercial, transportation, recreation, and agricultural activities. Although this land use is primarily forest and agricultural, there is a substantial amount of open water and non-forested wetland along the Savannah River Valley. Regional industrial land uses include a commercial nuclear power plant near Waynesboro, Georgia; a regional, low-level nuclear waste repository in Barnwell, South Carolina; a variety of conventional chemical industries near Augusta; and a variety of manufacturing industries in Aiken, South Carolina (DOE 2002a).

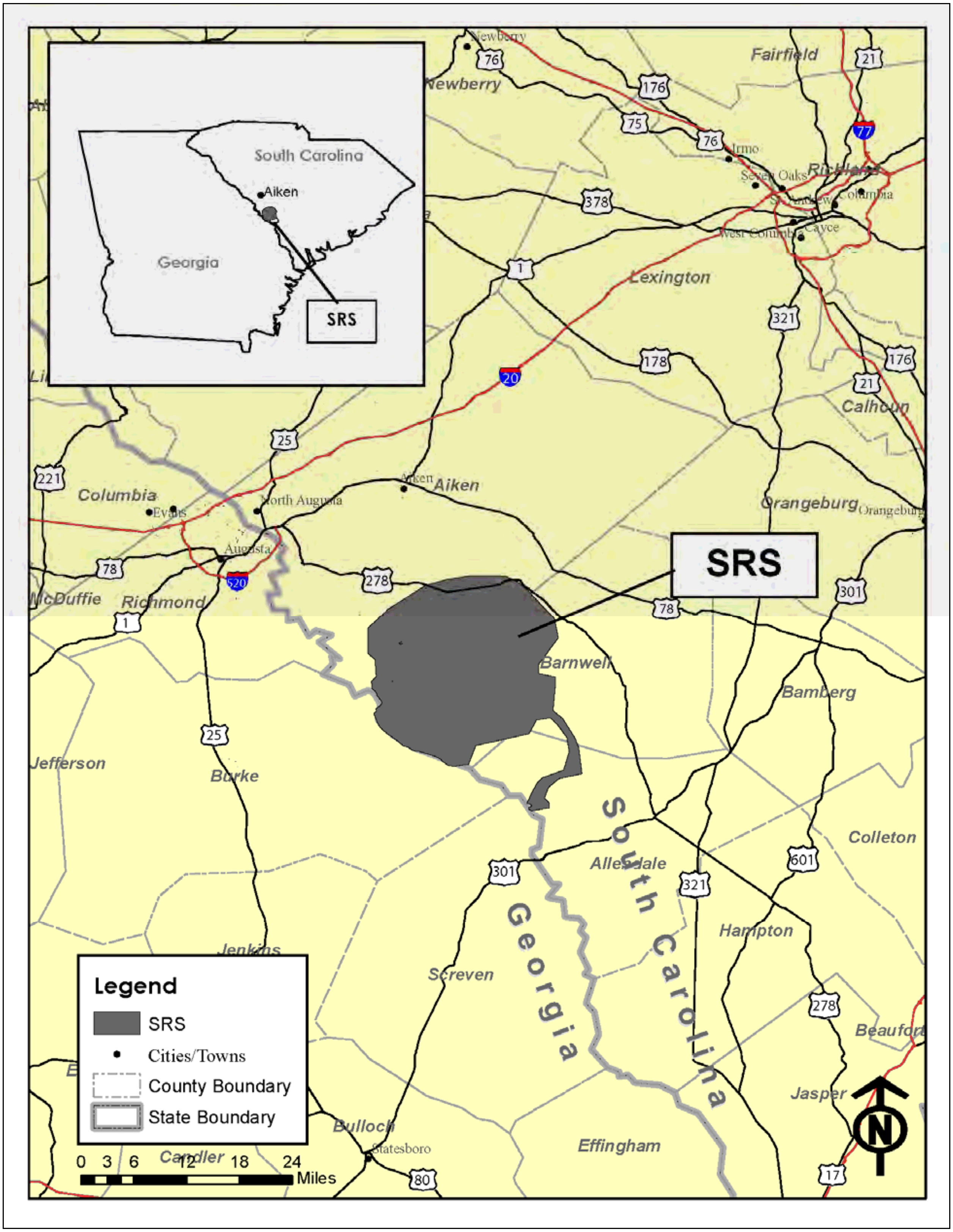


Figure 4.8-1—Location of SRS

4.8.2 Visual Resources

The dominant aesthetic settings in the vicinity of SRS are agricultural and forest, with limited industrial and residential areas. SRS is almost completely forested with 10 percent (19,000 acres) in use for industrial and administrative purposes. The industrial areas, including the reactors and large facilities, are primarily located in the interior of the site away from public access. SRS facilities are not generally visible from public access roads due to the distance to the boundary from the industrialized areas, the gently rolling terrain, and heavy vegetation. The limited public areas that have views of some SRS structures (other than the administrative areas) are approximately 5 miles or more away from viewable structures. These views have low visual sensitivity levels because most of these structures were built as many as 40 years ago and are well established in the viewer's expectations (DOE 2002a).

SRS land is heavily wooded (predominantly pine forest, which minimizes seasonal differences), with developed areas occupying approximately 10 percent of the total land area. The facilities are scattered across SRS and are brightly lit at night. Typically, the reactors and principal processing facilities are large concrete structures as much as 100 feet tall adjacent to shorter administrative and support buildings and parking lots. These facilities are visible in the direct line-of-sight when approaching them on SRS access roads. The only structure visible from a distance is the K-Reactor Cooling Tower. Since this tower will not be operated, the absence of a steam plume ensures no further visual impact. Otherwise, heavily wooded areas that border the SRS road system and public highways crossing the SRS limit views of the facilities.

4.8.3 Site Infrastructure

Table 4.8.3-1 briefly describes the existing infrastructure of the SRS as it pertains to the proposed action. Site infrastructure includes utilities, roads, and railroads needed to support construction and operation of the facilities.

4.8.3.1 *Electricity*

SRS uses a 115-kV power line system in a ring arrangement to supply electricity to the operations areas. Power is supplied by three transmission lines from the South Carolina Electric and Gas Company. The total SRS usage of electrical power is 370,000 MWh per year out of a site capacity of 4,400,000 MWh per year.

4.8.3.2 *Fuel*

Coal and oil are used at SRS to power steam plants located in A-, D-, H- and K-Areas. The produced steam is distributed across the site in an aboveground pipeline distribution system. Coal is delivered by rail and is stored at coal piles in A-, D-, and H-Areas. Number 2 grade fuel oil is delivered by truck and is used in the K-Area. Fuel oil consumption is approximately 500,000 gallons per year. Natural gas is not used at SRS. Annual gasoline consumption is about 138,690 liters.

Table 4.8.3-1—SRS Site Infrastructure Characteristics

Resource	Site Usage	Site Capacity
Transportation		
Paved Roads (miles)	143	143
Unpaved Roads (miles)	1,200	1,200
Railroads (miles)	64	64
Electricity		
Energy consumption (MWh/year)	370,000	4,400,000
Peak energy (MWe)	70	330
Fuel		
Natural gas (cubic yards per year)	0	a
Fuel oil (heating) (gallons per year)	500,000	a
Diesel fuel (gallons per year)	132,086	a
Gasoline (gallons per year)	138,690	a
Coal (tons per year)	850,000	a
Propane (gallons per year)	1,000	a
Water		
Water Use (gallons per year)	3,500,000,000	

Source: DOE 1999b, DOE 2000g.
[a] not limited

4.8.3.3 *Water*

Domestic water supplies at SRS come from a system composed of several wells and water treatment plants. The system includes three wells and a water treatment plant in the A-Area and two wells and a backup water treatment plant in the B-Area. A 27-mile pipe loop provides domestic water from the A- and B-Areas to other SRS operations areas. The regional drainage is dominated by the north to south running Savannah River. The Savannah River is classified as a freshwater source that is suitable for primary and secondary contact recreation, drinking after appropriate treatment, balanced native aquatic species development, and industrial and agricultural purposes. Monitoring data collected in 2006 indicate that SRS discharges are not adversely affecting the water quality of onsite streams or the Savannah River (SRS 2007). Water quality is discussed in Section 4.8.5. SRS is expected to continue using approximately 3.5 billion gallons of water per year.

4.8.4 Air Quality and Noise

4.8.4.1 *Air Quality*

4.8.4.1.1 Meteorology and Climatology

The climate at the SRS is characterized by short, mild winters and long, humid summers. Mountains to the north and west prevent or delay the approach of many cold air masses. The annual average wind speed is 6.1 miles per hour (mph) at Bush Field, which is located in Augusta, Georgia, about 15 miles northwest of SRS.

SRS averages approximately 49.5 inches of annual precipitation. Average monthly precipitation ranges from 2.7 inches in November to 4.6 inches in March. The average annual temperature at

Bush Field is 63.1 degrees Fahrenheit (ºF). January is the coldest month, with an average temperature of 44.8ºF, and July the warmest, averaging 80.8ºF.

4.8.4.1.2 Ambient Air Quality

The SRS is located in the Augusta-Aiken Interstate AQCR. All areas within this region are classified as achieving attainment with the NAAQS (40 CFR 50). The nearest area not in attainment with the NAAQS is Atlanta, Georgia, which is approximately 150 miles west of SRS. Because the Aiken-Augusta area has been out of compliance with the fine particulate ($PM_{2.5}$) standards for 3 of the last 4 years, and the last 2 years show an upward trend the EPA may declare the area non-attainment for fine particulate matter in 2009. Table 4.8.4-1 shows the actual criteria pollutant emissions from all SRS sources in 2005.

Ambient air quality data collected during 2005 from monitoring stations operated by South Carolina Department of Health and Environmental Control (SCDHEC) in Aiken and Barnwell Counties, South Carolina, are summarized in Table 4.8.4-2. This data indicates that ambient concentrations of the measured criteria pollutants are generally much less than the standards.

Table 4.8.4-1—2005 Criteria Pollutant Air Emissions

Pollutant Name	Actual Emissions (Tons/Year)
Sulfur dioxide (SO_2)	6.97×10^{3}
Total particulate matter (PM)	9.28×10^{2}
Particulate matter <10 microns (PM_{10})	5.71×10^{2}
Particulate matter <2.5 microns ($PM_{2.5}$)	4.77×10^{2}
Carbon monoxide (CO)	1.03×10^{2}
Ozone (volatile organic compounds) (VOC)	5.48×10^{2}
Gaseous fluorides (as hydrogen fluoride) (HF)	1.43×10^{-1}
Nitrogen (NO_x)	7.18×10^{3}
Lead (Pb)	1.74×10^{-1}

Source: SRS 2007.

Radiological Air Emissions

Atmospheric emissions of radionuclides from DOE facilities are limited under the EPA regulation NESHAP,” 40 CFR Part 61, Subpart H. The EPA annual effective dose equivalent limit of 10 millirem per year to members of the public for the atmospheric pathway is also incorporated in DOE Order 5400.5, “Radiation Protection of the Public and the Environment.”

In the SRS region, airborne radionuclides originate from natural (i.e., terrestrial and cosmic) sources, worldwide fallout, and SRS operations. Process area stacks that release, or have the potential to release, radioactive materials are monitored continuously by applicable online monitoring and/or sampling systems (SRS 2007).

Table 4.8.4-2—National Ambient Air Quality Standards and 2005 Background Ambient Air Concentration

Pollutant	Averaging Times	NAAQS Primary Standard	South Carolina Standard	Background Ambient Air Concentration	Locations (city, county, state)
Carbon Monoxide	8-hour(1)	10 μg/m^3	Same	(7)	(7)
	1-hour(1)	40 μg/m^3	Same	(7)	(7)
Lead	Quarterly Average	1.5 μg/m^3	Same	0.001 μg/m^3	Aiken, SC
Nitrogen Dioxide	Annual	100 μg/m^3	Same	7.9 μg/m^3	Aiken, SC
Particulate Matter (PM_{10})	Annual(2)	50 μg/m^3	Same	17.6 μg/m^3	Aiken, SC
	24-hour(1)	150 μg/m^3	Same	36 μg/m^3	Aiken, SC
Particulate Matter ($PM_{2.5}$)	Annual(3)	15 μg/m^3	Same	13.5 μg/m^3	Aiken, SC
	24-hour(4)	35 μg/m^3	Same	32.1 μg/m^3	Aiken, SC
Ozone	8-hour(5)	0.08 ppm	Same	0.069 ppm	Aiken, SC
	1-hour(6)	0.12 ppm	Same	0.082 ppm	Aiken, SC
Sulfur Oxides	Annual	80 μg/m^3	Same	4.5 μg/m^3	Barnwell, SC
	24-hour(1)	365 μg/m^3	Same	18.3 μg/m^3	Barnwell, SC
	3-hour(1)	NA	1300 μg/m^3	34.0 μg/m^3	Barnwell, SC
Total Suspended Particulates	Annual Geometric Mean	NA	75 μg/m^3	38.2 μg/m^3	Aiken, SC

Source: SCDHEC 2005, SRS 2007.
[1] Not to be exceeded more than once per year.
[2] To attain this standard, the 3-year average of the weighted annual mean PM_{10} concentration at each monitor within an area must not exceed 50 ug/m^3.
[3] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 ug/m^3.
[4] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 ug/m^3.
[5] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
[6] (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is $\leq$ 1, as determined by appendix H.
(b) As of June 15, 2005 EPA revoked the 1-hour ozone standard in all areas except the fourteen 8-hour ozone non-attainment Early Action Compact (EAC) Areas.
[7] No CO data in vicinity of SRS for 1990 – 2005.

Depending on the processes involved, discharge stacks also may be monitored with "real-time" instrumentation to determine instantaneous and cumulative atmospheric releases to the environment. Tritium is one of the radionuclides monitored with continuous real-time instrumentation. Tritium in elemental and oxide forms accounted for more than 99 percent of the total radioactivity released to the atmosphere from SRS operations. During 2005, about 40,800 curies of tritium were released from SRS, compared to about 61,300 curies in 2004 (SRS 2006c).

Average concentrations of radionuclides in airborne emissions are calculated by dividing the amount of each radionuclide released annually from each stack by the respective yearly stack-flow volumes. These average concentrations then can be compared to the DOE DCGs in DOE Order 5400.5, "Radiation Protection of the Public and the Environment," as a screening method to determine if existing effluent treatment systems are proper and effective. DCGs are used as reference concentrations for conducting environmental protection programs at all DOE sites.

DCGs are applicable at the point of discharge (prior to dilution or dispersion) under conditions of continuous exposure (SRS 2006c).

Most of the SRS radiological facilities release small quantities of radionuclides at concentrations below the DOE DCGs. However, tritium (in the oxide form) from the reactor (K-Area and L-Area main stacks) and tritium facilities was emitted in 2005 at concentration levels above the DCGs. The offsite dose from all atmospheric releases, however, remained well below the DOE and EPA annual atmospheric pathway dose standard of 10 millirem (SRS 2006c).

4.8.4.2 *Noise*

Major noise sources in active areas at the SRS include industrial facilities and equipment such as cooling systems, transformers, engines, vents, paging systems; construction and materials handling equipment; and vehicles. Outside of active operational areas, vehicles and trains generate noise. Most industrial facilities at the SRS are located far enough from the site boundary that the associated noise levels at the boundary would be barely distinguishable from background levels.

4.8.5 Water Resources

4.8.5.1 *Surface Water*

The regional drainage is dominated by the north to south running Savannah River. This major river forms with the confluence of the Seneca and the Tugaloo rivers in Lake Hartwell. The Savannah River drains a watershed of 10,577 square miles in the mountains of North Carolina, South Carolina and Georgia. In the western part of the upper basin, the Chatooga and the Tallulah Rivers meet to form the Tugaloo River. In the eastern part, the confluence of Twelve Mile Creek and the Keowee River form the Seneca River. In the upper reaches of Lake Hartwell the Seneca and Tugaloo Rivers join to form the Savannah River.

From the headwaters of the Savannah River to the Atlantic Ocean near Savannah, GA, the waters travel about 300 miles through 4 physiographic regions, the Blue Ridge Mountains, the piedmont, the upper coastal plain and the lower coastal plain. There are 5 main streams that originate on, or pass through the SRS before discharging into the Savannah River Swamp. These are Upper Three Runs, Steel Creek, Pen Branch, Fourmile Branch, and Lower Three Runs (Figure 4.8.5-1). There are 2 major artificial bodies of water onsite, Par Pond and L-Lake. Par Pond covers 2,640 acres and has an average depth of 20 feet, while L-Lake covers 1,000 acres.

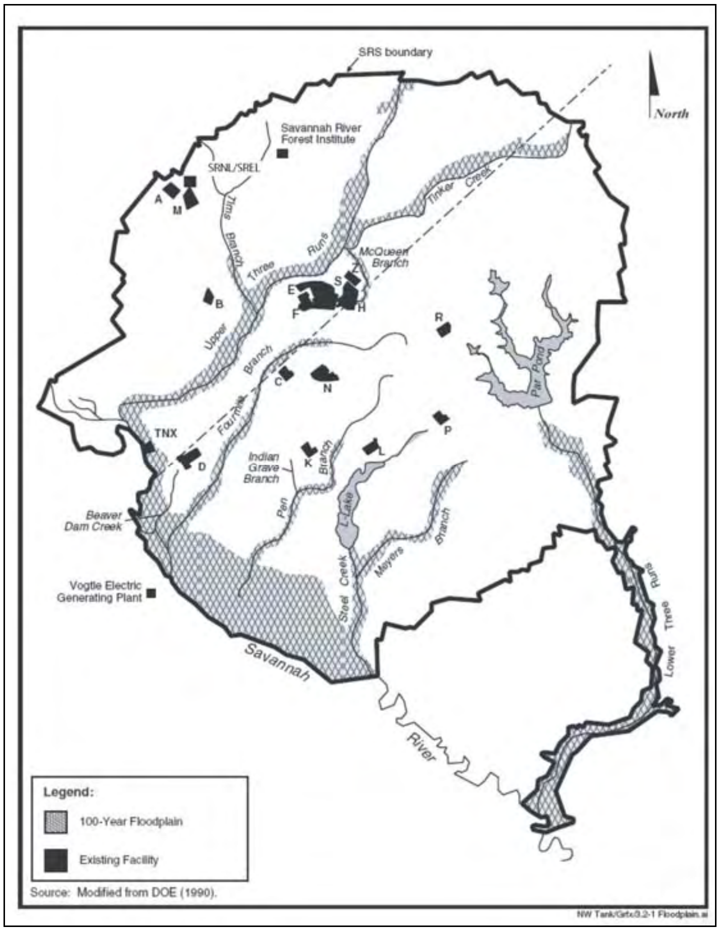


Figure 4.8.5-1—Water Resources at SRS

Upper Three Runs is a 24-mile backwater stream that drains an area of approximately 203 square miles (DOE 1997b; USGS 2008b). The mean monthly discharge for the Upper Three Runs ranges from a low of 201 cubic feet per second in July to a high of 293 cubic feet per second, in March (USGS 2008b).

The Steel Creek originates near the P-Reactor and drains a total area of about 35 square miles. Currently, the flow rate is closer to the natural flow rate of 35 cubic feet per second, and the mean monthly discharge for Steel Creek ranges from a low of 2.8 cubic feet per second in December to a high of 12 cubic feet per second in April (USGS 2008c).In the 1980s, DOE built the L-Lake Dam on Steel Creek to form a cooling reservoir for L-Reactor cooling water discharges.

Pen Branch is approximately 15 miles long and follows a southwesterly path from its headwaters draining an area of about 21 square miles. The mean monthly flow rate for Pen Branch ranges from a low of 5.1 cubic feet per second in June to a high of 13 cubic feet per second in March (USGS 2008d).

The Fourmile Branch follows a southwesterly route for approximately 15 miles and drains an area of 22 square miles. The mean monthly discharge at the USGS station at Road A212.2 ranges from a low of 116 cubic feet per second in October to a high of 160 cubic feet per second in January (USGS 2008e).

Lower Three Runs drains about 286 square miles and flows about 24 miles before entering the Savannah River. The mean monthly discharge on Lower Three Runs ranges from 25 cubic feet per second in October to a high of 48 cubic feet per second in March (USGS 2008f). In the 1950s, DOE built the PAR Pond Dam on Lower Three Runs to form a cooling reservoir for cooling water discharges from P- and R-Reactors.

4.8.5.1.1 Surface Water Quality

The Savannah River is classified as a freshwater source that is suitable for primary and secondary contact recreation, drinking after appropriate treatment, balanced native aquatic species development, and industrial and agricultural purposes. Primary contact is direct contact with the water, such as while swimming. Secondary contact is having some direct contact with the water but where swallowing is unlikely to occur, such as while fishing. Monitoring data collected in 2006 indicate that SRS discharges are not adversely affecting the water quality of onsite streams or the Savannah River (SRS 2007).

The Fourmile Branch watershed drains approximately 22 square miles and includes several facilities at SRS: C Area (reactor), F and H Areas (separations facilities, tank farms, and seepage basins), and the SWDF. Fourmile Branch receives NPDES-permitted discharges from C, F, and H Areas as well as the 1.05MGD Centralized Sanitary Wastewater Treatment Facility. From 1977 to 1995, the mean flow was 113 cubic feet per second, the 7-day low flow was 7.6 cubic feet per second, and the 7Q10 (streamflow that occurs over 7 consecutive days and has a 10-year recurrence interval period, or a 1 in 10 chance of occurring in any one year) was 8.2 cubic feet per second (SRS 2006c).

The Upper Three Runs watershed drains approximately 20.9 square miles with the southernmost 20.9 square miles located within the boundaries of SRS (DOE 2002a). Upper Three Runs receives NPDES-permitted discharges from the F-/H-Area ETF (including the 200-F and 200-H Separation Areas), fuel fabrication facilities (300-M Area), and the SRNL (700-A Area). Streamflow is strongly controlled by ground-water discharge, and mean monthly discharge varies over a narrow range from 96.8 cubic feet per second in October to 114.8 cubic feet per second in March (SRS 2006c).

Steel Creek received cooling water from L-Reactor and ash basins runoff, non-process cooling water, powerhouse wastewater, reactor process effluents, sanitary treatment plant effluents, and vehicle wash waters. From October 1990 to September 1991, the mean flow rate of Steel Creek at SRS Road A was 185 cubic feet per second, with an average temperature of 66°F (UG SREL 2002). During reactor operation, the mean water temperatures of Pen Branch ranged from 92 to 119°F.

The University of Georgia SREL (2006) reports on the historical studies of radioactive contamination on the water, sediments and fauna in and around SRS. Their findings show the presence of radiocesium on soils, plants, snakes, green tree frogs, herons, wood ducks, and arthropods from Steel Creek. Releases of radioactive materials to surface water were highest during the early and middle 1960s. Tritium, cesium-137, and strontium-90 were the main radioactive materials of concern for releases to surface streams at SRS. Meyer et al. (1999) estimated that, for all years of operation at SRS, the total tritium released to the Savannah River is 1.8 million curies, the total cesium-137 released is about 250 curies and the total strontium-90 released to the river for all years is about 100 curies. Other contaminants of concern that have been detected on the waters at SRS are trichloroethylene, cadmium, hydrogen sulfide, lead, mercury, nickel and nitrate. Tritum is the predominant radionuclide detected above background levels in the Savannah River. The annual mean tritium concentration at river mile 118.8 in 2006 was about 3 percent of the drinking water standard. Detectable gross beta activity was observed at all river sampling locations, and was consistent with long-term levels (SRS 2007). Six samples from the Savannah River showed traces of tritium, uranium-234, and -235, and americium-241. SRS conducted off-site sampling of drinking water systems to assess impacts from SRS activities. No EPA drinking water quality standards were exceeded for alpha or beta activity, tritium, strontium-89, and -90. Further, no cobolt-60, cesium-137, uranium-235, plutonium-238, and -239, or curium-244 were detected in any drinking water samples (SRS 2007). Americium-241 was detected at nine locations, uranium-234 at 10 locations, and uranium-238 at five locations (SRS 2007). All samples collected from SRS drinking water systems during 2006 were in compliance with SCDHEC and EPA water quality standards (SRS 2007).

Direct discharges of liquid effluents are quantified at the point of release to the receiving stream, prior to dilution by the stream. The release totals are based on measured concentrations and flow rates. Tritium accounts for more than 99 percent of the total amount of radioactivity released from the site to the Savannah River. In 2006, a total of 3,328 curies of tritium were released to the river (SRS 2007). Based on the measured tritium concentration at River Mile 118.8, this total includes releases from Georgia Power Company’s Vogtle Electric Generating Plant (1,860 curies). The total tritium transport in SRS streams in 2006 decreased by 42 percent from 2005 (SRS 2007). In 2005, the tritium transport in SRS stream was 2,378 curies. In 2006, it was measured at 1,391 curies (SRS 2007).

Due to the decreased river flow in 2006 compared to 2005, the 12-month average tritium concentration measured in Savannah River water near River Mile 118.8 (0.645 picocuries per milliliter) was 18 percent more than the 2005 concentration of 0.546 picocuries per milliliter (SRS 2007). The concentrations at the Beaufort-Jasper Water and Sewer Authority Chelsea (0.443 picocuries per milliliter) and Purrysberg (0.513 picocuries per milliliter) facilities and at the Savannah I&D water treatment plant (0.480 picocuries per milliliter) remained below the EPA MCL of 20 picocuries per milliliter (SRS 2007).

SRS monitors nonradioactive liquid discharges to surface waters through the NPDES, as mandated by the CWA. As required by EPA and SCDHEC, SRS has NPDES permits in place for discharges to the waters of the United States and South Carolina. These permits establish the specific sites to be monitored, parameters to be tested, and monitoring frequency, as well as analytical, reporting, and collection methods.

Under the CWA, SRS's NPDES compliance rate was 99.9 percent. Results from only three of the 4,950 sample analyses performed during 2006 exceeded permit limits (a 99.94 percent compliance rate). Two exceedances were for ammonia (March 2, and March 10 at Outfall G-10) and one exceedance was for lead (August 2, 22, 23, 24, 25, 28, 29, 31, 31 and Sept. 1 for Outfall F-08). DOE reported the exceedances and corrective actions were taken to address each of these permit noncompliances. Two Notices of Violations were received under NPDES from SCDHEC for ammonia at Outfall G-10 and lead at Outfall F-08 (SRS 2007).

At every sampling site, most water quality parameters and metals were detected in at least one sample. Only three samples had detectable pesticides/herbicides in 2006. Several stormwater outfalls exceeded EPA benchmarks for iron, copper, zinc, and other trace metals. Best management practices will be applied to reduce the future incidence of benchmark exceedances. The 2006 monitoring data indicate that SRS discharges are not significantly affecting water quality of the onsite streams or the river (SRS 2007).

4.8.5.2 *Groundwater*

The SRS is underlain by southeast-dipping wedges of unconsolidated sediments of the Atlantic Coastal Plain that extends from its contact with the Piedmont Province at the Fall Line to the edge of the continental shelf. These sediments range from Late Cretaceous to Miocene in age and comprise layers of sand, muddy sand, and clay with subordinate calcareous sediments. These unconsolidated sediments rest on crystalline and sedimentary basement rock (SRS 2006c).

The hydrostratigraphic units of primary interest beneath SRS are part of the Southeastern Coastal Plain Hydrogeologic Province. Within this sequence of aquifers and confining units are two principal subcategories, the overlying Floridan Aquifer System and the underlying Dublin-Midville Aquifer System. These systems are separated from one another by the Meyers Branch Confining System. In turn, each of the systems are subdivided into 2 aquifers, which are separated by a confining unit (SRS 2006c).

4.8.5.2.1 Groundwater Quality

The shallower groundwater aquifers underneath the SRS are contaminated with a variety of elements that range from organic compounds to metals and radionuclides. The sources of the detected groundwater contamination included burial grounds, waste management facilities, canyon buildings, seepage basins, and saltstone disposal facilities (NRC 2005). The shallower Upper Three Runs Aquifer is contaminated with solvents, metals, and low levels of radionuclides near several SRS areas and facilities, including the F-Area. Tritium has been reported in the Gordon Aquifer under the Separation Areas (F- and H-Areas). The deep Crouch Branch Aquifer is generally unaffected by site operations, except for a location near A-Area, where trichloroethylene (TCE) contamination has been found.

One of the most contaminated areas at SRS is near the F-Area seepage basins and inactive process sewer line. There is widespread radionuclide contamination and a subsurface plume of tritium and strontium contamination. Near the F-Area Tank Farm, tritium, mercury, nitrate-nitrite (as nitrogen), cadmium, gross alpha, and lead were detected in concentrations that exceeded drinking water standards in one or more wells. At the Sanitary Sludge Application Site, tritium, specific conductance, lead, and copper values exceeded their drinking water standards in one or more wells. The contaminant plume appears to originate inside F-Area and extend beneath the MOX Fuel Fabrication Facility site, with movement in a fan-like direction of groundwater flow under the proposed MOX facility site (NRC 2005).

There is another large chlorinated solvent plume near the A-Area/M-Area. DOE uses more than 200 wells in this area's groundwater monitoring program and some of the contaminated wells lie within a half-mile of the site boundary. While DOE believes that the major component of groundwater flow is not directly toward the site boundary, flow in the area is complex and difficult to predict (SRS 2006c). This area has been the subject of extensive groundwater cleanup efforts.

The groundwater beneath the Old F-Area Seepage Basin (OFASB) contains iodine-129, nitrate, radium-226, radium-228, strontium-90, tritium, uranium (total), and lead (NRC 2005). A small component of the contaminant plume from OFASB flows beneath the westernmost corner of the proposed MOX site. Contaminant fate and transport models predict that the aquifer is expected to return to an uncontaminated state within 2 to 115 years, depending on the specific contaminant (NRC 2005).

4.8.5.2.2 Groundwater Availability

In the central to southern portion of SRS, the Floridan Aquifer System is divided into the overlying Upper Three Runs Aquifer and the underlying Gordon Aquifer, which are separated by the Gordon Confining Unit. The water table surface can be as deep as 160 feet below ground surface, but intersects the ground surface in seeps along site streams. The top of the Gordon Aquifer typically is encountered at depths of 150–250 feet below ground surface. North of Upper Three Runs Creek, these units are collectively referred to as the Steed Pond Aquifer, in which the Upper Three Runs Aquifer is called the M-Area Aquifer Zone, and the Gordon Aquifer is referred to as the Lost Lake Aquifer Zone. There is an aquitard that separates them, referred to as the Green Clay Confining Zone unit above, which the water table usually occurs at SRS; hence, it is referred to informally as the "Water Table" aquifer (SRS 2006c).

The Dublin-Midville Aquifer System is divided into the overlying Crouch Branch Aquifer and the underlying McQueen Branch Aquifer, which are separated by the McQueen Branch Confining Unit. The top of the Crouch Branch Aquifer typically is encountered at depths of 350–500 feet bgs. The top of the McQueen's Branch Aquifer typically is encountered at depths of 650–750 feet bgs. In aquitards, groundwater velocities range from several inches to several feet per year and in aquifers, from tens to hundreds of feet per year (SRS 2006c).

4.8.6 Geology and Soils

SRS is on the Aiken Plateau of the Upper Atlantic Coastal Plain, about 25 miles southeast of the Fall Line that separates the Atlantic Coastal Plain from the Piedmont. The Aiken Plateau, the subdivision of the Coastal Plain that includes SRS, is highly dissected and characterized by broad, flat areas between streams and narrow, steep-sided valleys. It slopes from an elevation of approximately 650 feet at the Fall Line to an elevation of about 250 feet on the southeast edge of the plateau.

4.8.6.1 *Geology*

The sediments of the Atlantic Coastal Plain dip gently seaward from the Fall Line thickening from essentially 0 feet thick at the Fall Line to more than 4,000 feet at the coast. The topmost sediment layer (known as the Tinker/Santee Formation) consists of 60 feet of Paleocene-age clayey and silty quartz sand, and silt (SRS 2006c). Within this layer, there are occasional beds of clean sand, gravel, clay, or carbonate. Deposits of pebbly, clayey sand, conglomerate, and Miocene and Oligocene-age clay occur at higher elevations. This layer is noteworthy because it contains small, discontinuous, thin calcareous sand zones (i.e., sand containing calcium carbonate) that are potentially subject to dissolution by water. These “soft-zone” areas have the potential to subside, causing settling of the ground surface (SRS 2006c). The second layer of sediments overlies bedrock and consists of about 700 feet of Upper Cretaceous-age quartz sand, pebbly sand, and kaolinitic clay. The underlying bedrock consists of sandstones of Triassic age and older metamorphic and igneous rocks (SRS 2006c).

Because of the proximity of SRS to the Piedmont Province, it has more relief than areas that are nearer the coast, with onsite elevations ranging from 89 to 420 feet above mean sea level.

Subsidence (lowering of the ground surface) and soil liquefaction are two geologic processes that are potentially problematic at SRS. Rock strata under some areas of SRS include layers of pockets of carbonate rock that are subject to dissolution, which would cause subsidence and could lead to soil liquefaction. Sites underlain by these “soft zones” are considered unsuitable for structural formations unless extensive soil stabilization is done. Because the topography is generally flat at the Site, rockfalls and landslides are unlikely occurrences except along the banks of drainage valleys that are widely spaced across the SRS.

4.8.6.2 *Soils*

The surface soils at the SRS consist of Coastal Plain sediments. The surface soils are primarily sands and sandy loams with sporadic clay layers (DOE 1999) overlying a subsoil containing a mixture of sand, silt, and clay. These soils are gently sloping to moderately steep (0 to 10 percent grade) and have a slight erosion hazard (USDA 1990). Some soils on uplands are nearly level, and those on bottomlands along the major streams are level. Soils in small, narrow drainage valleys are steep. Most of the upland soils are well drained to excessively drained. The well-drained soils have a thick, sandy surface layer that extends to a depth of 7 feet or more in some areas. The soils on bottomlands range from well-drained to very poorly drained. Some soils on the abrupt slope breaks have a dense, brittle subsoil (DOE 1998).

4.8.6.3 *Seismology*

The Atlantic Coastal Plain tectonic province in which SRS is located is characterized by generally low seismic activity that is expected to remain subdued (DOE 2004a). There are no active faults on SRS, but several fault systems occur offsite, northwest of the Fall Line. The most active seismic zones in the southeastern United States are all located over 100 miles away from the site. Faults identified onsite include the Pen Branch, Steel Creek, Advanced Tactical Training Area, Crackerneck, Ellenton, and Upper Three Runs. The Upper Three Runs Fault, which passes approximately 1 mile northwest of F-Area, is a Paleozoic fault that does not cut Coast Plain sediments (SRS 2006a).

None of the faults discussed in this section are considered "capable," as defined by the Nuclear Regulatory Commission in 10 CFR 100.23. The capability of a fault is determined by several criteria, one of which is whether the fault has moved at or near the ground surface within the past 35,000 years.

Two major earthquakes have occurred within 186 miles of SRS. The Charleston, South Carolina, earthquake of 1886 had an estimated Richter scale magnitude of 6.8; it occurred approximately 90 miles from the SRS area, which experienced an estimated peak horizontal acceleration of 0.1 g (gravitational acceleration) (DOE 2002a). The Union County, South Carolina, earthquake of 1913 had an estimated Richter scale magnitude of 6.0 and occurred about 99 miles from the site (Bollinger 1973).

Other minor earthquakes occurring off-site of the SRS boundary all had magnitudes on the Richter scale of less than 4.2. In recent years, three minor earthquakes occurred inside the SRS boundary. In 1985, an earthquake occurred with a local Richter scale magnitude of 2.6. Another occurred in 1988 with a local Richter scale magnitude of 2.0. The most recent earthquake inside the SRS boundary was in 1997 with a Richter scale magnitude of 2.3.

4.8.7 Biological Resources

This section describes ecological resources at SRS including terrestrial and aquatic resources, T&E species, and floodplains and wetlands.

4.8.7.1 *Terrestrial Resources*

Currently, nearly 90 percent of the land (191,000 acres) at the SRS is forested with upland pine, hardwood, mixed (pine and hardwood), and bottomland hardwood forests. Loblolly-longleaf-slash pine plantation (*Pinus taeda*, *P. palustris*, *P. elliottii*) is the dominant habitat covering approximately 65 percent of the site. Swamp forests and bottomland hardwood forests are found along the Savannah River. SRS is near the transition between northern oak-hickory-pine forest and southern mixed forest. Thus, species typical of both forest types are found on SRS.

Farming, fire, soil, and topography have influenced SRS vegetation patterns. A variety of plant communities occur in the upland areas. Typically, scrub oak communities are found in the drier, sandier areas. Longleaf pine, turkey oak (*Quercus laevis*), bluejack oak (*Q. incana*), and blackjack oak (*Q. marilandica*) dominate these communities, which typically have understories of wire grass and huckleberry (*Vaccinium* spp.). Oak-hickory communities are usually located on more fertile, dry uplands; characteristic species are white oak (*Q. alba*), post oak (*Q. falcata*), mockernut hickory (*Carya tomentosa*), pignut hickory (*Carya glabra*), and loblolly pine, with and understory of sparkleberry (*Vaccinium arboretum*), holly (*Ilex* spp.), greenbriar (*Smilax* spp.), and poison ivy (*Toxicodendron radicans*).

Wildlife management includes control of white-tailed deer (*Odocoileous virginianus*) and wild pig (*Sus scrofa*) populations through supervised hunts. SRS, which was designated as the first National Environmental Research Park in 1972, is one of the most extensively-studied environments in this country (DOE 2004a).

SRS supports numerous animal species, including 44 amphibians, 60 reptiles, 255 birds and 55 mammals (SRS 2006a). The SRS has among the highest biodiversity of herpetofauna (reptiles and amphibians) in the United States because of the areas' warm, moist climate and its wide variety of habitats (SRS 2006a). Snakes that commonly occur at SRS include eastern hognose snake, eastern garter snake, eastern coachwhip, scarlet king snake, rat snake, corn snake, and pine snake. Lizards that are common include the green anole, southern fence lizard, several species of skinks, and the eastern glass lizard. Amphibians include the southern toad and oak toad. The southern leopard frog, bullfrog, and other frogs and toads commonly occur in the small drainage basins, while amphibians such as tree frogs and salamanders occur within the smaller tributaries (SRS 2006a).

Bird species at the SRS that are common to abundant include black vulture, eastern kingbird, Acadian flycatcher, common crow, northern mockingbird, blue-gray gnatcatcher, ruby-crowned kinglet, red-eyed vireo, northern parula, black-throated blue warbler, ovenbird, northern cardinal, savannah sparrow, white-throated sparrow, and song sparrow. Large numbers of ducks and coots are winter migrants at the SRS (DOE 1996b).

4.8.7.2 *Wetlands and Floodplains*

4.8.7.2.1 Wetlands

Wetlands on the SRS encompass approximately 49,030 acres (over 20 percent of the SRS area) and are extensively and widely distributed. These wetlands include bottomland hardwood forests, cypress-tupelo swamp forests, floodplains, creeks, impoundments, and over 370 Carolina Bays and wetland depressions. A major wetland area is the Savannah River swamp that borders the Savannah River and covers about 19 square miles of SRS (SRS 2007).

4.8.7.2.2 Floodplains

The 100 year flood event could affect the southern section of SRS in the Savannah River Swamp as well as Upper Three Runs, Lower Three Runs, and most of the drainage channels of Steel Creek, Meyers Branch, Four Mile Branch and Pen Branch. Figure 4.8.5-1 displays the 100-year floodplain and major stream systems in the vicinity of the SRS.

4.8.7.3 *Aquatic Resources*

At least 81 fish species have been identified at the SRS (NRC 2005). Man-made ponds support populations of bass and sunfish. Commercial and recreational fish species include American shad, hickory shad, striped bass, largemouth bass, chain pickerel, crappie, bream, sunfish, and catfish (NRC 2005).

Some SRS surface waters are classified as Category I resources. These waters are defined by the U.S. DOI as unique and irreplaceable on a national or eco-regional basis. These areas include Carolina bays and cypress-tupelo swamps. Any surface waters supporting species of concern and areas containing high-quality wetlands or headwater streams (e.g., portions of Upper Three Runs Creek) would also be considered for Category I status (NRC 2005). Aquatic invertebrates (e.g., aquatic insects, snails, clams and worms) and fish surveys indicate that Upper Three Runs Creek is unaffected by SRS NPDES-permitted discharges (NRC 2005). Figure 4.8.5-1 displays the major stream systems in the vicinity of the SRS.

4.8.7.4 *Threatened and Endangered Species*

Seven Federally-listed threatened and endangered species are known to occur on SRS. These are smooth purple coneflower (*Echinacea laevigata*), pondberry (*Lindera melissifolia*), shortnose sturgeon (*Acipenser brevirostrum*), American alligator (*Alligator mississippiensis*), wood stork (*Mycteria americana*), and red-cockaded woodpecker (*Picoides borealis*) (Wike et al. 2006). Table 4.8.7-1 presents the federally- and state-listed species that occur or may occur at SRS.

Table 4.8.7-1—Listed Federal- and State-Threatened and Endangered Species that Occur or May Occur at the SRS, South Carolina

Common Name	Scientific Name	Status	
		Federal	State
Plants			
Relict trillium	*Trillium reliquum*	Endangered	Endangered
Canby's dropwort	*Oxypolis canbyi*	Endangered	Endangered
Harperella	*Ptilimnium nodosum*	Endangered	Endangered
Pondberry	*Lindera melissifolia*	Endangered	Endangered
American chaffseed	*Schwalbea americana*	Endangered	Endangered
Smooth purple coneflower	*Echinacea laevigata*	Endangered	Endangered
Reptiles			
American alligator	*Alligator mississippiensis*	Listed Threatened for similarity in appearance to crocodiles	Not Listed
Gopher tortoise	*Gopherus polyphemus*	Not Listed	Endangered
Spotted Turtle	*Clemmys guttata*	Not Listed	Threatened
Amphibians			
Gopher frog	*Rana capito capito*	Not Listed	Endangered
Birds			
Red-cockaded woodpecker	*Picoides borealis*	Endangered	Endangered
Wood stork	*Mycteria americana*	Endangered	Endangered
Mammals			
Rafinesque's Big-eared bat	*Corynorhinus rafinesquii*	Not Listed	Endangered

Table 4.8.7-1—Listed Federal- and State-Threatened and Endangered Species that Occur or May Occur at the SRS, South Carolina (continued)

Common Name	Scientific Name	Status	
		Federal	State
Southeastern myotis	*Myotis austroriparius*	Not Listed	Threatened
Fish			
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered	Endangered

Sources: SCDNR 2006, DOE 2002a, NRC 2005.

4.8.7.5 *Biological Monitoring and Abatement Programs*

Environmental surveillance at and near the SRS is designed to survey and quantify any effects that routine and non-routine operations could have on the site and on the surrounding area and population. As part of the radiological surveillance program, routine surveillance of all radiation exposure pathways is performed on all environmental media that could lead to a measurable annual dose at and beyond the site boundary. Non-radioactive environmental surveillance at SRS involves the sampling and analysis of surface water, drinking water, sediment, groundwater, and fish. Terrestrial and aquatic food products are also sampled. Food products include meat (beef), fruit, green vegetables (collards), fish (freshwater and saltwater) and shellfish. Survey results are discussed in the *Savannah River Site Annual Environmental Reports* (SRS 2007).

4.8.8 Cultural Resources

4.8.8.1 *Archaeological Resources*

Prehistoric resources at SRS consist of villages, base camps, limited-activity sites, quarries, and workshops. Evidence of prehistoric use of the area is present at approximately 800 recorded archaeological sites. Fewer than 8 percent of these sites have been evaluated for NRHP eligibility (DOE 2002a).

Archaeological resources at the SRS date from the Eocene Age (54 to 39 million years ago) and include fossil plants, numerous invertebrate fossils, and deposits of giant oysters, other mollusks, and bryozoa. All resources from SRS are marine invertebrate deposits and, with the exception of the giant oysters, are relatively widespread and common fossils. Therefore, the assemblages have relatively low research potential or scientific value (DOE 2002a).

4.8.8.2 *Historic Resources*

Historic resources at SRS consist of farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farm dikes, dams, cattle pens, ferry locations, towns, churches, schools, cemeteries, commercial building locations, and roads. Evidence of historic use of the area has been found at approximately 400 of the recorded archaeological sites. About 10 percent of the historic sites have been evaluated for National Register eligibility (DOE 2002a). Systematic historic building surveys have not yet been conducted at SRS. Many of the pre-SRS historic structures were demolished during the initial establishment of SRS in 1950. No nuclear production facilities have been nominated to the NRHP and there are no plans for nominations. Existing SRS facilities lack architectural integrity and do not contribute to the broad historic theme of Manhattan Project or World War II-era nuclear materials.

From a Cold War perspective, SRS has been involved in tritium operations and other nuclear material production for more than 40 years; therefore, some existing facilities and engineering records may become significant as they attain the 50-year age criterion. Given the Site's ongoing missions, the SR and the NNSA-SRSO recognized that site operations may impact Cold War NRHP-eligible properties over the next decade and a plan was needed to avoid, minimize, or mitigate adverse affects to these properties. As a result, the Cold War Built Environment Cultural Resources Management Plan (CRMP) was developed. The CRMP contained a process for reaching decisions concerning the future treatment of SRS Cold War NRHP-eligible historic properties, taking into account their historical significance, integrity, future interpretation and treatment.

4.8.8.3 *Native American Resources*

Native American groups with traditional ties to the SRS area include the Apalachee, Cherokee, Chickasaw, Creek, Shawnee, Westo, and Yuchi. At different times, each of these groups was encouraged by the English to settle in the area to provide protection from French, Spanish, or other Native American groups. During the 1800s, most of the remaining Native Americans residing in the region were relocated to Oklahoma Territory (DOE 2002a). Native American resources in the region include villages, ceremonial lodges, burials, cemeteries, and natural areas containing traditional plants used in ceremonies. In 1991, DOE conducted a survey of Native American concerns about religious rights in the central Savannah River valley. Six Native American groups—the Yuchi Tribal Organization, the National Council of Muskogee Creek, the Indian People's Muskogee Tribal Town Confederacy, the Pee Dee Indian Nation, the Ma Chis Lower Alabama Creek Indian Tribe, and the United Keetoowah Band of the Cherokee—have expressed concerns about sites and items of religious significance within SRS, including plant species traditionally used by them in ceremonies that exist on the SRS (DOE 2002a). DOE has continued to consult with the interested tribal organizations by notifying them about major planned actions at SRS and by providing environmental reports that address proposed actions at the SRS to the organizations for their review and comment (DOE 2002a).

4.8.9 Socioeconomic Resources

Socioeconomic characteristics addressed at SRS include employment, regional economy, and population, housing, and community services. Socioeconomic characteristics are presented for a ROI. The ROI was identified based on the distribution of residences for current SRS employees. The ROI is defined as those counties where approximately 90 percent of the workforce lives.

Portions of SRS are located in Aiken and Barnwell counties. Statistics for socioeconomic characteristics are presented for the ROI, a region consisting of Aiken and Barnwell, South Carolina and Burke and Richmond, Georgia. Figure 4.8.9-1 presents a map of the counties composing the SRS ROI.

4.8.9.1 *Employment and Income*

Labor force statistics are summarized in Table 4.8.9-1. The available labor force (e.g., those greater than 16 years of age and able to work) of the ROI grew by approximately 5 percent from 176,248 in 2000 to 184,646 in 2005. The overall ROI employment experienced a growth rate of 2 percent with 168,894 in 2000 to 172,751 in 2005 (BLS 2007).

The ROI unemployment rate was 6.4 percent in 2005 and 4.2 percent in 2000. In 2005, unemployment rates within the ROI ranged from a low of 5.8 percent in Aiken County, South Carolina to a high of 9 percent in Barnwell County, South Carolina. The unemployment rate in South Carolina in 2005 was 6.7 percent and 5.2 percent in Georgia (BLS 2007).

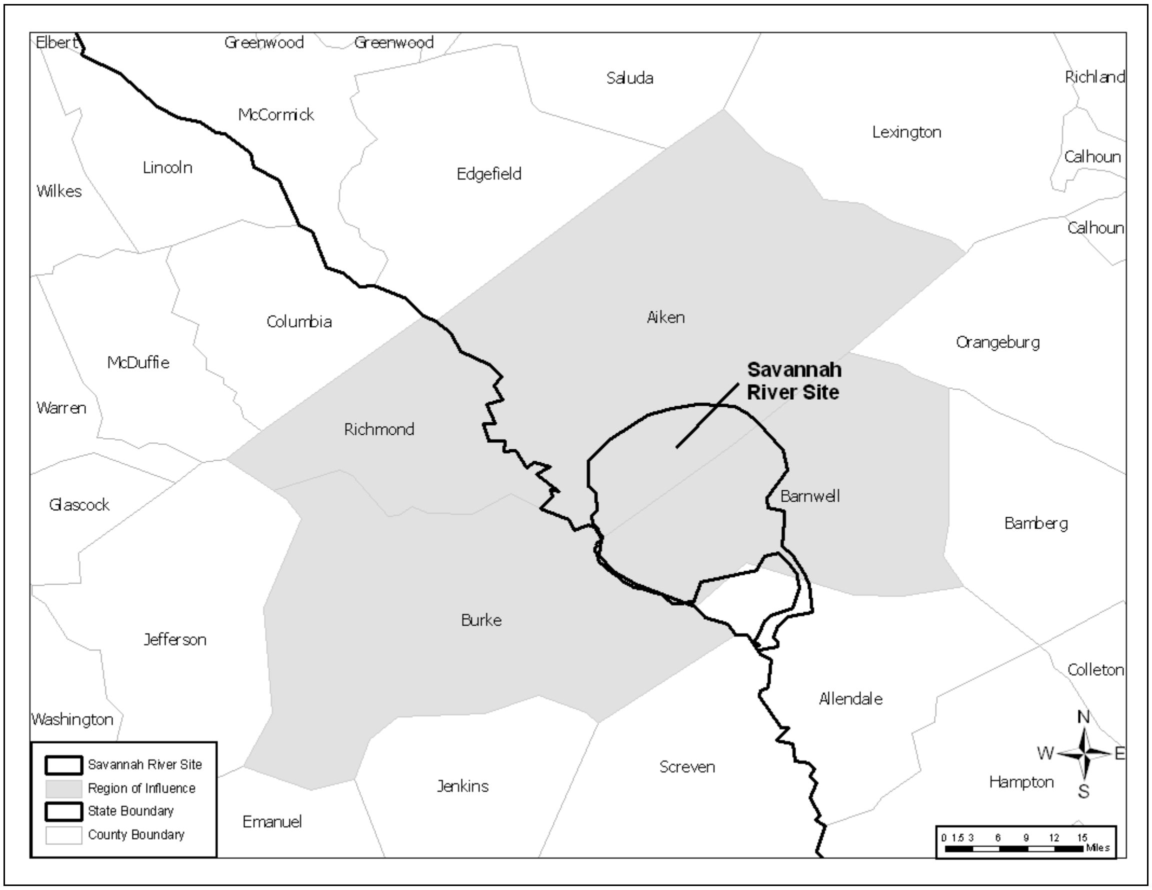


Figure 4.8.9-1—Region of Influence for Socioeconomic Impacts at SRS

Table 4.8.9-1—Labor Force Statistics for ROI, South Carolina, and Georgia

	ROI		South Carolina		Georgia	
	2000	**2005**	**2000**	**2005**	**2000**	**2005**
Civilian Labor Force	176,248	184,646	1,972,850	2,079,339	4,242,889	4,622,105
Employment	168,894	172,751	1,902,029	1,939,646	4,095,362	4,384,030
Unemployment	7,354	11,895	70,821	139,693	147,527	238,075
Unemployment Rate (percent)	4.2	6.4	3.6	6.7	3.5	5.2

Source: BLS 2007.

Income information for the SRS ROI is provided in Table 4.8.9-2. Barnwell County, South Carolina is at the low end of the ROI with a median household income in 2004 of $27,194 and a per capita income of $19,774. Aiken County, South Carolina, at the high end, had a household income of $40,052 and a per capita income of $27,524 (BEA 2007).

Table 4.8.9-2—Income Information for the SRS ROI, 2004

	Per capita income (dollars)	Median household income (dollars)
Aiken	27,524	40,052
Barnwell	19,774	27,194
Burke	19,215	29,159
Richmond	25,343	32,775
South Carolina	27,090	39,454
Georgia	29,628	42,679

Source: BEA 2007.

4.8.9.2 *Population and Housing*

The ROI is used to analyze the primary economic impacts on population and housing. Table 4.8.9-3 presents historic and projected population in the ROI and the state.

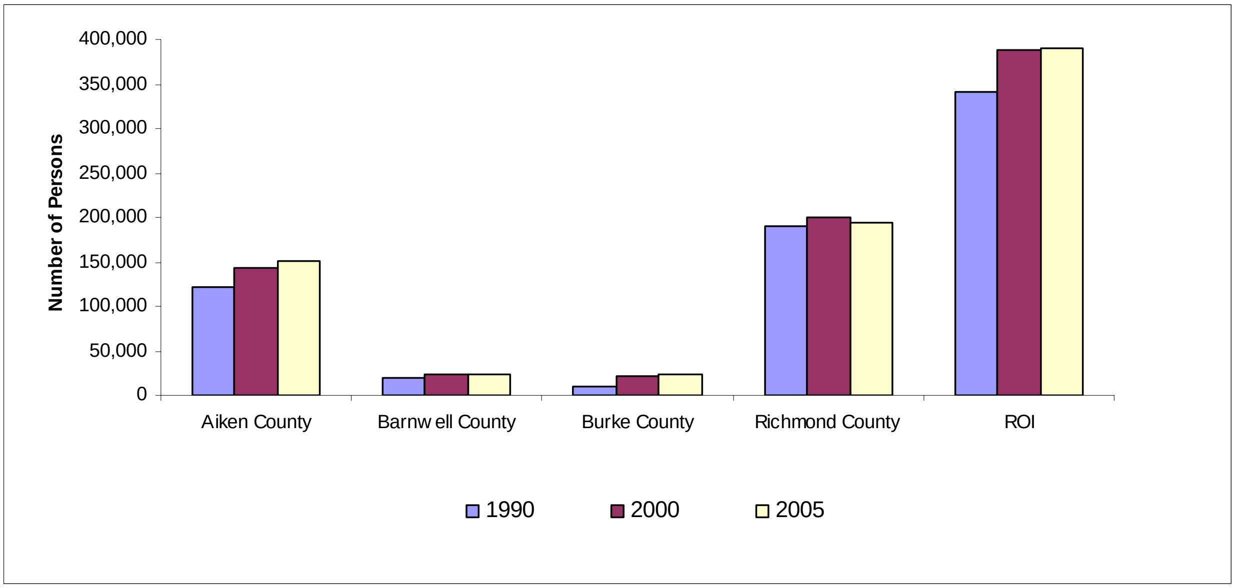
Table 4.8.9-3—Historic and Projected Population

Region	1990	2000	2005	2010	2015
Aiken County	120,940	142,552	150,053	160,020	169,820
Barnwell County	20,293	23,478	23,289	24,340	25,350
Burke County	9,912	22,243	23,154	24,561	25,765
Richmond County	189,719	199,775	194,135	193,194	191,563
ROI	340,864	388,048	390,631	402,115	412,498
South Carolina	3,486,703	4,012,012	4,246,933	4,486,700	4,717,890
Georgia	6,478,216	8,186,453	9,132,553	10,554,171	10,813,573

Source: USCB 2007.

Between 1990 and 2000, the ROI population increased 14 percent from 340,864 in 1990 to 388,048 in 2000. From 2000 to 2005, the population of the ROI increased 1 percent to 390,631 in 2005. Aiken County, South Carolina experienced the largest population growth within the ROI between 2000 and 2005 with an increase of 5 percent while Richmond County, Georgia experienced a decrease of 3 percent (USCB 2007). Figure 4.8.9-2 presents the trends in population within the SRS ROI.

Table 4.8.9-4 lists the total number of housing units and vacancy rates in the ROI. In 2000, the total number of housing units in the ROI was 163,332 with 146,462 occupied (90 percent). There were 97,716 owner-occupied housing units and 48,746 rental units in the ROI. The median value of owner-occupied units in Aiken County, South Carolina was the greatest of the counties in the SRS ROI ($87,600). The vacancy rate was the lowest in Richmond County, Georgia (10.2 percent) and the highest in Barnwell County, South Carolina (11.5 percent) (USCB 2007).



Source: USCB 2007.

Figure 4.8.9-2—Trends in Population for the SRS ROI, 1990-2005

Table 4.8.9-4—Housing in the SRS ROI, 2000

	Total Units	Occupied Housing Units	Owner Occupied Units	Renter Occupied Units	Vacant units	Vacancy Rate (percent)	Median value of Owner Occupied Units (dollars)
Aiken County	61,987	55,587	42,036	13,551	6,400	10.3	87,600
Barnwell County	10,191	9,021	6,810	2,211	1,170	11.5	66,600
Burke County	8,842	7,934	6,030	1,904	908	10.3	59,800
Richmond County	82,312	73,920	42,840	31,080	8,392	10.2	76,800
ROI	163,332	146,462	97,716	48,746	16,870	10.3	79,686

Source: USCB 2007.

4.8.9.3 *Community Services*

Community services analyzed in the ROI include public schools, law enforcement, fire suppression and medical services. There are 7 school districts with 116 schools serving the SRS ROI. Educational services are provided for approximately 67,899 students by an estimated 4,521 teachers for the 2005 to 2006 school year (IES 2006e). The student-to-teacher ratio in these school districts ranges from a high of 15:1 in the Richmond County School District to a low of 14:1 in the Barnwell County School District 19. The average student-to-teacher ratio in the ROI is 15:1 (IES 2006e).

The counties within the ROI employ approximately 4,800 firefighters and law enforcement officers. There are seven hospitals that serve residents of the ROI with the majority located in Richmond County. These hospitals have a total bed capacity of 2,220 (ESRI 2007).

4.8.10 Environmental Justice

The potentially affected area considered for environmental justice analysis is the area within a 50-mile radius of SRS. Figure 4.8.10-1 shows counties potentially at risk from the current missions performed at SRS. There are 20 counties included in the potentially affected area. Table 4.8.10-1 provides the demographic profile of the potentially affected area using data obtained from the 2000 Census.

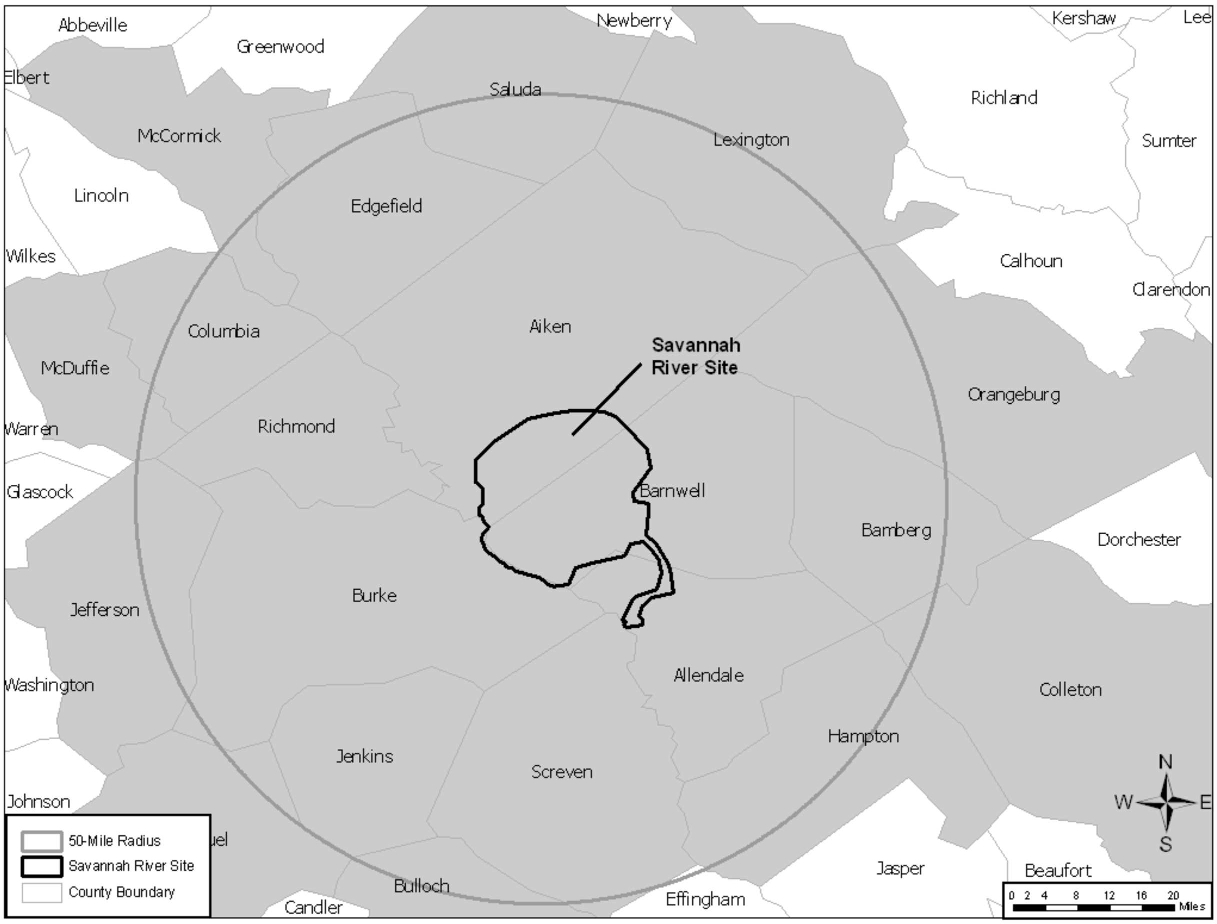


Figure 4.8.10-1—Potentially Affected Counties Surrounding SRS Environmental Justice

In 2000, minority populations represented 39.3 percent of the total population of counties within the 50-mile radius of SRS. Based on 2000 census data, Figure 4.8.10-2 shows minority census SRS census tracts within the 50-mile radius where more than 50 percent of the census SRS population is minority.

Census tracts with minority populations exceeding 50 percent were considered minority census tracts. Based on 2000 census data, Figure 4.8.10-2 shows minority census tracts within the 50-mile radius where more than 50 percent of the census tract population is minority.

Table 4.8.10-1—Population in Potentially Affected Counties Surrounding SRS, 2000

Population Group	Population	Percent
Minority	419,197	**39.3**
Hispanic	14,795	1.4
Black or African American	369,417	34.6
American Indian and Alaska Native	3,348	0.3
Asian	10,647	1.0
Native Hawaiian and Other Pacific Islander	551	0.1
Some other race	8,846	0.8
Two or more races	11,593	1.1
White alone	647,254	**60.7**
Total Population[1]	1,485,648	**100.0**

Source: USCB 2007.
[1] total population in this table reflects the 50-mile population surrounding SRS, which is significantly higher than the ROI population discussed in Section 4.8.9.

Census tracts were considered low-income census tracts if the percentage of the populations living below the poverty threshold exceeded 50 percent. Based on 2000 Census data, Figure 4.8.10-3 shows low-income census tracts within the 50-mile radius where more than 50 percent of the census tracts population is living below the Federal poverty threshold.

According to 2000 census data, approximately 109,296 individuals residing within census tracts in the 50-mile radius of SRS were identified as living below the Federal poverty threshold, which represents approximately 16.4 percent of the census tracts population within the 50-mile radius. There two census tracts located in Richmond County, Georgia with populations greater than 50 percent identified as living below the Federal poverty threshold. In 2000, 14.1 percent of individuals for whom poverty status is determined were below the poverty level in South Carolina, 13 percent in Georgia, and 12.4 percent in the U.S. (USCB 2007).

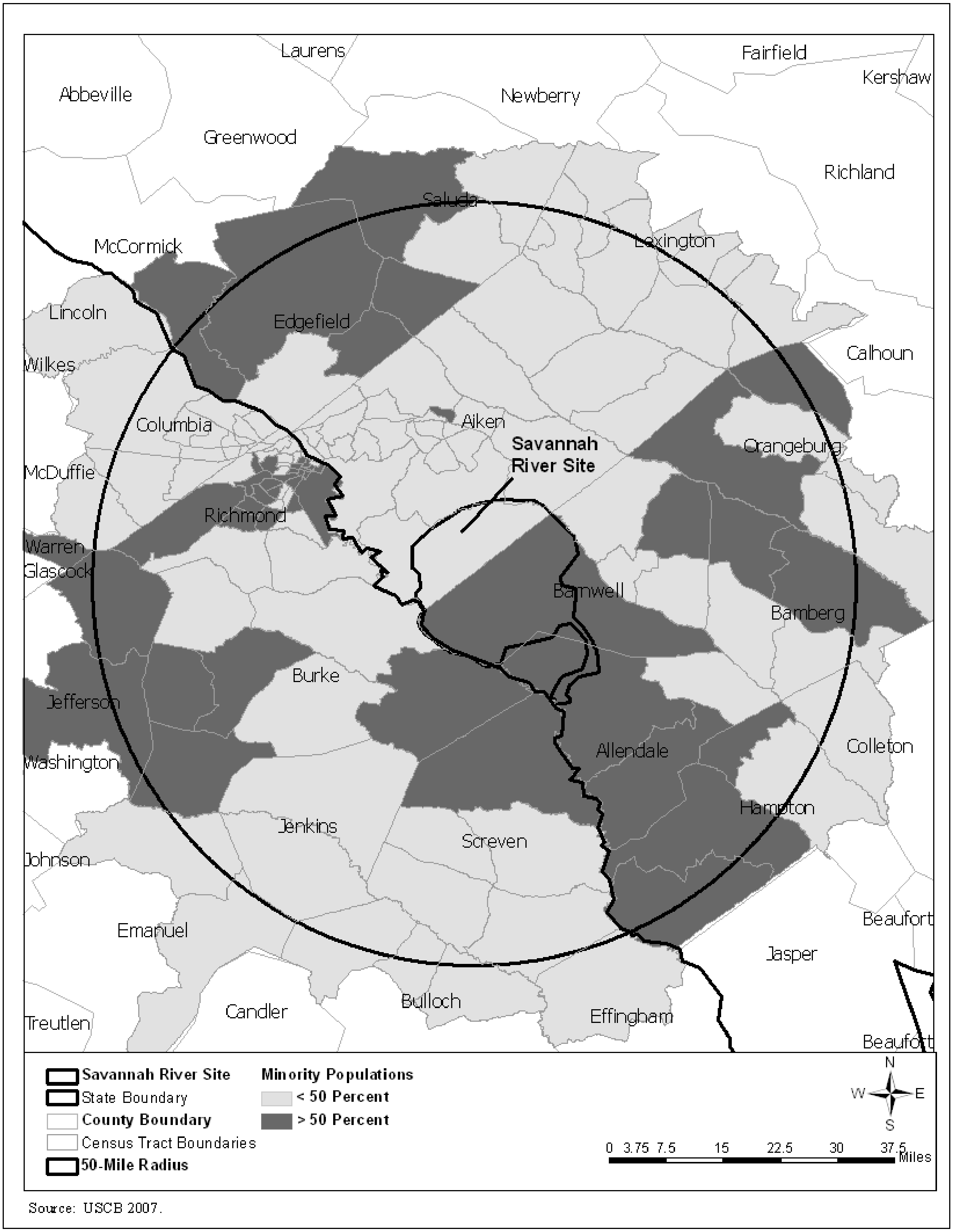


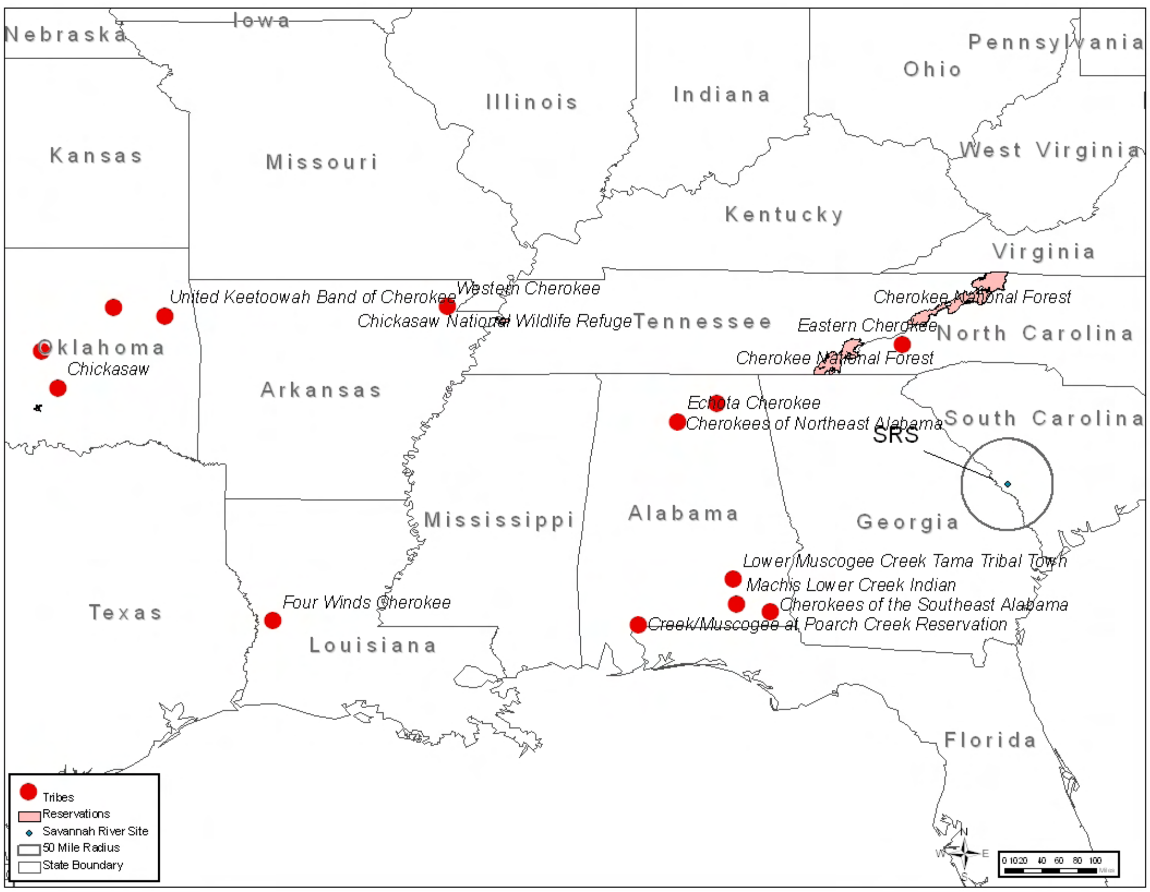
Figure 4.8.10-2—Minority Population – Census Tracts with More than 50 Percent Minority Population in a 50-Mile Radius of SRS

Source: USCB 2007.

Figure 4.8.10-3—Low-Income Population – Census Tracts with More than 50 Percent Low-Income Population in a 50-Mile Radius of SRS

4.8.10.1 *Characteristics of Native American Populations within the Vicinity of or with Interest in SRS Activities/Operations*

As discussed in Section 4.8.8.3, Native American groups with traditional ties to the SRS area include the Apalachee, Cherokee, Chickasaw, Creek, Shawnee, Westo, and Yuchi. Those groups who have recently expressed concern about sites and items of religious significance in the SRS area are the Yuchi Tribal Organization, the National Council of Muskogee Creek, the Indian People's Muskogee Tribal Town Confederacy, the Pee Dee Indian Nation, the Ma Chis Lower Alabama Creek Indian Tribe, and the United Keetoowah Band of the Cherokee. The 2000 U.S. Census Bureau was used to obtain characteristics, including population, employment, educational attainment, income, poverty level, average family size, and housing characteristics for all population subcategories associated with the groups mentioned above. Those groups which were not included in the U.S. Census Bureau data were not able to be included in the analysis and are the Apalachee, Westo, Pee Dee, and Yuchi. The locations of various tribes in relation to NTS are shown in Figure 4.8.10-4. The results of this analysis are provided in the following section.



Source: ESRI 2007.

Figure 4.8.10-4—Location of Tribes within Vicinity of or with Interest in SRS

As shown in Table 4.8.10-2, the Cherokee had the highest of the Native American populations with 302,569 and the Shawnee with the smallest at 6,001 in the year 2000. The Shawnee had the largest percentage of their population as members of the civilian labor force at 66.2 percent, the

Chickasaw with 66 percent, Creek with 65.6 percent, and the Cherokee with 63.9 percent. The Creek had the highest unemployment rate at 5.5 percent and the Chickasaw with the lowest unemployment rate at 4.3 percent (USCB 2007).

Of those individuals over 25 with some form of education, the largest constituency of all Native American populations with ties to SRS had received a high school diploma as shown in Table 4.8.10-3. A slightly lesser percentage of individuals had attended some college and lesser percentages of these populations had received degrees from higher learning institutions (Associate, Bachelor, or Graduate/Professional) (USCB 2007).

In 2000, all Native American populations with ties to SRS had comparable mean household earnings and per capita income. The Chickasaw had the highest mean household earnings and per capita income with $43,842 and $16,255, respectively as shown in Table 4.8.10-4. The Shawnee population had the lowest mean household earnings with $40,746 and the Creek had the lowest per capita income with $14,791 (USCB 2007).

Of all the Native American populations within the vicinity of SRS, the Cherokee had the largest percentage of individuals below the poverty level in 2000 with 18.1 percent as compared to the Shawnee population which had 17.1 percent of the total population living below the poverty level. The percentage of individuals below the poverty level was comparable for all four populations as shown in Table 4.8.10-4 (USCB 2007).

In 2000, the Shawnee had the largest average family size with 3.24 persons, followed by the Chickasaw with 3.23, the Creek with 3.22, and the Cherokee with 3.16 persons per family. The Cherokee had the greater number of occupied housing units which is consistent with their larger population as shown in Table 4.8.10-5 (USCB 2007).

Table 4.8.10-2—Population and Employment Estimates for Native American Populations within the Vicinity of or With Interest in SRS, 2000

SRS	Population	Civilian Labor Force	Civilian Labor Force (percent)	Employed	Employed (percent)	Unemployed	Unemployed (percent)
Cherokee	302,569	148,542	63.9	136,929	58.9	11,613	5
Cherokee Alone	277,862	136,353	63.6	125,527	58.6	10,826	5.1
Cherokees of Northeast Alabama	629	354	72.2	344	70.2	10	2
Cherokees of the Southeast Alabama	707	302	58.1	251	48.3	51	9.8
Eastern Cherokee	8,451	4,033	65.9	3,740	61.1	293	4.8
Echota Cherokee	4,206	2,200	72	2,062	67.5	138	4.5
Northern Cherokee Nation of Missouri and Arkansas	1,664	772	61.9	764	61.3	8	0.6
United Keetoowah Band of Cherokee	496	223	66.6	200	59.7	23	6.9
Western Cherokee	6,693	3,255	64.3	3,048	60.2	207	4.1
Southeastern Cherokee Council	441	266	72.9	254	69.6	12	3.3
Four Winds Cherokee	580	321	73.3	301	68.7	20	4.6
Chickasaw	21,098	9,923	66	9,284	61.8	639	4.3
Creek	40,487	19,194	65.6	17,584	60.1	1,610	5.5
Muscogee (Creek) Nation	36,734	17,330	65.6	15,877	60.1	1,453	5.5
Eastern Creek	1,010	582	72.8	538	67.3	44	5.5
Lower Muscogee Creek Tama Tribal Town	1,058	476	59.9	426	53.7	50	6.3

Table 4.8.10-2—Population and Employment Estimates for Native American Populations within the Vicinity of or With Interest in SRS, 2000 (continued)

SRS	Population	Civilian Labor Force	Civilian Labor Force (percent)	Employed	Employed (percent)	Unemployed	Unemployed (percent)
Machis Lower Creek Indian	187	82	64.1	73	57	9	7
Poarch Creek	1,027	490	63.8	464	60.4	26	3.4
Shawnee	6,001	3,096	66.2	2,865	61.2	231	4.9
Absentee Shawnee Tribe of Indians of Oklahoma	1,747	779	62	729	58	50	4
Eastern Shawnee	1,037	498	67.1	484	65.2	14	1.9
Shawnee Alone	3,210	1,817	68	1,650	61.7	167	6.2

Source: USCB 2007.

Table 4.8.10-3—Level of Educational Attainment by Native American Populations within the Vicinity of or With Interest in SRS, 2000

SRS	High School Graduate	High School Graduate (percent)	Some College	Some College (percent)	Associate Degree	Associate Degree (percent)	Bachelor Degree	Bachelor Degree (percent)	Graduate/ Professional Degree	Graduate/ Professional Degree (percent)
Cherokee	53,710	28.3	48,262	25.4	13,801	7.3	18,963	10	10,943	5.8
Cherokee Alone	49,622	28.3	44,167	25.2	12,566	7.2	17,307	9.9	9,875	5.6
Cherokees of Northeast Alabama	99	24.7	145	36.2	33	8.2	53	13.2	20	5
Cherokees of the Southeast Alabama	109	29.7	107	29.2	46	12.5	52	14.2	15	4.1
Eastern Cherokee	1,392	28.1	1,206	24.4	484	9.8	406	8.2	320	6.5
Echota Cherokee	607	27.4	747	33.7	139	6.3	303	13.7	165	7.5

Table 4.8.10-3—Level of Educational Attainment by Native American Populations within the Vicinity of or With Interest in SRS, 2000 (continued)

SRS	High School Graduate	High School Graduate (percent)	Some College	Some College (percent)	Associate Degree	Associate Degree (percent)	Bachelor Degree	Bachelor Degree (percent)	Graduate/ Professional Degree	Graduate/ Professional Degree (percent)
Northern Cherokee Nation of Missouri and Arkansas	257	24.8	315	30.4	73	7	124	12	111	10.7
United Keetoowah Band of Cherokee	98	37.8	34	13.1	0	0	33	12.7	55	21.2
Western Cherokee	1,113	25.8	1,219	28.2	362	8.4	589	13.6	334	7.7
Southeastern Cherokee Council	78	25.3	130	42.2	39	12.7	7	2.3	12	3.9
Four Winds Cherokee	173	49	54	15.3	36	10.2	10	2.8	4	1.1
Chickasaw	3,653	30.3	3,275	27.2	753	6.3	1,477	12.3	754	6.3
Creek	7,050	30.1	6,282	26.9	1,819	7.8	2,700	11.5	1,302	5.6
Muscogee (Creek) Nation	6,405	30.4	5,702	27	1,538	7.3	2,396	11.4	1,178	5.6
Eastern Creek	198	32.3	106	17.3	50	8.2	134	21.9	56	9.1
Lower Muscogee Creek Tama Tribal Town	228	33.5	187	27.5	72	10.6	31	4.6	42	6.2
Machis Lower Creek Indian	23	26.4	37	42.5	11	12.6	5	5.7	6	6.9
Poarch Creek	140	21.4	167	25.6	104	15.9	85	13	12	1.8
Shawnee	1,101	28.9	1,002	26.3	404	10.6	441	11.6	196	5.1
Absentee Shawnee Tribe of Indians of Oklahoma	300	31.9	219	23.3	66	7	83	8.8	57	6.1
Eastern Shawnee	168	27.6	149	24.5	55	9	90	14.8	36	5.9
Shawnee Alone	633	28.1	634	28.2	281	12.5	268	11.9	100	4.4

Source: USCB 2007.

Table 4.8.10-4—Income and Poverty Level Estimates for Native American Populations within the Vicinity of or With Interest in SRS, 2000

SRS	Mean Household Earnings	Per Capita Income	Individuals Below the Poverty Level	Individuals Below the Poverty Level (percent)
Cherokee	$43,460	$15,994	53,228	18.1
Cherokee Alone	$43,301	$15,968	49,729	18.4
Cherokees of Northeast Alabama	$44,375	$16,281	25	4
Cherokees of the Southeast Alabama	$46,606	$14,349	50	7.1
Eastern Cherokee	$41,727	$14,955	1,517	18.5
Echota Cherokee	$50,087	$17,051	485	11.6
Northern Cherokee Nation of Missouri and Arkansas	$51,654	$18,007	157	9.5
United Keetoowah Band of Cherokee	$30,285	$10,468	189	38.7
Western Cherokee	$45,538	$17,611	883	13.6
Southeastern Cherokee Council	$47,799	$18,665	52	11.8
Four Winds Cherokee	$41,834	$15,043	77	13.4
Chickasaw	$43,842	$16,255	3,556	17.3
Creek	$42,440	$14,791	7,095	18
Muscogee (Creek) Nation	$42,093	$14,641	6,594	18.5
Eastern Creek	$55,615	$19,799	66	6.5
Lower Muscogee Creek Tama Tribal Town	$42,498	$14,186	174	16.7
Machis Lower Creek Indian	$26,916	$7,425	70	37.4
Poarch Creek	$44,954	$17,055	126	12.5
Shawnee	$40,746	$16,094	995	17.1
Absentee Shawnee Tribe of Indians of Oklahoma	$37,771	$12,162	295	17.4
Eastern Shawnee	$37,713	$14,652	139	13.9
Shawnee Alone	$42,825	$18,686	561	18.1

Source: USCB 2007.

Table 4.8.10-5—Housing Characteristics for Native American Populations within the Vicinity of or With Interest in SRS, 2000

SRS	Average Family Size	Housing Units	Occupied Housing Units	Owner Occupied Housing Units	Owner Occupied Housing Units (percent)	Renter Occupied Housing Units	Renter Occupied Housing Units (percent)
Cherokee	3.16	113,244	112,873	69,001	61.1	43,872	38.9
Cherokee Alone	3.16	104,243	103,926	62,673	60.3	41,253	39.7
Cherokees of Northeast Alabama	2.73	269	274	191	69.7	83	30.3
Cherokees of the Southeast Alabama	3.28	223	239	171	71.5	68	28.5
Eastern Cherokee	3.17	3,008	3,020	2,274	75.3	746	24.7
Echota Cherokee	3.29	1,357	1,326	934	70.4	392	29.6
Northern Cherokee Nation of Missouri and Arkansas	3.22	671	655	470	71.8	185	28.2
United Keetoowah Band of Cherokee	3.59	142	147	77	52.4	70	47.6
Western Cherokee	3.06	2,610	2,543	1,692	66.5	851	33.5
Southeastern Cherokee Council	2.76	185	178	137	77	41	23
Four Winds Cherokee	3.01	220	228	166	72.8	62	27.2
Chickasaw	3.23	7,554	7,600	4,771	62.8	2,829	37.2
Creek	3.22	14,413	14,431	9,251	64.1	5,180	35.9
Muscogee (Creek) Nation	3.23	12,984	12,984	8,106	62.4	4,878	37.6
Eastern Creek	2.8	401	388	317	81.7	71	18.3
Lower Muscogee Creek Tama Tribal Town	3.31	392	387	302	78	85	22
Machis Lower Creek Indian	2.98	60	60	50	83.3	10	16.7
Poarch Creek	3.33	405	441	329	74.6	112	25.4
Shawnee	3.24	2,290	2,331	1,367	58.6	964	41.4
Absentee Shawnee Tribe of Indians of Oklahoma	3.49	630	662	403	60.9	259	39.1
Eastern Shawnee	3.11	298	291	157	54	134	46
Shawnee Alone	3.14	1,359	1,374	803	58.4	571	41.6

Source: USCB 2007.

4.8.11 Health and Safety

Current activities associated with routine operations at SRS have the potential to affect worker and public health. The following discussion characterizes the human health impacts from current releases of radioactive and nonradioactive materials at SRS. It is against this baseline that the potential incremental and cumulative impacts associated with the alternatives are compared and evaluated.

4.8.11.1 *Public Health*

4.8.11.1.1 Radiological

Releases of radionuclides to the environment from SRS operations are a source of radiation exposure to individuals in the vicinity of SRS. During 2005, SRS' environmental radiological monitoring program was conducted according to DOE Orders 450.1, "Environmental Protection Program," and 5400.5, "Radiation Protection of the Public and the Environment." The program involved measuring radioactivity in environmental samples in addition to calculating the potential radiological dose to the offsite public.

The exposure of members of the public to all DOE sources of radiation is limited by the DOE to levels that shall not cause, in a year, an effective dose equivalent greater than 100 millirem. Demonstration of compliance with this limit is documented by a combination of measurements and calculations including the comparison of concentrations of radioactive material in air and water to DCGs listed in Chapter III of DOE Order 5400.5. The DOE provides a level of protection for persons consuming water from a public drinking water supply equivalent to the drinking water criteria in 40 CFR 141 by limiting the effective dose equivalent in a year to 4 millirem. Compliance with this criterion is demonstrated by comparing measured concentrations of radionuclides in drinking water to 4 percent of the DCG values for ingested water. The DOE further limits emissions of radionuclides to the ambient air from DOE facilities to those amounts that would not cause any member of the public to receive, in any year, an effective dose equivalent of 10 millirem per year. This limit is equivalent to the limit for air emissions of radionuclides other than radon established by the EPA at 40 CFR 61.92.

Compliance with the dose limit specified in 40 CFR 61.92 (and hence that for the air pathway specified in DOE Order 5400.5) is demonstrated by calculating the effective dose equivalent received by the maximally exposed individual member of the general public. This individual is a person who resides near SRS, and who would receive, based on theoretical assumptions about lifestyle that maximize exposure to radiological emissions, the highest effective dose equivalent from SRS operations. Calculations are performed using the EPA's CAP88-PC model (EPA 1992).

The dose received by the MEI and the collective population dose are tabulated in Table 4.8.11-1. As shown in that table, the highest potential dose to the MEI from liquid releases in 2005 was estimated at 0.08 millirem. This dose is 0.08 percent of the DOE Order 5400.5 ("Radiation Protection of the Public and the Environment") 100-millirem all-pathway dose standard for annual exposure and is 11 percent less than the 2004 dose of 0.09 millirem. Approximately

57 percent of the 2005 dose to the MEI resulted from the ingestion of cesium-137, mainly from the consumption of fish, and about 32 percent resulted from the ingestion (via drinking water) of tritium. In 2005, the collective dose from SRS liquid releases was estimated at 2.5 person-rem. This is 19 percent less than the 2004 collective dose of 3.1 person-rem (SRS 2006c).

In 2005, the estimated dose from atmospheric releases to the MEI was 0.05 millirem, which is 0.5 percent of the DOE Order 5400.5 air pathway standard of 10 millirem per year. This dose is slightly less than the 2004 MEI dose of 0.06 millirem. Tritium oxide releases accounted for 66 percent of the dose to the MEI, and iodine-129 emissions accounted for 10 percent of the dose. No other radionuclide accounted for more than 5 percent of the MEI dose. The major pathways contributing to the dose to the MEI from atmospheric releases were inhalation (43 percent) and the consumption of vegetation (41 percent), cow milk (10 percent), and meat (4 percent). In 2005, the collective dose was estimated at 2.5 person-rem, which is less than 0.01 percent of the collective dose received from natural sources of radiation (about 214,000 person-rem). Tritium oxide releases accounted for about 68 percent of the collective dose. The 2005 collective dose is 14 percent less than the 2004 collective dose of 2.9 person-rem (SRS 2006c).

Table 4.8.11-1—Radiation Doses to the Public from Normal SRS Operations in 2004 (Total Effective Dose Equivalent)

Members Of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Offsite MEI (mrem)	10	0.05	4	0.08	100	0.13
Population within 50 miles[b] (person-rem)	None	2.5	None	2.5	None	5.0

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the *Clean Air Act* (40 CFR 61) and the 4-mrem/yr limit is required by the *Safe Drinking Water Act* (40 CFR 141). For this EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. If the potential collective dose to the offsite population exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.

[b] 50-mile population is approximately 808,000 based on 2000 census data

Source: SRS 2006c.

mrem=millirem

SRS workers receive the same dose as the general public from background radiation, but they also may receive an additional dose from working in facilities with nuclear materials. The current DOE worker exposure limit is 5,000 millirem per year, and the SRS administrative control level for the whole body is 500 millirem per year. SRS worker doses have typically been well below DOE worker exposure limits.

As shown in Table 4.8.11-2, the average radiation dose recorded for workers at SRS in 2005 was 51.4 millirem (SRS 2006c). The cumulative dose to all workers at SRS from operations in 2001 was 121.3 person-rem. These doses fall within the radiological regulatory limits of 10 CFR 835.

4.8.11.1.2 Nonradiological

In 2004, the annual air compliance inspection was conducted in two phases—the first phase by both SCDHEC and EPA as part of a multimedia inspection and the second by the SCDHEC District Air manager. During these inspections, all SRS permitted sources were found to be in compliance with their respective permit conditions and limits, and all required reports were determined to have been submitted to SCDHEC within specified time limits (SRS 2006c).

Under existing regulations, SRS is not required to conduct onsite monitoring for ambient air quality; however, the site is required to show compliance with various air quality standards. To accomplish this, air dispersion modeling was conducted during 2004 for new emission sources or modified sources as part of the sources' construction permitting process. The modeling analysis showed that SRS air emission sources were in compliance with applicable regulations (SRS 2006c).

Table 4.8.11-2—Radiation Doses to Workers From Normal SRS Operations in 2005 (Total Effective Dose Equivalent)

Occupational Personnel	Standard	Actual
Average radiation worker dose (mrem)	5,000[a]	51.4
Collective radiation worker dose[b] (person-rem)	None	121.3

Source: SRS 2006c.
[a] DOE's goal is to maintain radiological exposure as low as is reasonably achievable. The SRS Administrative Control Level (ACL) for 2001 was 800 mrem.
[b] There were 2,360 workers with measurable doses in 2005.

4.8.12 Transportation

SRS is surrounded by a system of interstate highways, U. S. highways, state highways, and railroads. The regional transportation network services the 4 South Carolina counties (Aiken, Allendale, Bamberg, and Barnwell) and 2 Georgia counties (Columbia and Richmond) that generate nearly all of the SRS commuter traffic. Figure 4.8.12.1–1 shows the regional transportation infrastructure.

I-20 serves the SRS region, providing the primary east-west corridor. I-520 provides a loop around Augusta, Georgia. Truck shipments to (or from) the SRS or from (or to) other DOE sites normally enter the region from the west on I-20. In Augusta, Georgia, the trucks typically take I-520 to the Georgia/South Carolina border where U.S. 278 and S.C. 125 route the trucks into site at the Jackson Gate.

There are 6 principal access roads to the site: 3 from the north (S.C. 125, S.C. 57, and S.C. 19) and 3 from the east and south (S.C. 125, S.C. 64, and S.C. 39). The eastern and southern accesses are from rural areas and do not bear a large fraction of the SRS commuting traffic. Those from the north, however, provide access to SRS from the metropolitan areas surrounding Augusta, Georgia, and Aiken and North Augusta, South Carolina. The traffic on these access roads can be heavy at times, with a significant contribution from SRS traffic. The average commute is assumed to be a 20 mile round trip, with an average occupancy of 1.5 passengers per car. Information is based on best data available.

Transportation of Surplus Plutonium to SRS

DOE will ship plutonium materials compliant with the DOE-STD-3013 in 3013 packages inside Type B shipping containers (e.g., 9975 containers) from Hanford, LLNL, and LANL to KAMS at SRS using safe secure trailers (SST). DOE will ship unirradiated FFTF fuel from Hanford to

SRS in Type B shipping packages (e.g., the Hanford Un-irradiated Fuel Package) in SSTs. At KAMS, the 9975 containers will be received and stored; the 3013 packages will not be removed from the 9975 shipping containers. The Type B shipping packages containing the unirradiated FFTF fuel will be stored in the K-Area complex at SRS.

In the *Surplus Plutonium Disposition (SPD) EIS* (DOE 1999h), DOE estimated that normal (incident-free) transportation operations could result in 0.024 latent cancer fatalities (LCF) among transportation workers and 0.034 LCF in the total affected population over the duration of the transportation activities. In preparing the SPD EIS, DOE used a dose conversion factor of 5×10^{-4} deaths per rem of dose to the affected population. Currently, DOE recommends a dose conversion factor of 6×10^{-4} deaths per rem. Using the currently recommended dose conversion factor, the estimated risk would be about 0.029 LCF among transport workers and about 0.041 LCF in the total affected population.

In addition, DOE estimated that 0.019 nonradiological fatalities could occur as a result of vehicular emissions. DOE also estimated the impacts of accident scenarios, and in all cases the risk of a fatality is less than one. No accidents occurred during shipment of the RFETS plutonium to the SRS.

4.8.12.1 *Aircraft Operations*

Aiken Municipal Airport serves Aiken and Aiken County and is owned by the city of Aiken. This airport is approximately 5 miles from Aiken and provides general aviation services. The nearest commercial airport is Augusta Regional Airport in Augusta, Georgia, approximately 35 miles from Aiken. Augusta Regional Airport and Columbia Metropolitan Airport in Columbia, South Carolina, approximately 60 miles from Aiken, receive jet air passenger and cargo service from both national and local carriers. There also are numerous smaller private airports located in Aiken and surrounding areas.

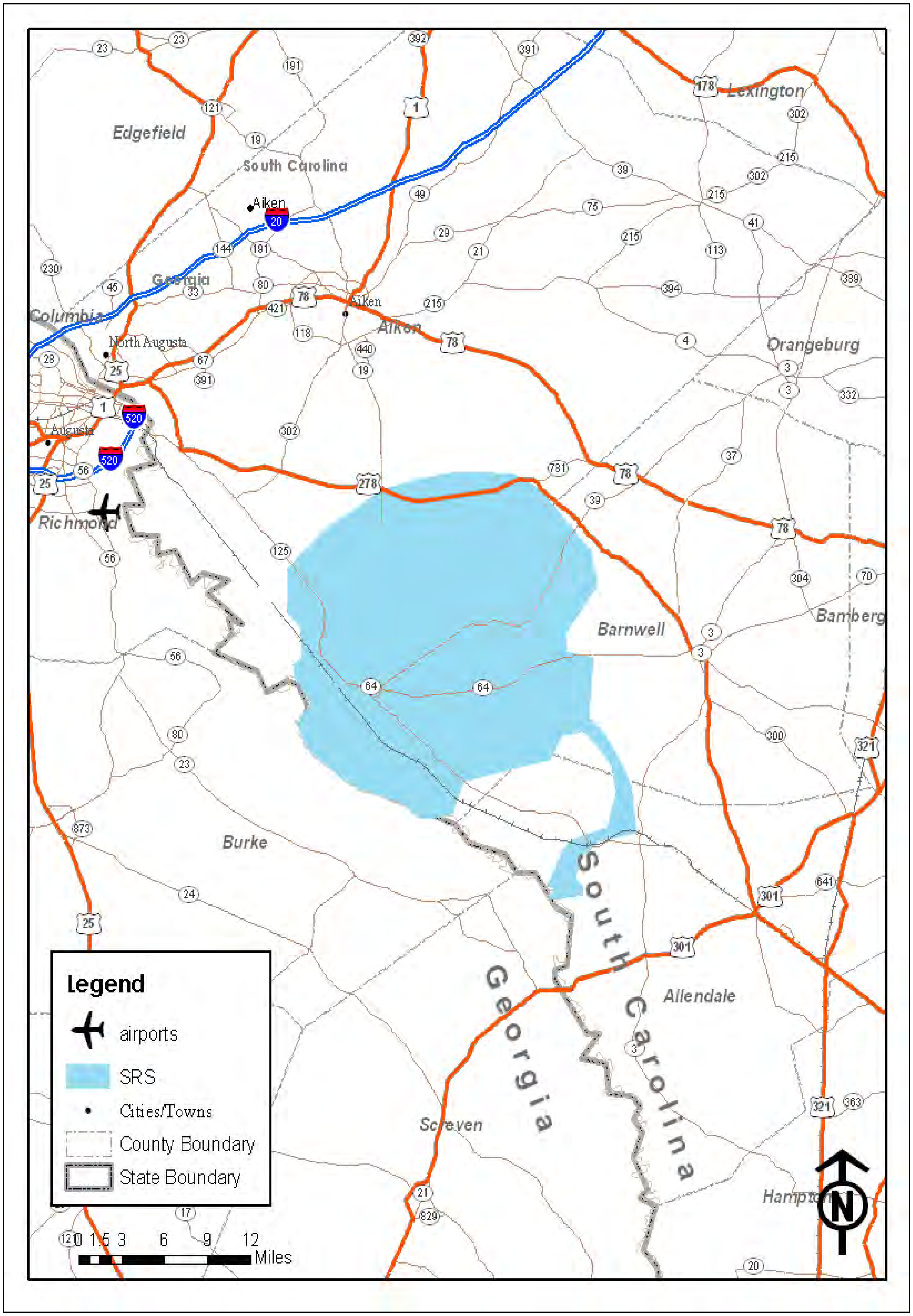


Figure 4.8.12–1—Roads in the Vicinity of the SRS

4.8.13 Waste Management

SRS manages spent nuclear fuel, high-level waste (HLW), LLW, MLLW, TRU waste, hazardous waste, sanitary solid waste, low-level wastewater, and sanitary sewage. Table 4.8.13-1 provides the routine waste generation rates at SRS. Table 4.8.13-2 summarizes the waste management capabilities at SRS.

Each operation at SRS has the goal of identifying and implementing measures that minimize waste and prevent pollution. Pollution prevention is integral to the SRS Environmental Management System. SRS's Pollution Prevention Program establishes the preference of source reduction and recycling over treatment, storage, and disposal. Accomplishment during 2004 included completion of 51 pollution prevention projects, resulting in an annualized avoidance of 9,277 cubic yards of waste, with an accompanying cost avoidance of $41.5 million (SRS 2006c).

SRS is also engaged in cleanup and decommissioning and demolition projects. SRS is responsible for cleaning up more than 500 waste and groundwater units to reduce risk and protect human health and the environment. In 2004, SRS had completed more than 300 of the units. By 2025, all inactive SRS waste sites that pose a risk to human health or the environment will be remediated and controlled, and contaminated surface and groundwater will be remediated, in remediation, or closely monitored. Across the site, there are about 6,000 buildings, encompassing about 10 million square feet. D&D work is expected to continue until about 2025 (SRS 2006c).

4.8.13.1 *Low-Level Waste*

DOE uses a number of methods for treating and disposing of LLW at SRS, depending on the waste form and activity. Some LLW that is not technically or economically suitable for disposal at SRS is shipped to the NTS or the Energy Solutions Disposal Facility in Utah for disposal (DOE 2002a). SRS completed disposing of its legacy LLW in 2005 (SRS 2006c).

4.8.13.2 *Mixed Low-Level Waste*

Storage facilities for MLLW are located in several SRS areas (see Table 4.8.13-2). These facilities are dedicated to solid, containerized, or bulk liquid waste and all are approved under RCRA as interim status or permitted facilities, or as CWA-permitted tank systems.

SRS is utilizing offsite permitted vendors for MLLW treatment and disposal. In 2005, 343 cubic yards were shipped offsite for disposal (SRS 2006c). In December 2005, the NTS received a RCRA permit that would allow disposal of mixed waste generated at other DOE sites (NTS 2006a). SRS plans to dispose of mixed waste at the NTS. Mixed waste not suitable for existing treatment and disposal facilities will continue to be stored at SRS, while DOE pursues treatment options.

4.8.13.3 *High-Level Waste*

SRS continues to manage approximately 36 million gallons of HLW in 49 underground tanks. The waste separates into 2 parts, sludge that settles on the bottom of the tank containing most of the radioactivity and a watery supernate that occupies the area above the sludge. The supernate is volume reduced by an evaporator. As the concentrated supernate cools, salts precipitate and form a solid salt cake (SRS 2006c).

Sludge is transferred to the Extended Sludge Processing Facility where it is washed to reduce the concentration of sodium salts. The washed sludge is then processed in the Defense Waste Processing Facility (DWPF) where it is vitrified with glass frit and sealed in stainless steel canisters. The sealed canisters will be stored at SRS until a federal repository is available.

The salt cake and concentrated supernate will be processed in the Salt Waste Processing Facility. The start of radioactive operations is planned for 2011. In order to ensure that tank space is available to operate the DWPF, the Modular Caustic Side Solvent Extraction Unit and the Actinide Removal Process will be used for salt waste processing until a full-scale facility is operational.

4.8.13.4 *Transuranic Waste*

DOE TRU waste is to be disposed of at the WIPP in New Mexico. SRS stores transuranic waste from past DOE onsite and offsite operations on concrete pads. In 2001, SRS initiated its program to re-package TRU waste and ship it to the WIPP. DOE uses a vendor for the inspection, characterization, and shipment of TRU waste. The vendor's equipment was set up on TRU Pads 3 and 4 and began operations in 2001 using three mobile systems; a real-time radiography trailer, nondestructive assay trailer, and drum headspace gas sampling system. After inspection/characterization of the waste is completed, a mobile loading unit places the drums into Transuranic Package Transporter (TRUPACT-II) containers for transport. The vendor processes are supported by the SRS Visual Examination Facility located on Pad 6 (Washington SRC 2006).

4.8.13.5 *Hazardous Waste*

At present, DOE stores hazardous wastes in three buildings and on three pads that have RCRA permits. SRS hazardous waste streams consist of a variety of materials, including mercury, chromate, lead, paint solvents, and various laboratory equipment. Hazardous waste is sent to offsite treatment and disposal facilities. DOE also plans to continue to recycle, reuse, or recover certain hazardous wastes, including metals, excess chemicals, solvents, and chlorofluorocarbons (DOE 2002a).

4.8.13.6 *Nonhazardous Solid Waste*

SRS sanitary waste volumes have declined due to increased recycling and the decreasing workforce. DOE sends sanitary waste that is not recycled or reused to the Three Rivers Regional Landfill located on SRS (DOE 2002a). It is expected that the level of sanitary waste at SRS could increase in the next several years.

The construction and demolition debris generated by SRS operations is disposed of at a planned facility.

4.8.13.7 *Waste Generation*

Average annual amounts of waste generated from normal operations at SRS are listed in Table 4.8.13-1.

Table 4.8.13-1—Annual Routine Waste Generation from SRS Operations (m^3)

Waste type	1996	1997	1998	1999	2000	2001
Transuranic	165	119	61.9	42.4	54	64.1
Low-level	5,780	6,620	6,520	4,970	5,220	4,610
Mixed	452	286	463	402	290	380
Hazardous[a]	57.0	55.0	177	26.5	30.8	45.3
Sanitary[b]	2,780	2,770	2,640	1,760	1,550	1,560

Source: DOE 2002o.
[a]Hazardous waste reported in metric tons.
[b]From DOE 2002o (1996 data) and DOE's Central Internet Database. Sanitary waste reported in metric tons.

4.8.13.8 *Waste Management Facilities*

Facilities at SRS used for the management of hazardous and nonhazardous waste are listed in Table 4.8.13-2.

Table 4.8.13–2—Waste Management Facilities at SRS

Facility Name/Description	Capacity	Status	Waste Type							
			High-level	Spent fuel	Low-level	Mixed	TRU	Hazardous	Non-hazardous solid	Sanitary sewage
Treatment Facility (cubic meters per year)										
TRU waste characterization/certification		Operational					X			
Saltstone Manufacturing and Disposal Facility		Operational			X	X				
Defense Waste Processing Facility		Operational	X							
Extended Sludge Processing Facility		Operational	X							
Modular Caustic Side Solvent Extraction Unit		Planned	X							
Salt Waste Processing Facility		Planned	X							
Effluent Treatment Facility		Operational			X	X				
Centralized Sanitary Wastewater Treatment Facility		Operational								X
Waste Sort Facility		Operational			X					
Supercompacter Facility		Operational			X					
Storage Facility (cubic meters)										
Hazardous Waste Storage Facility	2,956[a]	Operational						X		
Mixed Waste Storage Building 643-29E	504[a]	TBD				X				
Mixed Waste Storage Building 643-43E	1,651[a]	TBD								
Mixed Waste Storage Building 316-M	117[a]	TBD								
TRU Waste Pads 1-19	15,257[a]	Operational					X			
Long-lived waste storage buildings	140[a]	Operational								
Glass waste storage buildings (number of canisters)	TBD	Operational	X							
SRTC Mixed Waste Storage Tanks	198[a]	TBD				X				

Table 4.8.13–2—Waste Management Facilities at SRS (continued)

Facility Name/Description	Capacity	Status	Waste Type							
			High-level	Spent fuel	Low-level	Mixed	TRU	Hazardous	Non-hazardous solid	Sanitary sewage
Storage Facility (cubic meters) (continued)										
Liquid Waste Solvent Tanks S33-S36	454 [a]	TBD				X				
F-Area Tank Farm		Operational	X							
H-Area Tank Farm		Operational	X							
Disposal Facility										
E-Area shallow land disposal trenches		Operational			X					
E-Area low-activity waste vaults	30,500 ea. [a]	Operational			X					
E-Area intermediate-activity waste vaults	5,300 ea. [a]	Operational			X					
Saltstone Manufacturing and Disposal Facility	80,000 per vault [a]	Operational	X							
Three Rivers Landfill		Operational							X	

[a] Source: DOE 2002a.

4.9 Y-12 SITE

The Oak Ridge Reservation (ORR) was established in 1943 as one of the three original Manhattan Project sites, and includes the Y-12 Site, the Oak Ridge National Laboratory (ORNL), and the East Tennessee Technology Park (ETTP). Most of ORR lies within the corporate limits of the city of Oak Ridge, Tennessee. The ORR is bordered on the north and east by the city of Oak Ridge and on the south and west by the Clinch River/Melton Hill Lake impoundment. ORR is approximately 15 miles west of Knoxville, Tennessee. The ORR covers approximately 35,000 acres in Oak Ridge, TN (Figure 4.9-1).

Y-12 is the primary site for enriched uranium (EU) processing and storage, and one of the primary manufacturing facilities for maintaining the U.S. nuclear weapons stockpile. Y-12 is unique in that it is the only source of secondaries, cases, and other weapons components within the Complex. Y-12 also dismantles weapons components, safely and securely stores and manages SNM, supplies SNM for use in naval and research reactors, and dispositions surplus materials. Y-12's nuclear nonproliferation programs play a critical role in securing our Nation and the globe by combating the spread of weapons of mass destruction by removing, securing, and dispositioning special nuclear threats. Other activities at Y-12 are not defense-related, and include environmental monitoring, remediation, and D&D activities; management of waste materials from past and current operations; research activities operated by ORNL; and support of other Federal agencies.

4.9.1 Land Use

4.9.1.1 *Onsite Land Uses*

DOE classifies land use on the ORR according to five categories: Institutional/Research, Industrial, Mixed Industrial, Institutional/Environmental Laboratory, and Mixed Research/Future Initiatives (DOE 2001a). Remote sensing data from 1994 showed 70 percent of the ORR in forest cover while 20 percent was transitional, consisting of old fields, agricultural areas, cutover forest lands, roadsides, and utility corridors (LMER 1999a). Less than 2 percent of ORR is still open agricultural fields. The finer textured soils of the Armuchee-Montellallo-Hamblen association have been designated as prime farmland when drained.

As shown on Figure 4.9.1-1, the main area of Y-12 is largely developed and encompasses approximately 800 acres, nearly 600 of which are enclosed by perimeter security fences. The main site, which has restricted access, is roughly 2.5 miles in length and 0.5 mile wide. At the end of FY 2005, real property included 440 buildings and other structures with a floor area of approximately 7.1 million square feet. While NNSA is the site landlord and is responsible for approximately 74 percent of the floor space (5.3 million square feet), other DOE program offices have responsibility for the remaining 26 percent. DOE's Offices of Science and Nuclear Energy own approximately 1.2 million square feet, and the Office of Environmental Management (EM) owns approximately 0.6 million square feet (NNSA 2007c). As a result of the site's defense support, manufacturing, and storage facilities, the land in the Y-12 area is classified as industrial.

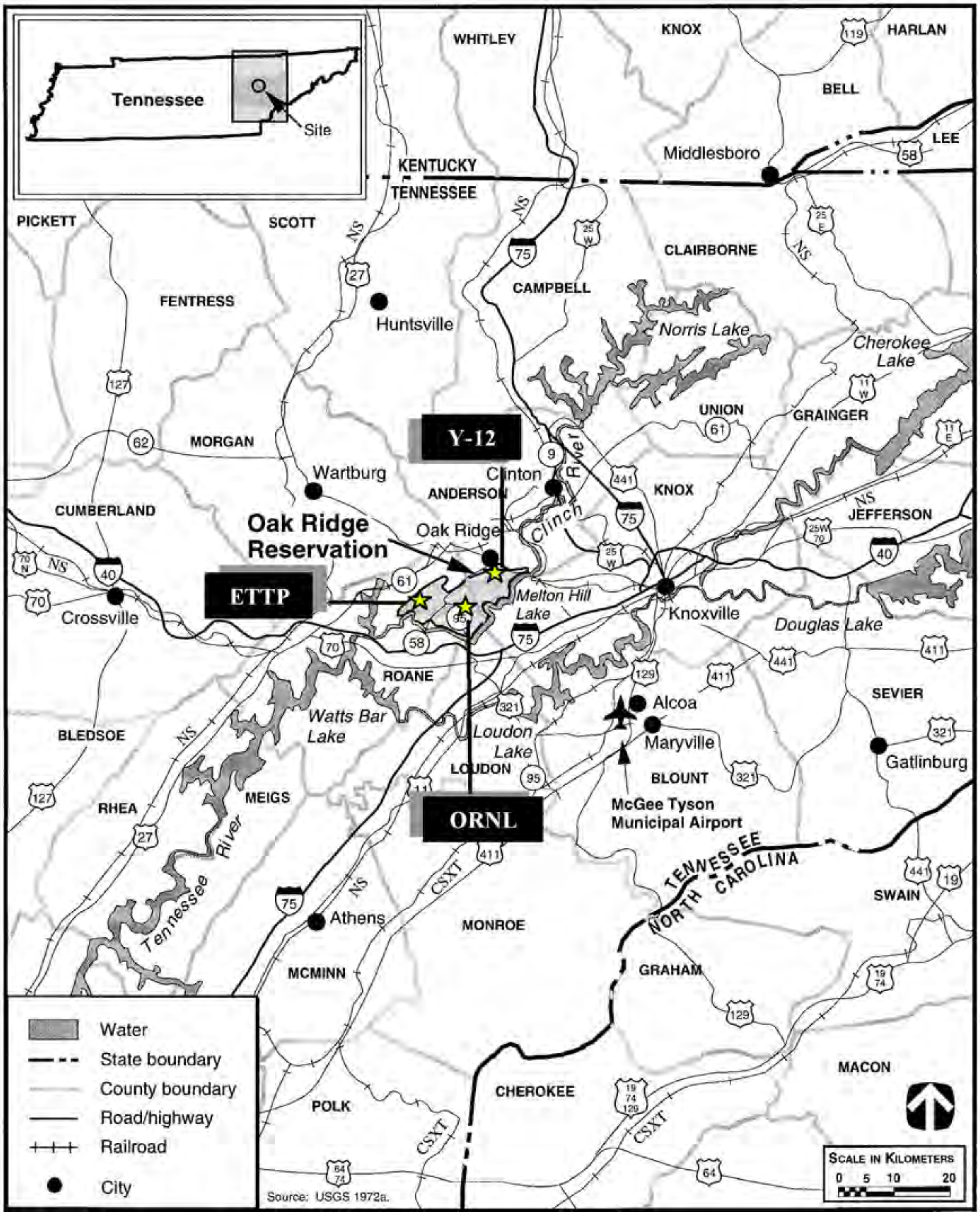


Figure 4.9-1—Location of the Y-12 Site

The eastern portion of Y-12 is occupied by Lake Reality and the former New Hope Pond (now closed), maintenance facilities, office space, training facilities, change houses, and former ORNL Biology Division facilities. The far western portion of Y-12 consists primarily of waste management facilities and construction contractor support areas. The central and west-central portions of the Y-12 Site encompass the high-security portion, which supports core NNSA missions.

4.9.1.2 *Surrounding Land Uses*

The city of Oak Ridge lies within the Great Valley of Eastern Tennessee between the Cumberland and Great Smoky Mountains and is bordered on two sides by the Clinch River. The Cumberland Mountains are 10 miles to the northwest; and the Great Smoky Mountains are 32 miles to the southeast (Figure 4.9-1).

Lands bordering ORR and Y-12 are predominantly rural and are used primarily for residences, small farms, forest land, and pasture land. The city of Oak Ridge, Tennessee, has a typical urban mix of residential, public, commercial, and industrial land uses. It also includes almost all of ORR. The residential section of Oak Ridge forms the northern boundary of the reservation. There are four residential areas along the northern boundary of ORR, several of which have houses located within 98 ft of the site boundary.

4.9.2 Visual Resources

The landscape at ORR is characterized by a series of ridges and valleys that trend in a northeast-to-southwest direction. The vegetation is dominated by deciduous forest mixed with some coniferous forest. The majority of the original open field space at the site has been planted in shortleaf and loblolly pine, although smaller areas have been planted in a variety of deciduous and coniferous trees. The viewshed, which is the extent of the area that may be viewed from the ORR, consists mainly of rural land. The city of Oak Ridge is the only adjoining urban area. Viewpoints affected by DOE facilities are primarily associated with the public access roadways, the Clinch River/Melton Hill Lake, and the bluffs on the opposite side of the Clinch River. Views are limited by the hilly terrain, heavy vegetation, and generally hazy atmospheric conditions. Some partial views of the city of Oak Ridge Water Treatment Plant facilities, located at Y-12, can be seen from the urban areas of the city of Oak Ridge.

Y-12 is situated in Bear Creek Valley at the eastern boundary of the ORR. It is bounded by Pine Ridge to the north and Chestnut Ridge to the south. The area surrounding Y-12 consists of a mixture of wooded and undeveloped areas. Facilities at Y-12 are brightly lit at night, making them especially visible. However, structures at Y-12 are mostly low profile, reaching heights of three stories or less, and built in the 1940s of masonry and concrete. The tallest structure is the meteorological tower erected in 1985 located on the west end of the Complex. There was also an east tower constructed in 1985 but has since been removed. Although the west tower only reaches a height of 197 feet, it is actually higher in elevation than the east tower was. There are no visible daytime plumes over Y-12 (DOE 2001a).

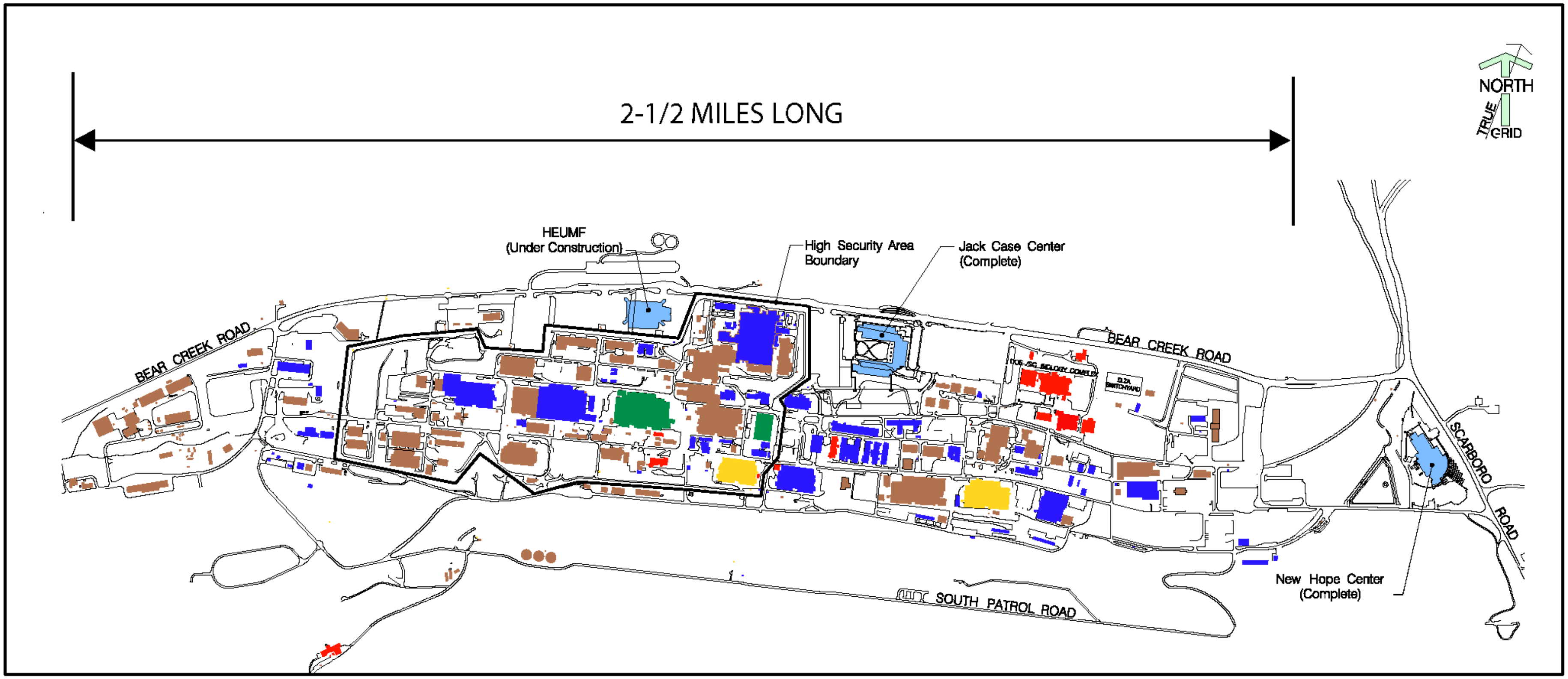
The Scarboro Community is the closest developed area to Y-12 (approximately 0.6 mile), and is located to the north of Y-12. However, as a result of their separation by Pine Ridge, Y-12 is not visible from the Scarboro Community (DOE 2001a).

For the purpose of rating the scenic quality of Y-12 and surrounding areas, the BLM Visual Resources Management Classification System (Table 4.9.2-1) was used. Although this classification system is designed for undeveloped and open land managed by BLM, this is one of the only systems of its kind available for the analysis of visual resource management and planning activities. Currently, there is no BLM classification for Y-12; however, the level of development at Y-12 is consistent with VRM Class IV which is used to describe a highly developed area. Most of the land surrounding the Y-12 site would be consistent with VRM Class II and III (i.e., left to its natural state with little to moderate changes).

Table 4.9.2-1—BLM Visual Resource Management Rating System

Class	Objective
Class I	To preserve the existing character of the landscape, the level of change to the characteristic landscape should be very low and must not attract attention.
Class II	To retain the existing character of the landscape, the level of change to the characteristic landscape should be low.
Class III	To partially retain the existing character of the landscape, the level of change to the characteristic landscape should be moderate.
Class IV	To provide for management activities which require major modification of the existing character of the landscape, the level of change to the characteristic landscape can be high.

Source: BLM 1980.



Projected State – EOFY 2007

	Footprint Data	Total Site EOFY 2007	NNSA Only EOFY 2007
ACTIVE	Operating	3,239,978 S.F.	3,181,668 S.F.
ACTIVE	Operating Pending D&D	2,439,577 S.F.	1,890,691 S.F.
ACTIVE	New Facilities	550,000 S.F.	550,000 S.F.
	Total Active	6,229,555 S.F.	5,622,359 S.F.
EXCESS	Shutdown Pending D&D	527,793 S.F.	23,076 S.F.
EXCESS	D&D in Progress	568,030 S.F.	57,812 S.F.
	Total Excess	1,095,823 S.F.	80,888 S.F.
	Operational Standby	258,446 S.F.	2,790 S.F.
	Total Site Footprint	7,583,824 S.F.	5,706,037 S.F.

Figure 4.9.1-1—Y-12 Site Map

4.9.3 Site Infrastructure

An extensive network of existing infrastructure supports Y-12 facilities and activities. Site infrastructure available at Y-12 includes an extensive roads and railroad system; electric power provided by the Tennessee Valley Authority (TVA); natural gas supplied by the East Tennessee Natural Gas Company and Sigcorp Energy Services; steam; raw, treated, demineralized, and chilled water; sanitary sewer; industrial gases; and telecommunications. The baseline characteristics of these systems are presented in Table 4.9.3-1.

Table 4.9.3-1—Baseline Characteristics for Y-12 Site

Characteristics	Current Value	Site Capacity
Land		
Area (acres)	800	800
Roads (miles)	65	65
Railroads (miles)	4	4
Electrical		
Energy consumption (MWh/yr)	349,251	3,766,800
Available capacity (MWe)	40	390
Steam		
Generation	1.5 billion lbs/yr	1.7 billion lbs/yr at 500º
Water		
Treated Water Usage (gallons/yr)	2,000,000	Not limited

Source: BWXT 2002.

4.9.3.1 *Electricity*

Electric power is supplied by TVA and is distributed throughout the Y-12 Site via three 161-kilovolt (kV) overhead radial feeders; these, in turn, feed eleven 13.8-kV distribution systems consisting of high-voltage transformers, switch gear, and 15-kV feeder cables; and the 13.8-kV feeders distribute power to approximately 400 distribution transformers located throughout the Y-12 Site. In addition, there is one 161-kV interconnecting overhead header. Thirteen 13.8-kV distribution systems ranging in size from 20 megavolt ampere (MVA) to 50 MVA are located within many Y-12 buildings. Each system consists of a high-voltage outdoor transformer with indoor switchgear, 15-kV feeder cables, power distribution transformers, and auxiliary substation equipment. There are more than 30 miles of overhead electrical lines on Y-12 and more than 10 miles of underground cables (BWXT 2002).

4.9.3.2 *Water*

Raw water for ORR is obtained from the Clinch River south of the eastern end of Y-12 and pumped to the water treatment plant located on the ridge northeast of Y-12. Ownership and operation of the treated water system was transferred from DOE to the city of Oak Ridge in April 2000. The water treatment plant can deliver water to two water storage reservoirs at a potential rate of 24 million gallons per day. Water from the reservoirs is distributed to the Y-12 Plant, ORNL, and the city of Oak Ridge. Separate underground piping systems provide distribution of raw and treated water within Y-12. Raw water is routed to Y-12 by two lines: a 16-inch main from the booster station, installed in 1943, and an 18-inch main from the 24-inch filtration plant feed line. The raw water system has approximately 5 miles of pipes with diameters ranging from

4 inch to 18 inch. The primary use of the raw water is to maintain a minimum flow of 7 million gallons/day in the East Fork Poplar Creek (EFPC). Treated water is routed to Y-12 by three lines: one 24-inch main and two 16-inch mains. The total treated water system contains approximately 19 miles of pipe ranging in size from 1 inch to 24 inches in diameter. The treated water system supplies water for fire protection, process operations, sanitary sewerage requirements, and boiler feed at the steam plant. Treated water usage at Y-12 averages 4.2 million gallons per day or 1.538 billion gallons per year.

4.9.3.3 *Natural Gas*

Sigcorp Energy Services supplies natural gas to ORR and Y-12. Natural gas, which is used for furnaces, the Y-12 Steam Plant, and laboratories, is supplied via a pipeline from the East Tennessee Natural Gas Company at "C" Station located south of Bethel Valley Road near the eastern end of Y-12. A 14-inch, 125-psig line is routed from "C" Station to the southwest corner of the Y-12 perimeter fence. From this point, an 8-inch line feeds the steam plant and a 6-inch branch line serves the process buildings and laboratories on the eastern end of Y-12. The western end of Y-12 is served by 4-inch and 2-inch headers that are fed from the steam plant line. Two pressure-reducing stations reduce the gas pressure from 125 pounds per square inch gauge (psig) to 25 psig and 35 psig, respectively. The gas pressure is further reduced and the flow metered at each use point (BWXT 2002).

4.9.4 Air Quality and Noise

4.9.4.1 *Air Quality*

4.9.4.1.1 Meteorology and Climatology

Oak Ridge lies in a valley between the Cumberland and Great Smoky Mountain ranges and is bordered on two sides by the Clinch River. The Cumberland Mountains are located about 10 miles to the northwest; and the Great Smoky Mountains are 32 miles to the southeast (ORR 2005). The ROI specific to air quality is primarily the Bear Creek Valley for Y-12. This valley is bordered by ridges that generally confine facility emissions to the valley between the ridges.

The mean annual temperature for the Oak Ridge area is 57.6°F. Local winters consist of migratory cyclones that produce significant precipitation events every 3 to 5 days. The coldest month is usually January with an average temperature of about 36.7°F and low temperatures that occasionally drop as low as -23.8°F. Summers are characterized by warm, humid conditions. July is typically the hottest month of the year with an average temperature of about 77.4°F and high temperatures that occasionally exceed 100°F. In the course of a year, the average difference between the maximum and minimum daily temperatures is 22.7°F. Average temperature in 2004 was 59.7°F (ORR 2005).

The 30-year annual average precipitation is 55 inches which includes about 9.6 inches of snowfall. Precipitation in the region is greatest in the winter months, December through February. Precipitation in the spring exceeds the summer rainfall, but the summer rainfall may be locally heavy because of thunderstorm activity. The driest periods generally occur during the fall months when high-pressure systems are most frequent (ORR 2005).

4.9.4.1.2 Ambient Air Quality

The ORR is located in Anderson and Roane Counties in the Eastern Tennessee-Southwestern Virginia AQCR 207, and Y-12 is completely within Anderson County. The EPA has designated Anderson County as a basic non-attainment area for the 8-hour ozone standard, as part of the larger Knoxville basic 8-hour ozone non-attainment area that encompasses several counties; and for $PM_{2.5}$ based on a revision to the standards (DOE 2007). For all other criteria pollutants for which EPA has made attainment designations, existing air quality in the greater Knoxville and Oak Ridge areas is in attainment with the NAAQS.

Airborne discharges from DOE Oak Ridge facilities, both radioactive and nonradioactive, are subject to regulation by the EPA, the Tennessee Department of Environment and Conservation (TDEC) Division of Air Pollution Control, and DOE Orders. Y-12 has a comprehensive air regulation compliance assurance and monitoring program to ensure that airborne emissions satisfy all regulatory requirements and do not adversely affect ambient air quality. Common air pollution control devices employed on the ORR include exhaust gas scrubbers, baghouses, and other exhaust filtration systems designed to remove contaminants from exhaust gases before release to the atmosphere. Process modifications and material substitutions are also made to minimize air emissions. In addition, administrative control plays a role to regulate emissions (ORR 2005).

Concentration of regulated pollutants observed during 1999 at locations near the ORR are presented in Table 4.9.4–1. Sample results show that the ORR operations have an insignificant effect on local air quality (ORR 2005).

The primary source of criteria pollutants at Y-12 is the steam plant, where coal and natural gas are burned. In fact, more than 90 percent of the Y-12 pollutant emissions to the atmosphere are attributed to the operation of the steam plant (ORR 2005). However, actual emissions from the steam plant are well below allowable emissions.

Radiological Air Emissions

The release of radiological contaminants, primarily uranium, into the atmosphere at Y-12 occurs as a result of plant production, maintenance, and waste management activities. Atmospheric emissions of radionuclides from DOE facilities are limited by EPA regulations found under NESHAP regulations (40 CFR Part 61, Subpart H), which have been delegated to TDEC for implementation. All three ORR facilities are operated in accordance with the Tennessee regulatory dose limits for HAPs for Radionuclides and have met all emission and test procedures. The NESHAP establishes a dose limit of 10 millirem per year for any member of the public. The total 2004 dose to the MEI from the Y-12 activities was 0.4 millirem (ORR 2005). Details on the annual radionuclide compliance modeling and other NESHAP that cover asbestos and specific source categories on the ORR are reported in the 2004 *Oak Ridge Reservation Annual Site Environmental Report* (ORR 2005).

Table 4.9.4-1—Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at Y-12/Oak Ridge Reservation

Pollutant	Averaging Time	Maximum standard (g/m^3)	Measured Concentration (g/m^3)
SO_2	3-hr	1,700.3	520.2[1]
	24-hr	477.4	61.6[2]
	Annual	104.6	13.7[2]
PM_{10}	Annual[1]	65.4	33.2[2]
	24-Hour[2]	150	100.6[1]
$PM_{2.5}$	Annual[1]	19.6	No Data
	24-Hour[2]	85	63[1]
CO	1-hr	52,280	16,615
	8-hr	13,070	5,867[2]
Ozone	1-hr	307.1	294[1]
	8-hr	205.2	246[1]
NO_2	Annual	130.7	19.7[1]
Lead	Calendar quarterly mean	2.0	0[1]
Gaseous Flourides (as HF)	30-day	1.6	No Data
	7-day	2.1	0.1[1]
	24-hr	3.8	No Data
	12-hr	4.8	No Data

Source: DOE 2000a.
1= TDEC 2005c.
2= DOE 2001a.

An estimated 0.01 curies (2.17 kilograms) of uranium was released into the atmosphere in 2004 as a result of Y-12 activities. The specific activity of enriched uranium is much greater than that of depleted uranium, and about 80 percent of the curies release was composed of emissions of enriched uranium particulate, even though approximately 6 percent of the total mass of uranium released was enriched material (ORR 2005).

The TDEC also conducts a perimeter air monitoring program on the ORR using low volume air samplers. Surveillance of airborne radionuclides includes measurement of ambient levels of alpha-, beta-, and gamma-emitting radionuclides and tritium. This program, in conjunction with associated air monitoring programs, provides information used to assess the impact of DOE activities on the local environment and public health. In the program, samples are collected biweekly from twelve air monitors stationed near the boundaries of the reservation and at a background location (i.e., Fort Loudoun Dam). Each sample is analyzed for gross alpha and gross beta radiation at the state radiochemistry laboratory. A composite sample from each location is analyzed annually for gamma emitters. Results from the perimeter monitoring stations are compared to the background measurements and environmental standards provided in the CAA. The data for 2004 did not indicate a significant impact on local air quality from activities on the reservation (TDEC 2005a).

The release of radiological contaminants, primarily uranium, into the atmosphere at Y-12 occurs almost exclusively as a result of plant production, maintenance, and waste management activities. NESHAP regulations for radionuclides require continuous emission sampling of major sources (a “major source” is considered to be any emission point that potentially can contribute more than 0.1 millirem per year estimated dose equivalent to an off-site individual). During

2004, 42 of the 55 stacks suitable for continuous monitoring were judged to be major sources. Eighteen of the stacks with the greatest potential to emit significant amounts of uranium are equipped with alarmed breakthrough detectors, which alert operations personnel to process-upset conditions or to a decline in filtration-system efficiencies, allowing them to investigate and correct the problem before a significant release occurs. As of January 1, 2004, Y-12 had continuous monitoring capability on a total of 55 stacks, 46 of which were active and 9 of which were temporarily shut down. Emissions from unmonitored process and laboratory exhausts, categorized as minor emission sources, are estimated according to calculation methods approved by the EPA. In 2004, there were 46 unmonitored processes operated by Y-12. These are included as minor sources in the Y-12 source term (ORR 2005).

4.9.4.2 *Noise*

The acoustic environment along the Y-12 site boundary, in rural areas, and at nearby residences away from traffic noise, is typical of a rural location with a Day-Night Average Sound Level (DNL) in the range of 35 to 50 adjusted dBA. Areas near the Y-12 site within Oak Ridge are typical of a suburban area, with a DNL in the range of 53 to 62 dBA. Traffic is the primary source of noise at the Y-12 site boundary and at residences located near roads. During peak hours, the Y-12 worker traffic is a major contributor to traffic noise levels in the area (DOE 2001a).

Major noise emission sources within Y-12 include various industrial facilities, and equipment and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most Y-12 industrial facilities are at a sufficient distance from the site boundary so that noise levels at the boundary from these sources are not distinguishable from background noise levels. Within the Y-12 site boundary, noise levels from Y-12 mission operations are typical of industrial facilities, ranging from 50 to 70 dBA (DOE 2001a).

4.9.5 Water Resources

4.9.5.1 *Surface Water*

Within the Y-12 area, the two major surface water drainage basins are those of Bear Creek and East Fork Poplar Creek (EFPC). The upper reaches of the EFPC drain the majority of the industrial facilities at Y-12. The in-plant portion of EFPC has been designated as upper EFPC (UEFPC). EFPC, which discharges into Poplar Creek east of the ETTP, flows northeast along the south side of Y-12. Various Y-12 wastewater discharges to the UEFPC from the late 1940s to the early 1980s left a legacy of contamination, such as mercury, PCBs, and uranium that has been the subject of water quality improvement initiatives over the past 22 years (ORR 2005).

The Clinch River is the source of potable water for Oak Ridge, which provides potable water for Y-12 and ORNL. The Clinch River has an average flow of 4,662 cubic feet per second as measured at the downstream side of Melton Hill Dam at mile 23.1. The average flow of Bear Creek near Y-12 is 3.88 cubic feet per second. Base flow without augmentation in UEFPC, measured downstream of Y-12 averages 45.9 cubic feet per second. Y-12 uses approximately

2,000 million gallons per year of water while the ORR uses approximately twice as much. The ORR water supply system, which includes the city of Oak Ridge treatment facility and the ETTP treatment facility, has a capacity of 11,715 million gallons per year (DOE 2005b).

Clinch River water levels in the vicinity of the ORR are regulated by a system of dams operated by the TVA. Melton Hill Dam controls the flow of the Clinch River along the northeast and southeast sides of the ORR. Watts Bar Dam, located on the Tennessee River downstream of the lower end of the Clinch River, affects the flow of the Clinch River along the southeast side of the ORR.

4.9.5.1.1 Surface Water Quality

The streams and creeks of Tennessee are classified by TDEC and defined in the State of Tennessee Water Quality Standards. Classifications are based on water quality, designated uses, and resident aquatic biota. The Clinch River is the only surface water body on the ORR classified for domestic water supply. Most of the streams at the ORR are classified for fish and aquatic life, livestock watering, wildlife, and recreation. White Oak Creek and Melton Branch are the only streams not classified for irrigation, while portions of Poplar Creek and Melton Branch are not classified for recreation.

There are seven wastewater treatment facilities which operate under NPDES permits at Y-12. Another facility known as Big Spring Water Treatment Facility began operation in 2005 as an interim remedial action to remove mercury under a CERCLA Record of Decision. Sanitary and certain industrial wastewaters are permitted for discharge to the City of Oak Ridge wastewater collection and treatment systems.

The water quality of surface streams in the vicinity of Y-12 is affected by current and past operations. While stormwater, groundwater, and wastewater flows may contribute contaminants to UEFPC, the water quality and ecological health of this stream has greatly improved over the last 20 years. This is primarily due to rerouting of discharge pipes, construction and operation of wastewater treatment facilities, dechlorination of process waters, and other ongoing environmental protection activities at Y-12.

Among the three hydrogeologic regimes at Y-12, the UEFPC regime contains most of the known and potential sources of surface water contamination. Surface water contaminants in UEFPC include metals (particularly mercury and uranium), organics, and radionuclides (especially uranium isotopes). Water quality in Bear Creek is influenced significantly by a groundwater hydraulic connection either directly to Bear Creek or to tributaries of Bear Creek. Contaminants in Bear Creek, from multiple formerly used waste ponds, burial trenches and pits, include nitrates, metals (e.g., uranium), radionuclides (e.g., uranium isotopes, technetium), and chlorinated organics (ORR 2005).

The current Y-12 NPDES permit requires sampling, analysis, and reporting for approximately 90 outfalls. Currently, Y-12 has outfalls and monitoring points in the following water drainage areas: EFPC, Bear Creek, and several unnamed tributaries on the south side of Chestnut Ridge. These creeks and tributaries eventually drain to the Clinch River. Routine surface water surveillance monitoring, above and beyond that required by the NPDES permit, is performed as a best management practice. Monitoring is conducted at Station 17, in EFPC, near the junction of Scarboro and Bear Creek roads. A 1999 TDEC consent order mandates management of mercury concentrations in EFPC. DOE has been unable to achieve an interim guideline of 5 grams per day, averaged over 3 months (ORR 2005).

More than 6,000 surface water samples were collected in 2004. As shown in Table 4.9.5-1, comparisons with the Tennessee water quality criteria indicate that only mercury, cadmium, zinc and copper from samples collected at Station 17 were detected above the criteria maximum (ORR 2005). There was only one instance where mercury levels sampled from Station 304 exceeded the water quality criteria. Of all the parameters measured in the surface water as a best management practice, mercury is the only demonstrated contaminant of concern (ORR 2005).

Table 4.9.5-1—Surface Water Surveillance Measurements Exceeding Tennessee Water Quality Criteria at Y-12, 2004

Parameter Detected	Location	Number Of samples	Concentration (milligrams per liter)			Water quality criteria (milligrams per liter)	Number exceeding criteria
			Detection limit	Max	Avg		
Cadmium	Station 17	149	0.01	0.0128	<0.01	0.0039	1
Copper	Station 17	149	0.02	0.0504	<0.02	0.0177	2
Mercury	Station 17	398	0.0002	0.0081	<0.0005	0.000051	284
Zinc	Station 17	149	0.05	0.216	<0.05	0.177	1
Mercury	Station 304	12	0.0002	0.0081	<0.0005	0.000051	1

Source: ORR 2005.

Additionally, TDEC conducts an ambient surface water monitoring program that monitors 26 sites semi-annually for the purpose of detecting possible contamination from DOE sites. The sampling data set up a baseline for comparison to previous sampling events. In the case of an unplanned release or an accident, the sampling data may help to reflect the amount and extent of the pollution. Samples were analyzed for *Escherichia coli*, Enterococcus, ammonia, chemical oxygen demand, dissolved residue, NO3 & NO2 nitrogen, suspended residue, total hardness, total kjeldahl nitrogen, total phosphate, arsenic, cadmium, copper, iron, lead, manganese, mercury, chromium, and zinc. The water quality of the Clinch River and the tributaries sampled is good. Lab results indicate that there is no threat to human health or wildlife. (TDEC 2005b).

4.9.5.1.2 Surface Water Rights and Permits

In Tennessee, the state's water rights are codified in the *Water Quality Control Act*. In effect, the water rights are similar to riparian rights in that the designated uses of a body of water cannot be impaired. The only requirement to withdraw from surface water would be a TDEC Chapter 1200-5-8 Water Registration Requirement, and the USACE and TVA permits to construct intake structures.

4.9.5.2 *Groundwater*

Y-12, bound on the north by Pine Ridge and on the south by Chestnut Ridge, is located near the boundary between the Knox Aquifer and the ORR aquitards. The ORR aquitards underlie Pine Ridge and Bear Creek Valley, which contains the main plant area of Y-12 and the disposal facilities of western Bear Creek Valley. The Knox Aquifer underlies Chestnut Ridge and the stream channels of Bear Creek and the UEFPC. Bedrock formations comprising the aquitards are hydraulically upgradient of the aquifer, which functions as a hydrologic drain in Bear Creek Valley. Fractures provide the principal groundwater flowpaths in both the aquifer and aquitards. Dissolution of carbonates in the aquifer has enlarged fractures and produced solution cavities and conduits that greatly enhance its hydraulic conductivity relative to the aquitards.

4.9.5.2.1 Groundwater Quality

More than 200 sites have been identified at Y-12 that represent known or potential sources of contamination to the environment as a result of past waste management practices. Because of that contamination, extensive groundwater monitoring is performed to comply with regulations and DOE orders. Compliance requirements were met by the monitoring of 254 wells and 51 surface water locations, springs, and one building sump. Historical monitoring efforts have shown that four types of contaminants have affected groundwater quality at Y-12: nitrate, VOCs, metals, and radionuclides. Of those, nitrate and volatile organic compounds are the most widespread. Some radionuclides, particularly uranium and technetium, are significant, principally in the Bear Creek regime and the western and central portions of the UEFPC regime. Trace metals, the least extensive groundwater contaminants, generally occur in the unconsolidated zone close to sources of contamination due to their typically low solubility in groundwater (ORR 2005).

Nitrate concentrations in groundwater at Y-12 exceed the 10 milligrams per liter drinking water standard in a large part of the western portion of the UEFPC regime. The extent of the nitrate plume is defined in the unconsolidated and shallow bedrock zones. An increasing trend in nitrate concentrations at monitoring wells in the eastern portion of Y-12 has been observed. This increase possibly indicates that the nitrate plume in the Maynardville Limestone has migrated into the eastern area of Y-12 from the S-2 and/or the S-3 sites. Historical results from monitoring wells in near source areas indicate generally decreasing trends (ORR 2005).

Concentrations of barium, cadmium, chromium, lead, nickel, thallium, and uranium exceeded drinking water standards during 2004 in samples collected from various monitoring wells and surface water locations downgradient of the S-2 Site, the S-3 Site, the Salvage Yard, and throughout the complex. Elevated concentrations of these metals in groundwater were most commonly observed from monitoring wells in the unconsolidated zone. Concentrations of uranium exceed the standard (0.03 milligrams per liter) in a number of source areas (e.g., production areas, the Uranium Oxide Vault, and the Former Oil Skimmer Basin) and contribute to the uranium concentration in the UEFPC (ORR 2005).

Groundwater concentrations of trace metals exceeded regulatory standards during 2004 at three locations. Concentrations above the drinking water standard for nickel were observed in samples from one monitoring well. Two surface water monitoring stations showed elevated concentrations of arsenic. Nickel concentrations above the drinking water standard (0.1 milligrams per liter) were observed from one well at the Industrial Landfill IV (ORR 2005).

In CY 2004, gross alpha activities were above the drinking water standard of 15 picocuries per liter at only one monitoring station. One of the 2 samples obtained from the surface water monitoring location upgradient of the Filled Coal Ash Pond wetlands slightly exceeded the standard. Gross beta activities were below the screening level of 50 picocuries per liter at all monitoring stations except at a monitoring well at the United Nuclear Corporation site. This location has consistently exceeded the screening level since August 1999.

4.9.5.2.2 Groundwater Availability

Groundwater at Y-12 is divided into three hydrogeologic regimes, which are delineated by surface water drainage patterns, topography, and groundwater flow characteristics. The regimes are further defined by the waste sites they contain. These regimes include the Bear Creek Hydrogeologic Regime, the UEFPC Hydrogeologic Regime, and the Chestnut Ridge Hydrogeologic Regime.

Recharge occurs over most of the area but is most effective where overburdened soils are thin or permeable. Groundwater flow in the aquitard and the aquifer is primarily parallel to bedding planes. There are no Class I sole-source aquifers that lie beneath the ORR. All aquifers are considered Class II aquifers, current potential sources of drinking water. Because of the abundance of surface water and its proximity to the points of use, very little groundwater is used at the ORR.

4.9.6 Geology and Soils

ORR lies in the Valley and Ridge Physiographic Province of eastern Tennessee. The topography consists of alternating valleys and ridges that have a northeast-southwest trend, with most ORR facilities occupying the valleys. In general, the ridges consist of resistant siltstone, sandstone, and dolomite units, and the valleys, which resulted from stream erosion along fault traces, consist of less-resistant shales and shale-rich carbonates (DOE 2001a).

The topography within the ORR ranges from a low of 750 feet above mean sea level (AMSL) along the Clinch River to a high of 1,260 feet AMSL along Pine Ridge. Within the ORR, the topographic relief between the valley floors and ridge crests is generally about 300 to 350 feet (DOE 2001a).

4.9.6.1 *Geology*

Several geologic formations are present in the ORR area. The Rome Formation, which is present north of Y-12 and forms Pine Ridge, consists of massive to thinly bedded sandstones interbedded with minor amounts of thinly bedded, silty mudstones, shales, and dolomites. In the ORR area, the stratigraphic thickness of the Rome Formation is uncertain because of the displacement caused by the White Oak Mountain Thrust Fault. The Conasauga

Group, which underlies Bear Creek Valley, consists primarily of calcareous shales, siltstone, and limestone. The Knox Group, which is present immediately south of Y-12, can be divided into five formations of dolomite and limestone, which have all been identified at the ORR. The Knox Group, which underlies Chestnut Ridge, is estimated to be approximately 2,400 feet thick. The Knox Group weathers to a thick, orange-red, clay residuum that consists of abundant chert and contains karst features (DOE 2001a).

Y-12 is located within Bear Creek Valley, which is underlain by Middle to Late Cambrian strata of the Conasauga Group (see Figure 4.5.2–1). The Conasauga Group consists primarily of highly fractured and jointed shale, siltstone, calcareous siltstone, and limestone in the site area. The upper part of the group is mainly limestone, while the lower part consists mostly of shale (LMER 1999a).

Y-12 is situated on carbonate bedrock such that groundwater flow and contaminant transport are controlled by solution conduits in the bedrock. These karst features, including large fractures, cavities, and conduits, are most widespread in the Maynardville Limestone and the Knox Group. These cavities and conduits are often connected and typically found at depths greater than approximately 1000 feet (DOE 2001a).

Karst features are dissolutional features occurring in carbonate bedrock. Karst features represent a spectrum ranging from minor solutional enlargement of fractures to conduit flowpaths to caves large enough for a person to walk into. Numerous surface indications of karst development have been identified at ORR. Surface evidence of karst development includes sinking streams (swallets) and overflow swallets, karst and overflow springs, accessible caves, and numerous sinkholes of varying size. In general, karst appears most developed in association with the Knox Group carbonate bedrock, as the highest density of sinkholes occurs in this group (DOE 2001a).

Unconsolidated materials overlying bedrock in the UEFPC watershed include alluvium (stream-laid deposits), colluvium (material transported downslope), man-made fill, fine-grained residuum from the weathering of the bedrock, saprolite (a transitional mixture of fine-grained residuum and bedrock remains), and weathered bedrock. The overall thickness of these materials in the Y-12 area is typically less than 40 feet. In the undeveloped areas of Y-12, the saprolite retains primary texture features of the unweathered bedrock including fractures.

4.9.6.2 *Soils*

Y-12 is located in Bear Creek Valley at the eastern boundary of the ORR. Bear Creek Valley lies on well to moderately well-drained soils underlain by shale, siltstone, and silty limestone. Developed portions of the valley are designated as urban land. Soil erosion from past land uses has ranged from slight to severe. Erosion potential is very high in those areas that have been eroded in the past with slopes greater than 25 percent. Erosion potential is lowest in the nearly flat-lying permeable soils that have a loamy texture. Additionally, shrink-swell potential is low to moderate and the soils are generally acceptable for standard construction techniques (DOE 2001a).

Y-12 lies on soils of the Armuchee-Montevallo-Hamblen, the Fullerton-Claiborne-Bodine, and the Lewhew-Armuchee-Muskinghum associations (DOE 2001a). Due to extensive cut-and-fill grading during the construction of Y-12, very few areas within the UEFPC watershed have a sequence of natural soil horizons. Soil erosion due to past land use has ranged from slight to severe.

4.9.6.3 *Seismology*

The Oak Ridge area lies in seismic Zones 1 and 2 of the Uniform Building Code, indicating that the probability of a strong earthquake occurrence is low. Y-12 is cut by many inactive faults formed during the late Paleozoic Era and there is no evidence of capable faults in the immediate area of Oak Ridge, as defined by 10 CFR Part 100 (surface movement within the past 35,000 years or movement of a recurring nature within the past 500,000 years). The nearest capable faults are approximately 300 miles west of the ORR in the New Madrid Fault zone. Since the New Madrid earthquakes of 1811 to 1812, at least 26 other earthquakes with a Modified Mercalli Intensity (MMI) of III to VI have been felt in the Oak Ridge area, the majority of these having occurred in the Valley and Ridge Province. One of the closest and most intense seismic events to the ORR occurred in 1930; its epicenter was 5 miles from the ORR with an MMI of V at the site (DOE 2001a).

The largest recent earthquake in eastern Tennessee registered 4.6 on the Richter scale and occurred on November 30, 1973, in Maryville, Tennessee, about 32 kilometers (20 miles) southeast of ORR. This earthquake produced an MMI of V to VI at ORNL (as estimated at HFIR) (DOE 2000f). The region has continued to be seismically active, with 55 earthquakes recorded within a radius of 100 kilometers (62 miles) of ORNL since 1973. The closest of those events occurred on June 17, 1998, with an epicenter within ORR, registering a magnitude 3.6 (USGS 2005d).

4.9.7 Biological Resources

This section describes ecological resources at ORR including terrestrial and aquatic resources, threatened and endangered (T&E) species, and floodplains and wetlands. Information for Y-12 is also included.

4.9.7.1 *Terrestrial Resources*

The ORR is mostly contiguous native eastern deciduous forest. Forested areas are found throughout the reservation. Local plant life is characteristic of the intermountain regions of central and southern Appalachia; pine and pine-hardwood forest and oak-hickory forest are the most extensive plant communities found at the ORR (DOE 2001a). The forests are mostly oak-hickory, pine-hardwood, or pine. Minor areas of other hardwood forest cover types are found throughout the ORR, including northern hardwoods, a few small natural stands of hemlock or white pine, and floodplain forests. Over 1,100 vascular plant species are found on the ORR (ORNL 2002). Animal species found on the ORR include approximately 59 species of amphibians and reptiles; up to 260 species of migratory, transient, and resident birds; and

38 species of mammals (DOE 2001a). Less than 2 percent of the ORR remains as open agricultural fields (ORNL 2002).

At ORR, DOE has set aside large tracts of land for conservation, including approximately 3,000 acres set-aside in April 2005. This conservation land is located on the western end of the ORR and features mature forests, wetlands, river bluffs, cliffs and caves and is home to several rare species. Another conservation easement is Parcel G which contains a palustrine emergent/scrub-shrub wetland system totaling approximately 3.4 acres.

Within the fenced, developed portion of Y-12, grassy and unvegetated areas surround the entire facility. Building and parking lots dominate the landscape at Y-12, with limited vegetation present. Fauna within the Y-12 area is limited due to the lack of large areas of natural habitat. Aquatic habitat on or adjacent to the ORR ranges from small, free-flowing streams in undisturbed watersheds to larger streams with altered flow patterns due to dam construction. These aquatic habitats include tailwaters, impoundments, reservoir embayments, and large and small perennial streams. Aquatic areas within the ORR also include seasonal and intermittent streams (DOE 2001a).

4.9.7.2 *Wetlands and Floodplains*

4.9.7.2.1 Wetlands

Approximately 600 acres of wetlands have been identified on the ORR, with most classified as forested palustrine, scrub/shrub, and emergent wetlands (ORR 2005). Most occur at low elevation primarily in riparian zones of headwater streams and their receiving streams. A wetlands survey of the Y-12 area found palustrine, scrub/shrub, and emergent wetlands. An emergent wetland was found at the eastern end of Y-12, at a seep by a small tributary of EFPC, between New Hope Cemetery and Bear Creek Road. Eleven small wetlands have been identified north of Bear Creek Road in remnants of the UEFPC. A relatively undisturbed, forested wetland was identified in the stream bottomland of Bear Creek Tributary 1, between Bear Creek Road and the powerline right-of-way (LMES 1997).

4.9.7.2.2 Floodplains

A floodplain is defined as the valley floor adjacent to a streambed or arroyo channel that may be inundated during high water. The TVA has conducted floodplain studies along the Clinch River, Bear Creek, and EFPC. Eastern Portions of Y-12 lie within the 100- and 500-year floodplains of EFPC.

4.9.7.3 *Aquatic Resources*

Sixty-four fish species have been collected on or adjacent to the ORR. Fish species representative of the Clinch River in the vicinity of the ORR include shad and herring (Clupeidae), common carp (*Cyprinus carpio*), catfish and bullheads (Ictaluridae), bluegill (*Lepomis macrochirus*), crappie (*Pomoxis* spp.), and freshwater drum (*Aplodinotus grunniens*) (ORNL 1981a). The most important fish species taken commercially in the ORR area are common carp and catfish. Commercial fishing is permitted on the Clinch River downstream from

Melton Hill Dam (TWRA 1995). Recreational species consist of crappie, largemouth bass (*Micropterus salmonides*), sauger (*Stizostedion canadense*), sunfish (*Lepomis* spp.*)*, and catfish. Sport fishing is not permitted within the ORR.

4.9.7.4 *Threatened and Endangered Species*

Forty-five Federal- or state-listed threatened, endangered, and other special status species have been identified on the ORR; however none have been observed at Y-12. Among these, 20 Federal- or state-protected vertebrate species have been confirmed in recent surveys (Table 4.9.7-1) (ORNL 2002). State threatened and endangered species observed on the ORR include 22 plants, 1 mammal, and 2 raptor species (ORR 2005). A number of rare or state-listed animals and plants are present in the vicinity of Y-12. No critical habitat for threatened or endangered species, as defined in the *Endangered Species Act*, exists on the ORR (DOE 2001a). There are no federally-listed threatened or endangered plant species on the ORR but 4 plant species of federal special concern have been reported from the ORR (Table 4.9.7-2).

Table 4.9.7-1—Federal and State Listed Species Potentially Occurring at the ORR[a]

Scientific name	Common name	Status[b]		
		Federal	State	PIF[c]
	Fish			
Phoxinus tennesseensis	Tennesee dace		NM	
Cyprinella monacha	Spotfin chub	T	T	
	Amphibians and reptiles			
Hemidactylim scutatum	Four-toed salamander		NM	
	Birds		NM	
Accipiter striatus	Sharp-shinned hawk		NM	
Anhinga anhinga	Anhinga		NM	
Ardea alba	Great egret		NM	
curiesrcus cyaneus	Northern harrier		NM	
Caprimulgus carolinensis	Chuck-will's-widow			C
Contopus cooperi	Olive-sided flycatcher		NM	
Dendroica caerulescens	Black-throated blue warbler			C
Dendroica cerulean	Cerulean warbler		NM	C
Dendroica discolor	Prairie warbler			C
Egretta caerulea	Little blue heron		NM	
Egretta thula	Snowy egret		NM	
Falco peregrinus	Peregrine falcon	*d*	E	
Helmitheros vermivorus	Worm-eating warbler			C
Hylocicha mustelina	Wood thrush			C
Lanius ludovicianus	Loggerhead shrike		NM	
Oporornis formosus	Kentucky warbler			C
Pooecetes gramineus	Vesper sparrow		NM	
Protonotaria citrea	Prothonotary warbler			C
Seiurus motacilla	Louisiana waterthrush			C

Table 4.9.7-2—Federal and State Listed Species Potentially Occurring at the ORR[a] (continued)

Scientific name	Common name	Status[b]		
		Federal	State	PIF[c]
Sitta pusilla	Brown-headed nuthatch			C
Sphyrapicus varius	Yellow-bellied sapsucker		NM	
Spizella pusilla	Field sparrow			C
Tyto alba	Barn Owl			C
Vermivora chrysoptera	Golden-winged warbler		NM	C
Vermivora pinus	Blue-winged warbler			C
Myotis grisescens	Gray bat	E	E	
Sorex longirostris	Southeastern shrew		NM	

Source: ORR 2005.
a=Land and surface waters of the ORR exlusive of the Clinch River, which borders the ORR.
b=E = endangered T= threatened, NM = in need of management, C = birds of concern.
c=Partners in Flight.
d=The peregrine falcon was federally delisted on August 25, 1999.

Table 4.9.7-3—Vascular Plant Species Listed by State or Federal Agencies, 2005

Species	Common name	Habitat on ORR	Status code[a]
Currently known or previously reported from the ORR			
Aureolaria patula	Spreading false-foxglove	River bluff	FSC, T
Carex gravida	Heavy sedge	Varied	S
Carex oxylepis var. pubescens[b]	Hairy sharp-scaled sedge	Shaded wetlands	S
Curiesmicifuga rubifolia	Appalachian bugbane	River slope	FSC, T
Cypripedium acaule	Pink lady's-slipper	Dry to rich woods	E, CE
Delphinium exaltatum	Tall larkspur	Barrens and woods	FSC, E
Diervilla lonicera	Northern bush-honeysuckle	River bluff	T
Draba ramosissima	Branching whitlow-grass	Limestone cliff	S
Elodea nuttallii	Nuttall waterweed	Pond, embayment	S
Fothergilla major	Mountain witch-alder	Woods	T
Hydrastis canadensis	Golden seal	Rich woods	S, CE
Juglans cinerea	Butternut	Slope near stream	FSC, T
Juncus brachycephalus	Small-head rush	Open wetland	S
Lilium canadense	Canada lily	Moist woods	T
Lilium michiganense[c]	Michigan lily	Moist woods	T
Liparis loeselii	Fen orchid	Forested wetland	E
Panax quinquifolius	Ginseng	Rich woods	S, CE
Platanthera flava var. herbiola	Tuberculed rein-orchid	Forested wetland	T
Populus grandidentata[d]	Large-tooth aspen	Dry, woodlands	S
Ruellia purshiana	Pursh's wild-petunia	Dry, open woods	S
Scirpus fluviatilis	River bulrush	Wetland	S
Spiranthes lucida	Shining ladies-tresses	Boggy wetland	T
Thuja occidentalis	Northern white cedar	Rocky river bluffs	S
Viola tripartite var. tripartita	Three-parted violet	Rocky woods	S
Rare plants that occur near and could be present on the ORR			
Agalinis auriculata	Earleaf false foxglove	Calcareous barren	FSC, E
Allium burdickii or A. tricoccom	Ramps	Moist woods	S, CE
Berberis canadensis	American barberry	Rocky bluff, creek bank	S
Gnaphalium helleri	Catfoot	Dry woodland edge	S

Table 4.9.7-4—Vascular Plant Species Listed by State or Federal Agencies, 2005 (continued)

Species	Common name	Habitat on ORR	Status code[a]
Rare plants that occur near and could be present on the ORR			
Lathyrus palustris	A vetch	Moist meadows	S
Liatris cylindracea	Slender blazing star	Calcareous barren	E
Lonicera dioica	Mountain honeysuckle	Rocky river bluff	S
Meehania cordata	Heartleaf meehania	Moist calcareous woods	T
Pedicularis lanceolata	Swamp lousewort	Calcareous wet meadow	T
Pycnanthemum torrei	Torrey's mountain-mint	Calcareous barren edge	S
Solidago ptarmicoides	Prairie goldenrod	Calcareous barren	E

Source: ORR 2005.
FSC Federal Special Concern; formerly designated as C2. See Federal Register, February 28,1996.
E Endangered in Tennessee.
T Threatened in Tennessee.
S Special concern in Tennessee.
CE Status due to commercial exploitation.
a: Status codes:
b Carex oxylepis var. pubescens has not been observed during recent surveys.
c Lilium michiganense is believed to have been extirpated from the ORR by the impoundment at Melton Hill.
d Populus grandidentata was reported in two ORR locations in 2003. One of the reports was confirmed, but the tree died during the year. In 2004 additional trees were found in the vicinity of the dead tree.
e Ramps have been reported near the ORR, but there is not sufficient information to determine which of the two species is present or if the occurrence may have been introduced by planting. Both species of ramps have the same state status.

4.9.7.5 *Biological Monitoring and Abatement Programs*

The NPDES permit issued to Y-12 in 1995 mandates a biological monitoring and abatement program with the objective of demonstrating that the effluent limitations established for the facility protect the classified uses of the receiving stream, EFPC. Mercury and PCB levels in EFPC fish have historically been elevated relative to fish in uncontaminated reference streams. Mercury concentrations remained much higher during 2004 in fish from EFPC than in fish from reference streams. Elevated mercury concentrations in fish from the upper reaches of EFPC indicate that Y-12 remains a continuing source of mercury to fish in the stream. Although concentrations have leveled off in recent years, mercury concentrations in water in UEFPC have decreased significantly over much of the last decade. In contrast, mercury concentrations in fish have remained relatively constant since the late 1980s. PCB concentrations measured in EFPC sunfish during 2004 were within ranges typical of past monitoring efforts at these sites. The health and reproductive condition of fish from sites upstream in EFPC remain lower in several respects than in fish from reference sites or downstream EFPC.

4.9.8 Cultural Resources

4.9.8.1 *Archaeological Resources*

The ORR is underlain by bedrock formations predominated by calcareous siltstones, limestones, sandstones, siliceous shales, and siliceous dolostones. The majority of geologic units with surface exposures on the ORR contain Archaeological materials. All of these Archaeological materials consist of common invertebrate remains which are unlikely to be unique from those available throughout the East Tennessee region.

Human occupation and use of the East Tennessee Valley between the Cumberland Mountains and the southern Appalachians is believed to date back to the Late Pleistocene, at least 14,000 years ago. Archaeologists have traditionally believed that these Paleo-Indian bands subsisted primarily by hunting the large game of that era and collecting wild plant foods.

4.9.8.2 *Historic Resources*

During the Mississippian cultural periods (900 A.D. to historic times), larger scale, permanent communities developed, first along the alluvial terraces, and later on the second river terraces in rich bottomlands suitable for intensive agriculture. These expanding villages included multiple structures, storage pits, hearths, mounds, stockades, plazas, and semi subterranean earth lodges. Archaeological evidence reflects an increasingly complex and specialized society with a high degree of organization, which included the development of elite social classes. Just prior to Euro-American contact in the late 17th century, however, there appears to have been a breakdown in the hierarchies and a scaling-back of both village size and elaborate public structures. The first Euro-Americans to visit the region were French and English traders and trappers, soon followed by permanent settlers. These newcomers introduced a variety of domesticated animals, fruit trees, food crops, beads, metal, glass, and other raw materials and derived products to the native inhabitants, now known as the Overhill Cherokee. After a series of conflicts, most of the Cherokee were forcibly relocated to the Oklahoma Territory in 1838. Small, close-knit, agricultural communities developed and continued until 1942 when 58,575 acres were purchased by the U.S. government as a military reservation. To contribute to the development of nuclear weapons for the World War II effort, three production facilities (including Y-12) and a residential townsite were built inside the reservation. New facilities were constructed on the ORR after the War and new missions continued through the Cold War period to the present.

Approximately 90 percent of the ORR has been surveyed, on a reconnaissance level, for prehistoric and historic archaeological resources. Less than 5 percent has been intensely surveyed. To date, over 44 prehistoric sites and 254 historic sites, including 32 cemeteries, have been recorded within the current boundaries of the ORR. Fifteen prehistoric sites and 35 historic archaeological resources are considered eligible for listing on the NRHP (Souza 1997).

A total of 248 properties were individually recorded and evaluated, and the remaining 325 facilities were identified and categorized by use. At least 10 major archaeological reconnaissance-level surveys have been conducted on the ORR. Y-12 contains only one known archaeological site. A survey conducted of Y-12 in the early 1990s identified one archeological site (40AN68) which is located on a flat rise overlooking the EFPC within the boundaries of Y-12. This site is of an ephemeral nature and is not eligible for inclusion in the NRHP pursuant to 36 CFR Part 60.4 (DuVall and Associates 1999). It was concluded that the potential is low for identifying significant archeological sites within Y-12 proper which meet the criteria for inclusion in the NRHP. All buildings and structures in Y-12 have been surveyed and evaluated.

While no cultural resources at Y-12 are currently listed on the NRHP, Y-12 has 76 existing historic properties (NNSA 2005c). The Tennessee State Historic Preservation Officer (SHPO) has concurred with this determination (Thomason and Associates 2003). The district and its contributing properties are eligible under Criterion A for its historical associations with the

Manhattan Project, development as a nuclear weapons component plant within the post-World War II scientific movement, and early nuclear activities. The historic district is also eligible under Criterion C for the engineering merits of many of the properties and their contributions to science.

There are at least 32 cemeteries located within the boundaries of the ORR, 7 of which are located on the Y-12 site. These cemeteries are associated with Euro-American use of the area prior to World War II and are likely to have religious or cultural importance to descendants and the local community (DOE 2001a). All are currently maintained and protected. No other traditional, ethnic, or religious resources have been identified on the Y-12 site.

4.9.8.3 *Native American Resources*

Ancestors of the Eastern Band of the Cherokee Indians and the Cherokee Nation of Oklahoma may be culturally affiliated with the prehistoric use of the Y-12 area. Procedures for consulting with the Cherokee regarding traditional cultural places are in place. No Native American traditional use areas or religious sites are known to be present on the Y-12 site. Also, no artifacts of Native American religious significance are known to exist or to have been removed from the Y-12 site (DOE 2001a).

4.9.9 Socioeconomic Resources

Socioeconomic characteristics addressed at Y-12 include employment, regional economy, and population, housing, and community services. Socioeconomic characteristics are presented for a ROI. The ROI was identified based on the distribution of residences for current Y-12 employees. The ROI is defined as those counties where approximately 90 percent of the workforce lives.

Y-12 is located in Anderson County, Tennessee. Statistics for socioeconomic characteristics are presented for the ROI, a region consisting of Anderson, Knox, Loudon, and Roane Counties. Figure 4.9.9-1 presents a map of the counties composing the Y-12 ROI.

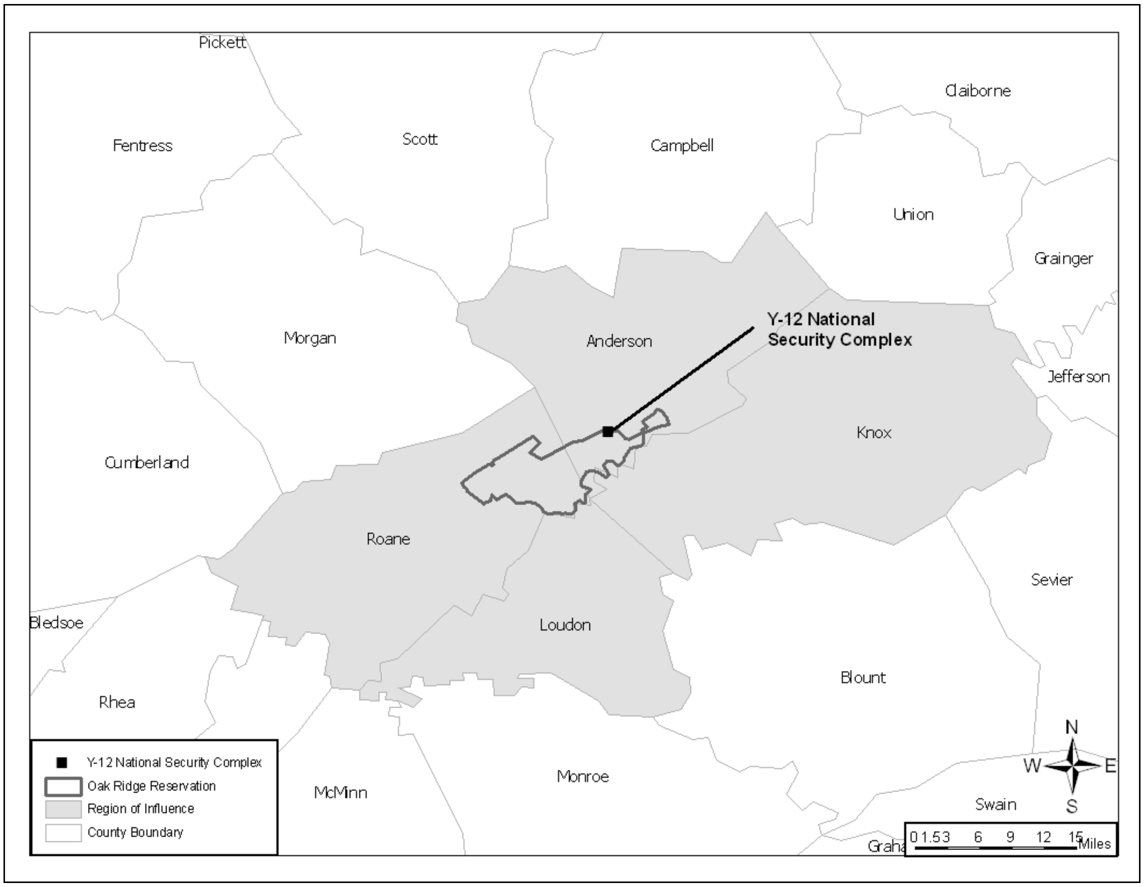


Figure 4.9.9-1—Region of Influence for Socioeconomic Impacts at Y-12

4.9.9.1 *Employment and Income*

Labor force statistics are summarized in Table 4.9.9-1. The available labor force (e.g., those greater than 16 years old and capable of work) of the ROI grew by approximately 6 percent from 280,986 in 2000 to 297,049 in 2005. The overall ROI employment experienced a growth rate of 4.6 percent with 271,363 in 2000 to 283,721 in 2005 (BLS 2007).

The ROI unemployment rate was 4.5 percent in 2005 and 3.4 percent in 2000. In 2005, unemployment rates within the ROI ranged from a low of 4.2 percent in Knox County to a high of 5.8 percent in Roane County. The unemployment rate in Tennessee in 2005 was 5.6 percent (BLS 2007).

Table 4.9.9-1—Labor Force Statistics for ROI and Tennessee

	ROI		Tennessee	
	2000	**2005**	**2000**	**2005**
Civilian Labor Force	280,986	297,049	2,871,539	2,920,400
Employment	271,363	283,721	2,756,498	2,758,184
Unemployment	9,623	13,328	115,041	162,216
Unemployment Rate (percent)	3.4	4.5	4.0	5.6

Source: BLS 2007.

Income information for the Y-12 ROI is provided in Table 4.9.9-2. Roane County is at the low end of the ROI with a median household income in 2004 of $38,172 and a per capita income of $26,447. Loudon County, at the high end of the ROI, had a median household income of $45,595 in 2004. Knox County, at the high end of the ROI, had a per capita income of $31,417 in 2004 (BEA 2007).

Table 4.9.9-2—Income Information for the Y-12 ROI, 2004

	Per capita income (dollars)	Median household income (dollars)
Anderson	28,055	38,954
Knox	31,417	41,618
Loudon	29,554	45,595
Roane	26,447	38,172
Tennessee	29,641	38,945

Source: BEA 2007.

4.9.9.2 *Population and Housing*

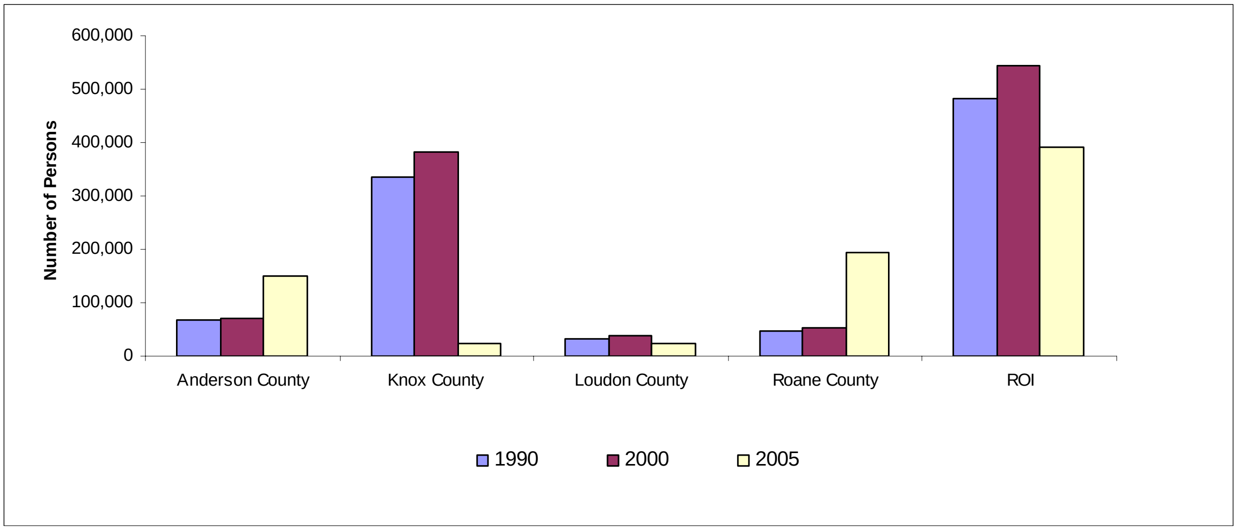
The ROI is used to analyze the primary economic impacts on population and housing. Table 4.9.9-3 presents historic and projected population in the ROI and the state.

Table 4.9.9-3—Historic and Projected Population

Region	1990	2000	2005	2010	2020
Anderson County	68,250	71,330	72,518	76,000	79,275
Knox County	335,749	382,032	405,355	404,666	432,866
Loudon County	31,255	39,086	43,411	44,941	50,238
Roane County	47,227	51,910	52,753	54,433	58,113
ROI	482,481	544,358	574,037	580,040	620,492
Tennessee	3,486,703	4,012,012	5,885,597	6,062,695	6,593,194

Source: USCB 2007.

Between 1990 and 2000, the ROI population increased 13 percent from 482,481 in 1990 to 544,358 in 2000. From 2000 to 2005, the population of the ROI increased 5 percent to 574,037 in 2005. Loudon County experienced the largest population growth within the ROI between 2000 and 2005 with an increase of 10 percent. Anderson County experienced an increase of 2 percent (USCB 2007). Figure 4.9.9-2 presents the trends in population within the Y-12 ROI.



Source: USCB 2007.

Figure 4.9.9-2—Trends in Population for the Y-12 ROI, 1990-2005

Table 4.9.9-4 lists the total number of housing units and vacancy rates in the ROI. In 2000, the total number of housing units in the ROI was 244,537 with 224,796 occupied (91.9 percent). There were 156,219 owner-occupied housing units and 68,577 rental units. The median value of owner-occupied units in Loudon County was the greatest of the counties in the Y-12 ROI ($97,300). The vacancy rate was the lowest in Loudon County (7.7 percent) and the highest in Roane County (9.3 percent) (USCB 2007).

Table 4.9.9-4—Housing in the Y-12 ROI, 2000

	Total Units	Occupied housing Units	Owner Occupied Units	Renter Occupied Units	Vacant units	Vacancy Rate (percent)	Median value of Owner Occupied Units (dollars)
Anderson County	32,452	29,780	21,592	8,188	2,671	8.2	87,500
Knox County	171,439	157,872	105,562	52,310	13,567	7.9	98,500
Loudon County	17,277	15,944	12,612	3,332	1,333	7.7	97,300
Roane County	23,369	21,200	16,453	4,747	2,169	9.3	86,500
ROI	244,537	224,796	156,219	68,577	19,740	8.1	95,619

Source: USCB 2007.

4.9.9.3 *Community Services*

Community services analyzed in the ROI include public schools, law enforcement, fire suppression and medical services. There are 7 school districts with 145 schools serving the Y-12 ROI. Educational services are provided for approximately 81,729 students by an estimated 5,216 teachers for the 2005 to 2006 school year (IES 2006f). The student-to-teacher ratio in these school districts ranges from a high of 18:1 in the Lenoir City School District in Loudon County to a low of 14:1 in the Oak Ridge School District. The student-to-teacher ratio in the ROI was 16:1 (IES 2006f).

The counties within the ROI employ approximately 46,000 firefighters and law enforcement officers. Security at Y-12 is provided by Wackenhut Services, Inc. (DOE 2001a). There are eleven hospitals that serve residents of the ROI with the majority located in Knox County. These hospitals have a total bed capacity of 2,195 (ESRI 2007).

4.9.10 Environmental Justice

The potentially affected area considered for environmental justice analysis is the area within a 50-mile radius of Y-12. Figure 4.9.10-1 shows counties potentially at risk from the current missions performed at Y-12. There are 19 counties that are included in the potentially affected area. Table 4.9.10-1 provides the demographic profile of the potentially affected area using data obtained from the 2000 Census.

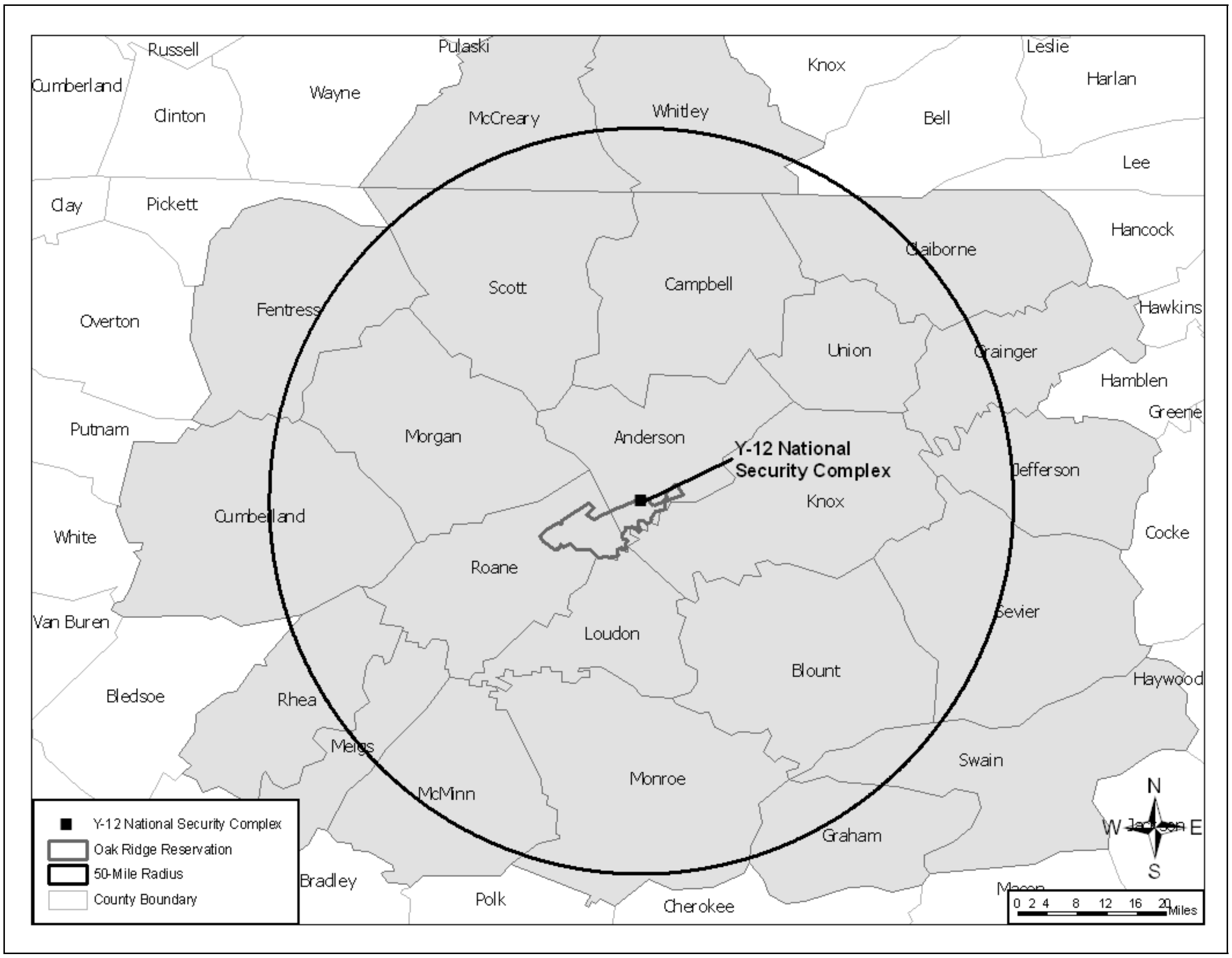


Figure 4.9.10-1—Potentially Affected Counties Surrounding Y-12 Environmental Justice

Table 4.9.10-1—Demographic Profile of the Potentially Affected Area Surrounding Y-12, 2000

Population Group	Population	Percent
Minority	**81,942**	**7.4**
Hispanic alone	7,115	0.6
Black or African American	46,871	4.2
American Indian and Alaska Native	3,058	0.3
Asian	8,053	0.7
Native Hawaiian and Other Pacific Islander	267	0.02
Some other race	5,185	0.5
Two or more races	11,393	1.0
White alone	**1,023,659**	**92.6**
Total Population	**1,105,601**	**100.0**

Source: USCB 2007.

In 2000, persons self-designated as minority individuals in the potentially affected area comprised 7.4 percent of the total population. This minority population is composed largely of Black or African American residents. As a percentage of the total resident population in 2000, Tennessee had a minority population of 20.8 percent and the U.S. had a minority population of 30.9 percent (USCB 2007).

Census tracts with minority populations exceeding 50 percent were considered minority census tracts. Based on 2000 census data, Figure 4.9.10-2 shows minority census tracts within the 50-mile radius where more than 50 percent of the census tract population is minority.

Census tracts were considered low-income census tracts if the percentage of the populations living below the poverty threshold exceeded 50 percent. Based on 2000 Census data, Figure 4.9.10-3 shows low-income census tracts within the 50-mile radius where more than 50 percent of the census tracts population is living below the Federal poverty threshold.

According to 2000 census data, approximately 122,216 individuals residing within census tracts in the 50-mile radius of Y-12 were identified as living below the Federal poverty threshold, which represents approximately 13 percent of the census tracts population within the 50-mile radius. There were five census tracts located in Knox County with populations greater than 50 percent identified as living below the Federal poverty threshold. In 2000, 13.5 percent of individuals for whom poverty status is determined were below the poverty level in Tennessee and 12.4 percent in the U.S. (USCB 2007).

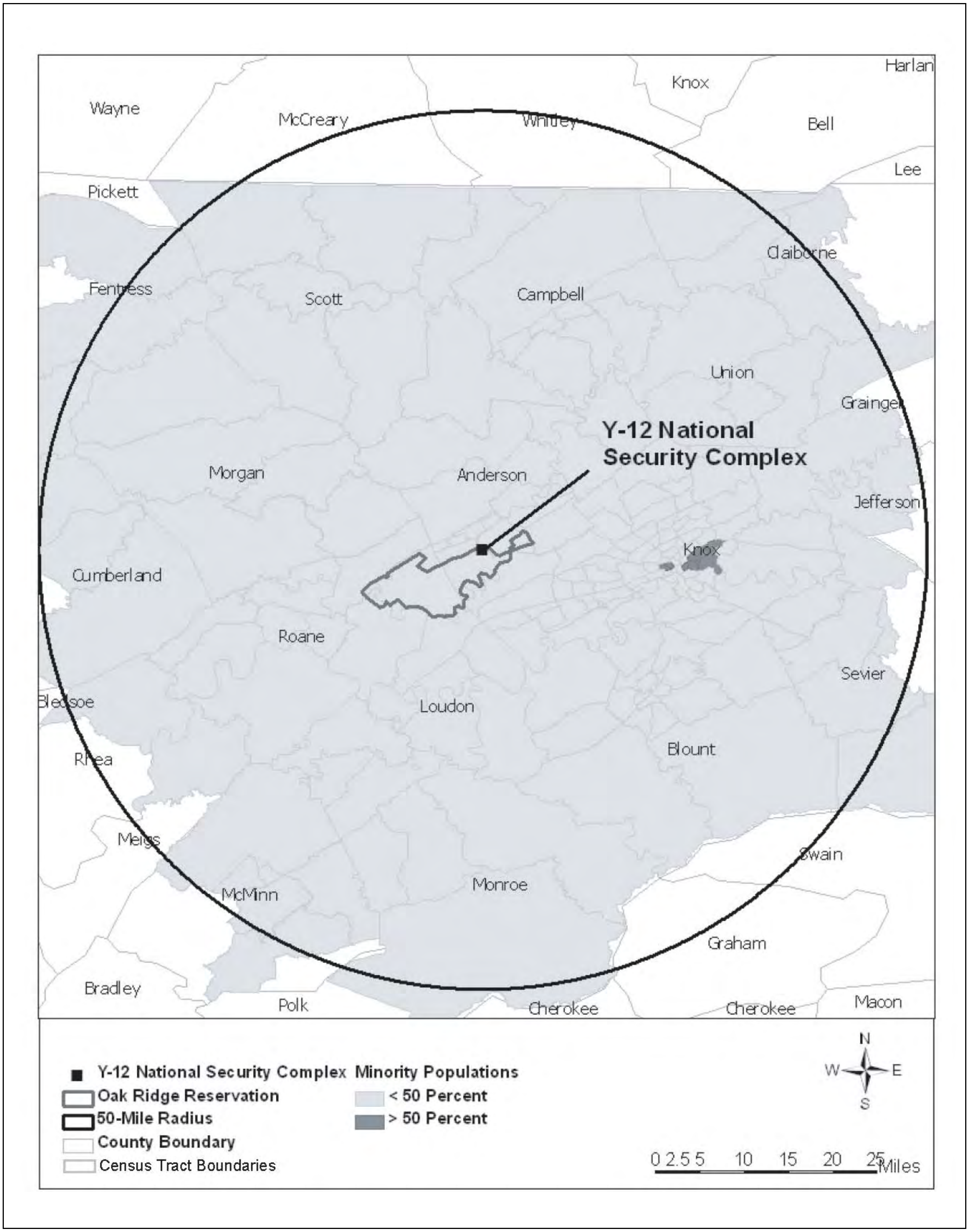


Figure 4.9.10-2—Minority Population – Census Tracts with More than 50 Percent Minority Population in a 50-Mile Radius of Y-12

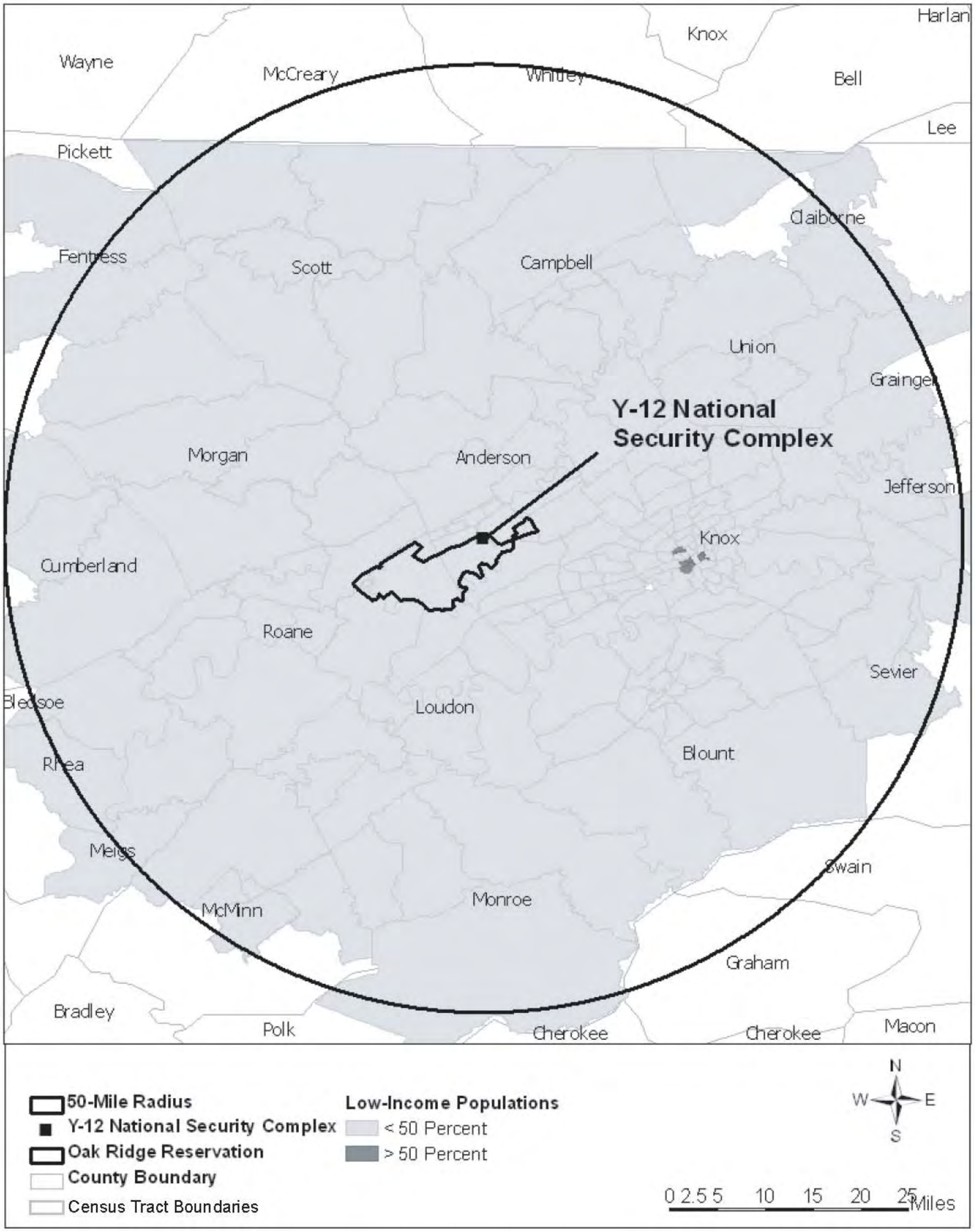
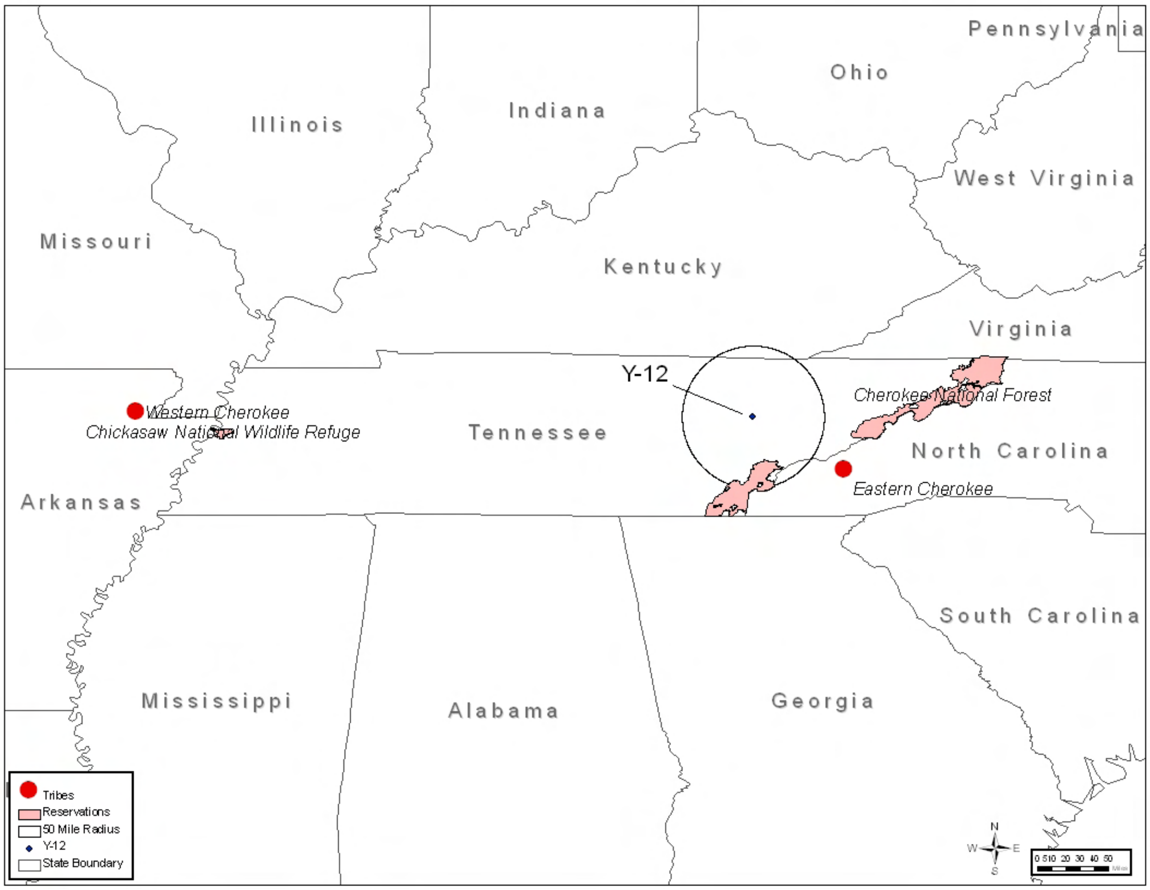


Figure 4.9.10-3—Low-Income Population – Census Tracts with More than 50 Percent Low-Income Population in a 50-Mile Radius of Y-12

4.9.10.1 *Characteristics of Native American Populations within the Vicinity of or with Interest in Y-12 Activities/Operations*

As discussed in Section 4.9.8.3, Native American groups which are known to have used the lands surrounding Y-12 are the Ancestors of the Eastern Band of the Cherokee Indians and the Cherokee Nation of Oklahoma. The 2000 U.S. Census Bureau was used to obtain characteristics, including population, employment, educational attainment, income, poverty level, average family size, and housing characteristics for all population subcategories associated with the ones mentioned above. The locations of various tribes in relation to Y-12 are shown in Figure 4.9.10-4. The results of this analysis are provided in the following section.



Source: ESRI 2007

Figure 4.9.10-4—Location of Tribes within Vicinity of or with Interest in Y-12

As shown in Table 4.9.10-2, the Eastern Cherokee had a population of 8,451, which was larger than the Western Cherokee population of 6,693. The Eastern Cherokee also have a larger percentage of their population as members of the civilian labor force with 65.9 percent and the Western Cherokee with a smaller percentage of their population as members of the civilian labor force with 64.3 percent. The Eastern Cherokee had a higher unemployment rate at 4.8 percent and the Western Cherokee had a lower unemployment rate of 4.1 percent (USCB 2007).

Of those individuals over 25 with some form of education, the largest constituency of the two Native American populations had received a high school diploma as shown in Table 4.9.10-3. A slightly lesser percentage of individuals had attended some college and lesser percentages of these populations had received degrees from institutions of higher learning (Associate, Bachelor, or Graduate/Professional) (USCB 2007).

The Western Cherokee population had the higher mean household earnings and per capita income with $45,538 and $17,616, respectively, in 2000 as shown in Table 4.9.10-4. The Eastern Cherokee population had the lower mean household earnings with $41,727 and the lower per capita income with $14,955 (USCB 2007).

Of the two Native American populations with ties to Y-12, the Eastern Cherokee had the larger percentage of individuals below the poverty level in 2000 with 18.5 percent as compared to the Western Cherokee population which had 13.6 percent of the total population living below the poverty level as shown in Table 4.9.10-4 (USCB 2007).

In 2000, the Eastern Cherokee had the larger average family size with 3.17 persons per family as compared to the Western Cherokees who had an average family size of 3.06 persons per family. The Eastern Cherokee had the greater number of occupied housing units which is consistent with their larger population as shown in Table 4.9.10-5 (USCB 2007).

Table 4.9.10-2—Population and Employment Estimates for Native American Populations within the Vicinity of or With Interest in Y-12, 2000

Y-12	Population	Civilian Labor Force	Civilian Labor Force (percent)	Employed	Employed (percent)	Unemployed	Unemployed (percent)
Eastern Cherokee	8,451	4,033	65.9	3,740	61.1	293	4.8
Western Cherokee	6,693	3,255	64.3	3,048	60.2	207	4.1

Source: USCB 2007

Table 4.9.10-3—Level of Educational Attainment by Native American Populations within the Vicinity of or With Interest in Y-12, 2000

Y-12	High School Graduate	High School Graduate (percent)	Some College	Some College (percent)	Associate Degree	Associate Degree (percent)	Bachelor Degree	Bachelor Degree (percent)	Graduate/ Professional Degree	Graduate/ Professional Degree (percent)
Eastern Cherokee	1,392	28.1	1,206	24.4	484	9.8	406	8.2	320	6.5
Western Cherokee	1,113	25.8	1,219	28.2	362	8.4	589	13.6	334	7.7

Source: USCB 2007

Table 4.9.10-4—Income and Poverty Level Estimates for Native American Populations within the Vicinity of or With Interest in Y-12, 2000

Y-12	Mean Household Earnings	Per Capita Income	Individuals Below the Poverty Level	Individuals Below the Poverty Level (percent)
Eastern Cherokee	$41,727	$14,955	1,517	18.5
Western Cherokee	$45,538	$17,611	883	13.6

Source: USCB 2007

Table 4.9.10-5—Housing Characteristics for Native American Populations within the Vicinity of or With Interest in Y-12, 2000

Y-12	Average Family Size	Housing Units	Occupied Housing Units	Owner Occupied Housing Units	Owner Occupied Housing Units (percent)	Renter Occupied Housing Units	Renter Occupied Housing Units (percent)
Eastern Cherokee	3.17	3,008	3,020	2,274	75.3	746	24.7
Western Cherokee	3.06	2,610	2,543	1,692	66.5	851	33.5

Source: USCB 2007

4.9.11 Health and Safety

Current activities associated with routine operations at Y-12 have the potential to affect worker and public health. The following discussion characterizes the human health impacts from current releases of radioactive and nonradioactive materials at Y-12. It is against this baseline that the potential incremental and cumulative impacts associated with the alternatives are compared and evaluated.

4.9.11.1 *Public Health*

4.9.11.1.1 Radiological

Releases of radionuclides to the environment from Y-12 operations provide a source of radiation exposure to individuals in the vicinity of Y-12. During 2005, Y-12' environmental radiological monitoring program was conducted according to DOE Orders 450.1, "Environmental Protection Program,"1 and 5400.5, "Radiation Protection of the Public and the Environment". The program involved measuring radioactivity in environmental samples in addition to calculating the potential radiological dose to the offsite public.

The exposure of members of the public to all DOE sources of radiation is limited by the DOE to levels that shall not cause, in a year, an effective dose equivalent greater than 100 millirem. Demonstration of compliance with this limit is documented by a combination of measurements and calculations including the comparison of concentrations of radioactive material in air and water to DCGs listed in Chapter III of DOE Order 5400.5. The DOE provides a level of protection for persons consuming water from a public drinking water supply equivalent to the drinking water criteria in 40 CFR 141 by limiting the effective dose equivalent in a year to

4 millirem. Compliance with the aforementioned criterion is accomplished by comparing measured concentrations of radionuclides in drinking water to 4 percent of the DCG values for ingested water. The DOE further limits emissions of radionuclides to the ambient air from DOE facilities to those amounts that would not cause any member of the public to receive, in any year, an effective dose equivalent of 10 millirem per year. This limit is equivalent to the limit for emissions of radionuclides other than radon to this pathway established by the EPA at 40 CFR 61.92.

Compliance with the dose limit specified in 40 CFR 61.92 (and hence that for the air pathway specified in DOE Order 5400.5) is demonstrated by calculating the effective dose equivalent received by the maximally exposed individual member of the general public. This individual is a person who resides near Y-12, and who would receive, based on theoretical assumptions about lifestyle that maximize exposure to radiological emissions, the highest effective dose equivalent from Plant operations. Calculations are performed using the EPA's CAP88-PC model (EPA 1992).

The dose received by the MEI is found in Table 4.9.11-1. A hypothetical MEI could have received a total dose of about 0.4 millirem from radionuclides emitted into the atmosphere from all of the sources in the ORR in 2004. This dose is 0.4 percent of the DOE Order 5400.5 ("Radiation Protection of the Public and the Environment") 100-millirem all-pathway dose standard for annual exposure. The standard for airborne releases is 10 millirem per year and applies to the sum of doses from all airborne pathways, e.g. inhalation, submersion in a plume, exposure to radionuclides deposited on the ground, and consumption of foods contaminated as a result of deposition of radionuclides. Inhalation and ingestion of uranium radioisotopes (i.e., U-232, U-233, U-234, U-235, U-236, and U-239) accounted for more than 99 percent of the dose.

As shown on Table 4.9.11-2, the calculated collective dose from airborne releases to the entire population within 50 miles of the ORR (about 1.1 million persons) was about 10.4 person-rem, which is approximately 0.003 percent of the 312,012 person-rem that this population received from natural sources of radiation. The contribution of Y-12 emissions to the 50-year dose the population residing within 50-miles of the ORR was calculated to be about 5.8 person-rem, which is approximately 56 percent of the collective dose for the ORR.

Table 4.9.11-1—Calculated Radiation Doses to Maximally Exposed Individuals from Airborne Releases during 2004

Total effective dose equivalents [mrem]		
Plant	**At plant max**	**At ORR max**
ORNL	0.1	0.02
ETTP	0.08	0.005
Y-12	0.4	0.4
Entire ORR	*a*	0.4

Source: ORR 2005.
a Not applicable. The maximally exposed individual for the entire ORR is the Y-12 MEI.

Table 4.9.11- 2—Calculated Collective Effective Dose Equivalents from Airborne Releases during 2004

Plant	Effective dose equivalents[a] (Person-rem)
ORNL	2.5
ETTP	2.1
Y-12	5.8
Entire ORR	10.4

Source: ORR 2005.
[a] Collective effective dose equivalents to the approximately 1.1 million persons within 50 miles of the ORR.

Radionuclides discharged to surface waters from the ORR enter the Tennessee River system by way of the Clinch River Adding worst-case doses for all pathways in a water-body segment gives a maximum individual dose of about 0.4 millirem to a person obtaining his or her full annual complement of fish, drinking water, and participation in other water uses from the Upper Clinch River. This dose is based on a person eating 46 pounds per year of the most contaminated accessible fish, drinking 193 gallons per year of the most contaminated drinking water, and using the shoreline near the most contaminated stretch of water for 60 hours per year. The maximum collective dose to the 50-mile population could be as high as 5 person-rem. These are small percentages of individual and collective doses attributable to natural background radiation, about 0.1 percent and 0.002 percent, respectively. The DOE standard is 4 millirem per year to the MEI from the drinking water pathway (ORR 2005).

Table 4.9.11-3 presents the potential radiological impacts to the public, from all sources, resulting from normal operations at Y-12.

The average annual dose to an involved worker at Y-12 during 2004 was 17.1 millirem. The dose to the involved workforce of 3,699 radiation workers was estimated to be 63.4 person-rem. The 2004 values are in-line with doses received during the past five years. Table 4.9.11-4 lists the individual and collective doses for all radiation (involved) workers from 2000 to 2004, as presented in the Y-12 Dosimetry Records System database.

Table 4.9.11-3—Potential Radiological Impacts to the Public Resulting from Normal Operations at Y-12

Affected Environment	Individual Dose (millirem-year)	Percentage of Standard[a]	Collective Dose (person-rem)
Atmospheric Releases	0.4	4	10.4
Waterborne Releases	0.4[b]	N /A	5
Totals	**0.8**	**0.8**	**15.4**

Source: ORR 2005.
[a] Radionuclide NESHAP standard is 10 millirem per year from atmospheric releases. DOE Order 5400.5 Change 2 radiological standard for atmospheric releases is 10 millirem per year, 4 millirem per year for drinking water pathway, and 100 millirem per year from all exposures.
[b] Maximum potential exposure to the individual based on radionuclide discharges to the Clinch-Poplar Creek system, based on a person eating 21 kg/year of the most contaminated accessible fish, drinking 730 L/year of the most contaminated drinking water, and using the shoreline near the most contaminated stretch of water for 60 h/year.

Table 4.9.11-4—Y-12 Radiological Worker Annual Individual and Collective Radiation Doses

Year	Number of Radiological Workers	Average Individual Worker Dose (millirem)	Radiological Worker Collective Dose (person-rem)
2000	3,264	20.5	66.9
2001	3,069	17.2	52.7
2002	3,376	18.1	61.2
2003	3,675	16.2	59.7
2004	3,699	17.1	63.4

Source: DOE 2005d.

4.9.11.1.2 Nonradiological

DOE submits an annual toxic release inventory report to EPA and TDEC on or before July 1 of each year. Operations involving toxic release inventory chemicals were compared with regulatory thresholds to determine which chemicals exceeded the reporting thresholds based on amounts manufactured, processed, or otherwise used at each facility.

Total 2004 reportable toxic releases to air, water, and land and waste transferred off site for treatment, disposal, and recycling remained about the same compared with the amounts reported for Y-12 in 2003. Releases for most metals decreased in 2004 as a result of declining machining and welding operations. In contrast, nitrate and nitric acid releases increased slightly as a result of increased waste treatment activities.

4.9.12 Transportation

Y-12 is located within 50 miles of three interstate highways: I-40, I-75, and I-81 (Figure 4.9.12-1). Interstate 40, an east-west highway, extends from North Carolina to California. Interstate 75 is a north-south highway extending from Michigan to Florida. Interstate 81 is a north-south interstate extending from New York to Tennessee. Interstate 81 connects with I-40 east of Knoxville, and I-40 and I-75 connect west of Knoxville near the city of Oak Ridge. In addition, SR 61, SR 162, and US25W at Clinton serve Y-12 transportation needs off site (DOE 2001a). Primary roads on the ORR serving Y-12 include SRS 95, 58, 62, and 170 (Bethel Valley Road). Traffic on Bear Creek Road, north of Y-12, flows in an east-west direction and connects Scarboro Road on the east end of the plant with SRs 95 and 58. Bear Creek Road has restricted access around Y-12 and is not a public thoroughfare. Bethel Valley Road is also closed to public access. The average commute is assumed to be 20 miles round trip, with an average occupancy of 1.5 passengers per car. The daily traffic numbers for various public roads at the ORR are given in Table 4.9.12-1.

Table 4.9.12-1—Existing Average Daily Traffic Counts on the ORR Serving Y-12

Road	To	From	Average Daily Traffic Vehicles/day
TSR 58	TSR 95	I-40	13,970
TSR 95	TSR 62	TSR 58	25,150
TSR 62	TSR 170	N/A	31,620
TSR 170 (Bethel Valley Road)	TSR 62	N/A	9,350

4.9.12.1 *Onsite Shipments*

On-site circulation consists of materials handling, movement of personnel between buildings, and contractor and vendor personnel movement. The main onsite road is Bethel Valley Road, which is currently closed to non-authorized traffic. This east−west road provides access to the site and leads to all the parking lots. Completion of several construction and expansion projects has helped alleviate some of the chronic parking problems experienced at the Bethel Valley site. Several main roads and access roads provide on-site transportation. The primary north and south corridors are First, Second, Third, Fourth, and Fifth streets. The major east and west corridors are White Oak and Central Avenues. Materials are transported via the same routes used by employees and visitors. The main roads in Melton Valley are Melton Valley Drive, Ramsey Drive, and Melton Valley Access Road.

4.9.12.2 *Offsite Shipments*

Various chemicals and other materials being used for Y-12 operations are transported by truck using the above-addressed roads (TSRs 58, 62, 95, and 170; I-40, I-75, and I-81). LLW, hazardous waste, and municipal and solid wastes are being generated by Y-12 operations. LLW is being stored on-site in temporary storage facilities and would eventually be disposed off-site at a DOE Site (DOE 2001a).

4.9.12.2.1 Aircraft Operations

Air transportation to and from the Y-12 National Security Complex is offered through the McGhee Tyson Airport, approximately 27.5 miles southeast of the Oak Ridge Reservation. The airport is located in the city of Alcoa in Blount County.

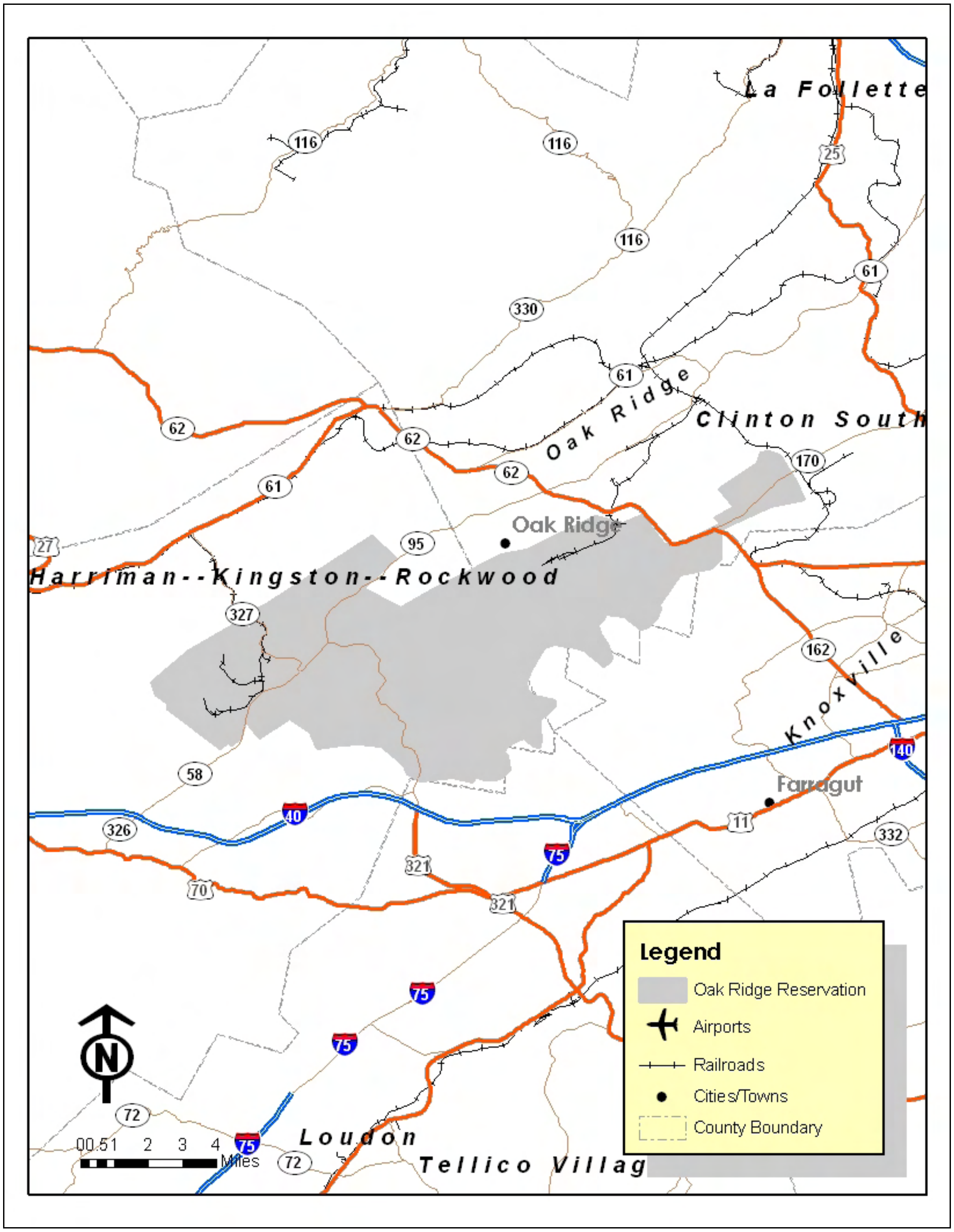


Figure 4.9.12-1—Roads in the Vicinity of ORR

4.9.13 Waste Management

The disposal facilities and landfills are operated by the EM Program. The majority of the waste management, treatment and storage facilities are operated by NNSA. Waste management facilities are located in buildings or on the sites where they are needed, or are collocated with other waste management facilities or operations.

The TDEC Division of Solid Waste Management (DSWM) regulates the management of waste streams under the *Tennessee Solid Waste Management Act* (TSWMA). Onsite waste disposal facilities in operation at Y-12 include industrial, construction/demolition landfills, and a CERCLA waste landfill.

The major waste types generated at Y-12 from routine operations include LLW, MLLW, hazardous waste, and nonhazardous waste (Table 4.9.13-1). Other waste includes sanitary and industrial wastewater, PCBs, asbestos, construction debris, general refuse, and medical wastes. Y-12 does not generate or manage high-level radiological waste or TRU waste.

Table 4.9.13-1—Waste Generation Totals by Waste Type for Routine Operations at Y-12

Waste Type	Waste Volume (FY-2003)
LLW (Liquid)	17.42 cubic yards
LLW (Solid)	7796.69 cubic yards
MLLW (Liquid)	17.87 cubic yards
MLLW (Solid)	21.12 cubic yards
RCRA Waste	14.37 short tons
TSCA Waste	14.84 short tons
Mixed TSCA	32.04 short tons
Sanitary Waste	7923.71 short tons

Source: Gilbert 2003.

Waste Management PEIS RODs affecting ORR and Y-12 are shown in Table 4.9.13-2 for the waste types analyzed in this SPEIS. Decisions on the various waste types are being announced in a series of RODs that have been issued under the *Waste Management PEIS*. The initial transuranic (TRU) waste ROD was issued on January 20, 1998 (63 FR 3629) with several subsequent amendments; the hazardous waste ROD was issued on August 5, 1998 (63 FR 41810); the high-level radioactive waste ROD was issued on August 12, 1999 (64 FR 46661), and the low-level radioactive waste and mixed low-level radioactive waste ROD was issued on February 18, 2000 (65 FR 10061). The TRU waste ROD states that DOE will develop and operate mobile and fixed facilities to characterize and prepare TRU waste for disposal at WIPP. Y-12 does not generate TRU waste. Each DOE site that has or will generate TRU waste will, as needed, prepare and store its TRU waste onsite until the waste is shipped to WIPP. The hazardous waste ROD states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the non-wastewater hazardous waste, with ORR and the SRS continuing to treat some of their own non-wastewater hazardous waste onsite in existing facilities where it is economically feasible.

The high-level radioactive waste ROD states that immobilized high-level radioactive waste will be stored at the site of generation until transferred to a geologic repository. The ROD for low-level waste (LLW) and mixed-LLW states that, for the management of LLW, minimal treatment will be performed at all sites and disposal will continue, to the extent practicable, onsite at Idaho National Environmental Laboratory (INEL), LANL, ORR, and SRS. In addition, the Hanford Site and NTS will be available to all DOE sites for LLW disposal.

Mixed-LLW will be treated at the Hanford Site, INL, ORR, and SRS and disposed of at the Hanford Site and the NTS. More detailed information concerning DOE's preferred alternatives for the future configuration of waste management facilities at ORR is presented in the *Waste Management PEIS* as well as the high-level radioactive waste, TRU waste, hazardous waste, and LLW and mixed-LLW waste RODs.

Table 4.9.13-2—Waste Management PEIS Records of Decision Affecting Oak Ridge Reservation and Y-12

Waste Type	Preferred Action
High-level radioactive	ORR does not currently manage high-level radioactive waste.[a]
Transuranic and mixed transuranic	DOE has decided that ORR should prepare and store its transuranic waste onsite pending disposal at WIPP.[b]
Low-level radioactive	DOE has decided to treat ORR liquid low-level radioactive waste onsite.[c] Separate from the *Waste Management PEIS*, DOE prefers offsite management of ORR solid low-level radioactive waste after temporary onsite storage.
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at ORR. This includes the onsite treatment of ORR waste and could include treatment of some mixed low-level radioactive waste generated at other sites.[d]
Hazardous	DOE has decided to use commercial and onsite ORR facilities for treatment of ORR nonwastewater hazardous waste. DOE will also continue to use onsite facilities for wastewater hazardous waste.[e]

[a] From the ROD for high-level radioactive waste (64 FR 46661).
[b] From the ROD for transuranic waste (63 FR 3629).
[c] From the ROD for low-level waste (65 FR 10061).
[d] From the ROD for mixed low-level waste (65 FR 10061).
[e] From the ROD for hazardous waste (63 FR 41810).

4.9.13.1 *Low-Level Waste*

Solid LLW, consisting primarily of radioactively contaminated scrap metal, construction debris, wood, paper, asbestos, filters containing solids, and process equipment is generated at Y-12. In FY2003, Y-12 generated approximately 7,797 cubic yards of solid LLW. Liquid LLW is treated in several facilities, including the West End Treatment Facility (WETF). Y-12 is the largest generator of routine LLW at Oak Ridge. In FY2003, Y-12 generated 42 cubic yards of liquid LLW.

4.9.13.2 *Mixed Low-Level Waste*

Mixed waste subject to treatment requirements to meet Land Disposal Restrictions (LDRs) under RCRA are generated and stored at Y-12. DOE is under a State Commissioner's Order (October 1, 1995) to treat and dispose of these wastes in accordance with milestones established in the *Site Treatment Plan for Mixed Waste on the Oak Ridge Reservation* and to comply with a *Federal Facilities Compliance Act* (FFC Act) that went into effect on June 12, 1992. *Toxic Substance Control Act* (TSCA)-regulated waste (containing PCBs) that is also radioactive waste is managed under a separate Federal Facilities Compliance Agreement (FFCA), first effective February 20, 1992.

4.9.13.3 *Hazardous Waste*

RCRA-hazardous waste is generated through a wide variety of production and maintenance operations. The majority of RCRA-hazardous waste is in solid form. In FY 2003, Y-12 generated

14 short tons of RCRA waste. The hazardous waste is shipped offsite for treatment and disposal at either DOE or commercially-permitted facilities.

4.9.13.4 *Nonhazardous Waste*

During 2004, the sanitary wastewater flow averaged about 663,000 gallons per day. Treated sanitary wastewater is discharged to the sanitary system in accordance with the Industrial and Commercial User Wastewater Discharge Permit No. 1-91. PCBs are transported to permitted facilities for treatment and disposal. Medical wastes are autoclaved to render them noninfectious and are then sent to a Y-12 sanitary industrial landfill, as are asbestos wastes and general refuse. Construction, demolition, and nonhazardous industrial materials are disposed of in a construction/demolition landfill at Y-12.

4.9.13.5 *Waste Generation Capacities*

Excess treatment and disposal capacity for hazardous waste exist both onsite and offsite at Y-12. Storage capacities at Y-12 are currently adequate for hazardous, MLLW, and LLW.

4.9.13.6 *Waste Management Facilities*

The majority of waste management facilities at Y-12 are operated by NNSA. Waste management facilities are located in buildings, or on sites, dedicated to their individual functions, or are collocated with other waste management facilities or operations. Many of the facilities are used for more than one waste stream.