CHAPTER 5

Environmental Consequences

Chapter 5 provides information on the methods of analysis applied in the Site-Wide Environmental Impact Statement (SWEIS) and the results of analyses for Sandia National Laboratories/New Mexico (SNL/NM). The chapter begins with an introduction and a summary of the impact assessment methodologies that have been applied. It continues with descriptions of the impacts of the No Action, the Expanded Operations, and the Reduced Operations Alternatives. Within each alternative, impacts are presented by resource area (for example, infrastructure, land use, geology and soils) or topic area (for example, waste generation, transportation, environmental justice). Also addressed later in this chapter are mitigation measures, irreversible and irretrievable commitments of resources, unavoidable adverse environmental impacts, and relationships between short-term uses of the environment and long-term productivity.

5.1 INTRODUCTION

Chapter 5 provides an analytical comparison of the environmental impacts associated with the alternatives. Section 5.2 contains a summary discussion of the methodologies used to assess potential impacts to that aspect. Detailed methodologies, analyses, and supporting data are provided in resource-specific appendixes A through H. Section 5.3, No Action Alternative; Section 5.4, Expanded Operations Alternative; and Section 5.5, Reduced Operations Alternative are formatted so that, within each alternative, the discussion is divided into the following resource and topic areas:

- Land Use and Visual Resources
- Infrastructure
- Geology and Soils
- Water Resources and Hydrology
- Biological and Ecological Resources
- Cultural Resources
- Air Quality
- Human Health and Worker Safety (including Accidents)
- Transportation (including Accidents)
- Waste Generation
- Noise and Vibration
- Socioeconomics
- Environmental Justice

For comparison purposes, environmental emissions and other potential environmental effects are presented with regulatory standards or guidelines, as appropriate. However, for *National Environmental Policy Act 1969* (NEPA) purposes, compliance with regulatory standards is not necessarily an indication of the significance or severity of the environmental impact.

Types of Impacts

Direct Impacts

These are effects that are caused by the action and occur at the same time and place. Examples of these would be the elimination of original land use due to the erection of a building or change of land use. Direct impacts may cause indirect impacts, such as ground disturbance resulting in resuspension of dust and decreasing visibility.

Indirect Impacts

These are effects that are caused by the action or by direct impact, occur later in time or are farther removed in the distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use (such as population density or growth rate and related effects on air and water and other natural systems, including ecosystems).

Cumulative Impacts

These are effects that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of which agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

Several resource-specific evaluations have also been performed that address the consequences and risks associated with the U.S. Department of Energy's (DOE's) operations at SNL/NM. Each evaluation has a unique scope and purpose. Figure 5.1-1 illustrates how the facility-based assessments and SWEIS-specific evaluations and consultations flow into the SNL/NM SWEIS.

This chapter also provides a discussion of mitigation measures (Section 5.6), unavoidable adverse impacts (Section 5.7), the relationship between short-term uses and long-term productivity (Section 5.8), and the irreversible or irretrievable commitment of resources (Section 5.9). A discussion of cumulative impacts is presented in Chapter 6.

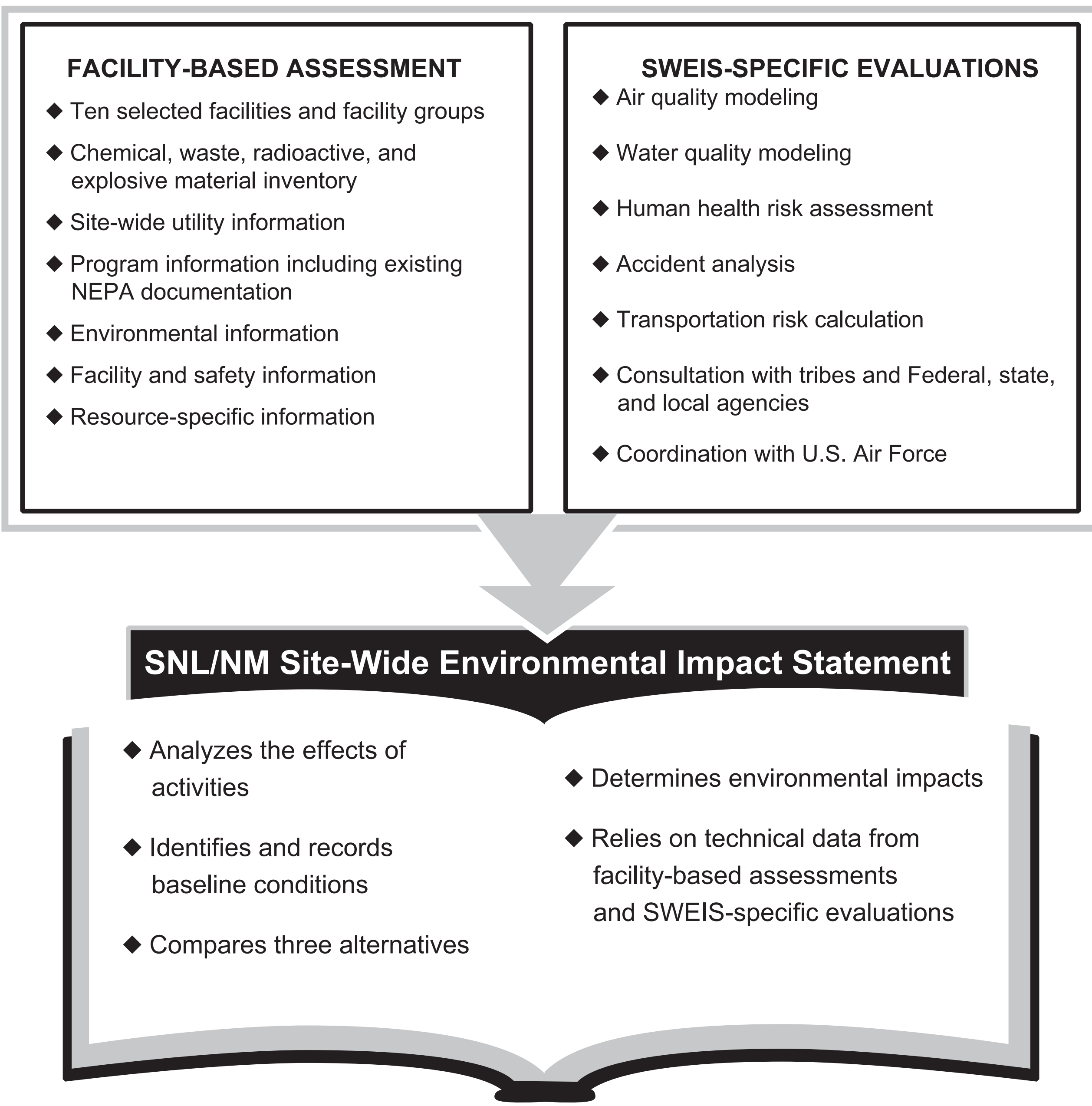

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Figure 5.1-1. Data and Analytical Contributions to the SNL/NM Site-Wide Environmental Impact Statement

The SWEIS is related to many other DOE resource-specific studies.

5.2 METHODOLOGY

Following are brief descriptions of the impact assessment approaches used in the SWEIS for addressing potential impacts of SNL/NM operations under the No Action, Expanded Operations, and Reduced Operations Alternatives. The *Sandia National Laboratories Site-Wide Environmental Impact Statement Final Methodologies for Impact Analysis* (TtNUS 1998e) provides in-depth information concerning the assessment methodologies used in the SWEIS.

5.2.1 Land Use and Visual Resources

A comparative methodology was used to determine impacts to SNL/NM land use. Facility operations and any construction or modification activities associated with each alternative were examined and compared to existing land use conditions. Impacts, if any, were identified as they relate to changes in land ownership and use classifications, extent and size figures, alternative or conflicting uses, and accessibility concerns.

The analysis of visual impacts was also comparative and consisted of a qualitative examination of potential changes in visual resources. The method of assessing a visual resource was based on the U.S. Forest Service (USFS) Scenery Management System (SMS). The SMS combines aspects of scenic attractiveness and landscape visibility to establish a series of six scenic classes. These classes indicate the degree of public value for a landscape area and serve as guidelines for future landscape changes. The higher the scenic class (on a scale where 1 is highest), the more important it is to maintain the highest scenic value. The scenic classes are 1-2, 3-4, and 5-6, corresponding to high public value, moderate public value, and low public value, respectively.

Aspects of visual modification examined included site development or modification activities that could alter the visibility of SNL/NM structures or obscure views of the surrounding landscape, changes in surrounding land cover that could make structures more or less visible, and air or light pollution associated with operations that could influence visibility factors in the area.

5.2.2 Infrastructure

Incremental changes to SNL/NM facilities and infrastructure were assessed by comparing the support requirements of the alternatives to current site infrastructure utility demands (water and electricity) based on projected facility square footage requirements and available capacities. Site-wide utility usage was adjusted for contributions from the selected facilities. Impacts were considered on a wide variety of structures and systems used by SNL/NM, including infrastructure support provided by Kirtland Air Force Base (KAFB), and assessment was focused on infrastructure, facilities, services, and utility systems. Four infrastructure facilities (steam plant, Radioactive and Mixed Waste Management Facility [RMWMF], Hazardous Waste Management Facility [HWMF], and Thermal Treatment Facility [TTF]) were specifically evaluated for impacts as representative of SNL/NM (see Section 2.3).

5.2.3 Geology and Soils

Geology and soils analyses encompassed three distinct areas: seismic, soil contamination, and slope stability. The consequences of potential seismic activity at SNL/NM are addressed within the accident analysis sections (5.3.8.2, 5.4.8.2, and 5.5.8.2) and Appendix F.

The soil contamination analysis considered the potential for human contact of near-surface (the top 6 inches to 1 ft) contaminated soils and limitations on future land use of these areas. The analysis examined the types of sites where soil contamination could be present (environmental restoration and outdoor testing areas) and site characteristics. Soil contaminant concentrations were projected under each alternative and compared with criteria for future designated land use.

The slope stability analysis examined the location of SNL/NM facilities relative to areas with potentially unstable slopes. SNL/NM facilities near these slopes were identified using a map generated from a geographic information system (GIS) showing slopes of at least 10 percent. The 10 percent value was selected as a conservative screening criterion based on the dry site soil conditions and lack of previous slope stability problems at SNL/NM. For each SNL/NM facility identified, field observations were conducted to support a qualitative evaluation of the effects of SNL/NM activities on these slopes.

5.2.4 Water Resources and Hydrology

Water resources and hydrology analyses focused on four distinct areas: groundwater quality, groundwater quantity, surface water quality, and surface water quantity.

The groundwater quality analysis determined to what extent contamination from SNL/NM sites in the unsaturated and saturated zones would limit the potential use of groundwater, particularly as drinking water. Unsaturated zone and groundwater contamination sites that have not been removed, are planned for removal, or are final or proposed no further action (NFA) sites were characterized in terms of their contaminants, concentrations, and extent. Where information was available, contaminant migration through the unsaturated zone beneath the contaminant source was characterized in terms of flow and transport parameters. A *MODFLOW/MODPATH* model maintained by the Environmental Restoration (ER) Project was used to simulate the path of contaminants from the water table beneath the source in the downgradient direction (DOE 1997a). This trajectory modeling was used with a one-dimensional (1-D)/ three-dimensional (3-D) flow/transport model to determine the maximum portion of the aquifer (area and extent) that would exceed applicable water quality criteria.

The groundwater quantity analysis examined future SNL/NM water use projections, evaluating potential impacts of groundwater withdrawal. Using records of local groundwater withdrawals and water level measurements from 1985 through 1996, a simple linear relationship between withdrawal and drawdown was established. This linear relationship was used with projections of groundwater withdrawals from KAFB (includes SNL/NM), Ridgecrest, and Mesa del Sol wells under each alternative to estimate future aquifer drawdown. Impacts of drawdown were evaluated for existing water supply wells, springs, and land subsidence.

The surface water quality analysis examined the potential for future storm water runoff contamination in Tijeras Arroyo. Tijeras Arroyo water quality measurements at the point where the arroyo crosses the KAFB boundary were examined and compared with New Mexico Water Quality Control Commission (NMWQCC)-listed constituents and standards for designated use (general standards, livestock watering, and wildlife habitat) (NMWQCC 1994). The analysis examined changes in potential SNL/NM contributions to surface water contamination under the three alternatives and the likelihood of these changes affecting regulatory compliance at the downstream exit point of Tijeras Arroyo from KAFB.

Effects of SNL/NM facilities on surface water quantity were analyzed based on the incremental contribution of SNL/NM to Rio Grande flow from storm water runoff and wastewater discharge. The SNL/NM contribution to storm water runoff was determined by calculating the difference between estimated natural runoff (10 percent of rainfall) and an assumed 100 percent runoff from the SNL/NM area covered by buildings and parking lots. Using flow measurements from the Montessa Park gaging station in Tijeras Arroyo, a portion of total Tijeras Arroyo flow was attributed to SNL/NM, based on the percentage of watershed area covered by SNL/NM facilities. This portion was added to the projected wastewater discharge quantities (wastewater is discharged to the Rio Grande after treatment at the Southside Water Reclamation Plant) for each alternative and compared with total Rio Grande flow. Potential impacts of this additional water quantity to the Rio Grande are discussed qualitatively.

5.2.5 Biological and Ecological Resources

A qualitative analysis addresses the impacts of the activities under each alternative to biological and ecological resources. The methodology focused on those biological resources with the potential to be appreciably affected, and for which analyses assessing alternative impacts were possible. Biological resources include biological communities, biodiversity, habitat, and ecological processes. Among these resources are the vegetation, wildlife, aquatic resources, and sensitive species that are present or use SNL/NM and contiguous areas. The potential sources of impacts to biological resources that were considered include noise, outdoor tests, hydrologic changes affecting availability of water to plants and animals, erosion, hazardous materials releases and radiological releases from normal operations, and security measures that restrict access to SNL/NM.

The biological data from earlier projects, wetlands surveys, and plant and animal inventories of portions of KAFB were reviewed to identify the locations of plant and animal species and wetlands. Lists of sensitive species potentially present on KAFB were obtained from the U.S. Fish and Wildlife Service (USFWS) (USFWS 1998), the New Mexico Department of Game and Fish (NMDGF 1997), the USFS (USFS 1990), and the New Mexico Energy, Minerals, and Natural Resources Department; Forestry and Resources Conservation Division (NMEM&NRD 1995).

Activities and potential releases identified under the three alternatives were reviewed for their potential to affect plants, animals, and the sensitive species under Federal and New Mexico laws and regulations. Potential beneficial and negative impacts to plants and animals were evaluated for gain, loss, disturbance, or displacement. Impacts to wetlands were evaluated to determine if their areal extent would change. Monitoring data on selected small mammal, reptile, amphibian, bird, and plant species were reviewed for radionuclide and metal contamination (SNL/NM 1997u). Data from the ER Project were reviewed for impact to biological resources (DOE 1996c).

5.2.6 Cultural Resources

Potential impacts to cultural resources were assessed under the No Action, Expanded Operations, and Reduced Operations Alternatives. Cultural resources include prehistoric archaeological sites, historic sites, and traditional cultural properties (TCPs). Information used for impact assessment was derived from the results of systematic cultural resource inventories on KAFB, review of literature concerning TCPs and traditional uses of the area, and consultations with 15 Native American tribal governments and the New Mexico State Historic Preservation Officer (SHPO).

Data on SNL/NM activities occurring under the three alternatives were used to analyze impacts to resources (SNL/NM 1998a). The results of consequence analyses for hydrology, transportation, infrastructure, and land use were used to determine the potential for other impacts to cultural resources. Human health, noise, and vibration analyses were used to assess impacts to human users of TCPs. The types of effects, or actions leading to effects, evaluated include the following:

- New construction
- Demolition
- Vibration
- Visual impact
- Radiation releases
- Hazardous material releases
- Maintenance
- Restricted access
- Explosive testing debris and shrapnel
- Hydrologic changes
- Erosion or soil movement
- Off-road vehicle traffic
- Unintended fires and fire suppression

Potential impacts to cultural resources can fall into four broad categories, called Criteria of Effect and Adverse Effect (36 Code of Federal Regulations [CFR] §800.9), as defined in the implementing regulations for the *National Historic Preservation Act* (NHPA), as amended (16 Unite State Code [U.S.C.] Section [§] 470). These categories consist of 1) destruction or alteration; 2) isolation and restriction of access; 3) introduction of visible, audible, or atmospheric elements out of character with the resource; and 4) neglect leading to deterioration and vandalism. The locations of known cultural resources were compared to the areas of potential effect from SNL/NM activities. The potential for impacts from these activities to cultural resources was then assessed.

5.2.7 Air Quality

5.2.7.1 Nonradiological Air Quality

Nonradiological air quality impacts were determined by modeling site emissions of criteria and chemical pollutants for the 1996 baseline conditions, plus those pollutant sources expected to become operational by 2008. The site-specific emissions were modeled in accordance with U.S. Environmental Protection Agency (EPA), state of New Mexico, and city of Albuquerque guidelines. The EPA-recommended *Industrial Source Complex Short-Term Model, Version 3 (ISCST3)* was selected as the most appropriate model to perform the air dispersion modeling analysis from stationary continuous emission sources. *ISCST3* and the available hourly meteorological data for 1994 through 1996 were used in the assessment of criteria pollutant air quality. The maximum concentrations of the seven criteria pollutants included in the primary and secondary National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) and the New Mexico Ambient Air Quality Standards (NMAAQS) (20 New Mexico Administrative Code [NMAC] 2.3) were assessed, including carbon monoxide, lead, nitrogen dioxide, total suspended particulates (TSP), particulate matter smaller than 10 microns in diameter (PM_{10}), sulfur dioxide, and ozone. Ambient air monitoring data were used to supplement modeled pollutant concentrations for those pollutants for which no emission data were available.

The New Mexico Air Pollution Control Bureau approved the Ozone Limiting Method (OLM) to estimate nitrogen dioxide concentrations in modeled nitrogen oxides emissions. The OLM was employed to estimate nitrogen dioxide concentrations in cases where the modeled nitrogen oxides concentration is greater than the NMAAQS for nitrogen dioxide. The modeled 24-hour average nitrogen oxides concentration resulting from nitrogen oxides emissions from SNL/NM exceeds the NMAAQS for nitrogen dioxide. As a result, the OLM was implemented.

Evaluation of chemical pollutant air quality consisted of modeling chemical pollutant emissions derived from the Chemical Information System (CIS), CheMaster, and Hazardous Chemicals Purchased Inventory (HCPI) databases. The modeling was performed using the model *ISCST3*, the hourly meteorological data used for the criteria pollutant assessment, chemical purchase data, and chemical release assumptions.

Receptor locations for the criteria and chemical pollutant modeling included the maximum offsite concentration location, public access areas, hospitals, and schools. The maximum criteria pollutant concentrations at receptor locations were compared with the NAAQS and NMAAQS to determine compliance with standards, while the chemical pollutant concentrations were compared with health guidelines derived from occupational exposure limits (OEL) divided by 100 and unit cancer risk factors for 10^{-8} risk levels in lieu of established regulatory ambient air quality standards. Chemical pollutants of concern were identified through a progressive series of screening steps, each step involving fewer pollutants, which were screened by methods that involved more rigorous and realistic emission rates and modeling parameters than the step before. Chemicals that failed the screening process were referred to the Human Health risk assessment. This approach, consistent with EPA guidance, focused detailed analyses only on those chemicals of concern that have the potential to cause adverse health effects.

Analysis of the contribution of mobile sources (vehicular traffic) entering SNL/NM was performed using the *Mobile Source Emission Factor Model (MOBILE 5a)* to estimate mobile source emissions of carbon monoxide (EPA 1994). Assessment of air quality also included modeling the criteria and chemical emissions from fire testing facilities using the *Open Burn/Open Detonation Dispersion Model (OBODM)* developed by the U.S. Army and the EPA (Bjorklund et al. 1997).

5.2.7.2 Radiological Air Quality

Radiological emissions from routine SNL/NM facility operations were evaluated on the basis of dose to the maximally exposed individual (MEI) and collective dose to the general population within 50 mi of SNL/NM. This evaluation was compared to the standards in the National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61). NESHAP standards limit the radiation dose that a member of the public may receive from radiological material released to the atmosphere from normal operations to 10 mrem per year. The emissions from all SNL/NM facilities were reviewed. Those facilities that did not contribute more than 0.01 mrem per year (0.1 percent of the NESHAP limit) to the MEI were excluded. Ten facilities exceeding the threshold were included in the dose impact evaluation: Annular Core Research Reactor (ACRR), Defense Programs (DP) configuration; ACRR, medical isotopes production configuration; Sandia Pulsed Reactor (SPR); Hot Cell Facility (HCF); RMWMF; Mixed Waste Landfill (MWL); High-Energy Radiation Megavolt Electron Source III (HERMES III); Radiographic Integrated Test Stand (RITS); Neutron Generator Facility (NGF); and Explosive Components Facility (ECF).

The radiological impacts of normal operations were based on estimated radionuclide emission rates and were calculated using the EPA-approved *Clean Air Assessment Package (CAP88-PC)* computer model (DOE 1997e). *CAP88-PC* conservatively calculates radiological impacts extending up to 50 mi.

Two dose quantities were calculated with the *CAP88-PC* model: the effective dose equivalent from external sources and the committed effective dose equivalent from internal sources. The external dose represents exposure from airborne radiation emissions or exposure from the ground, such as standing on ground that is contaminated with radioactive material. The pathways for internal exposure include ingesting food products contaminated by airborne radiation. Although the SNL/NM site does not contain any agricultural production, agricultural data beyond the site boundary to a 50-mi radius were considered in the impact evaluation.

Potential MEIs were identified as receptor locations. These receptor locations were selected based on distance, direction, and wind speed and direction from each modeled facility. The total dose was calculated at each of the receptor locations from each of the modeled facilities. The receptor with the highest combined dose from all facilities was identified as the MEI and compared with regulatory standards. The collective dose to the population within 50 mi of SNL/NM was also determined. The methodology for assessing MEI and collective population dose impacts is further discussed in Section 5.2.8, below.

5.2.8 Human Health and Worker Safety

5.2.8.1 Normal Operations

An analysis of environmental conditions related to SNL/NM routine operations under each alternative and an assessment of the release of hazardous materials by way of different transport pathways were used to identify possible exposure pathways of concern to receptor locations within the SNL/NM vicinity. All environmental releases of chemicals and radionuclides with the potential to adversely impact public health or worker health and safety were evaluated for human health risk. The health risk assessment process is a series of steps associating environmental conditions with potential health effects resulting from contact with the contaminants in the environment, as illustrated in Figure 5.2.8 1.

An initial assessment identified potential sources at SNL/NM as emissions from stacks and open burning, radiological material transportation, and existing environmental contamination. Exposure pathways analyzed include inhaling affected ambient air, ingesting food products affected by radiological air releases, direct radiation exposure from radioactive air emissions and ground deposition, and direct radiation exposure from radioactive materials shipments. Human health risk calculations used exposure information derived from analysis of nonradiological air quality, radiological air quality, and transportation of hazardous material.

A receptor s exposure to a chemical contaminant was expressed in terms of chronic daily intake (CDI) or Lifetime Average Daily Dose (LADD). The numerical approach for CDI calculated potential chronic exposures averaged over a lifetime from noncarcinogenic chemicals and related them as a ratio to the EPA-derived health risk factors known as reference doses. The ratio estimates the increased risk that an individual exposed to that compound could develop an adverse health effect. The numerical approach for LADD estimated potential chronic exposures to carcinogenic chemicals and associated them with the EPA-derived health risk factor for carcinogens known as cancer slope factors (CSF). The daily intake was multiplied by the health risk CSF to estimate the increased likelihood of an individual getting cancer in his or her lifetime from that exposure.

The radiological dose assessment looked at appropriate health risk estimators for excess latent cancer fatalities (LCFs), nonfatal cancers, and excess genetic disorders. The risk estimators used are recommended by the International Commission on Radiological Protection (ICRP 1991) and are promulgated in Federal guidance. Dose to the individual was converted to the increase in lifetime risk of fatal cancer, nonfatal cancer, and genetic disorders. Population collective dose was converted to the additional number of LCFs, nonfatal cancers, and genetic disorders in the population assessed.

To account for multiple pathways, a composite cancer risk for an individual member of the public, due to both carcinogenic chemicals and radiological exposures, was derived by adding the radiological MEI cancer risk with the excess lifetime cancer risk (ELCR) due to chemical exposure. Two scenarios were developed expressing composite risk: the risk at the radiological MEI receptor location was evaluated for the contribution added by chemical exposures at the same location; and a worst-case composite risk was calculated, assuming the radiological MEI risk is hypothetically combined with the upper-bound value for cancer risk from chemicals, even though these concentrations occur at different locations.

Radiological doses to the radiation worker population were evaluated using the historic dosimetry data available for 1992 through 1996. Nonradiological impacts to workers were evaluated using occupational illness and injury data, occurrence reports, and industrial hygiene investigation reports available for the same period.

The SNL/NM illness/injury rate per year under each alternative is expected to remain consistent with the average illness/injury rate calculated for 1992 through 1996. Estimating the number of illnesses and injuries per year was based on projected changes in the total number of workers under each alternative multiplied by the 5-year average illness/injury rate.

The same approach was used to estimate radiation workers annual workforce collective dose. Estimating the annual workforce collective dose was based on the projected changes in the number of radiation workers under each alternative multiplied by the 5-year average annual workforce collective dose. Annual workforce collective dose was converted to total number of fatal cancers in the radiation worker population from one year s dose.

Maximum worker dose and average worker dose under each alternative are expected to be consistent with data collected in base year 1996 (see Section 4.10).

5.2.9 Accident Analysis

The requirements for accident analysis are set forth by the DOE (DOE 1993b). DOE guidance for accident analysis allows a graded approach that analyzes accidents at a level of detail that is consistent with the magnitude of the potential impacts. The Department requires that potential hazards be considered if they can lead to accidents that are reasonably foreseeable; that is, there is a mechanism for their occurrence and their probability of occurrence is generally greater than one chance in a

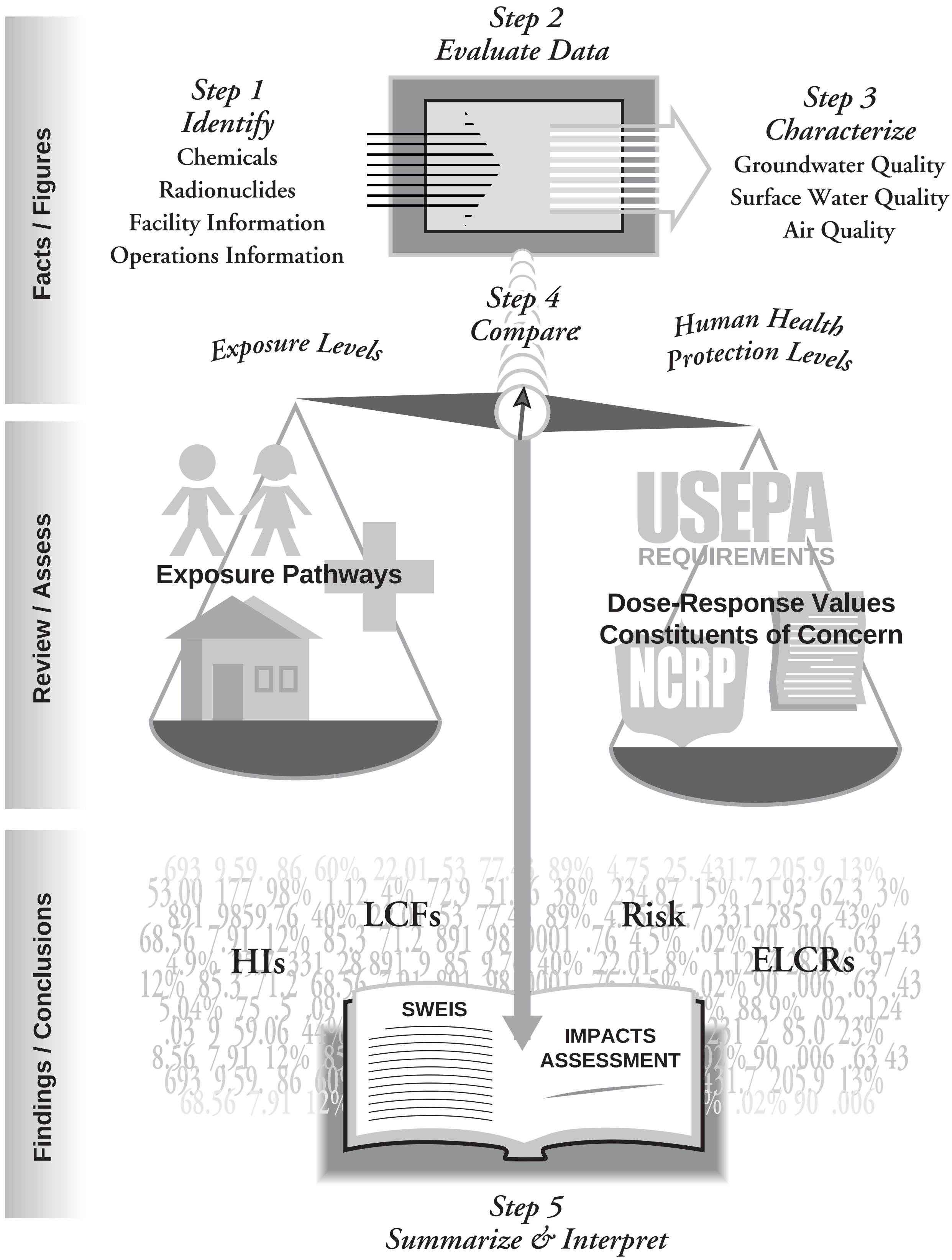

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Figure 5.2.8 1. The Health Risk Assessment Process

The health risk assessment process is a series of steps associating environmental conditions with potential health effects.

million per year ($1x10^{-6}$). Accidents that are less frequent may also be considered if they could result in high consequences and provide information important to decision-making. Although the impacts of all potential accidents are not required, the accident analysis is required to evaluate a sample of reasonably foreseeable accidents, to demonstrate the range of potential impacts. These accidents would include both low-frequency high-consequence and high-frequency-low consequence-events.

The accident impacts described in this section were developed as a result of detailed studies of selected SNL/NM facilities that included

meetings with facility managers; environment, safety, and health coordinators; and/or safety personnel to identify major potential hazards and identify safety documentation applicable to the SWEIS;

facility visits and tours to identify potential hazardous situations, gain an understanding of the mechanisms that could cause an accident, and obtain information for the development of accident scenarios; and

reviews of facility safety documentation, including safety assessments (SAs), hazard assessment (HA) documents, process hazard surveys or studies, safety analysis reports (SARs), environmental impact statements (EISs), environmental assessments (EAs), hazardous material databases, environmental monitoring reports permits, and other source documents prepared by SNL/NM for the SWEIS.

The information and data obtained during these activities were used extensively for assessing hazards at SNL/NM facilities, developing accident scenarios, and estimating accident impacts (TtNUS 1998k).

Preliminary screenings of SNL/NM activities and operations were conducted to select facilities and operations to be evaluated. Because of the relatively large number of activities and operations at SNL/NM facilities and the large number of potential accident scenarios that could be postulated, further screening was performed to eliminate low-hazard activities and operations that would result in small consequences to receptors.

Facility SARs analyze accidents that have multiple conservative assumptions, resulting in the highest consequences. Radiological accidents generally represent accidents affecting the facility or the experiment being performed that contain radioactive materials. For accident scenarios involving stored materials, the accidents represent the maximum quantities that could be involved. Similar conservative assumptions also hold for nonradiological accidents.

The impacts to humans that could result from potential radiological accident scenarios were evaluated in terms of dose units (such as rem or person-rem), and LCFs. For chemical releases, the impacts were evaluated in terms of chemical concentrations in relation to environmental response planning guideline (ERPG) levels for specified workers and the public (AIHA 1997). The potential for accidents whose impacts are measured in units other than LCF and chemical concentrations were also addressed.

The impacts of accidents were measured in terms of the effects for six types of human receptors: 1) 14 core receptors at various onsite and offsite locations; 2) receptor locations at the KAFB boundary at the 16 compass points; 3) the MEI, who has the highest reported dose of either core receptors or boundary receptors; 4) the offsite population within 50 mi; 5) a noninvolved worker at 100 m; and 6) involved workers (generally in the immediate vicinity of the accident).

The estimated impacts of accidents can be affected by unavoidable uncertainties in the analyses. These uncertainties can be attributed to modeling techniques, source-term estimates, release fractions, health effects estimators, accident scenario definitions, meteorological data, population estimates, and similar causes. Several actions were taken to minimize the effects of uncertainties. These included the use of approved methodologies, approved and verified models, formally documented data in approved reports, conservative data estimation practices, and formal quality assurance reviews. The effects of any remaining uncertainties were further minimized when accident impacts for alternatives were compared on a relative, rather than absolute, basis.

Many of the accident scenarios excluded the effects of mitigation measures such as filtration or scrubbing of the effluent prior to release to the environment. Some chemical storage containers are equipped with internal flow restrictors that would limit the uncontrolled release of their contents. Also, emergency procedures, sheltering, and evacuation would reduce the extent of human exposures.

5.2.10 Transportation

Transportation impacts were addressed by examining onsite and offsite transportation activities involving radioactive, chemical, and explosive materials and wastes, including assessing existing transportation facilities and modes of transport. Both incident-free exposures and accident exposures to workers and the public were analyzed. Regional traffic impacts related to the alternatives were also addressed. The analysis presents a summary of the regulatory framework as it applies to transportation activities and considers current transportation procedures.

The analysis includes assessing impacts of local transportation; incident-free radiological dose to the crew and public; radiological dose (consequences) due to potential accidental release of radioactivity for a given accident (category VII); nonradiological impact due to traffic fatalities; and LCFs due to potential vehicle emissions of air pollutants from offsite transportation of materials and waste. The nonradiological traffic fatalities were calculated based on unit risk factors (fatalities per kilometer of travel for crew and public) developed from national statistics for highway accident-related deaths (SNL 1986). The radiological impacts were calculated using the *RADTRAN4* model developed at SNL/NM and documented by Neusher and Kanipe (SNL/NM 1992a). The LCFs due to vehicle emissions were calculated by using unit risk factors (fatalities per kilometer of urban travel) developed by SNL/NM (1982). The transportation impacts due to the movement of materials and wastes between SNL/NM and other sites would be bounding compared to the transportation impacts due to onsite transfers or movement of the materials and wastes (see Appendix G). Therefore, a detailed impact analysis was performed considering offsite transport of the materials and wastes. The details of this offsite transportation analysis are presented in Appendix G. Overall impact was evaluated in terms of total lifetime fatalities due to offsite transportation of materials and waste from SNL/NM operations.

Activity Multipliers

The activities proposed under the alternatives would potentially impact the types and quantities of material used and transported at SNL/NM. The activity scenarios from the SNL/NM Facility Information Manager were used to project inventories for facilities based on activities at the facilities. The selected existing facilities represent the types of operations that will occur at SNL/NM over the next 10 years. These activities primarily relate to test shots, production levels, and/or manpower estimates for these selected facilities. These activities have been converted to unit-less numbers that have been normalized so that a site-wide aggregate multiplier for each alternative could be developed. In turn, these multipliers were used to develop projections for the waste management and transportation consequence analysis. The operations at new facilities were not considered for the multiplier because the start-up of these operations reaching their planned production levels would artificially inflate the multiplier and not truly reflect the anticipated activity levels at SNL/NM. The details of the activity multipliers are presented in Appendix A.

5.2.11 Waste Generation

The waste generation analysis examined potential impacts associated with waste generation activities of SNL/NM, including low-level waste (LLW), low-level mixed waste (LLMW), transuranic (TRU) waste, mixed transuranic (MTRU) waste, hazardous waste, and process wastewater. The ongoing waste management practices relating to generating, handling, treating, and storing wastes are described. The analysis also presents a summary of the regulatory framework as it applies to waste management and a summary of current and projected waste generation activities. Selected facilities or activities that generate waste were evaluated for changes in the baseline quantity of waste generated as a result of the proposed alternatives. SNL/NM treatment and storage facilities were evaluated for any impacts on their capabilities to manage wastes before transportation to offsite disposal. Potential impacts considered included physical safety, regulatory requirements, and security measures associated with storage capacity, personnel safety, and treatment capacity.

A quantity projected under the No Action Alternative for 2003 and 2008 represents the maximum quantity projected for any given year during the 1998-2003 and 2004-2008 5-year time frames. Waste volume estimates for 2003 and 2008 are considered to be conservative and bounding based on current annual projections.

For each selected facility, a waste quantity projected under the Expanded Operations Alternative represents the maximum possible waste generation level, and thus the bounding level of operation. This applies to all waste types (including LLW, LLMW, and *Resource Conservation and Recovery Act* (RCRA) hazardous waste).

A quantity projected under the Reduced Operations Alternative represents the projected quantity of waste generated during any given year as a result of maintaining programmatic capabilities across SNL/NM at minimum operational levels based on selected facilities.

5.2.12 Noise and Vibration

The noise and vibration analysis describes the noise sources at SNL/NM by activity and location and qualitatively discusses the impacts of these noise sources. Direct and indirect impacts of the alternatives and compliance with applicable regulations are addressed. The number of noise events projected for each alternative from tests of high explosives, tests using rocket motors, tests producing sonic booms, tests involving large-caliber weapons, as well as increased noise from aircraft, vehicular traffic, and industrial sources were compared with the available baseline data. A qualitative discussion of baseline noise at SNL/NM presents examples of dBA sound levels that are typical of short-term noise impacts from SNL/NM test activities. Estimated sound levels are presented for area locations as examples of the impacts from SNL/NM test activities.

5.2.13 Socioeconomics

The socioeconomic analysis measured the incremental effects from changes in expenditures, income, and employment associated with the three alternatives at SNL/NM and their overall effect on the region of influence (ROI). The ROI, as described in Chapter 4, is the four-county central New Mexico region around SNL/NM, including the city of Albuquerque, where 97.5 percent of SNL/NM employees and their families live, spend their wages and salaries, and use their benefits.

Spending by SNL directly affects the ROI in terms of dollars of expenditures gained or lost for individuals and businesses, dollars of income gained or lost to households, and the number of jobs created or lost. Changes in expenditures by SNL (that is, dollars spent for capital goods and services in the ROI) directly affect the number of jobs created and amount of income received by individuals and businesses who provide SNL with required goods and services. In addition, by spending their income in the ROI, SNL/NM employees and their families also directly affect the number of jobs created and amount of income received by individuals and businesses in the ROI who provide them with goods and services. Changes in employment at SNL/NM directly affect the overall economic and social activities of the communities and people living in the ROI. Additionally, businesses and households in the ROI respend SNL/NM money, which creates, in turn, indirect and induced socioeconomic effects from SNL/NM operations. Every subsequent re-spending of money by businesses and households in the ROI is another tier of indirect and induced socioeconomic effects originating from SNL/NM operations.

Economic activity (expenditures), income, and employment multipliers are factors used in calculating the incremental effect of changes in socioeconomic conditions at SNL/NM. These multipliers were developed by New Mexico State University (NMSU) and are presented in *The Economic Impact of Sandia National Laboratories on Central New Mexico and the State of New Mexico, Fiscal Year 1996* (DOE 1997j). The 1997 report (update) was reviewed; however, 1996 remained the representative year for analyzing socioeconomic impacts because overall impacts remained stable.

Following are the selected socioeconomic impact areas examined:

- *Demographics* evaluating the impact of the alternatives on the ROI s demographics;
- *Economic base* evaluating the impact of the alternatives on the ROI economy; and
- *Housing and community services* evaluating the impact of the alternatives on housing availability and services in the ROI

5.2.14 Environmental Justice

The potential for disproportionately high and adverse human health or environmental impacts from the proposed alternatives on minority and low-income populations was examined in accordance with Executive Order (EO) 12898, *Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629). Both the *Environmental Justice Guidance Under the National Environmental Policy Act* (CEQ 1997) and the *Guidance for Incorporating Environmental Justice Concerns in EPA s NEPA Compliance Analyses* (EPA 1998d) provide guidance for identifying minority and low-income populations and determining whether the human health and environmental effects on these populations are disproportionately high and adverse.

The environmental justice analysis presents selected demographics and identifies the locations of minority and low-income populations living in the ROI of a 50-mi radius around SNL/NM (see Section 4.15.2). For the purposes of consistency and conservative analysis, data were extracted from *Addressing Environmental Justice Under the National Environmental Policy Act at Sandia National Laboratories/New Mexico* (SNL 1997f). In this report, minority and low-income populations within the ROI were identified at the U.S. Bureau of the Census block-group level, which allows for potential localized impact analysis.

In New Mexico, the minority population in 1990 was approximately 49 percent (51 percent by 1996) of the total state population (Census 1998). In accordance with the *Environmental Justice Guidance Under the National Environmental Policy Act* (CEQ 1997), all block groups with a percent minority population greater than 49 percent were identified as being minority.

Because ROIs vary by resource area, an environmental justice impact evaluation was conducted by individual resource area. The environmental justice analysis considered impacts to minority populations and low-income populations in the ROI. Resource areas having ROIs smaller than 50 mi and not having substantial impacts were assumed to have inconsequential impacts beyond the smaller ROI. Resource areas having substantial impacts (or of potential concern) were evaluated on an individual basis with respect to minority populations and low-income populations. Three resource areas evaluated individually were water resources, cultural resources, and transportation

Twenty-one percent of the state population in 1989 was considered to be living below the poverty level (Census 1996). Therefore, for analysis purposes, all block groups with a poverty percentage greater than 21 were identified as being low-income. Environmental justice impacts were assessed and compared to the analysis presented for the general population by resource area for each of the alternatives. Environmental justice-related impacts are only present if the impacts to minority or low-income populations are disproportionately high and adverse in comparison to the general population.

5.3 NO ACTION ALTERNATIVE

Under the No Action Alternative, ongoing DOE and interagency programs and activities at SNL/NM would continue at currently planned levels in support of assigned missions. This would include any activities that the DOE has approved and that have existing NEPA documentation. Sections 5.3.1 through 5.3.13 describe how this alternative would affect the resource or topic areas evaluated in the SWEIS.

5.3.1 Land Use and Visual Resources

The implementation of the No Action Alternative would not affect the existing land use patterns or visual resources at SNL/NM facilities on KAFB. Sections 5.3.1.1 and 5.3.1.2 discuss these resource areas in relation to the No Action Alternative.

5.3.1.1 Land Use

The extent of DOE land and U.S. Air Force (USAF)-permitted acreage currently available for use by SNL/NM on KAFB would remain the same. Due to DOE-wide consolidation efforts and general guidance to return real estate that exceeds the Department s needs, the acquisition of additional land would be limited. One real estate transaction involving the acquisition of approximately 4 ac from the city of Albuquerque is ongoing (see Section 4.3.3.7). In general, the TAs, which encompass over 2,800 ac of DOE property, would not change. In addition, the SNL/NM use of more than 5,900 ac on KAFB, permitted by the USAF to the DOE, would continue with periodic modifications due to the expiration of permits and the initiation of new or modified requests. The continued operation of the 10,000-ft sled track in TA-III would require continuation of leases for land adjacent to KAFB as safety buffer zones. The lease with the Pueblo of Isleta for more than 6,300 ac would remain in effect. The renewal of the lease with the state of New Mexico for more than 2,700 ac is in negotiation. SNL/NM operations would remain consistent with industrial research park uses and would have no foreseeable effects on established land use patterns or requirements. Planned SNL/NM facilities, expansions, and upgrades referred to in the *1998 Sites Comprehensive Plan* (SNL 1997a) would not require changes to current land ownership or classification status because the DOE would place such facilities in or near existing facilities, in disturbed or developed areas, or on land under DOE control.

At locations on permitted land where operations would be declining or shut down by the owning organization, SNL/NM would continue to hold the sites to conduct periodic safety checks and complete any ER actions (Section 5.3.3.1). Before returning land, SNL/NM would be responsible for conducting any demolition work and restoring it to its condition when originally acquired from the USAF (SNL 1997a).

5.3.1.2 Visual Resources

As stated above, the No Action Alternative would not adversely change the overall appearance of the existing landscape, obscure views, increase the visibility of SNL/NM structures, or otherwise detract from the scenic perspectives of existing and planned residential developments adjacent to KAFB. New SNL/NM facilities, expansions, and upgrades would be planned at or near existing facilities in areas with common scenic quality. Efforts initiated by SNL/NM to incorporate campus-style design are expected to continue. This style contains established principles and design guidance that provide a framework for the physical development and redevelopment of SNL/NM sites. The guidance covers building massing, facades, colors, building orientation and entries, traffic circulation corridors, standardized signage, and landscaping, including low-water-use plant selections. These efforts would be consistent with the generally high concern for scenery due to the number of observers and users in and around the area.

Limited operations at outdoor testing facilities in the Coyote Test Field and the Withdrawn Area would continue; however, no additional development is anticipated that would alter visual resources. Some testing activities would be conducted producing smoke and dust of variable quantity and duration, but these conditions would be periodic and short-term and would not change the visual characteristics of the area. Where decommissioning, demolition, or ER activities are planned, actions would be taken such as backfilling, reducing side slopes, applying topsoil, reseeding, and establishing plant growth to restore the area to its state when originally acquired by SNL/NM.

5.3.2 Infrastructure

Descriptions of important infrastructure-related services (such as maintenance), utilities (such as electricity), and facilities (such as the steam plant) are provided in the *SNL/NM Facilities and Safety Information Document* (SNL/NM 1998a), and the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a). Potential incremental changes to SNL/NM services, utilities, and facilities were reviewed for each alternative. The analysis focused on incremental changes for site-wide utility demands and for the selected infrastructure facilities, the steam plant, RMWMF, HWMF, and TTF.

Regarding site-wide utility demands, most SNL/NM facilities do not meter utility use. However, annual site-wide utility demands are known and were used, in part, to make projections for this alternative (SNL/NM 1998c). These projections were made by identifying representative base years for each specific utility and calculating usage based on square footage presented in the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a). These site-wide demand calculations were made independent of data collected on the selected facilities identified in Chapter 2. Facility-specific utility demand estimates are presented in Chapter 3, Table 3.6 2. The assumptions used are detailed in the *SNL/NM Facilities and Safety Information Document* (SNL/NM 1998a). Any incremental changes from the base year in utility demands for the selected facilities were taken into account by adjusting site-wide demand accordingly, as presented in Table 5.3.2 1.

Analysis of four specific facilities in the selected infrastructure facility group (Section 2.3.4) was straightforward, relying on the information presented in the *SNL/NM Facilities and Safety Information Document* (SNL/NM 1998a). Projected throughput was compared to reported operational capacities as presented in Table 5.3.2 2. Air emissions from the steam plant are addressed in Section 5.3.7.1, radioactive air emissions are addressed in Section 5.3.7.2, and SNL/NM site-wide and specific facility waste generation is addressed in Section 5.3.10.

Implementation of the No Action Alternative would not affect current demands on infrastructure (described in Section 4.2). Water consumption would increase from 440 M gal per year to 463 M gal per year by 2008. However, SNL/NM has committed to a 30 percent reduction in water use by 2004. Table 5.3.2 1 shows the water use projections for the No Action Alternative and for a conservation-based scenario. The conservation-based scenario has water use decreasing from 440 M gal to 308 M gal per year before 2008. In Section 5.3.4, water use is conservatively analyzed at the 440 to 463 M gal per year projection. SNL/NM would generate approximately 280 to 304 M gal of wastewater per year. If the water use reduction effort is successful, a reduction in wastewater discharge would also occur (see Table 5.3.2 1). Annual electrical consumption would decrease from 197,000 to 186,000 MWh. Projections of annual consumption of natural gas, fuel oil, and propane are also presented in Table 5.3.2 1.

Table 5.3.2 1 shows water use and wastewater discharge increasing through fiscal year (FY) 2008, while electrical use and natural gas use decrease during the same period. This seemingly inconsistent effect is related to the fact that electricity and natural gas typically provide lighting and work environment control on a 24-hour basis regardless of activity level. This 24-hour support involves heating, steam distributing, air conditioning, and ventilating facilities, including maintaining clean room conditions and laboratory fume hoods. Thus, reducing square footage would drive a reduction in electrical and natural gas use. In contrast, water use and wastewater discharge are people-dependent and would potentially

Table 5.3.2 1. Annual SNL/NM Utility Usage and Capacities Under the No Action Alternative[a]

RESOURCE/ DATA SOURCE	BASE YEAR USAGE	FY 2003 USAGE	FY 2008 USAGE	SYSTEM CAPACITY[b]	USAGE[c] AS PERCENT OF CAPACITY
WATER USE					
Site-wide Demand[d]	440 M gal	430 M gal	417 M gal	2.0 B gal	21-22
Selected Facilities/ Facility Groups[e]	0 M gal	23.6 M gal	45.6 M gal	NA	
TOTAL	**440 M gal**	**454 M gal**	**463 M gal**	**2.0 B gal**	**22-23**
Conservation-Based Scenario[f]	**440 M gal**	**352 M gal**	**308 M gal**	**2.0 B gal**	**15-22**
WASTEWATER DISCHARGE					
Site-wide Demand[d]	280 M gal	273 M gal	265 M gal	850 M gal	32-33
Selected Facilities/ Facility Groups[e]	0 M gal	16.9 M gal	39.0 M gal	NA	
TOTAL	**280 M gal**	**290 M gal**	**304 M gal**	**850 M gal**	**33-36**
Conservation-Based Scenario[f]	**280 M gal**	**224 M gal**	**196 M gal**	**850 M gal**	**23-33**
ELECTRICAL USE					
Site-wide Demand[d]	197,000 MWh	192,000 MWh	186,000 MWh	1,095,000 MWh[g]	17-18
Selected Facilities/ Facility Groups[e]	0 MWh	225 MWh	225 MWh	NA	
TOTAL	**197,000 MWh**	**192,225 MWh**	**186,225 MWh**	**1,095,000 MWh**[g]	**17-18**
NATURAL GAS USE					
Site-wide Demand[d, h]	475 M ft^3	464 M ft^3	450 M ft^3	2.3 B ft^3	21-22
Selected Facilities/ Facility Groups[e, i]	0 M ft^3	0 M ft^3	0 M ft^3	NA	
TOTAL	**475 M ft^3**	**464 M ft^3**	**450 M ft^3**	**2.3 B ft^3**	**21-22**

Table 5.3.2 1. Annual SNL/NM Utility Usage and Capacities Under the No Action Alternative[a] (concluded)

RESOURCE/ DATA SOURCE	BASE YEAR USAGE	FY 2003 USAGE	FY 2008 USAGE	SYSTEM CAPACITY[b]	USAGE[c] AS PERCENT OF CAPACITY
MISCELLANEOUS					
Fuel Oil[i, j]	7,000 gal	7,000 gal	7,000 gal	Not limited by infrastructure	NA
Propane[h, i]	383,000 gal	374,000 gal	362,000 gal	Not limited by infrastructure	NA

Sources: DOE 1997k; SNL 1997a; SNL/NM 1998a, c; USAF 1998a
B: billion
BY: base year
ft³: cubic feet
FY: fiscal year
gal: gallon
M: million
MW: megawatt
MWh: megawatt hour
NA: Not applicable
psi: pounds per square inch
[a] Base Year is 1996 or 1997, the most representative of usage; not necessarily the same as in Chapter 4.
[b] Capacity means the actual or calculated maximum amount of water, wastewater, or other resource that can be used, discharged, or consumed.
[c] Usage means the actual or calculated annual amount of water, waste water, or other resource used, discharged, or consumed.
[d] Prorated based on the following square footage: base year = 5.266 M; FY 2003 = 5.143 M; FY 2008 = 4.986 M
[e] Base-year site-wide demand usage was assumed to include selected facilities/facility groups; however, any changes in selected facilities projected future usage were used to adjust site-wide demand for bounding purposes.
[f] SNL/NM expects to reduce water use by 30% based on 1996 usage of 440 M gal. Thus, between 2004 and 2008, SNL/NM water use would be 308 M gal per year. Wastewater would be similarly reduced.
[g] Based on 125-MW rating.
[h] Estimated based on 60 psi.
[i] No adjustments were reported in SNL/NM 1998a.
[j] Fuel oil is used in emergency situations at the steam plant and is not dependent upon square footage.

Table 5.3.2 2. Annual Throughput[a] and Capacities Under the No Action Alternative for the Infrastructure Facility Group

FACILITY[d]	BASE YEAR 1997	FY 2003	FY 2008	SYSTEM CAPACITY	THROUGHPUT AS PERCENT OF CAPACITY
Steam Plant (steam produced)[e]	544 M lb	544 M lb	544 M lb	3.33 B lb[b]	16
HWMF (waste handled)[e]	203,000 kg	192,000 kg	196,000 kg	579,000 kg[c]	33-35
RMWMF (waste handled)[e]	1.6 M lb	2.1 M lb	2.1 M lb	2.7 M lb	59-78
TTF (waste handled)[e]	Minimal	336 lb	336 lb	7,300 lb[b]	5

Source: SNL/NM 1998b
B: billion
ft³: cubic feet
HWMF: Hazardous Waste Management Facility
kg: kilogram
lb: pound
M: million
RMWMF: Radioactive Mixed Waste Management Facility
TTF: Thermal Treatment Facility
FY: fiscal year
[a] Throughput means the amount of steam produced or waste handled.
[b] Permit capacity
[c] This is the capacity for single shift work with current employment level, not permit capacity.
[d] See Section 2.3 for discussion on how these facilities were selected.
[e] See Table 3.6 1, Infrastructure category.

increase despite a reduction in square footage.

Projected utility consumption rates would likely fluctuate annually due to weather. The projected reduction in square footage is part of a facility strategic investment plan currently underway at SNL/NM (SNL 1997a). The minor changes in square footage are a result of removing substandard structures.

Under the No Action Alternative, current infrastructure resources are capable of accommodating SNL/NM facility requirements and no major additional infrastructure facilities are proposed to be built. Operational levels of SNL/NM buildings, services, communications, maintenance programs (including upgrades, repairs, and limited renovations), roads, material storage, and waste storage activities would remain compatible with system requirements. SNL/NM maintains an active decontamination and decommissioning (D&D) program that identifies and removes from active service outdated or substandard facilities. An overall reduction in the number of active facilities would reduce the overall impacts to SNL/NM infrastructure. Specific details on these systems and programs are presented in the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a). Many of these activities are common to all alternatives and are discussed in Section 2.3.3. Additional details on land use and water resources are provided in Sections 5.3.1 and 5.3.4, respectively. Traffic-related impacts are presented in Section 5.3.9. KAFB utility usage is specifically discussed in Section 6.2.

Four specific infrastructure facilities were analyzed for impacts (Figure 5.3.2 1), including the steam plant. Steam production would continue at 544 M lb per year, which represents 16 percent of capacity. While production capacity can expand, distribution capacity has some limitations. The steam distribution system in a portion of TA-I is 40 years old and is in poor condition. In addition, the main trunk steam line is in poor condition and operates at maximum capacity (SNL 1997a). Furthermore, three of the five boilers have reached or exceeded their design life. A study to upgrade or replace the steam plant was completed in 1998. The study recommended the upgrade begin in FY 2004; however, no decision has been made to upgrade the boilers (SNL/NM 1998b).

The other three infrastructure facilities are waste management facilities (Figure 5.3.2 1). The HWMF would manage approximately 195,000 kg of waste per year by 2008 (Table 5.3.2 2). Annual radioactive and mixed waste management would increase to 2.7 M lb per year by 2008 at the RMWMF. The TTF would process small quantities of explosive wastes. Small fluctuations would occur during normal operations due to operational scheduling and shifts in priorities. ER project wastes are discussed in Section 5.3.10 by waste category.

5.3.3 Geology and Soils

Minimal impacts due to soil contamination would be possible, as discussed in Section 5.3.3.1. A brief summary is available at the end of Section 5.3.3.1. Similarly, it would be extremely unlikely to cause impacts on slope stability, as discussed in Section 5.3.3.2.

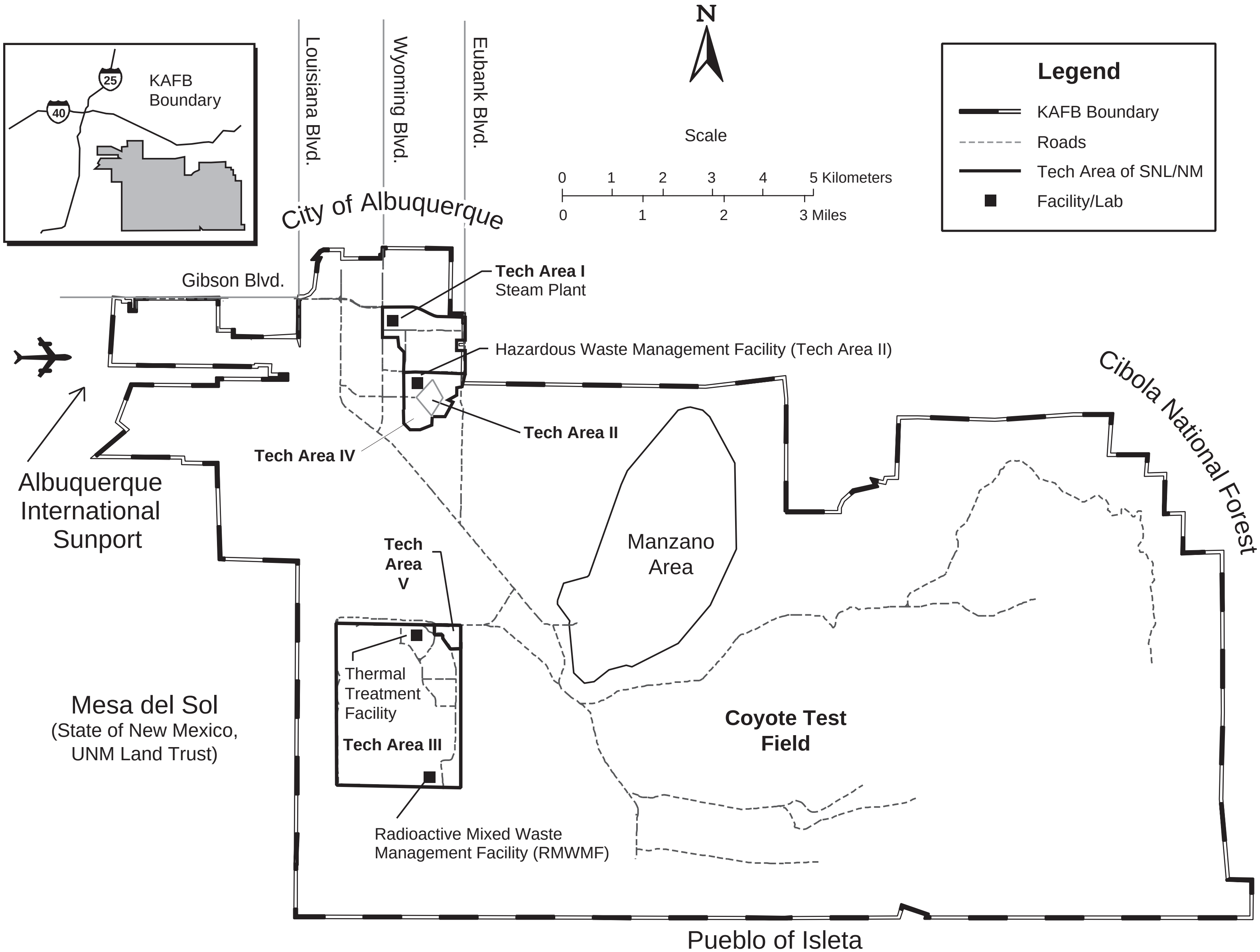
5.3.3.1 Soil Contamination

The term soil contamination, as used in the SWEIS, is the presence of any toxic, hazardous, or radioactive substance in the near-surface soil (nominally, the upper 6 inches to 1 ft) that is not naturally occurring. Determining whether concentrations of substances, particularly metals, are contamination and not naturally occurring, is often problematic (see text box).

Near-surface soils have the potential for direct contact with humans. Onsite workers could potentially contact these soils, although workers in contaminated areas (such as environmental restoration sites) would be subject to health and safety plans. However, there would be no direct effect on the public because affected sites are not available to public use (DOE 1996c).

Indirect pathway effects, such as soil contamination as an intermediary to groundwater or surface water contamination, are considered in Section 5.3.4.

Soil contamination at SNL/NM occurred as the result of past operations and may be occurring from ongoing operations in outdoor testing areas and radioactive material management areas. The cleanup of these soils is performed to a level that meets the health risk-based standards corresponding to the intended future uses of the site. Intended land uses are typically residential, recreational, or industrial. Soil cleanup levels are set so that the health risk to an individual using the site for its intended purpose is acceptable. Exposure levels used in the risk analysis are use-dependent. Such factors as typical time spent indoors and outdoors, amount of soil incidentally ingested, volume of air breathed while onsite, and ingestion of food grown onsite (for residential) affect the exposure and thus the residual concentrations the cleanup must meet. Remediation action levels and residual radiation site cleanup levels are based on these risk analyses.



Source: SNL/NM 1997]

Figure 5.3.2   1. Selected Infrastructure Facilities/Facility Groups

Four selected SNL/NM infrastructure facilities/facility groups were analyzed for potential impacts.

ER Project Sites

As of August 1998, the ER Project at SNL/NM had identified 182 sites with soil contamination from past and continuing operations. Because contamination levels pose no threat to human health or the environment, the DOE has proposed no further action for 122 of 182 sites to the New Mexico Environment Department (NMED). Of these 122 sites, 48 have been approved. The remaining 74 sites are being evaluated by the NMED and may require additional characterization or some cleanup.

Inactive Sites

Of the 60 remaining sites (182 minus 122), approximately 40 are inactive sites that are undergoing further characterization or cleanup. These sites will be cleaned up to levels appropriate for future use, either as recreational or industrial sites. The Future Use, Logistics, and Support Working Group (consisting of SNL/NM, DOE, EPA, NMED, and members of the public) has agreed upon future use. Remediation of these sites was analyzed in the ER Project EA (DOE 1996c), which is described in Section 1.7 and incorporated by reference. All inactive sites, with the exception of subsurface contamination at the Chemical Waste Landfill (CWL), are scheduled for cleanup by 1999 (SNL 1997d). The ER Project is scheduled for completion in 2004.

Active Sites

Of the 60 remaining sites, 20 are active. These include outdoor testing facilities, several oil spills, and storage areas. Although many of these sites may have very low levels of contamination that would normally allow them to be proposed for no further action, ongoing and potential future activities at the sites may necessitate remediation. The NMED and SNL/NM are discussing how and when characterization and cleanup activities would be completed in the future when operations cease at the active sites.

Potential soil contamination from continuing operations has been identified at four test facilities in TA-III and the Coyote Test Field: the Terminal Ballistics Complex, Sled Track Complex, Aerial Cable Facility, and the Lurance Canyon Burn Site. All of these sites are listed as active ER Project sites.

The Terminal Ballistics Complex in TA-III (ER Project Site 84) has had projectile tests conducted using lead and depleted uranium (DU) as both projectile and target materials. A total of 50 point sources and 6 small area sources were cleaned up at this site during a voluntary corrective measure of radioactive surface contamination (SNL 1997e). After the corrective measure, the maximum residual radionuclide activity at this site was 31.1 pCi of uranium-238 per g of soil (compared with an average background value of 1.4 pCi/g). A preliminary risk assessment using *Residual Radioactivity (RESRAD)*, a computer modeling program, indicated that potential effects on human health due to exposure to radionuclides would be within proposed standards for the industrial land use designation developed by the Future Use, Logistics, and Support Working Group (SNL 1997e).

The Sled Track Complex in TA-III (ER Project Sites 83 and 240) has had DU, beryllium, and lead fragments released from high velocity impact tests. A total of 1,601 point sources and 33 area sources were cleaned up during a voluntary corrective measure of radioactive surface contamination (SNL 1997e). After the corrective measure, the maximum residual radionuclide activity at this site was 28.3 pCi of uranium-238 per g of soil (compared with an average background value of 1.4 pCi/g). A preliminary risk assessment using *RESRAD* indicated that potential effects on human health due to exposure to radionuclides would be within proposed standards for the industrial land use designation developed by the Future Use, Logistics, and Support Working Group (SNL 1997e).

The Aerial Cable Facility at the Coyote Test Field (ER Project Site 81) could introduce small amounts of lead, beryllium, and DU into the soil from weapons test units that could break open on impact. This has occurred twice since operations began at this site in 1971. Each time, almost all of this material was collected and properly disposed of. A radiological survey of the site indicated no elevated radiation except for naturally occurring material in rock outcrops (SNL 1997e).

The Lurance Canyon Burn Site (ER Project Site 65) has the potential for test object rupture and subsequent release of DU. Pretest and posttest sampling of the test object and surrounding area is used to confirm the integrity of the test. It is estimated that once every 10 years, less than 25 kg of DU would be released over a 1,000-ft^2 area (that is, a 35-ft-diameter circle), resulting in a soil concentration of about 7,000 µg of DU per g of soil (SNL/NM 1998a). As with all of the above sites, a release of concern such as this one would be decontaminated and cleaned up on an interim basis by trained personnel in accordance with DOE policies. The area surrounding the Lurance Canyon Burn Site, including ER Site 94, the explosive item burner within the Burn Site, was surveyed and remediated as part of a voluntary corrective measure (SNL 1997e). Fifty-four point sources and 14 area sources were cleaned up; the maximum residual activity at the site was 35.8 pCi of uranium-238 per g of soil (compared with an average background value of 2.3 pCi/g). A preliminary risk assessment using *RESRAD* indicated that potential effects on human health due to exposure to radionuclides would be within proposed standards for the recreational land use designation developed by the Future Use, Logistics, and Support Working Group (SNL 1997e).

Radioactive Material Management Areas

As of May 1998, there were 68 radioactive material management areas at SNL/NM. These are primarily indoor laboratories where radioactive materials are used in manufacturing processes or research. The Drop/Impact Complex is an outdoor radioactive material management area where sealed assemblies containing DU are tested. Impact velocities at this facility are much lower than those that would normally result in rupture and release of DU. There have been no recorded releases of DU to the environment at this facility.

Summary of Soil Contamination

In summary, known locations of soil contamination at inactive sites are planned for cleanup by 2004. Cleanup will be to levels apropriate for designated future uses. Soil contamination at active sites is monitored, and SNL/NM conducted periodic voluntary cleanups to ensure that potential human health effects are withing proposed standards for the designated future land uses. The NMED and SNL/NM are discussing how and when future further characterization and cleanup activities would be completed when operations cease at the active sites.

5.3.3.2 Slope Stability

Slope stability depends on a variety of factors, including soil type, soil moisture, and load. With unloaded natural slopes that have reached a state of equilibrium over a period of years, slope failure almost invariably involves partial saturation of the sliding mass of soil by groundwater (Spangler & Handy 1973). Slope failure most commonly occurs in clay-rich soils, where platy minerals align to form a shear surface (Bromhead 1986). The arid desert climate, combined with the predominance of loamy (mixed clay, silt, sand, and organic matter) rather than clayey soils, tends to reduce the likelihood of slope failure in the SNL/NM area (SNL/NM 1997a). There are no known instances of slope failure at SNL/NM.

An analysis of slope stability was conducted to determine whether SNL/NM activities could cause destabilization of slopes, thereby affecting other resources, such as cultural resource sites, if such resources were present. The types of slope destabilizing activities evaluated were vibrations, surface disturbances, and burning.

A GIS-generated slope map was combined with an overlay map of SNL/NM structures to determine which SNL/NM facilities are near 10 percent or greater slopes (Figure 5.3.3 1). The 10-percent slope map simply provides a tool to identify which SNL/NM facilities are closest to slopes, so they can be evaluated on an individual basis. Ten percent is not a threshold for whether a slope is stable or unstable. The stability of slopes is heavily dependent on additional factors such as soil type, soil thickness, moisture content, and vegetation. Ten percent or greater slopes are generally confined to the Manzanita Mountains and foothills, the Manzano Area, and along the banks of arroyos.

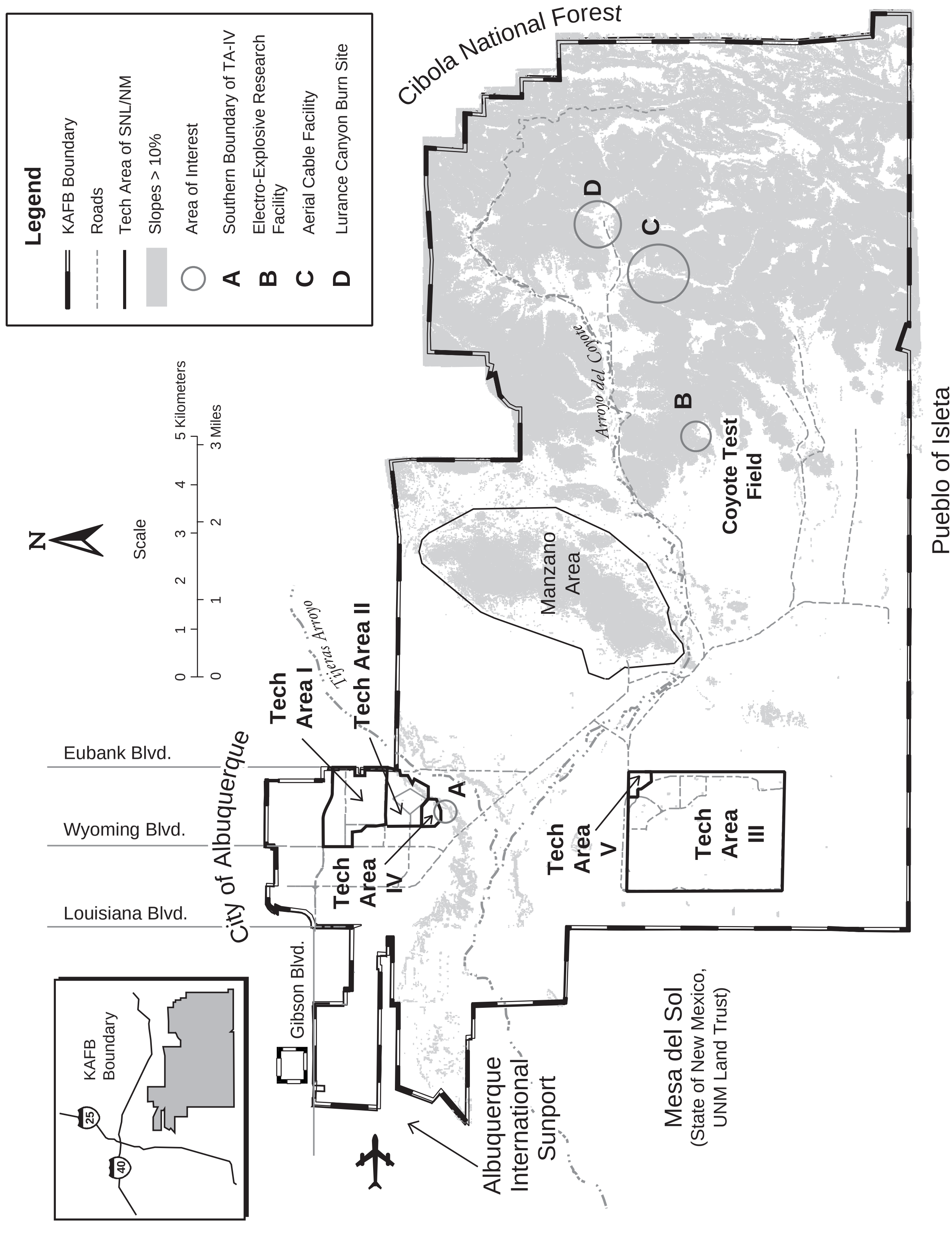
Four areas were identified for further analysis based on Figure 5.3.3 1: the southern boundary of TA-IV, the Aerial Cable Facility, the Lurance Canyon Burn Site, and the Electro-Explosive Research Facility. These areas were evaluated using field observations of facility configuration, vegetation, evidence of erosion, and any other factors that could contribute to slope destabilization.

Southern Boundary of TA-IV

Along the southern boundary of TA-IV, five SNL/NM facilities are housed in buildings within 100 ft of a graded-fill slope above the main Tijeras Arroyo escarpment. (More complete descriptions of these facilities are provided in Chapter 2.)

The SATURN and the Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX) facilities are both located in Building 981. SATURN simulates the radiation effects of nuclear countermeasures on electronic and material components. SPHINX is used to measure X-ray-induced photocurrents from short pulses in integrated circuits and thermostructural response in materials.

The Repetitive High Energy Pulsed Power (RHEPP)-I facility in Building 986 supports the development of technology for continuous operation of pulsed-power systems.



Source: SNL/NM 1997j

Figure 5.3.3 1. SNL/NM Facilities Near 10 Percent or Greater Slopes

SNL/NM facilities that are near 10 percent or greater slopes are generally confined to the Manzanita Mountains and foothills, the Manzano Area, and along the banks of arroyos.

The Z-Machine facility in Building 983 generates high intensity light-ion beams for the inertial confinement fusion program and high energy/density weapons physics program for stockpile stewardship.

The HERMES III facility in Building 970 provides gamma-ray effects testing for component and weapons systems development, helping to ensure operational reliability of weapons systems in radiation environments caused by nuclear explosions.

The foundations of these buildings sit in natural ground (gravelly, fine, sandy loams of the Embudo and Tijeras Series [SNL/NM 1997a]), although a graded-fill slope of about 30 percent exists along the periphery of TA-IV leading into Tijeras Arroyo (Winowich 1998). This graded-fill slope is approximately 30 ft high and has light vegetation (primarily grass) cover. Minor erosional channels from storm water runoff are visible along the slope surface, but these are less than 6 inches wide or deep. The areas around the buildings and extending to the edge of the slope are paved, eliminating destabilization from significant water infiltration. At the base of the graded-fill slope, a gentler, natural slope (less than 10 percent) leads toward the main channel of Tijeras Arroyo, approximately 500 ft to the south and southeast. The base of the graded-fill slope is 20 ft higher than the current Tijeras Arroyo channel; there is no evidence of erosion at this point from water running through Tijeras Arroyo. The facilities are not in a floodplain.

Under the No Action Alternative, no new activities would be conducted in this portion of TA-IV. Based on the low potential for water infiltration, the lack of slope-destabilizing activities identified at these facilities (SNL/NM 1998a), and SNL/NM experience to date, the likelihood of slope failure at this location is remote.

Aerial Cable Facility

The Aerial Cable Facility provides a controlled environment for high velocity impact testing on hard surfaces and precision testing of full-scale ground-to-air missiles, air-to-ground ordnance, and nuclear material shipping containers for certification. (A more complete description of this facility is provided in Chapter 2.) The slopes surrounding the Aerial Cable Facility exhibit numerous bedrock outcrops. No soil classification has been assigned to this area (SNL/NM 1997a), because only a thin veneer of soil overlies the bedrock. Medium to heavy juniper-dominated vegetation is present in areas with this thin soil cover. Activities at the Aerial Cable Facility can result in hot missile debris causing brush fires in the down-range impact area (SNL/NM 1998a). Evidence of one such burn (approximately 1 ac) was noted during the May 1998 reconnaissance. (Section 5.3.8 discusses other impacts associated with accidental burns.) However, there is no evidence of landslides or recent erosion in the burn area or other areas surrounding the facility.

Under the No Action Alternative, more tests would be conducted at the Aerial Cable Facility, with some types of tests doubling from their 1996 base-year frequency. However, based on the predominance of bedrock slopes and lack of evidence of slope instability (even in the burned area), the likelihood of slope failure at this location is remote.

Lurance Canyon Burn Site

Safety tests of various hazardous material shipping containers, weapon components, and weapon mockups in jet propulsion (JP)-8 aviation fuel fires, propellant fires, and wood fires are conducted at the Lurance Canyon Burn Site. (A more complete description of this facility is provided in Chapter 2.) The site is located in a canyon at the junction of two arroyos in the Manzanita Mountains. The facility sits on relatively level ground in the canyon bottom. Surrounding slopes have numerous bedrock outcrops. No soil classification has been assigned to this area (SNL/NM 1997a), as only a thin veneer of soil overlies the bedrock. Medium to heavy juniper-dominated vegetation is found in areas with soil cover. Adjacent arroyo channels are graded or have escarpments less than 3 ft high. The facility is graded with minor slopes and little vegetation. There is no visible evidence of landslides or erosion.

Under the No Action Alternative, testing at the Lurance Canyon Burn Site would continue at 1996 base-year levels. Based on the predominance of bedrock slopes and lack of evidence of slope instability, and because no slope-destabilizing activities have been identified at this facility (SNL/NM 1998a), the likelihood of slope failure at this location is remote.

Electro-Explosive Research Facility

The Electro-Explosive Research Facility has been used for the past five years for developing electromagnetic launch technology. The main building (Building 9990) is a concrete structure now used as a control, instrumentation, and shop facility. Two metal buildings house electromagnetic launchers and propulsion experiments. Although the main building was originally constructed for explosives testing, explosives are no longer stored or used at the site. Projectiles are launched at high velocity by magnetic fields, not propellants, a distance of 600 to 800 yards eastward to the adjacent hillside for projectile diagnostics, study of exterior ballistics, and technology demonstration (SNL/NM 1994a).

The main building and bunkers of this facility are located in a canyon in foothills of the Manzanita Mountains. The main building abuts a hill. Surrounding slopes are covered with grass and minor juniper vegetation. Bedrock outcrops indicate that the soil cover is thin, although soils in this area are assigned to the Salas Series (typically very gravelly loam and stony soils). There is no visible evidence of landslides or erosion. Based on the predominance of bedrock slopes and lack of evidence of slope instability, the likelihood of slope failure at this location is remote. Summary of slope stability.

Summary of Soil Stability

In summary, the four areas identified for further analysis were unlikely to pose a slope failure problem.

5.3.4 Water Resources and Hydrology

5.3.4.1 Groundwater Quality

Sites with potential or known groundwater contamination at SNL/NM are Sandia North (an ER Project designation for groundwater investigations of sites in TA-I and TA-II), the MWL, locations in TA-V, the Lurance Canyon Burn Site, and the CWL (SNL 1997d) (Figure 5.3.4 1). Information on the types and concentrations of potential contamination at these sites is presented in Section 4.6.1. Measurements (see Appendix B, Tables B.1 1 and B.1 2) indicate that some contaminants at some of these sites exceed the maximum contaminant levels (MCLs) contained in federal drinking water standards (40 CFR Part 141). MCLs are the levels of contaminants allowed in public drinking water systems, which are set by the EPA to provide protection from adverse health effects. MCLs are used in this analysis only as a frame of reference for evaluating groundwater quality. Existing institutional controls prevent access to this groundwater. Investigation or remediation of these sites is ongoing as part of the ER Project.

Sandia North

Current uncertainty regarding the nature of contamination sources and local hydrogeology at Sandia North precludes projections of future impacts at this time. As information is developed, SNL/NM will be projecting impacts and formulating mitigating measures to prevent such impacts. These formulations and, ultimately, site remediation actions will be performed under SNL/NM s ER Project and will be overseen by the NMED.

Mixed Waste Landfill

Tritium has been found in soil moisture to a depth of 120 ft below the MWL. The maximum tritium activity at this depth was 2.9 pCi/g, which, for 4.6 percent volumetric moisture content and a soil density of 1.8 g/cm^3 (SNL/NM 1996h), corresponds to a soil moisture concentration of 1.135x10^5 pCi/L. Assuming the tritium that has migrated the farthest is from the earliest release (1959), and using a linear time-distance relationship, this tritium will not reach the water table for 105 years from the time of the above measurement (1995). With a half-life of 12.3 years, the resulting tritium concentration in this soil moisture, when it reaches the aquifer (prior to dilution by aquifer water), would be 310 pCi/L, which is a factor of about 60 less than the MCL of 20,000 pCi/L. A similar calculation for the maximum measured soil concentration of 20,670 pCi/g, found at a depth of 26 ft, results in an estimated concentration upon reaching the aquifer (prior to dilution by aquifer water) of about 4,000 pCi/L, a factor of 5 less than the MCL. SNL/NM has removed broken and subsided concrete caps at the MWL to reduce the possibility of infiltration of precipitation into underlying wastes. The waste pits where the concrete caps were removed were backfilled with soil to ground surface. Site remediation is budgeted and planned to be completed in 1999.

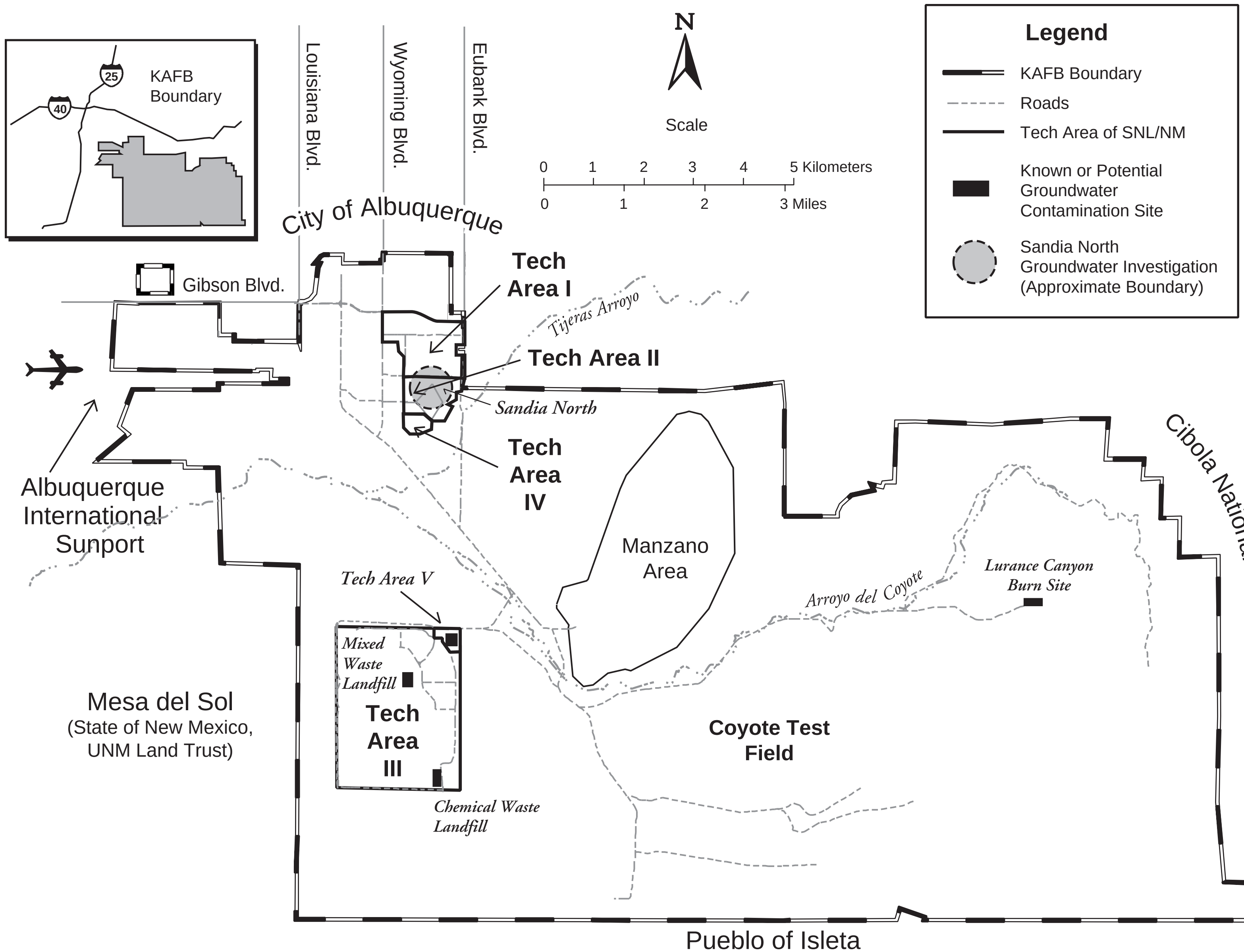
TA-V

The probable sources of the nitrate contamination shown in Table 4.6 1 at TA-V are septic tanks and leachfields. These septic tanks and leach fields have been closed and waste and contamination from these sites have been removed. Disposal is now to the sanitary sewer. Information about the hydrogeology and contamination at TA-V is presently being developed for a groundwater data report to be released by the SNL/NM ER Project in mid FY 1999.

Lurance Canyon Burn Site

Isotopic analyses performed by SNL/NM indicate that nitrates (see Section 4.6.1.3) present in groundwater at the Lurance Canyon Burn Site are not from septic systems or fertilizers and may be naturally occurring (SNL/NM 1997a). The source is being investigated.

Groundwater in this vicinity is found within a thin layer of alluvium in the canyon bottom and underlying



Source: SNL 1997d, SNL/NM 1997j

Figure 5.3.4 1. Sites with Potential or Known Groundwater Contamination

Sites with potential or known groundwater contamination are located at TAs-I, -II, -III, and -V and the Lurance Canyon Burn Site.

fractured bedrock. Contaminants could potentially be transported downgradient within the alluvium layer and the fractured bedrock, although the regional aquifer is 7 mi distant. There is no impact to existing potable water supplies beyond the immediate area of the Burn Site.

Chemical Waste Landfill

A study was performed for the SWEIS to consider the ultimate fate of the primary CWL contaminants (see Appendix B, Tables B.1 1 and B.1 2). The study used the *Multimedia Environmental Pollutant Assessment System (MEPAS)* model (PNL 1989), described in Appendix B, to estimate the downgradient concentrations of chromium and trichloroethene (TCE) in the aquifer.

The site conditions used in the modeling are described in detail in Appendix B. The source and unsaturated zone parameters represent the site directly beneath the CWL, in the region of vertical contaminant transport. The saturated zone parameters represent the site along the projected groundwater flow path, from the CWL to the nearby municipal well field (Ridgecrest), located approximately 7 mi north of the CWL (DOE 1997a). The nearest downgradient drinking water supply well, KAFB-4, located approximately 4 mi north of the landfill, also lies along this flow path (Figure 5.3.4-2) (SNL/NM 1995d).

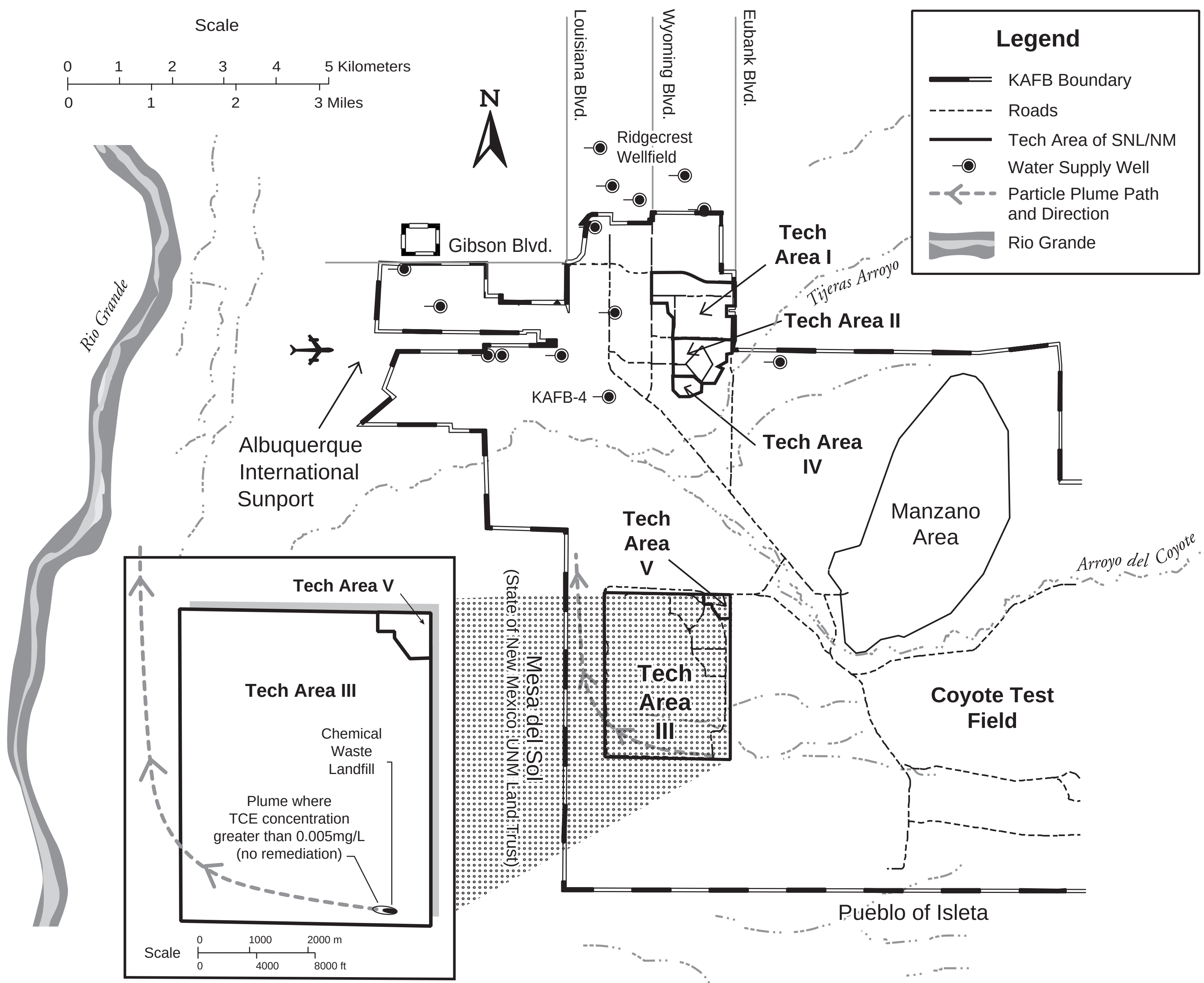
TCE presently in the groundwater is attributed to vapor phase transport of TCE volatilizing in the unsaturated zone (SNL/NM 1995d). Appendix B contains a discussion on the derivation of the vapor source term, which was calculated as 33 g per year into the uppermost saturated layer. This uppermost saturated layer is a silty clay layer, approximately 40 ft thick, through which the downward (vertical) movement occurs at a pore velocity of 0.03 ft per year and horizontal movement occurs at a pore velocity of 0.07 ft per year. Horizontal movement toward the drinking water wells would be predominantly through the underlying sandy aquifer. Appendix B describes the model s assumptions, inputs, and results.

The model results indicate that the maximum concentrations in the sandy aquifer (through which the potential contaminants would be transported from the landfill and from which the drinking water wells draw their water) would be an order of magnitude less than drinking water standards. The maximum downgradient distance from the source within which the 0.005 mg/L MCL would be exceeded is 410 ft, corresponding to an aquifer area of 1.7 ac (Figure 5.3.4 2). After remediation, planned for completion by 2001, downgradient concentrations would be expected to decline quickly. The maximum downgradient distance within which the MCL would be exceeded would decrease to 190 ft after 50 percent remediation, to 3 ft after 90 percent remediation (Ardito 1998), and would not exceed the MCL for a remediation efficiency of 95 percent. Concentrations in the silty clay layer immediately below the TCE source would continue to exceed the MCL, at a level up to 0.05 mg/L, decreasing in response to source remediation. Table 5.3.4 1 summarizes the model results. The MCL concentration at its farthest downgradiant extent will be reached approximately 5 years after introduction into the sandy layer and will begin to decrease approximately 10 years thereafter as a result of source remediation.

The liquid organic phase of the TCE currently resides totally in the unsaturated zone. This TCE is not presently affecting the saturated zone as a liquid product. Measurements have recently been taken that indicate degradation of this TCE to smaller chlorinated compounds including dichloroethane (Ardito 1998), which would result in undetectable concentrations of TCE in the water table (Appendix B).

Chromium was disposed of in the form of chromic acid, and presently resides totally in the unsaturated zone, to a depth of up to 75 ft below ground level. Although not presently affecting the saturated zone, this chromium may reach the saturated zone in the future. The EPA has conducted studies that show that hexavalent chromium is frequently reduced to trivalent chromium in the environment (Palmer & Puls 1994). Trivalent chromium has relatively low toxicity and very low mobility. The EPA has also indicated that hexavalent chromium can be expected to adsorb to soil, although not as strongly as trivalent chromium (EPA 1996b). This SWEIS conservatively assumes that the chromium would remain in its original hexavalent state and would not undergo soil adsorption (SNL/NM 1995d). Appendix B contains a description of the parameters used to conduct the analysis. The highest levels of chromium in the aquifer would be expected 7,900 years in the future, 1 m from the edge of the source, at a concentration of 0.005 mg/L. This concentration is a factor of 20 less than the MCL of 0.100 mg/L. Table 5.3.4 1 summarizes these modeling results.

The modeling of the CWL performed for this SWEIS is intended to provide a general estimate of future concentrations of TCE and chromium. It is not intended to substitute for SNL/NM ER Project modeling that may be performed to determine proper procedures for remediation.



Sources: SNL/NM 1997a, j

Figure 5.3.4 2. Projected Extent of Chemical Waste Landfill Trichloroethene Contamination Above Maximum Contaminant Level

The maximum calculated extent of TCE contamination above 0.005 mg/L is 410 ft from the CWL.

Table 5.3.4 1. Estimated Concentrations of Vapor-Phase Trichloroethene and Chromium in the Aquifer Beneath the Chemical Waste Landfill

CONTAMINANT	AMOUNT OF CONTAMINANT AVAILABLE FOR MOVEMENT (kg)	DRINKING WATER STANDARD (mg/L)	TIME OF MAXIMUM DOWNGRADIENT STANDARD EXCEEDANCE (YEARS FROM REACHING AQUIFER)	MAXIMUM DISTANCE FROM SOURCE AT WHICH STANDARD IS EXCEEDED (ft)[a]	MAXIMUM AREA OVER WHICH STANDARD IS EXCEEDED (ac)[a]
Trichloroethene Prior to Remediation	31,000	0.005	5[b]	410	1.7
Chromium[a, c]	9	0.100	-	0	0

Source: 40 CFR Part 141
ac: acres
ft: feet
kg: kilograms
MCL: maximum contaminant level
mg/L: milligrams per liter
[a] Assumes no remediation
[b] Reduced below MCL at this distance due to remediation 5 years from first exceedance
[c] Not projected to reach water table
Note: See Appendix B for details regarding calculations

Summary of Groundwater Impacts

Although there appears to be no immediate or long-term threat to human health through contamination of the water supply, there is short-term, localized degradation of the aquifer beneath the CWL from vapor-transported TCE. The area of degradation will decrease once cleanup near the ground surface begins to remove the source of the contamination. The presence, concentration, and location of this contamination are independent of any of the alternatives analyzed in the SWEIS. The contamination is a result of past waste management practices. Appropriate cleanup measures, developed in cooperation with the NMED, will proceed regardless of the alternative selected. Because of its effect on the aquifer, groundwater contamination at the CWL is identified as an adverse impact in the SWEIS.

5.3.4.2 Groundwater Quantity

The effects of continued SNL/NM groundwater usage on the aquifer in the KAFB vicinity were investigated. Projected usage under the No Action Alternative was compared with recent (1985-1996) usage and the associated changes to groundwater levels were estimated from recent trends.

Appendix B contains information showing historical pumpage rates from onsite KAFB wells and from Ridgecrest, the nearby Albuquerque well field. Future groundwater levels in the vicinity of KAFB are expected to be most dependent on pumpage from these wells.

Table 5.3.4 2 shows the recent and projected groundwater withdrawals. The proposed Mesa del Sol development (NMSLO 1997) was included in the projections because it would be a potential major contributor to groundwater usage in the vicinity of KAFB for the analysis period. The projected groundwater withdrawals were compared with historical withdrawals in order to establish a linear relationship for projecting future aquifer drawdown, which is also included in Table 5.3.4 2. SNL/NM groundwater use would account for 3 ft (11 percent) of drawdown over the 1998 to 2008 period. The distribution of the projected groundwater level declines in the vicinity of KAFB is indicated on Figure 5.3.4 3. Appendix B describes the method of projection, which includes considerations of population growth and the city of Albuquerque s goal of 30-percent reduction in per capita water use. SNL/NM s influence on drawdown would decrease with distance from KAFB. A one-dimensional Theis equation, assuming a 500 ft-thick aquifer and a hydraulic conductivity of 40 ft/day (Appendix B), indicates that 1 ft per yr or less of water level decline would be expected beyond 3 mi of KAFB wells from combined KAFB and SNL/NM water pumpage.

The city of Albuquerque San Juan/Chama Project is projected to begin operation in 2004 (COA n.d. [a]). The project will allow the city of Albuquerque, including Mesa del Sol, to meet its normal water demands from Rio Grande water. Groundwater withdrawals will be used only to supplement these normal demands. All of the city wells will remain online and ready for operation.

Table 5.3.4 2. Projected Groundwater Use and Water Level Declines in the Vicinity of KAFB

KAFB AREA CONTRIBUTOR	QUANTITY OF WATER WITHDRAWN IN 10 YEARS (1998 to 2008) (M ft^3)	MAXIMUM DRAWDOWN OVER 10-YEAR PERIOD (1998 to 2008) (ft)	PERCENT OF TOTAL DRAWDOWN CONTRIBUTION NEAR KAFB[a] (%)
Ridgecrest (city of Albuquerque)	3,243	16.8	61
KAFB (exclusive of SNL/NM)	829	4.3	15
SNL/NM	605	3.1	11
Mesa del Sol	683	3.5	13
TOTAL	**5,355**	**27.7**	**100%**

Source: SNL/NM 1998c [see also Appendix B, Table B2 3]
ft: feet
ft^3: cubic feet
KAFB: Kirtland Air Force Base
M: million
SNL/NM: Sandia National Laboratories/New Mexico
Note: See Appendix B for details regarding calculations.
[a] Local effect (basin-wide effect is less than 1 percent.)

Which wells will be operated (and how often and how much) has not yet been determined. Therefore, the San/Juan Chama Project has not been included in this analysis. It is expected that the Ridgecrest and Mesa del Sol well withdrawals would be substantially less than quantities used in this analysis.

Potential impacts of continued aquifer drawdown were identified and evaluated for the SWEIS. These were: exceedance of water rights (owned by KAFB); effects on well operations; effects on Pueblo of Isleta wells; effects on springs; and potential for land subsidence.

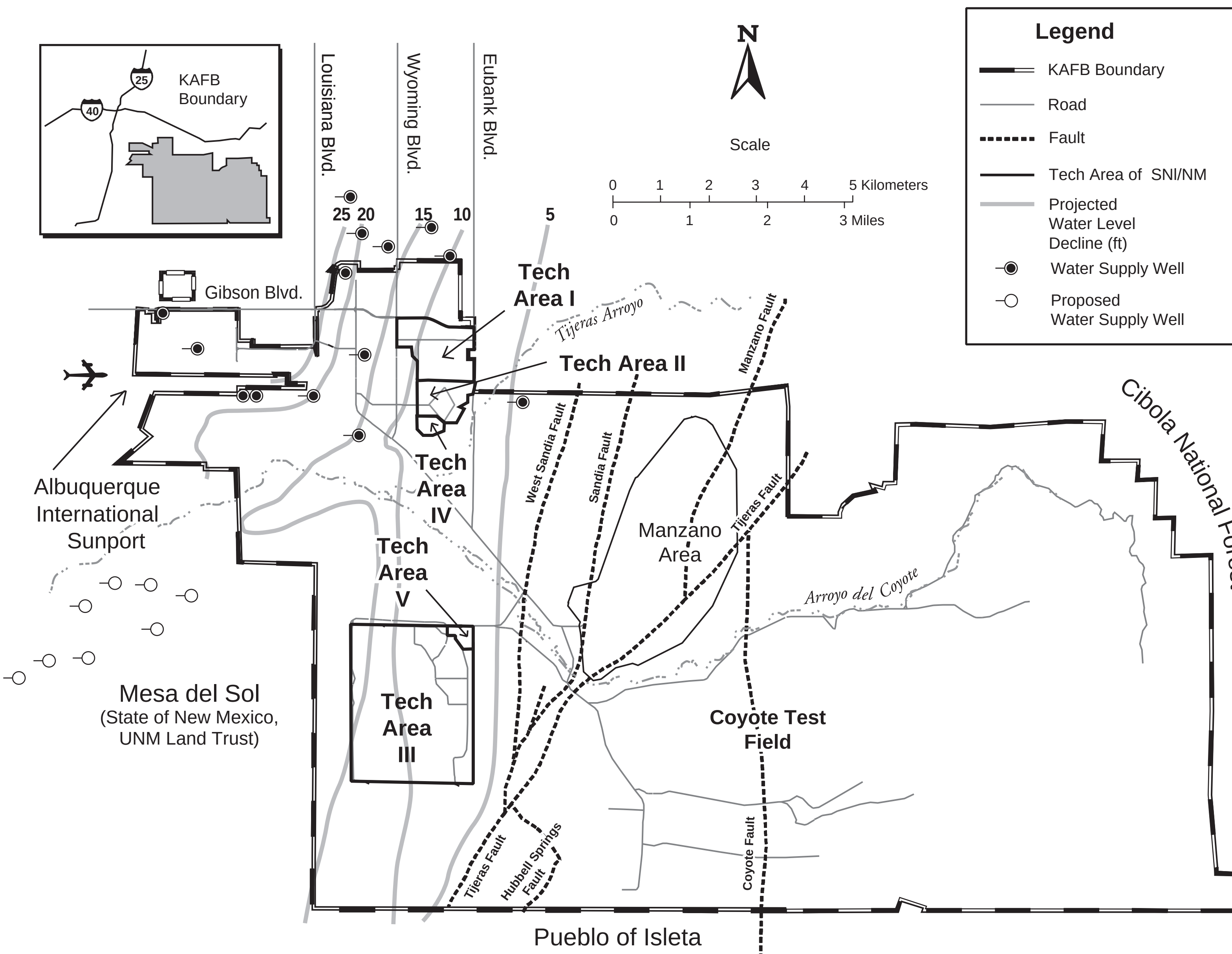
The maximum recent KAFB annual withdrawal was 235.7 M ft^3 (1992) (USGS 1995). KAFB withdrawals have been and are projected to remain significantly below the 278.7 M ft^3 per yr allowed by KAFB water rights (Bloom 1972).

KAFB area wells are typically screened from the water table surface to about 500 ft below the water table (USAF 1975, USAF 1983). The wells are designed specifically for declining water levels with long screens and movable pumps. When groundwater levels drop below the pump, the pump can be lowered until it is submerged again. The pumps are typically installed about 80 ft beneath the water surface and are lowered when they are 20 ft below the water surface. Pumping wells located in areas projected to have 28 ft of decline over the 10-year period, 1998 to 2008 would require pump lowering in 22 years. If water was not being withdrawn for SNL/NM use, then the pumps would need to be lowered every 24 years. KAFB has also recently installed two new wells, (early June 1998), KAFB-15 and -16, in the northwest portion of the site. These wells are screened over a 1,000-ft interval from the water table surface, (approximately 500 ft below ground surface) to 1,500 ft below ground surface.

SNL/NM operations would not be expected to have an impact on Pueblo of Isleta wells. The Pueblo of Isleta boundary is approximately 6 mi from the nearest KAFB water supply well. Of the 1-ft water level decline projected at this boundary, up to 1 inch per year (11 percent) would be attributed to SNL/NM operations.

The effect of local drawdown on spring flow was also considered. However, all local springs are east of the fault zone, an area in which groundwater levels are not affected by pumping in the vicinity of KAFB.

The possibility of subsidence due to excess withdrawal was also investigated. The threshold for subsidence has been estimated as 260 to 390 ft of aquifer drawdown (Haneberg 1995) and recently refined to 330 to 490 ft (Haneberg 1997). Adding the almost 28 ft of maximum projected drawdown in the vicinity of KAFB to the basin-wide maximum of 160 ft (USGS 1993), which is actually located about 1 mi north of KAFB (about 2 mi north-northeast of TA-I), suggests that the projected water withdrawal would not result in land subsidence. The potential impacts described above would tend to diminish at greater distances from KAFB.



Sources: NMSLO 1997; SNL/NM 1997a, j

Figure 5.3.4 3. Projected Decline in Albuquerque-Belen Basin Groundwater Levels

During the period from 1998 to 2008, groundwater levels at KAFB are projected to decline as much as 28 ft, 11 percent of which would be from SNL/NM water use.

Summary of Groundwater Quantity Impacts

Although this analysis indicates that no immediate effects of the projected water level decline over the 1998 to 2008 period would be expected, SNL/NM water use would continue to contribute to the depletion of the aquifer. Because the rate of basin-wide groundwater withdrawal significantly exceeds the recharge rate, all groundwater users contribute to this depletion to some degree. SNL/NM s local drawdown effect would be measurable (3 ft over the 1998 to 2008 period), accounting for 11 percent of groundwater decline in the northern portion of KAFB under the No Action Alternative. Because of the magnitude of the effect on local water level decline, SNL/NM s groundwater withdrawal is identified as an adverse impact in the SWEIS.

5.3.4.3 Surface Water Quality

During storm events in 1994 and 1995, SNL/NM collected 32 surface water samples from onsite arroyos (Figure 5.3.4–4). A summary of analytical results from these samples is presented in Section 4.6.2. Contaminants of concern, which include dissolved metals, explosives, and radionuclides, were found only at trace concentrations (SNL/NM 1996g). Of greatest importance to the SWEIS analysis are four surface water samples collected from Tijeras Arroyo within 1 mi of its exit point from KAFB (Figure 5.3.4 4). These samples, collected on July 20 and August 22, 1995, are downstream from all SNL/NM facilities and operations. They represent two different kinds of runoff events: Tijeras Arroyo runoff from the July 20th storm event did not reach the Rio Grande, whereas, the August 22nd storm event had the largest daily average flow measured in Tijeras Arroyo (14 ft^3 per second at the farthest downstream gaging station) of the three days during 1995 when flow reached the Rio Grande (USGS 1998). Therefore, these samples are the best available indicators of what contaminants could reasonably be transported offsite to ultimately enter the Rio Grande approximately 7 mi farther downstream. These sample results show no contaminants above NMWQCC limits for the state-designated Tijeras Arroyo use (livestock watering) (Table 5.3.4 3) (NMWQCC 1994). Furthermore, the August 22nd flow was only 2 percent of the 712 ft^3 per second measured at the nearest upstream gaging station on the Rio Grande for the same date; any contaminants in Tijeras Arroyo storm water runoff would likely be significantly diluted upon reaching the Rio Grande.

Potential Sources of Surface Water Contamination

Environmental Restoration Project Sites

Cleanup actions planned, underway, or completed at eight ER sites within 0.5 mi of Tijeras Arroyo or Arroyo del Coyote are intended to remove any potential source of surface water contamination, and the cleanup activities themselves are not expected to negatively affect surface water quality (DOE 1996c). The ER Project is scheduled for completion by 2004, with no projected variation in schedule under the No Action Alternative.

Permitted Storm Water Discharge

Surface water sampling results indicate storm water runoff from SNL/NM facilities in TAs-I, -II, and -IV does not contribute contaminants to Tijeras Arroyo. Under the No Action Alternative, no new activities are forecast in TAs-I, -II, or -IV that would cause contamination of storm water runoff (SNL/NM 1998a). The projected increase in SNL/NM staffing, 5 percent over current levels under the No Action Alternative (Section 5.3.12), could lead to runoff of additional organic compounds (primarily oil and grease) from vehicles in parking lots. The most recent storm water monitoring shows oil and grease concentrations ranging from 0.6 to 1.4 mg/L (SNL 1997d). Although there are no quantitative National Pollution Discharge Elimination System (NPDES) or state limits for oil and grease, these concentrations are near detection limits. A 5-percent increase in these values would be of no environmental consequence, especially considering dilution that would occur in Tijeras Arroyo during periods of runoff.

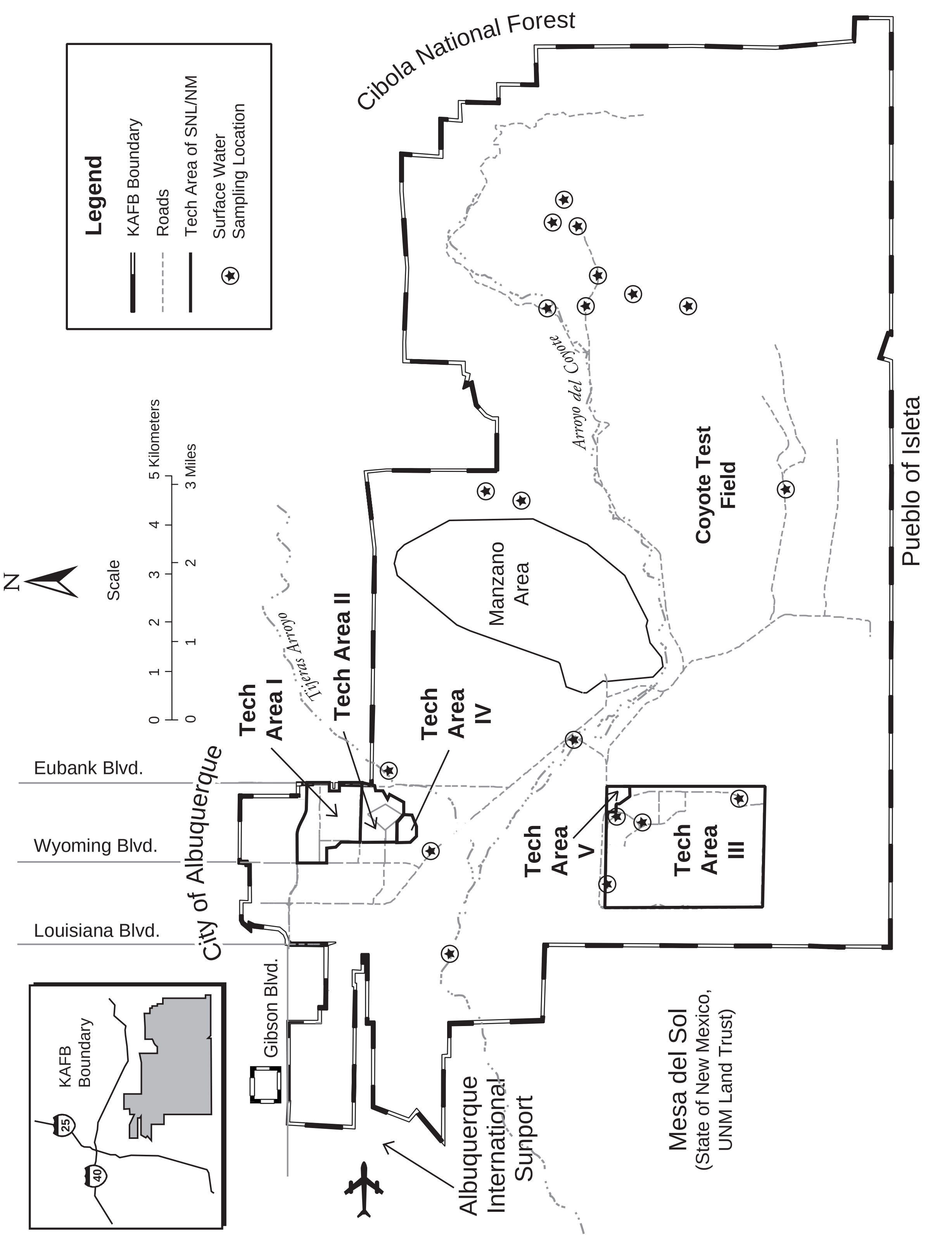
Outdoor Testing Facilities

A slight increase in outdoor testing activities is projected under the No Action Alternative, and some types of tests may double (SNL/NM 1998a). However, controls are in place to minimize the amount of soil contamination that could occur during these tests, including post-test surveys and material removal (SNL 1997e). Because no surface water radionuclide concentrations have been detected above background under current test levels, contamination is not anticipated under test levels projected for the No Action Alternative.

5.3.4.4 Surface Water Quantity

Storm Water Runoff

By calculating the difference between runoff that would occur from a natural surface and an impervious surface,



Sources: SNL 1995c , SNL/NM 1997j

Figure 5.3.4   4. Surface Water Sampling Locations at Tijeras Arroyo

Four surface water samples were collected from Tijeras Arroyo near the exit point from KAFB.

Table 5.3.4 3. Tijeras Arroyo Storm Water Sampling Results Near Downstream Boundary of KAFB (New Mexico Water Quality Control Commission-Listed Contaminants)

PARAMETER	UNITS	SAMPLING LOCATIONS[a]				NMWQCC LIMIT[b]
		25122	25123	25125	25126	
Aluminum	mg/L	0.67	0.048	ND	ND	5.0
Arsenic	mg/L	ND	ND	ND	ND	0.2
Boron	mg/L	NA	NA	NA	NA	5.0
Cadmium	mg/L	ND	ND	ND	ND	0.05
Chromium	mg/L	ND	ND	ND	ND	1.0
Cobalt	mg/L	ND	ND	ND	ND	1.0
Copper	mg/L	ND	0.01	ND	ND	0.5
Lead	mg/L	ND	ND	ND	ND	0.1
Mercury (total)	mg/L	ND	ND	ND	ND	0.01
Selenium	mg/L	ND	ND	ND	ND	0.05
Vanadium	mg/L	ND	0.006	ND	ND	0.1
Zinc	mg/L	0.16	0.003	ND	ND	25.0
Radium-226, -228	pCi/L	NA	NA	NA	NA	30.0
Tritium	pCi/L	NA	NA	NA	NA	20,000
Gross alpha	pCi/L	NA	NA	NA	NA	15

Sources: NMWQCC 1994, SNL/NM 1996g
mg/L: milligrams per liter
NA: not analyzed
ND: not detected
NMWQCC: New Mexico Water Quality Control Commission
pCi/L: picocuries per liter
[a] Limit for livestock watering use
[b] Locations shown in Figure 5.3.4 4

the net contribution of SNL/NM to runoff can be established. The percentage of rainfall that runs off natural surfaces at SNL/NM is estimated at 10 to 35 percent (SNL/NM 1997a), varying with factors such as slope, vegetation, and soil type. For this analysis, the increase in storm water runoff at SNL/NM was estimated by assuming that 100-percent of rainfall would run off areas with buildings and parking lots. Although the actual runoff percentage would be less because of pooling and evaporation of water on these surfaces, the 100 percent assumption provides a maximum estimate (greatest environmental effect) for the SNL/NM contribution to surface water quantity. The lower estimate of 10 percent was used for natural runoff, also to provide a maximum estimate of the SNL/NM contribution to storm water runoff. The calculations used in this analysis are shown in Appendix B.

The developed (impervious) area of SNL/NM is estimated to be 0.72 mi^2. This analysis indicates that SNL/NM contributes no more than 5 percent of the flow in Tijeras Arroyo. The maximum increase in annual surface runoff due to the presence of SNL/NM is estimated to have ranged from approximately 100,000 to 700,000 ft^3 from 1993 through 1995. These flows represent small fractions (0.0001 to 0.001 percent) of the annual Rio Grande flow above its confluence with Tijeras Arroyo.

Under the No Action Alternative, only minor net changes in building and parking lot areas would be anticipated. Annual variations in SNL/NM surface runoff would be likely; however, the overall impact would be minimal.

Discharge to Sanitary Sewer

During 1996, 37.4 M ft^3 (280 M gal) of SNL/NM process and sanitary sewage water were discharged to the city of Albuquerques Southside Water Reclamation Plant (SNL/NM 1997a). This water, which is treated and then discharged to the Rio Grande, 0.7 mi upstream of the river s confluence with Tijeras Arroyo, contributes approximately 0.06 percent to the 60.5-B-ft^3 annual average flow (upstream of the water reclamation plant) measured from 1993 through 1995 (USGS 1998).

Under the No Action Alternative, annual discharge to the sanitary sewer would be expected to increase slightly from the 1996 level to 40.6 M ft^3 (304 M gal). This would result in a contribution to Rio Grande flow of 0.07 percent. SNL/NM management has committed to a 30-percent reduction in water use by 2004 (SNL/NM 1997a). A decrease in the quantity of water discharged to the reclamation plant would be expected under this plan.

Based on this analysis, the total annual contribution of water to the Rio Grande from SNL/NM, including surface water runoff and discharge to the Southside Water Reclamation Plant, would be between 40.7 and 41.3 M ft^3 under the No Action Alternative. The vast majority of this contribution (40.6 M ft^3) would come from discharge to the water reclamation plant. The total SNL/NM contribution would be approximately 0.07 percent of the average annual Rio Grande flow. No discernible effects to the Rio Grande would be likely from the quantity of SNL/NM water discharged.

5.3.5 Biological and Ecological Resources

Implementation of the No Action Alternative would cause minimal impacts to biological and ecological resources. The ROI for biological resources consists of KAFB, the Withdrawn Area, buffer zones associated with operations in TA-III, and any adjacent lands that the No Action Alternative would affect.

Biological resources could be influenced by construction activities or outdoor operations that result in noise, projectiles, off-road vehicular traffic, unintended fires, and plumes of smoke. Radionuclides or chemicals could also be released from potential accidents or normal operations.

SNL/NM operations in TAs-I, -II, and -V would continue to occur primarily within buildings. Under the No Action Alternative, any proposed construction was analyzed and approved in separate NEPA documents (see Section 1.7): *Environmental Assessment for the Processing and Environmental Technology Laboratory* (DOE 1995d); *Environmental Assessment for Operations, Upgrades, and Modifications in SNL/NM Technical Area IV,* (DOE 1996g); *Neutron Generator/Switch Tube (NG/ST) Prototyping Relocation Environmental Assessment,* (DOE 1994a); and the *Environmental Assessment for the Radioactive and Mixed Waste Management Facility,* (DOE 1993a). Small areas of vegetation would be removed as a result of some of these projects, but the viability of the plant communities would not be affected. Proposed activities would likely result in the local displacement of wildlife; however, the impact would be minimal and temporary.

Wildlife species at KAFB are representative of those present in the areas surrounding KAFB. From observation, wildlife appears to have become accustomed to the noise and activities that currently exist. Data from raptor surveys at KAFB support this observation, because some raptor species at KAFB return to the same nest sites each year. For example, the western burrowing owl and Swainson s hawk migrate to KAFB to breed in the same nests (USAF 1997b).

Outdoor activities at TA-III and the Coyote Test Facility would continue to affect small localized areas. At the Aerial Cable Facility, 2.2-lb antitank skeet warheads would continue to be detonated. Small fragments of explosive test debris and shrapnel would potentially be dispersed over a 1,200-ft radius (SNL/NM 1998a). Such debris would have a minimal impact on the mortality or distribution of plants and animals. At the Lurance Canyon Burn Site, tests using fire are conducted in outdoor pools, the largest of which is 1,800 ft^2 (SNL/NM 1998a). Normal operations at these sites would potentially result in unintended fires of limited areal extent. As a result, a temporary loss of vegetation would occur. A few one-seed junipers and grasses would potentially be lost in a fire. Desert shrubs are only marginally affected by fire (Dick-Peddie 1993). Perennial grasses appear to recover from fire less effectively than shrubs or forbs (Dick-Peddie 1993). However, the immediate effects on perennial grasses may last only 1 or 2 years (Cable 1967). Although relationships between fire and vegetation are complex, it is unlikely that fires or their suppression have had much effect on the scrublands or nonmontane grasslands of New Mexico (Dick-Peddie 1993). Individuals of the grama grass cactus, a USFS sensitive species, would possibly be destroyed in a fire, but seeds would survive (PSL 1992). The population would recover, and the temporary impact on this species would be minimal.

Normal operations at the Lurance Canyon Burn Site would result in large plumes of carbon particulates that would extend thousands of feet into the air

(SNL/NM 1998a). These smoke plumes would be of short duration and would temporarily displace birds.

Under the No Action Alternative, there would be no impact on springs or wetlands, including the Burn Site Spring, the only spring or wetland on land used by SNL/NM.

Under the No Action Alternative, the federally endangered peregrine falcon would not be affected. There would not be a loss, gain, or degradation to the habitat of peregrine falcons. While peregrine falcons are regular spring migrants along ridge lines of the Sandia and Mazano Mountains, only one probable sighting of a peregrine falcon, which was likely migrating, has been documented during surveys on the KAFB. No evidence of nesting has been found on KAFB, which has marginal nesting potential (USAF 1995d). Prey availability for any migrating falcons would also not be affected by continued and planned operations. Impacts to other protected or sensitive species, or both, would be negligible.

Ecological risks of the DOE s ongoing environmental restoration activities were analyzed in the *Environmental Assessment of the Environmental Restoration Project at SNL/NM* (DOE 1996c). Results indicate that removing soil that has been contaminated by radioactive or hazardous materials would reduce the potential for exposure of animals and plants to these contaminants and any associated ecological risk. Corrective actions could generate contaminated dust and subsequent exposure of small mammals and plants to radionuclides, cadmium, chromium, and lead. The predicted exposures were well below the benchmark levels, above which adverse effects are a potential concern. This indicates that biota would be at minimal risk for adverse effects from contaminated dust and radiation (DOE 1996c).

Annual ecological monitoring of small mammal, reptile, amphibian, bird, and plant species at selected sites does not show significant contaminant loads of radionuclides or metals in the individuals tested (SNL/NM 1997u). This indicates that no significant contaminant loadings of radionuclides or metals would likely be found in biota traveling across the boundaries between the KAFB and the Pueblo of Isleta. Ecological risks to plants and animals would continue to be further assessed using a phased approach outlined by the EPA (SNL/NM 1998w). The exposures of indicator plant and animal species to constituents of potential ecological concern would be modeled in order to calculate hazard quotients. For example, perennial grasses, small mammals, and insects would be collected at selected ER sites and analyzed for the concentrations of selected metals, included uranium and lead (SNL/NM 1998w). No significant increases in contaminant loads of radionuclides or chemicals would be expected in plants or animals at KAFB under the No Action Alternative. Removal of contaminated soil would result in a short-term loss of vegetation and disturbance of wildlife.

Inventory and management of the biological resources by SNL/NM, KAFB, and the USFS would continue to protect the animals, plants, and sensitive species on KAFB.

5.3.6 Cultural Resources

The implementation of the No Action Alternative would have low to negligible impacts to cultural resources due to 1) the absence of prehistoric or historic archaeological sites on DOE-administered land, 2) the nature of the cultural resources found in the ROI (see Appendix C), 3) compliance with applicable regulations and established procedures for the protection and conservation of cultural resources located on lands administered by the DOE and on lands administered by other agencies and used by the DOE (see Section 4.8.3.2 and Chapter 7), and 4) the largely benign nature of SNL/NM activities near cultural resources. Implementation of the regulations and procedures would make unlikely any adverse impacts resulting from construction, demolition, decontamination, renovation, or ER Project activities.

No impacts would be anticipated to DOE buildings constructed during World War II or the Cold War era, some of which are eligible or potentially eligible for listing on the National Register of Historic Places (NRHP). Although some buildings on DOE-owned land have been assessed for eligibility, most have not because of their young age. Some of the buildings at SNL/NM have been proposed for decontamination, renovation, or demolition. Before any building is subjected to these activities, the DOE would assess the eligibility of the building for placement on the NRHP and, in consultation with the New Mexico SHPO, would determine if the activities would have an impact on an eligible building. This assessment would include determining measures to mitigate or avoid any potential impacts to eligible buildings.

Under the No Action Alternative, prehistoric and historic cultural resources could potentially be affected by activities performed at five SNL/NM facilities, although the potential for impact is low to negligible.

These facilities consist of the Aerial Cable Facility, Lurance Canyon Burn Site, Thunder Range, Sled Track Complex, and Terminal Ballistics Complex. The first three facilities are located on land not owned by the DOE. Impacts could potentially result from three activities at these facilities: production of explosive testing debris and shrapnel, off-road vehicle traffic, and unintended fires and fire suppression. Another source of potential impact derives from the restricted access present at KAFB and individual SNL/NM facilities. Discussions of potential impacts follow and are organized by impact source.

5.3.6.1 Explosive Testing Debris and Shrapnel

One source of potential impact to cultural resources would be explosive testing debris and shrapnel (referred to as debris) produced by outdoor explosions. Such explosions could cause the impact of airborne debris on cultural materials or the presence of debris on cultural resource sites. Activities at two SNL/NM facilities the Aerial Cable Facility and the Lurance Canyon Burn Site would have the potential for impacts to cultural resources due to debris from outdoor explosions. The potential for impacts would be low for both facilities, as explained below.

Activities at the Aerial Cable Facility would include testing antitank skeet warheads weighing approximately 2.2 lb. During the tests, which would be conducted in target areas that have previously been disturbed, the warheads would explode, dispersing debris (SNL/NM 1998a). Studies conducted at Los Alamos National Laboratory (LANL) for explosive tests measuring up to 500 lb have shown that debris primarily tend to fall within 800 ft of the firing site and no particles fall outside 1,200 ft (DOE 1998a).

No archaeological sites are located within an 800-ft radius of the Aerial Cable Facility. One eligible archaeological site is located within a 1,200-ft radius, where debris would be likely to fall less frequently. In addition, both the position of the site on a hill slope facing away from the facility and the surrounding vegetation would act to reduce both the velocity and amount of debris that could reach the site, thereby lowering the already low probability for impacts caused by debris. Dense pinyon and juniper trees and shrubs are present in the area, which would help protect the archaeological resource from airborne debris. Field observations conducted at this archaeological site in August 1998 by the SWEIS Cultural Resources Specialist did not reveal any visible effects that could be attributable to flying debris and no debris was identified on the site. Based on these studies, the probability of this one archaeological site being affected by flying debris from the facility would be low.

Activities at the Lurance Canyon Burn Site could result in unintended explosions that could disperse debris. Four archaeological sites (all NRHP eligible) are located within 800 ft of the facility and three archaeological sites (two eligible and one potentially eligible) are within the 800- to 1,200-ft range. For the same reasons stated above for the Aerial Cable Facility, the potential for impacts to these sites from debris would be low. In addition, for some burn tests at the Lurance Canyon Burn Site, barriers are erected around test sites to contain fragments in the event of an unintended explosion, thereby reducing the already low potential for impacts to cultural resources. Field observations conducted at these seven archaeological sites in August 1998 by the SWEIS Cultural Resources Specialist did not reveal any visible effects that could be attributable to debris.

5.3.6.2 Off-Road Vehicle Traffic

Off-road vehicle traffic would be another possible source of impact to cultural resources. Activities at Thunder Range would sometimes require off-road vehicle travel to place objects for object detection activities, although most targets and reflectors would be placed along existing dirt roads and would usually not require off-road travel. There is one potentially eligible archaeological site on Thunder Range near a dirt road. Off-road vehicle travel could physically affect this site; however, personnel working in the area are aware of its location and the need to avoid it. Therefore, the potential for impacts to this site would be negligible. Field observations conducted at this site in August 1998 by the SWEIS Cultural Resources Specialist did not reveal any visible effects due to off-road vehicle travel.

5.3.6.3 Unintended Fires and Fire Suppression

Fires and fire suppression activities can cause physical damage to cultural resources. After a fire, the lack of vegetation can allow sheet-washing during rainstorms, thereby eroding exposed resources and causing further physical damage. Activities at four facilities the Terminal Ballistics Complex, Sled Track Complex, Aerial Cable Facility, and Lurance Canyon Burn Site would have the potential to ignite accidental outdoor brush fires. However, the potential for subsequent impacts to cultural resources would be low to negligible for a number of reasons. First, fires would be expected to occur close to the originating facility. Personnel would be aware of the potential for such fires and trained to spot and extinguish them. Second, personnel would access the fire on foot and suppress it using portable chemical extinguishers or extinguishing blankets. Third, SNL/NM and the DOE would coordinate with KAFB and the USFS monthly to review scheduled activities with regard to the current fire hazard conditions and to determine if activities should be coordinated on a day-to-day basis (when the fire hazard is high). The Terminal Ballistics Complex and the Sled Track Complex are 1 mi or more away from any known cultural resources; thus, the probability for unintended fires and fire suppression activities from these facilities to affect these resources would be negligible. The other two facilities, the Aerial Cable Facility and the Lurance Canyon Burn Site, are in areas that contain many archaeological sites, with some sites located within 1,200 ft of the facilities. However, due to the training of personnel to identify and extinguish fires quickly, access them on foot, and use fire suppression methods that minimize ground disturbance, the probability for impacts to the archaeological sites at these two facilities would remain low.

5.3.6.4 Restricted Access

Restriction of access to areas within the ROI would have positive effects on cultural resources themselves. Under the No Action Alternative, current KAFB security levels that restrict access would remain. Additional access restrictions would be enforced at specific SNL/NM facilities during various activities. These restrictions would result in an increased level of protection for cultural resources in the ROI and particularly in the facility secure zones.

A TCP study is being conducted. Fifteen Native American tribes have been contacted to determine the presence of TCPs in the ROI. Of the 15 tribes contacted, 7 have responded and one tribe has declined consultation (see Appendix C). Consultations are continuing with the remaining seven tribes. Some tribes who traditionally used the area surrounding and including KAFB consider certain categories of features to be TCPs because of their sacred or religious association with the group or their use by the group in traditional lifeways. These features, which are present in the ROI, include archaeological sites, human burials, springs and other water sources, minerals, vegetation, and animals. However, no specific TCPs have been identified through these consultations and no TCPs are currently known to exist within the ROI.

5.3.7 Air Quality

The implementation of the No Action Alternative would continue the nonradiological and radiological emissions (Sections 5.3.7.1 and 5.3.7.2, respectively) from SNL/NM facilities. These emissions would continue to be well within the applicable standards for public and worker health and safety.

5.3.7.1 Nonradiological Air Quality

Local, state, and Federal regulations require Federal agencies to assess the effect of their activities on ambient air quality. Under Section 176 (c) of the *Clean Air Act*, each Federal agency has an affirmative responsibility to ensure that the agencys activities conform to state implementation plans designed to achieve and maintain the NAAQS.

Air emissions were assessed for compliance with the NAAQS, and the NMAAQS, and the Albuquerque/ Bernalillo County Air Quality Control Board (A/BC AQCB) regulations for criteria pollutants and guidelines for chemical concentrations. The A/BC AQCB enacted the General Conformity Regulation in November 1994 in the Air Quality Control Regulation (20 NMAC 11.04). A final Federal rule for Determining Conformity of General Federal Actions to State or Federal Implementation Plans was promulgated by the EPA on November 30, 1993 (58 FR 63214), and took effect on January 31, 1994 (40 CFR Parts 6, 51, and 93). This Federal rule established the conformity criteria and procedures necessary to ensure that Federal actions conform to the appropriate state implementation plan (SIP) and meet the provisions of the *Clean Air Act* (CAA) until the required conformity SIP revision by the state is approved by the EPA. In general, the final rule ensures that all criteria air pollutant emissions and volatile organic compounds (VOCs) are specifically identified and accounted for in the SIP s attainment or maintenance demonstration. This final rule establishes the criteria and procedures governing the determination of conformity for all Federal actions, except Federal highway and transit actions (transportation conformity).In addition, at the state level (under New Mexico Administrative Code, Title 20, 20 NMAC 2.98), are the provisions of Conformity of General Federal Actions to the State Implementation Plan passed on December 14, 1994, which echo the Federal conformity rule. These conformity regulations apply to nonattainment or maintenance areas for criteria pollutants. Bernalillo county is currently classified as a maintenance area for carbon monoxide and therefore these regulations apply to the current Federal actions at SNL/NM.

Criteria Pollutants

The nonradiological air quality for criteria pollutants at SNL/NM under the No Action Alternative is represented by 1996 baseline sources, plus those criteria pollutants sources expected to become operational by 2008. The criteria pollutants include PM_{10}, sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, TSP, and ozone. The No Action Alternative provides for SNL/NM to operate at current planned levels, which would include emission sources that are planned or under construction. These planned sources include a boiler designated by the Albuquerque Environmental Health Department (AEHD) as insignificant, an emergency generator in Building 701 (currently under construction), and a 600-kw-capacity generator in Building 870b.

> **Insignificant Source**
>
> An insignificant source is a source that is listed by the Albuquerque Environmental Health Department (AEHD) or approved by the [EPA] Administrator as insignificant on the basis of size, emissions, or production rate.
>
> Source: 20 NMAC 2.3

Following are the criteria pollutant sources included in the modeling analysis under the No Action Alternative:

- the steam plant,
- the electric power generator plant,
- a boiler and an emergency generator in Building 701, and
- the 600-kw-capacity generator in Building 870b.

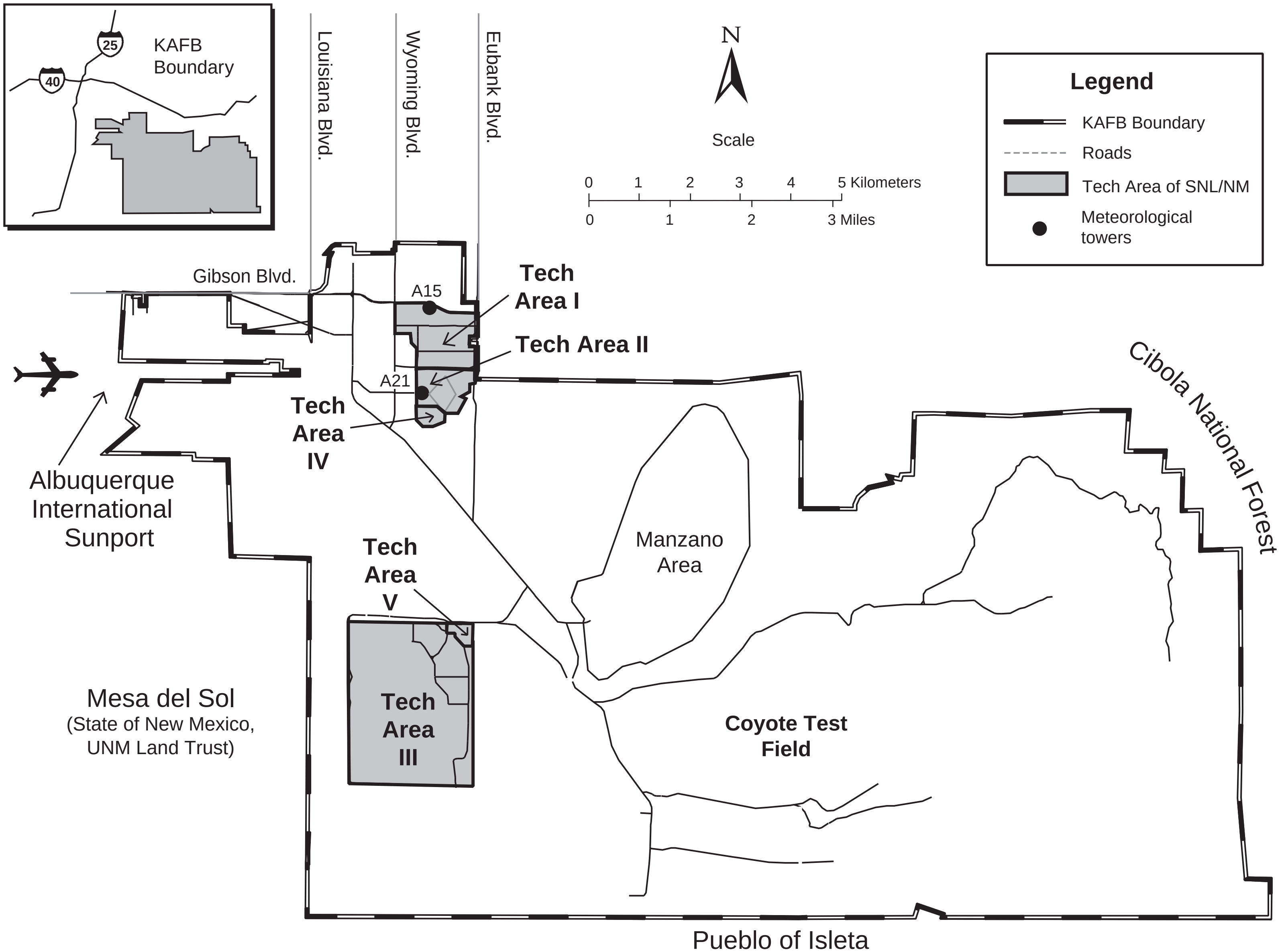
The Lurance Canyon Burn Site is an additional source of criteria pollutants. This source is a noncontinuous source, spatially separated from those listed above, and is, therefore, addressed separately within the fire testing facilities section that follows.

The estimated emissions of criteria pollutants under the No Action Alternative were modeled using the EPA-recommended *ISCST3* (version 97363) model to estimate concentrations of criteria pollutants at or beyond the SNL/NM boundary, including receptor locations such as public access areas (for example, the National Atomic Museum, hospitals, and schools). Onsite hourly meteorological data from meteorological tower A15 for 1995 and 1996 and from meteorological tower A21 for 1994, 1995, and 1996, were used to perform the modeling. Figure 5.3.7 1 shows the locations of the two meteorological towers in the vicinity of TA-I.

> **Receptor Location**
>
> A receptor location is a location at which any individual may be affected by SNL/NM activities.

Modeling results for nitrogen oxides using *ISCST3* for the 24-hour and annual averaging periods are 0.19 ppm (300 μg/m^3) and 0.02 ppm (28 μg/m^3), respectively. The NMAAQS standards for nitrogen dioxide for the 24-hour and annual averaging periods are 0.10 ppm (156 μg/m^3) and 0.05 ppm (78 μg/m^3), respectively. The modeling results indicate that the nitrogen oxides 24-hour concentrations exceed the NMAAQS standard for nitrogen dioxide. If the nitrogen oxides concentration is below the NMAAQS standard for nitrogen dioxide, then no further analysis is necessary to show compliance with the standard. Since the nitrogen oxides concentration is above the standard, a second step must be undertaken to show compliance. The second step implements the ozone-limiting method (OLM) to estimate nitrogen dioxide concentrations in modeled nitrogen oxides emissions.

The New Mexico Air Pollution Control Bureau has approved the OLM to estimate nitrogen dioxide concentrations in modeled nitrogen oxides emissions. A detailed description of the OLM is presented in Appendix D. The OLM results in a modeled annual average concentration of nitrogen dioxide of 0.006 ppm (10 μg/m^3) and a 24-hour average concentration of 0.066 ppm (103.7 μg/m^3). The OLM requires that background nitrogen dioxide concentrations be added to the model-calculated nitrogen dioxide concentrations to obtain a representative concentration of nitrogen dioxide. The maximum 24-hour average concentration of nitrogen dioxide at the chosen background station in 1996 was 0.029 ppm (46 μg/m^3); the annual average concentration was 0.008 ppm (13 μg/m^3). The future contribution from the Cobisa Power Station, located approximately 5 mi west of SNL/NM, will add to the annual average background concentration of nitrogen dioxide at the monitoring station. The calculated maximum incremental annual average nitrogen dioxide concentration from this facility will be 1.1 μg/m^3. These values, added to the modeled values of nitrogen dioxide,



Source: SNL/NM 1997a

Figure 5.3.7 1. Locations of Meteorological Towers Used for Criteria Pollutant Modeling

Two meteorological towers (A15 and A21) in the TA-I vicinity were used to perform modeling for criteria pollutants.

are reported in Table 5.3.7 1. Potential increases in the background for other criteria pollutants, due to the Cobisa Power Station, are also included. The maximum criteria pollutant concentrations at a public access area outside of the SNL/NM fence occurred at the National Atomic Museum. Table 5.3.7 1 presents the criteria pollutant concentrations of carbon monoxide, nitrogen dioxide, PM_{10}, TSP, and sulfur dioxide resulting from the modeling analysis, and maximum measured monitoring data for lead and ozone. In addition, the table presents the applicable Federal (40 CFR Part 50) and New Mexico state (20 NMAC 2.3) standards for each pollutant.

What is a Background Concentration?

Manufacturing processes may produce toxic, hazardous, and radioactive substances, either directly or as byproducts. However, many of these substances also occur naturally and can be found in air, water, and soils. Examples include: volatile chemicals produced by forests and phytoplankton; radioactive nuclides, such as uranium, radium, tritium, and beryllium, created by cosmic radiation; and all nonradioactive metals such as lead, chromium, nickel, and arsenic. In order to determine the amount of these substances in the environment resulting from human activity, it is necessary to subtract the naturally occurring or background concentrations from the concentrations measured in a finite number of environmental samples. Because background concentrations can vary substantially over an area and with depth, a difference between sample and background concentrations does not necessarily demonstrate that contaminants have been introduced into the environment.

Determining whether concentrations of metals or radionuclides are the result of contaminants introduced into the environment tends to be more problematic than situations involving volatile chemicals. Various metals and radionuclides occur naturally in measurable concentrations, and the amount of contamination introduced is often relatively small compared to the background values. To aid in the interpretation of metal and radionuclide concentrations in samples, SNL/NM conducted a study of background concentrations at KAFB (SNL/NM 1996e). Using more than 3,700 samples, SNL/NM demonstrated the variation in natural concentrations of 20 metals and 9 radionuclides in different regions of KAFB. This study was the basis for developing a set of agreed-upon maximum background concentrations with the NMED.

As shown in Table 5.3.7 1, the maximum concentrations for three criteria pollutants (nitrogen dioxide, TSP, and PM_{10}) were calculated to be within 96 percent of (or 4 percent below) the Federal and state regulatory agency standards for a 24-hour period. These standards, in general, are set to provide for an ample margin of safety below any pollutant concentration that might be of concern.

The methodology used in the criteria pollutant analysis also produces maximum concentration projections that are very conservative. For example, 100 percent of the maximum concentration of air pollutants projected for Cobisa Power Station (located 5 mi west of the National Atomic Museum) was added to the background concentration calculated for the Steam Plant location (near the museum). Also, the maximum concentrations of air pollutants, from a monitoring station measuring contributions from the surrounding community that are dominated by traffic emissions, were added to the worst-case contribution of pollutants from operating SNL/NM s diesel fuel-powered backup generators and fuel oil-powered Steam Plant boilers. Consequently, though close to the thresholds, these calculated concentrations for nitrogen dioxide, TSP, and PM_{10} are considered to be very conservative.

Table 5.3.7 2 presents the modeled incremental criteria pollutant concentrations representing only those new sources expected to become operational by 2008: an insignificant boiler and emergency generator in Building 701 and a 600-kw-capacity generator in Building 870b. These new sources are included in the concentrations presented in Table 5.3.7 1 and are presented separately in Table 5.3.7 2 to demonstrate the small incremental increase expected from these sources.

Table 5.3.7 1 presents carbon monoxide concentrations from stationary sources at SNL/NM, while carbon monoxide emissions from mobile (vehicular) sources are presented separately. Monitoring data best represent the combined impact of carbon monoxide emissions from these two sources, and the ambient concentrations of these pollutants are also provided in the table. On June 5, 1998, SNL/NM became subject to a new 8-hour, 0.08-ppm ozone standard, replacing the previous 1-hour, 0.12-ppm ozone standard (63 FR 31034). In the year 2000, the EPA will designate areas that do not meet the 8-hour standard based on the most recently available

Table 5.3.7-1. Criteria Pollutant Concentrations from SNL/NM Stationary Sources and Background with Applicable National and New Mexico Ambient Air Quality Standards Under the No Action Alternative

POLLUTANT (SNL/NM [Tons/yr])	AVERAGE TIME	NAAQS (ppm[µg/m³])	NMAAQS (ppm[µg/m³])	NO ACTION CONCENTRATION (ppm[µg/m³])	BACKGROUND CONCENTRATION (ppm[µg/m³])	TOTAL CONCENTRATION (ppm[µg/m³])	PERCENT OF STANDARD[i]
Carbon Monoxide (18.36)	8 hours	9[8,564]	8.7[8,279]	0.08[78.4]	4.9[4,663][g]	4.98[4,741]	57
	1 hour	35[33,305]	13.1[12,466]	0.13[119]	8.0[7,613][g]	8.1[7,732]	62
Lead	Quarterly	1.5[a]	-	0.001[a,b]	-	0.001[a,b]	0.07
Nitrogen Dioxide (162.36)	Annually	0.053[83]	0.05[78]	0.006[10.0]	0.009[14.1][f,g]	0.015[24.1]	30
	24 hours	-	0.10[156]	0.066[103.7]	0.029[46][f,g]	0.096[149.7]	96
TSP (7.46)	Annually	-	60[a]	11.4[a]	30[h]	41.4[a]	69
	30 days	-	90[a]	NA	NA	NA	NA
	7 days	-	110[a]	NA	NA	NA	NA
	24 hours	-	150[a]	114.2[a]	30[h]	144.2[a]	96
PM_{10}[d] (7.46)	Annually	50[a]	-	11.4[a]	30[h]	41.4[a]	83
	24 hours	150[a]	-	114.2[a]	30[h]	144.2[a]	96
Sulfur Dioxide (1.10)	Annually	0.03[65]	0.02[44]	0.0008[1.7]	0.00005[0.12][f]	0.00085[1.82]	4
	24 hours	0.14[305]	0.10[218]	0.006[12.2]	0.0008[1.7][f]	0.006[13.9]	6
	3 hours	0.50[1,088]	-	0.01[21.1]	0.006[13.5][f]	0.016[34.6]	3
Ozone[e]	1 hour	0.12[196]	-	0.103[168] [c]	-	0.103[168] [c]	86
Hydrogen Sulfide	1 hour	-	0.01/12	NA	-	NA	NA
Total Reduced Sulfur	0.5 hour	-	0.03/33	NA	-	NA	NA

Sources: 20 NMAC 2.03, 40 CFR Part 50, NMAPCB 1996, SNL/NM 1997d
mg/m³: micrograms per cubic meter
CPMS: criteria pollutant monitoring station
NA: Not Available
NAAQS: National Ambient Air Quality Standards
NMAAQS: New Mexico Ambient Air Quality Standards
PM_{10}: Particulate matter less than 10 microns in diameter
ppm: parts per million
TSP: total suspended particulates
[a] mg/m³
[b] Highest quarterly lead monitoring data measured at the CPMS site in 1996
[c] Highest 1-hour ozone monitoring data measured at the CPMS site in 1996
[d] PM_{10} assumed equal to TSP
[e] A new 8-hour, 0.08-ppm ozone standard is replacing the previous 1-hour, 0.12-ppm ozone standard based on the most recently available 3 years of ozone data. SNL/NM might not be in compliance with this standard in the year 2000 when the EPA will designate areas that do not meet the 8-hour standard.
[f] Background concentrations resulting from operation of the Cobisa Power Station
[g] 1996 maximum background concentrations from monitoring station 2R and/or 2ZR/2ZQ.
[h] Background PM_{10} values for 24-hour and annual PM_{10} cumulative impacts (NMAPCB 1996).
[i] Represents SNL/NM contribution plus background as a percent of standard.
Note: The standards for some of the pollutants are stated in ppm. These values were converted to mg/m³ with appropriate corrections for temperature (530 degrees Rankin) and pressure (elevation 5,400 feet) following New Mexico Dispersion Modeling Guidelines (NMAPCB 1996).

Table 5.3.7 2. Incremental Criteria Pollutant Concentrations from SNL/NM Stationary Sources with Applicable National and New Mexico Ambient Air Quality Standards

POLLUTANT	AVERAGING TIME	NAAQS (ppm[μg/m³])	NMAAQS (ppm[μg/m³])	INCREMENTAL CONCENTRATION (ppm[μg/m³])	PERCENT OF STANDARD
Carbon Monoxide	8 hours	9[8,564]	8.7[8,279]	0.03[29.7]	< 1
	1 hour	35[33,305]	13.1[12,466]	0.2[164.7]	1.3
Lead	Quarterly	1.5[a]	-	NA	NA
Nitrogen Dioxide[b]	Annual	0.053[83]	0.05[78]	0.001[1.1]	1.4
	24 hours	-	0.10[156]	0.02[12.2]	7.8
TSP	Annual	-	60[c]	0.1[a]	< 1
	24 hours	-	150[c]	1.2[a]	< 1
PM_{10}[c]	Annual	50[a]	-	0.1[a]	< 1
	24 hours	150[a]	-	1.2[a]	< 1
Sulfur Dioxide	Annual	0.03[65]	0.02[44]	0.0001[0.23]	< 1
	24 hours	0.14[305]	0.10[218]	0.001[2.7]	1.2
	3 hours	0.50[1,088]	-	0.007[15.1]	1.4
Ozone	Annual	-	-	NA	NA
	1 hour	0.12[196]	-	NA	NA
Hydrogen Sulfide	1 hour	-	0.01[12]	NA	NA
Total Reduced Sulfur	0.5 hour	-	0.03[33]	NA	NA

Sources: 20 NMAC 2.03, 40 CFR Part 50, NMAPCB 1996, SNL/NM 1997d
- indicates no standard for listed averaging time
μg/m³: micrograms per cubic meter
°R: degrees Rankin
ft: feet
NA: Not Available
NAAQS: National Ambient Air Quality Standards
NMAAQS: New Mexico Ambient Air Quality Standards
OLM: ozone limiting method
PM_{10}: Particulate matter less than 10 microns in diameter
ppm: parts per million
TSP: total suspended particulates
[a] μg/m³
[b] The OLM was employed to calculate the nitrogen dioxide component of the nitrogen oxides concentration.
[c] PM_{10} assumed equal to TSP
Note: The standards for some of the pollutants are stated in ppm. These values were converted to μg/m³ with appropriate corrections for temperature (530°R) and pressure (elevation 5,400 ft) following New Mexico Dispersion Modeling Guidelines (NMAPCB 1996).

3 years of ozone data available at that time (such as 1997 through 1999).

The modeling results presented in Table 5.3.7 1 indicate that the No Action Alternative criteria pollutant concentrations would be below the most stringent standards, which define the pollutant concentrations below which few adverse impacts to human health and the environment are expected. Appendix D contains the assumptions and model input parameters used to calculate the criteria pollutant concentrations presented in Table 5.3.7 1.

Mobile Sources

The model projected carbon monoxide emissions from mobile sources (motor vehicles) from SNL/NM commuter traffic, including on-base vehicles, would be 3,489 tons per year for 2005 (SNL 1996c), which is 596 tons per year below the 1996 baseline. These projections of carbon monoxide emissions are based on estimates of 13,582 vehicles per day entering SNL/NM, a 30 mi-per-day-per-vehicle average commuting distance, and 261 working days per year. The EPA mobile source emission factor model, *MOBILE5a*, was used to project emission factors for the years from 1996 through 2005. The resulting emission factors show a reduction in carbon monoxide emission rates for each successive year. The reduction is based on the model assumption that future vehicles will have inherently lower emission rates and that more stringent inspection and maintenance programs will maintain the lower rates. The trend of lower carbon monoxide emissions projected from SNL/NM would also occur for a similar mix of vehicles operating in the Bernalillo county area due to improvements in vehicle fleet emissions. Projected carbon monoxide emissions for Bernalillo county for 2005 would be 206 tons per day, or 75,190 tons per year (AEHD 1998). The contribution of carbon monoxide emissions from vehicles commuting to and from SNL/NM and from SNL/NM-operated on-base vehicles in 2005, as a percent of the total county highway mobile sources carbon monoxide emissions, would be 4.6 under the No Action Alternative.

Total carbon monoxide emissions are shown in Table 5.3.7 3. Estimates of future construction activities include use of small diesel generators, air compressors, front-end loaders, dozers, and dump trucks. Emissions for the construction activities have been estimated based on exhaust pollutant estimates for diesel construction equipment.

Total carbon monoxide emissions for the No Action Alternative are 596 tons per year less than the 1996 baseline, well below the 100 tons/year incremental increase above baseline that would require a conformity determination. In addition, the total carbon monoxide emissions for the No Action Alternative were found to be approximately 2.7 percent of the maintenance areas emissions of carbon monoxide. As a result, the DOE has concluded that no conformity determination is required for the No Action Alternative.

Lurance Canyon Burn Site

SNL/NM uses the Lurance Canyon Burn Site to test the responses of shipping containers, aerospace components, and other items to high-temperature conditions. Concentrations of pollutants from operations at the fire testing facilities under the No Action Alternative are represented by the emissions from the 42 tests performed during 1996. These tests consumed 10,400 gal of JP-8 aviation fuel and other aviation fuels and 16,050 lb of sawdust (or wood) (SNL/NM 1997a).

The largest of the tests, consuming 1,000 gal of JP-8 fuel, was used to represent the test with the maximum emissions for purposes of modeling. Concentrations of pollutants resulting from test emissions were calculated using the *OBODM* model (Bjorklund et al. 1997). The results for the criteria pollutants are presented in Table 5.3.7 4, along with the applicable Federal (40 CFR Part 50) and New Mexico state (20 NMAC 2.3) standards for each pollutant. Emissions of criteria pollutants resulting from activities at the Lurance Canyon Burn Site are presented in Table 4.9 2.

A total of 89 chemical pollutants resulting from the tests were also evaluated. Each of these pollutants was compared with the respective occupational exposure limit (OEL)/100 guideline, and each of the comparisons indicates that the chemical concentrations are below the guideline. Table D.1 31 in Appendix D contains the list of chemical emissions resulting from tests at the Lurance Canyon Burn Site.

Occupational Exposure Limit (OEL)

The occupational exposure limit is a time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect. The minimum OEL obtained from four reference sources divided by a safety factor of 100 is used as the screening guideline to determine chemicals of concern (COCs).

Chemical Pollutants

Approximately 465 chemicals, including hazardous air pollutants (HAPs), toxic air pollutants (TAPs), and volatile organic compounds (VOCs), were identified for evaluation from the CIS, CheMaster, and HCPI databases. These chemicals were purchased by the 12 facilities listed in Table 5.3.7 5 during 1996. The table lists all facilities that purchased chemicals at SNL/NM in 1996. Figure 5.3.7 2 shows the locations of these 12 facilities.

Hazardous chemicals purchased during 1996 are categorized into two groups: noncarcinogenic chemicals and carcinogenic chemicals. The list of 465 chemicals purchased during 1996 includes fifteen EPA-confirmed carcinogenic chemicals that were purchased by 5 facilities. The remaining chemicals are categorized as noncarcinogenic chemicals. Each group is evaluated using a screening technique based on 1/100 of the relevant OEL for noncarcinogens or 1/100 of the relevant unit risk factor for carcinogens in order to identify those chemicals of potential concern.

Table 5.3.7 3. Carbon Monoxide Emissions from SNL/NM Under the No Action Alternative (Tons per Year)

STATIONARY SOURCES	MOBILE SOURCES	CONSTRUCTION ACTIVITIES	LURANCE CANYON BURN SITE	TOTAL
18.36[a]	3,489	132	0.78[b]	3,640.14

Sources: SNL/NM 1998a, SNL 1996c

[a] Includes incremental carbon monoxide emissions from an insignificant boiler and emergency generator in Building 701 and a 600-kw-capacity generator in Building 870b added between 1996 and 2008.

[b] The number of tests at the Lurance Canyon Burn Site for the No Action Alternative are projected to be equal to those in 1996.

Table 5.3.7 4. Criteria Pollutant Concentrations from the Lurance Canyon Burn Site with Applicable National and New Mexico Ambient Air Quality Standards Under the No Action Alternative

POLLUTANT	AVERAGE TIME	NAAQS (ppm[μg/m^3])	NMAAQS (ppm[μg/m^3])	NO ACTION CONCENTRATION (ppm[μg/m^3])	PERCENT OF STANDARD
Carbon Monoxide	8 hours	9[8,564]	8.7[8,279]	0.023[21.45]	< 1
	1 hour	35[33,305]	13.1[12,466]	0.18[171.6]	1.4
Nitrogen Dioxide	Annual	0.053[83]	0.05[78]	6.4×10^{-7}[0.001]	< 1
	24 hours	-	0.10[156]	1.18×10^{-4}[0.184]	< 1
PM_{10}[a]	Annual	50[b]	-	0.018[b]	< 1
	24 hours	150[b]	-	6.51[b]	4.3
Sulfur Dioxide	Annual	0.03[65]	0.02[44]	4.6×10^{-7}[0.001]	< 1
	24 hours	0.14[305]	0.10[218]	1.7×10^{-4}[0.367]	< 1
	3 hours	0.50[1,088]	-	0.001[2.94]	< 1
TSP	Annual	-	60[b]	0.018[b]	< 1
	24 hours	-	150[b]	6.51[b]	4.3

Sources: 20 NMAC 2.3, 40 CFR Part 50, SNL 1997a

mg/m^3: micrograms per cubic meter

°R: degrees Rankin

ft: feet

NAAQS: National Ambient Air Quality Standards

NMAAQS: New Mexico Ambient Air Quality Standards

PM_{10}: particulate matter less than 10 microns in diameter

ppm: parts per million

TSP: total suspended particulates

[a] PM_{10} assumed equal to TSP

[b] mg/m^3

Note: The standards for some of the pollutants are stated in ppm. These values were converted to mg/m^3 with appropriate corrections for temperature (530° R) and pressure (elevation 5,400 ft) following New Mexico Dispersion Modeling Guidelines (NMAPCB 1996).

Table 5.3.7 5. SNL/NM Facilities from which Chemical Emissions were Modeled

TECHNICAL AREA	BUILDING NUMBER	FACILITY NAME
I	605	Steam plant
I	858	Microelectronics Development Laboratory (MDL)
I	870	Neutron Generator Facility (NGF)
I	878	Advanced Manufacturing Processes Laboratory (AMPL)
I	893	Compound Semiconductor Research Laboratory (CSRL)
I	897	Integrated Materials Research Laboratory (IMRL)
II	905	Explosive Components Facility (ECF)
III	6920	Radioactive and Mixed Waste Management Facility (RMWMF)
IV	963	Repetitive High Energy Pulsed Power Unit II (RHEPP II)
IV	981	Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX)
IV	986	Repetitive High Energy Pulsed Power Unit I (RHEPP I)
V	6580	Hot Cell Facility (HCF)

Source: SNL/NM 1998a

Unit Risk Factor

The unit risk factor is a dose response parameter used to identify lifetime carcinogenic health effects relative to the level of chemical exposure (risk per unit concentration). The unit risk factor multiplied by the exposure concentration equals the excess lifetime cancer risk. The carcinogenic chemical guideline used to screen the carcinogenic chemicals represents a lifetime cancer risk of 1.0×10^{-8}. It is calculated by dividing 1.0×10^{-8} risk by the chemical-specific unit risk factor. This results in a chemical concentration below which no health effect is expected.

Noncarcinogenic Chemical Screening

Noncarcinogenic chemicals that could cause air quality impacts at SNL/NM are identified through a progressive series of screening steps detailed in Appendix D in which each successive step reduces the number of pollutants to only those chemicals that have a reasonable chance of being chemicals of concern.

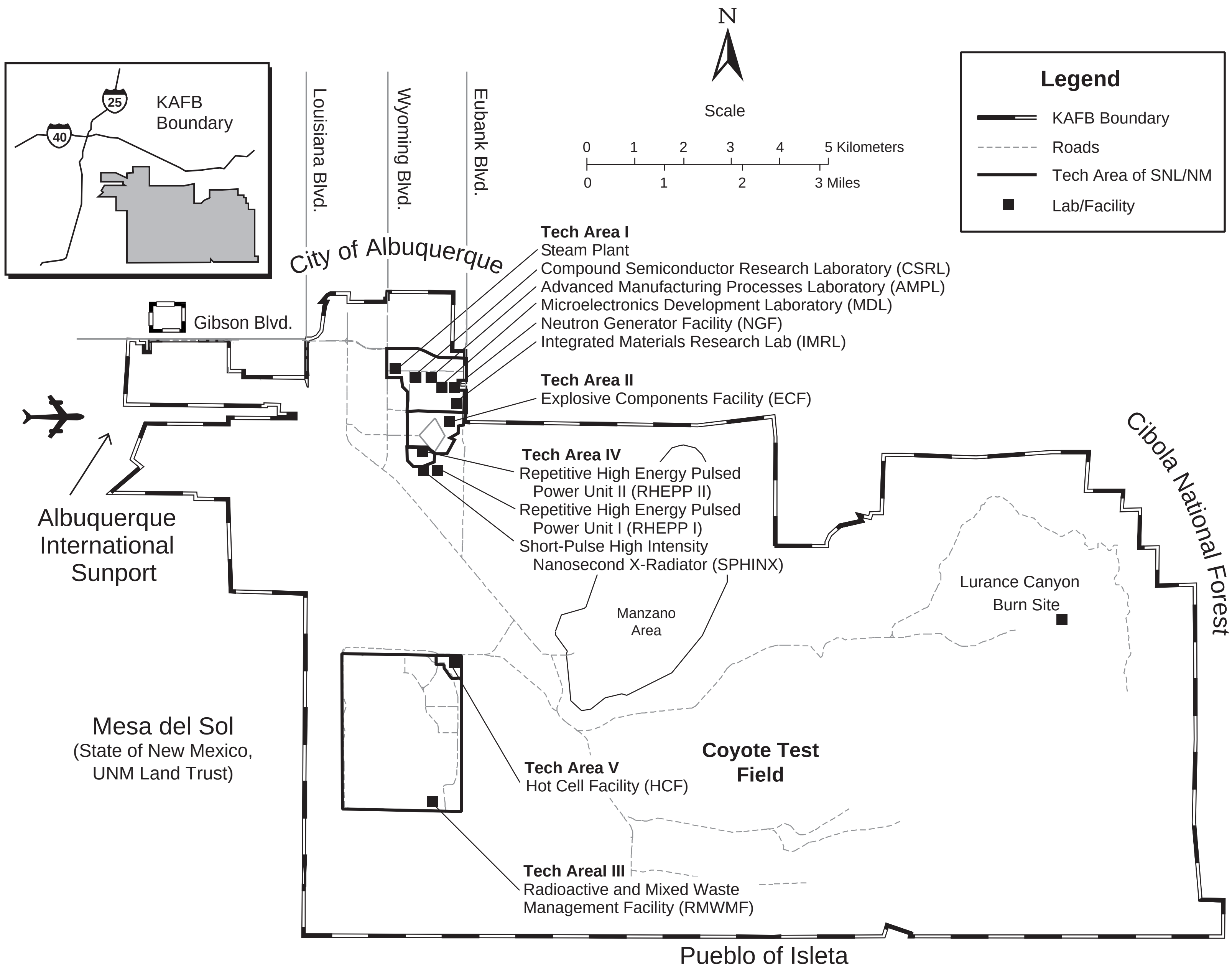
Only 30 noncarcinogenic chemicals from 5 facilities exceed the screening level based upon emission rates calculated from purchases. Only 1 of the 30 noncarcinogenic chemicals exceeded the screening level based upon facility-estimated emission rates. The human health impacts from this chemical, chromium trioxide (Building 870), are presented in Section 5.3.8. The results of the screening analysis are presented in detail in Appendix D.

Carcinogenic Chemical Screening

Table 5.3.7 6 presents those carcinogenic chemicals with estimated emission rates greater than the screening level. Human health impacts from these 10 carcinogenic chemicals are presented in Section 5.3.8.

Summary of Nonradiological Air Quality Impacts

Under the No Action Alternative, nonradiological air quality concentrations for criteria and chemical pollutants are below regulatory standards and human health guidelines. Maximum concentrations of criteria pollutants from operation of the steam plant, electric power generator plant, boiler and emergency generator in Building 701, and 600-kw-capacity generator in Building 870b represent a maximum of 96 percent of the allowable regulatory limit at a public access area. Thirty noncarcinogenic chemicals exceed the screening levels based upon emission rates calculated from purchased quantities, but only one noncarcinogenic chemical



Source: SNL/NM 1997a

Figure 5.3.7 2. Major Chemical-Emitting Facilities at SNL/NM

Twelve SNL/NM facilities emit the majority of chemicals.

Table 5.3.7 6. Annual Carcinogenic Chemical Concentrations from Facility Emissions Under the No Action Alternative

CHEMICALS EXCEEDING SCREENING LEVELS	BUILDING SOURCE	NO ACTION CONCENTRATION (ppb/µg/m^3)
Chloroform (Trichloromethane)	6580	1.45×10^{-3}[5.89×10^{-3}]
Dichloromethane (Methylene chloride)	870	7.31×10^{-2}[2.11×10^{-1}]
Dichloromethane (Methylene chloride)	878	2.66×10^{-3}[7.67×10^{-3}]
Formaldehyde	878	4.77×10^{-4}[4.87×10^{-4}]
Trichloroethene	878	8.74×10^{-3}[3.90×10^{-2}]
1,2-Dichloroethane (Ethylene dichloride)	893	2.93×10^{-4}[9.85×10^{-4}]
1,4-Dichloro-2-butene	897	3.96×10^{-5}[1.68×10^{-4}]
Acrylonitrile	897	1.52×10^{-4}[2.74×10^{-4}]
Chloroform (Trichloromethane)	897	1.25×10^{-3}[5.07×10^{-3}]
Trichloroethene	897	1.58×10^{-3}[7.06×10^{-3}]

Source: SNL/NM 1998a
mg/m^3: micrograms per cubic meter
ppb: parts per billion
Bldg. 6580 Hot Cell Facility (HCF)
Bldg. 870 Neutron Generator Facility
Bldg. 878 Advanced Manufacturing Processes Laboratory (AMPL)
Bldg. 893 Compound Semiconductor Research Laboratory (CSRL)
Bldg. 897 Integrated Materials Research Laboratory (IMRL)

exceeds the screening levels based upon process engineering estimates of actual emission rates. Further analysis of this one noncarcinogenic chemical is performed in Section 5.3.8. The risks due to exposure of the 10 carcinogenic chemicals that exceeded the screening levels are evaluated in Section 5.3.8, Human Health and Worker Safety.

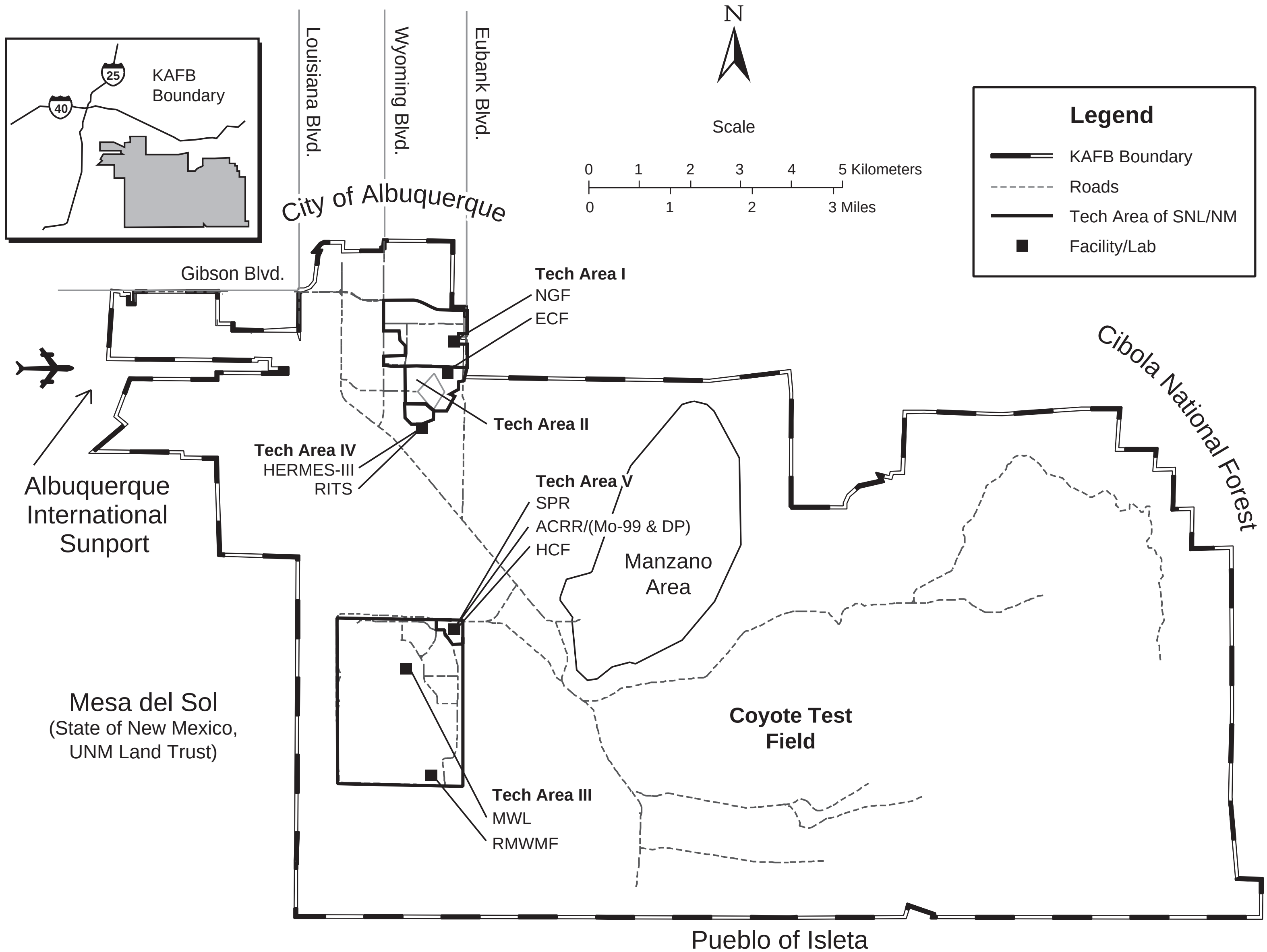
5.3.7.2 Radiological Air Quality

The SWEIS analysis reviewed the radiological emissions from all SNL/NM facilities. Section 4.9.2 identifies 17 SNL/NM facilities as producing radiological emissions. Based on historic SNL/NM radionuclide emissions data, National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61), compliance reports, and the *SNL/NM Facilities and Safety Information Documents* (FSID) (SNL/NM 1998ee), 10 of the 17 SNL/NM facilities were modeled for radiological impacts (Table 5.3.7 7). The ACRR would be operated under one of two configurations: medical isotopes production (primarily molybdenum-99 production) or DP. However, for the purpose of conservative analysis, the ACRR was evaluated under simultaneous operation of both configurations. Based on the review of historical dose evaluations, facilities other than these 10 would not contribute more than 0.01 mrem/yr (0.1 percent of the NESHAP limit) to the MEI and were screened from further consideration in the SWEIS. The modeled releases to the environment would result in a calculated dose to the MEI and the population within 50 mi of TA-V. TA-V was selected as a center for the population within a 50-mi radius, because the majority of radiological emissions would be from TA-V, specifically the HCF, and TA-V is historically addressed for annual SNL/NM NESHAP compliance (SNL/NM 1996u). The *CAP88-PC* computer model (DOE 1997e) was used to calculate the doses. Details on the *CAP88-PC* model, radionuclide emissions, model and source parameters, exposures, meteorological data, and population data are presented in Appendix D. Figure 5.3.7 3 shows the locations of the 10 facilities modeled in the SWEIS. Table 5.3.7 7 presents the estimated radiological emissions from the 10 SNL/NM facilities under the No Action Alternative. The radiological emissions from each facility were estimated based on SNL/NM planned operations and tests projected into the future. Detailed information is available in the FSID (SNL/NM 1998ee). The ACRR and HCF emissions for base year 1996 are different due to the refurbishing operations to change over to medical isotopes production configuration. The SPR emissions were estimated to be higher than the base year. This was due to instituting NESHAP requirements for confirmatory measurements of radiological air emissions where measured emission factors were determined for both the SPR and the ACRR. These measured emission factors were found to be higher than the calculated emission factors. These measurements are

Table 5.3.7 7. Radiological Emissions from Sources at SNL/NM Under the No Action Alternative

FACILITY NAME	TECHNICAL AREA	RADIONUCLIDE[a]	RELEASE (Ci/yr)
Annular Core Research Reactor (ACRR) (DP configuration), Building 6588	V	Argon-41	2.6
Annular Core Research Reactor (ACRR) (medical isotopes production configuration), Building 6588	V	Argon-41 Tritium	1.1 1.1
Explosive Components Facility (ECF), Building 905	II	Tritium	2.0×10^{-3}
High-Energy Radiation Megavolt Electron Source (HERMES III), Building 970	IV	Nitrogen-13 Oxygen-15	1.245×10^{-3} 1.245×10^{-4}
Hot Cell Facility (HCF), Building 6580	V	Iodine-131 Iodine-132 Iodine-133 Iodine-134 Iodine-135 Krypton-83m Krypton-85 Krypton-85m Krypton-87 Krypton-88 Xenon-131m Xenon-133 Xenon-133m Xenon-135 Xenon-135m	1.17 3.0 5.4 0.22 3.3 198.0 0.19 290.0 57.0 480.0 1.8 2,160.0 102.0 2,070.0 360.0
Mixed Waste Landfill (MWL)	III	Tritium	0.29
Neutron Generator Facility (NGF), Building 870	I	Tritium	156.0
Radioactive and Mixed Waste Management Facility (RMWMF), Building 6920	III	Tritium	2.203[b]
Radiographic Integrated Test Stand (RITS), Building 970	IV	Nitrogen-13	0.12
Sandia Pulsed Reactor (SPR), Building 6590	V	Argon-41	9.5

Source: SNL/NM 1998a
Ci/yr: curies per year
DP: Defense Programs
SNL/CA: Sandia National Laboratories/California
[a] Radiological emissions are projections based on planned activities, projects, and programs. Radionuclide releases are not the same as those presented in Chapter 4.
[b] Because SNL/CA tritium-contaminated oil levels handled at the RMWMF during the base year were abnormally high, this maximum level of emissions was assumed to be released in any year and, therefore, was constant for all alternatives.



Source: Original

Figure 5.3.7 3. Locations of Radionuclide-Releasing Facilities at SNL/NM

The 10 SNL/NM facilities that release radionuclides are in 5 technical areas.

source-specific to the SPR and ACRR and would not affect the calculations or measurements for other facilities.

Because the general public and USAF personnel have access to SNL/NM, 14 core receptor locations and 2 offsite receptor locations of public concern were considered for dose impacts evaluations (see Appendix D.2). Based on NESHAP reports, 16 onsite and 6 offsite additional receptor locations were also evaluated. A total of 38 receptor locations were evaluated for dose impacts. The core receptor locations include schools, hospitals, a museum, and clubs, and were considered for analysis because of potential impacts to children, the sick, and the elderly. The 32 modeled onsite and core receptor locations and locations of public concern are shown in Figure 5.3.7 4.

The dose to an individual at each receptor location and to the population within 50 mi from the radionuclide emissions from each source was calculated using the *CAP88-PC* model. The public receptor receiving the maximum reported dose is identified as the MEI. The model-calculated dose contributions, including external, inhalation, and ingestion exposure pathways from each of the 10 sources, calculated individually at each receptor location, were combined to determine the overall SNL/NM site-wide normal operations dose to the MEI. Under the No Action Alternative, the maximum effective dose equivalent (EDE) to the MEI from all exposure pathways from all modeled sources was calculated to be 0.15 mrem/yr. The MEI is located at the Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC), north of TA-V. This location is consistent with the location of the MEI historically identified in the annual NESHAP compliance reports. The EDE contributions from these 10 sources to this highest combined MEI dose are presented in Table 5.3.7 8. Table 5.3.7 9 presents the doses to 38 onsite, core, and offsite receptor locations. The potential doses for these additional locations would be much lower than the MEI dose. Under the No Action Alternative, the total collective dose to the population of 732,523 within a 50-mi radius of TA-V was calculated to be 5.0 person-rem per year. Section 5.3.8 discusses the human health impacts of radiological emissions at SNL/NM. The contributions from the 10 modeled sources to the overall SNL/NM site-wide normal operations collective dose to the population within 50 mi are also presented in Table 5.3.7 8. The average dose to an individual (collective dose divided by the total population) in the population within 50 mi of TA-V would be 6.8×10^{-3} mrem/yr.

The calculated total MEI dose of 0.15 mrem/yr would be much lower than the regulatory limit of 10 mrem/yr to an MEI from SNL/NM site-wide total airborne releases of radiological materials (40 CFR Part 61). This dose is small compared to an individual background radiation dose of 360 mrem/yr (see Figure 4.10 2). The calculated collective dose from SNL/NM operations to the population within 50 mi of TA-V, 5.0 person-rem per year, is much lower than the collective dose to the population from background radiation. Based on the individual background radiation dose, the population within 50 mi of TA-V would receive 263,700 person-rem per year.

5.3.8 Human Health and Worker Safety

The implementation of the No Action Alternative could result in impacts to public health and worker health and safety from both normal facility operations and postulated accident scenarios. The impacts would be the result of radiological and nonradiological releases from SNL/NM operations. The following sections describe these impacts.

A receptor is any individual who could be affected by SNL/NM operations. Health risk assessments for receptors at specific locations in the immediate SNL/NM vicinity were used to characterize the health risks for all possible receptors.

Fourteen core receptor locations were consistent among the evaluations for impacts due to routine operations, chemical and radiological emissions, and potential facility accidents at SNL/NM. These receptor locations were selected based on a review of historic NESHAP compliance reports, which discuss the location of the MEI member of public and take into consideration that the general public and Air Force personnel have access to SNL/NM. Other factors taken into account include information contained in the *SNL/NM Facility Source Documents* (SNL/NM 1998a), receptor locations in close proximity to the sources, the nearest site boundary in the prevailing wind directions, and the presence of potentially sensitive receptors such as children, the sick, and the elderly. These 14 receptor locations are listed below.

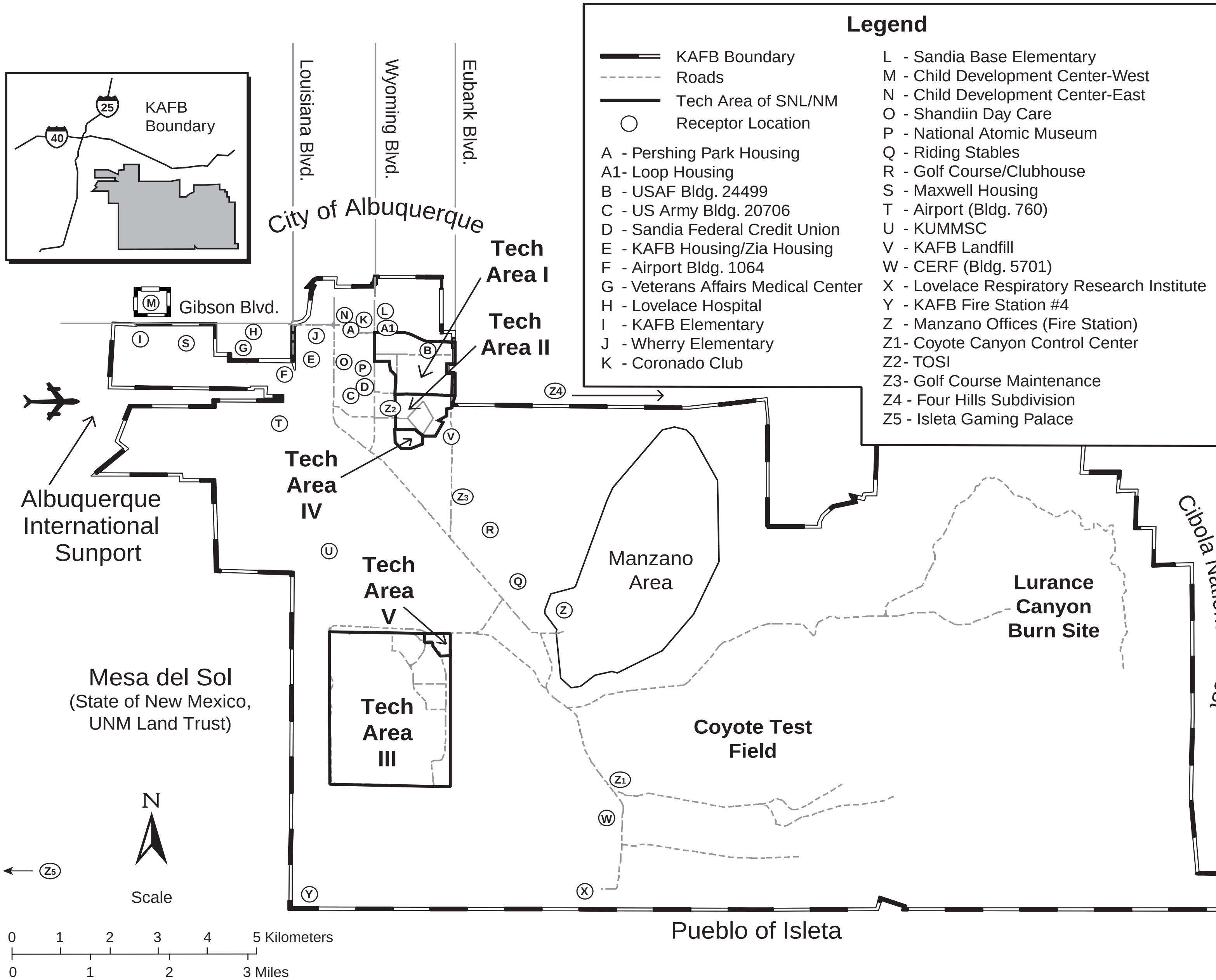
Child Development Center-East

Child Development Center-West

Coronado Club

Golf Course (Clubhouse)

Kirtland Elementary School



Source: SNL/NM 1996l

Figure 5.3.7 4. Normal Operational Onsite and Core Receptor Locations

Thirty-two onsite and core receptor locations were evaluated for potential normal operation impacts.

Table 5.3.7 8. Summary of Dose Estimates from Radioactive Air Emissions to the SNL/NM Public Under the No Action Alternative

SOURCE	ANNUAL MEI DOSE, EDE (mrem)	ANNUAL POPULATION DOSE, PERSON-REM
Annular Core Research Reactor (ACRR) (DP configuration)	$4.2x10^{-4}$	$7.2x10^{-3}$
Annular Core Research Reactor (ACRR) (medical isotopes production configuration)	$2.1x10^{-4}$	$5.36x10^{-3}$
Explosive Components Facility (ECF)	$9.9x10^{-9}$	$4.19x10^{-6}$
High-Energy Radiation Megavolt Electron Source (HERMES III)	$1.0x10^{-8}$	$2.1x10^{-7}$
Hot Cell Facility (HCF)	$1.5x10^{-1}$	4.61
Mixed Waste Landfill (MWL)	$4.0x10^{-6}$	$6.16x10^{-4}$
Neutron Generator Facility (NGF)	$7.4x10^{-4}$	$3.22x10^{-1}$
Radioactive and Mixed Waste Management Facility (RMWMF)	$7.5x10^{-6}$	$3.24x10^{-3}$
Radiographic Integrated Test Stand (RITS)	$9.8x10^{-7}$	$4.5x10^{-7}$
Sandia Pulsed Reactor (SPR)	$1.3x10^{-3}$	$2.54x10^{-2}$
TOTAL MEI DOSE	**0.15**	**-**
50-MILE POPULATION COLLECTIVE DOSE	**-**	**5.0**

Sources: DOE 1997e, SNL/NM 1998a
DP: Defense Programs
EDE: effective dose equivalent
MEI: maximally exposed individual
mrem: millirem

Note: Although the Annular Core Research Reactor is expected to be operated under DP configuration intermittently, for this analysis it was assumed to be operated simultaneously with the medical isotopes production configuration. Its contribution to the total dose is not appreciable.

Table 5.3.7 9. Summary of Dose Estimates from Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the No Action Alternative

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
ONSITE AND NEAR-SITE RECEPTORS	
Albuquerque International Sunport (Bldg. 1064)	$1.8x10^{-2}$
Albuquerque International Sunport (Bldg. 760)	$3.9x10^{-2}$
Building 20706	$2.8x10^{-2}$
Building 24499	$2.0x10^{-2}$
Child Development Center-East	$1.8x10^{-2}$
Child Development Center-West	$1.9x10^{-2}$
Civil Engineering Research Facility (Bldg. 5701)	$1.2x10^{-2}$
Coronado Club	$2.0x10^{-2}$
Coyote Canyon Control Center	$1.2x10^{-2}$
Golf Course Clubhouse	$7.2x10^{-2}$

Table 5.3.7 9. Summary of Dose Estimates from Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the No Action Alternative (concluded)

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
Golf Course Maintenance Area	$4.5x10^{-2}$
Kirtland Elementary School	$1.9x10^{-2}$
KAFB Firestation #4 (Bldg. 9002)	$1.7x10^{-2}$
KAFB Landfill	$2.9x10^{-2}$
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	$1.5x10^{-1}$
Loop Housing	$2.1x10^{-2}$
Lovelace Hospital	$1.4x10^{-2}$
Lovelace Respiratory Research Institute	$1.2x10^{-2}$
Manzano Offices (Fire Station)	$3.4x10^{-2}$
Maxwell Housing	$2.2x10^{-2}$
National Atomic Museum	$2.5x10^{-2}$
Pershing Park Housing	$1.7x10^{-2}$
Riding Stables	$6.3x10^{-2}$
Sandia Base Elementary	$1.7x10^{-2}$
Sandia Federal Credit Union	$3.1x10^{-2}$
Shandiin Day Care Center	$2.2x10^{-2}$
Technical Onsite Inspection Facility	$3.3x10^{-2}$
Veterans Affairs Medical Center	$2.7x10^{-2}$
Wherry Elementary School	$1.8x10^{-2}$
Zia Park Housing	$2.4x10^{-2}$
OFFSITE RECEPTORS	
Albuquerque City Offices	$5.1x10^{-2}$
East Resident	$2.4x10^{-2}$
Eubank Gate Area (Bldg. 8895)	$4.5x10^{-2}$
Four Hills Subdivision	$4.1x10^{-2}$
Isleta Gaming Palace	$2.7x10^{-2}$
Northeast Resident	$3.0x10^{-2}$
Seismic Center (USGS)	$2.7x10^{-2}$
Tijeras Arroyo (West)	$6.3x10^{-2}$

Sources: DOE 1997e, SNL/NM 1998a
EDE: effective dose equivalent
MEI: maximally exposed individual
mrem: millirem
USGS: U.S. Geological Survey

KAFB Housing (Zia Housing)

Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)

Lovelace Hospital

National Atomic Museum

Riding Stables

Sandia Base Elementary School

Shandiin Day Care Center

Veterans Affairs Medical Center (Hospital)

Wherry Elementary School

In addition to these 14 core receptor locations, 2 locations of public concern, the Four Hills Subdivision and the Isleta Gaming Palace, were also evaluated for human health. The specific evaluations of chemical air emissions, radiological air emissions, and facility accidents also included additional receptor locations unique to the needs of the resource area, in order to complete their analyses of impacts (see discussions in radiological air, chemical air, and accident analyses).

5.3.8.1 Normal Operations

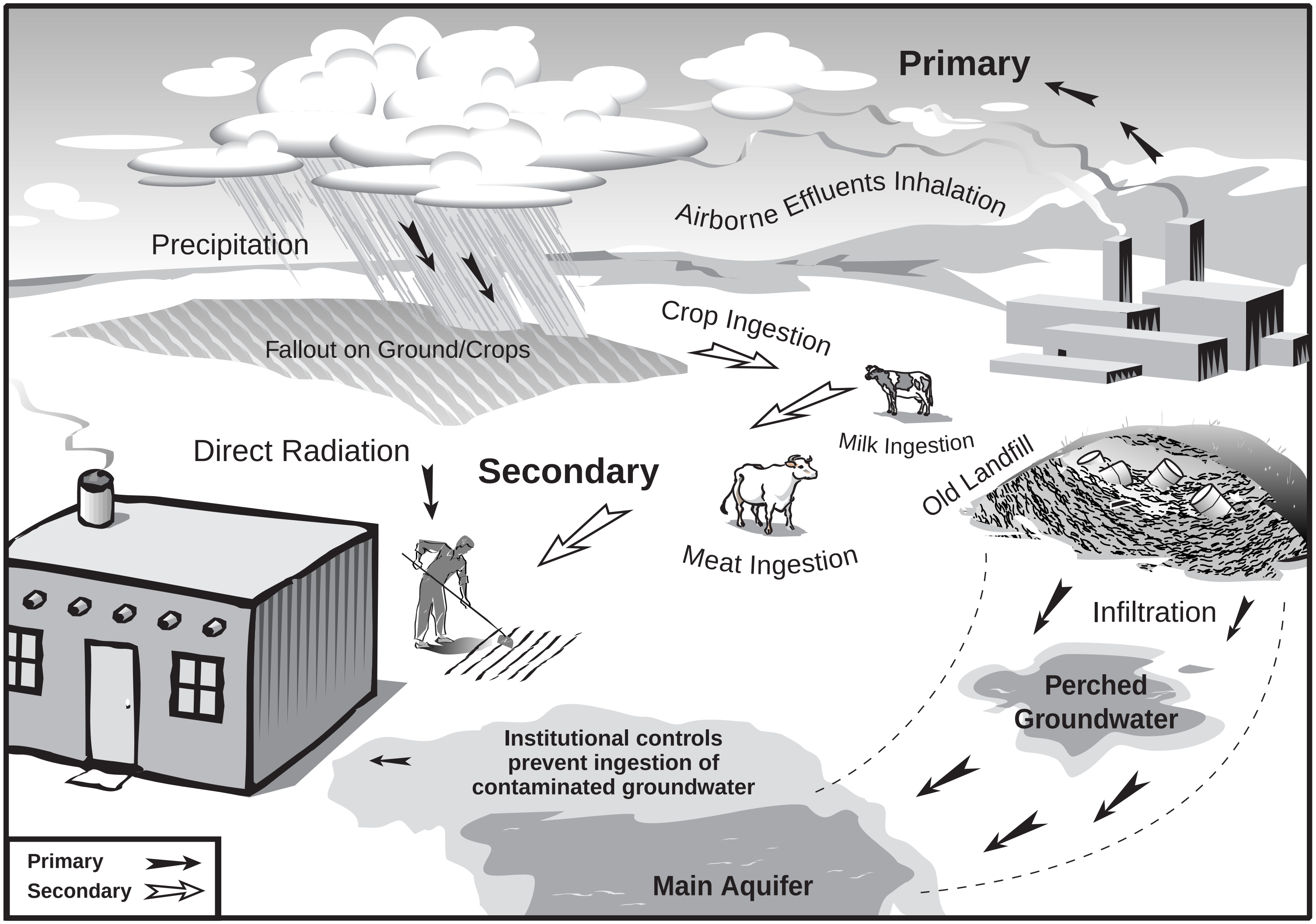
This section provides information on public health and worker health and safety under the No Action Alternative. It assesses the potential human health impacts associated with releases of radioactive and nonradioactive hazardous material from SNL/NM normal operations. Human health risk analyses identify potential health effects to all possible receptors, such as SNL/NM employees, contractors, visitors, and members of the public within and outside the KAFB boundary. For detailed discussions of analytical methods and results, along with terminology, definitions, and descriptions, see Appendix E.

Radiological and nonradiological hazardous material released by SNL/NM during normal operations reach the environment and potentially reach people in different ways (Figure 5.3.8 1). See specific sections in Chapter 5 on geology and soils, water, and air quality for a description of SNL/NM s impacts to the different environmental media. These sections discuss historic results from environmental sampling programs and predictive modeling of future conditions. They also present quantitative and qualitative assessments of the potential exposure pathways associated with these media. The air pathway is the primary exposure pathway identified in the SWEIS that has the potential to carry materials directly from SNL/NM facilities to the environment and then to people who are exposed directly by way of inhalation. Secondary air exposure pathways exist from the indirect ingestion of pollutants by way of foods, including crops contaminated by airborne pollutants and livestock products from animals ingesting contaminated crops.

Other pathways investigated include groundwater, surface water, and soils. The potential primary exposure pathway of directly ingesting contaminated water was investigated, but the determination was made that the area of polluted groundwater beneath SNL/NM would not migrate to areas planned or currently in use for the drinking water supply (see Appendix B). People would not be exposed through ingesting surface water because SNL/NM normal operations would not affect surface water resources (see Sections 5.3.4, 5.4.4, and 5.5.4). Affected soils at SNL/NM would be controlled under the ER Project. Potential routine (nonremedial) releases of contaminated soils or dust are controlled on a site-specific basis, thus preventing potential exposures by way of inhalation or ingestion (DOE 1996c).

The different health risks identified for specific receptor locations, individual exposure scenarios, and the potential maximum exposures adequately characterize health risks from SNL/NM normal operations.

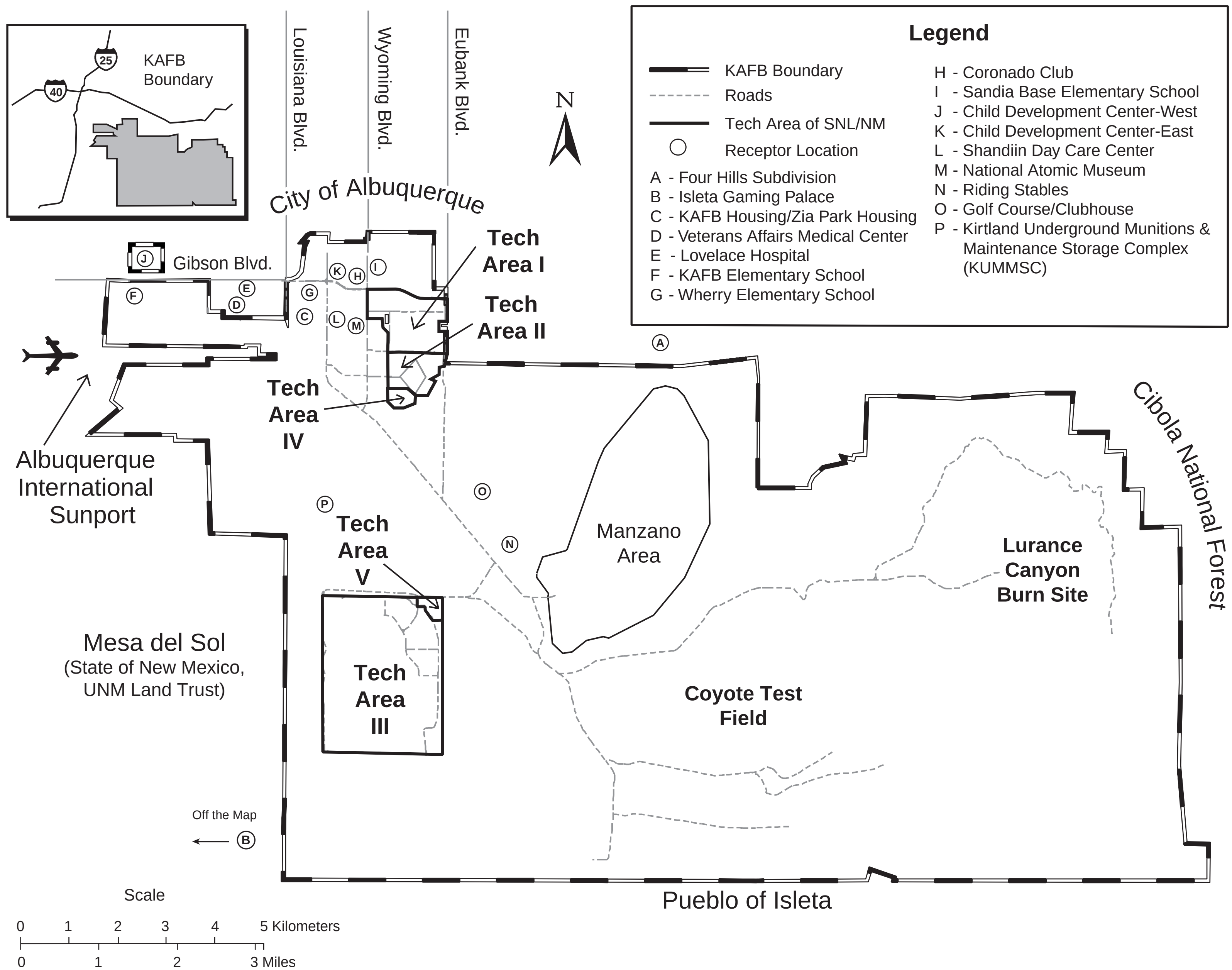
Health risk analyses are presented for potential exposures at each specific receptor location and for the maximum potential exposures to radiation and chemical air releases. Figure 5.3.8 2 shows the core- and public concern-receptor locations selected for health risk analyses. The maximum potential exposure to radiation is known to likely occur within KAFB at the KUMMSC, based on analysis of years of data collected to meet NESHAP requirements. Health risk at the KUMMSC receptor location, therefore, represents the maximum potential health risk from radiation and is referred to as the MEI for normal operations. A location where the maximum potential exposure to chemical air releases could occur was not identified because of limited historical chemical air emissions information. Instead, a bounding value for health risk from chemical air emissions was calculated based on a hypothetical worst-case exposure scenario. The hypothetical worst-case exposure scenario assumed simultaneous exposure to the estimated maximum offsite concentration of each chemical. Because these estimated concentrations are expected to occur at different locations, this exposure level would be implausible. The actual potential maximum exposure to chemical air emissions and the associated health risks are identified as less than this upper-bound health risk value.



Source: Original

Figure 5.3.8 1. Primary and Secondary Complete Exposure Pathways Associated with SNL/NM Normal Operations

Radiological and nonradiological hazardous material released by SNL/NM operations have the potential to reach people through different exposure pathways.



Source: SNL/NM 1997j

Figure 5.3.8 2. Receptor Locations in the SNL/NM Vicinity Assessed for Human Health Impacts

Specific receptor locations in the SNL/NM vicinity are used to assess human health risk from SNL/NM normal operations.

Maximally Exposed Individual

The maximally exposed individual is referred to as the MEI. This is a hypothetical member of the general public assumed to be located outdoors in a public area where the radiation dose is highest. This individual is assumed to be an adult who is exposed to the entire plume in an unshielded condition. The impacts on the MEI are, therefore, greater than the impacts to any member of the public located onsite or offsite.

A range of health risks was used to evaluate the possibility of adverse health impacts due to SNL/NM normal operations. Health risks depend on a person actually coming in contact with hazardous material released into the environment. Receptor location, estimated time of exposure to the material, and age of the receptor are among the parameters used to establish exposure scenarios. In the case of transport by way of the air pathway, exposure also varies with wind direction and distance from the source. This equates to variability in potential health risks.

Chemical Air Release Pathways

Air releases of hazardous chemicals from laboratories and other chemical operations at SNL/NM are reported in compliance with Superfund Amendments Reauthorization Act (SARA) Title III requirements. Actual monitoring of emissions from each potential building source is not required. Estimates of total pounds emitted of HAPs, TAPs, and VOCs were based on the conservative assumption that the entire purchased amounts of chemicals would be released. For purposes of assessing routine exposures to chemical releases from SNL/NM normal operations, potential emissions were first estimated and then evaluated against screening TEVs that are based on the OELs/100 for noncarcinogens, and a 10^{-8} cancer risk for carcinogens (see Appendix D). Only those chemical sources (buildings and amounts) exceeding the screening TEVs could be expected to result in potential exposures to receptors in the SNL/NM vicinity. Air exposure concentrations were estimated and used to evaluate potential health risk. Concentrations of chemicals having toxicity dose-response information become the basis for calculating the hazard index (HI) and excess lifetime cancer risk (ELCR) values under different exposure scenarios. This chemical assessment process identified seven individual chemicals of concern (COCs) (three chemicals are common) under the No Action Alternative (see Appendix E, Table E.3 2). These COCs are associated with SNL/NM s operations in Buildings 878 (Advanced Manufacturing Processes Laboratory [AMPL]), 893 (Compound Semiconductor Research Laboratory [CSRL]), 897 (Integrated Materials Research Laboratory [IMRL]), 6580 (HCF), and 870 (NGF).

The potential for human contact with airborne chemicals would vary with time and distance from the SNL/NM building source. The health risk and corresponding potential for adverse health effects is a range of values. Several receptor locations, individual exposure scenarios, and a hypothetical worst-case exposure scenario were used to present the range of health risks from airborne chemicals in the SNL/NM vicinity. Adult and child and residential and visitor risk assessments were calculated. The health risk values presented are the total risk to a receptor due to chronic exposure to all COCs.

The calculation of HIs and ELCRs takes into account potentially sensitive subpopulations. To take into account differences among individuals, such as breathing rate or bodyweight within the potentially exposed population, the EPA recommends doing both a reasonable maximum exposed (RME) and an average exposed individual (AEI) risk assessment (EPA 1989). The assessment of the RME uses upper bound (90th percentile) intake parameters to describe the individual. The assessment of the AEI uses central tendency (50th percentile) intake parameters to describe the individual (see Appendix E, Table E.5 1). The risks to the AEI are applicable to the general population, while risks to the RME are applicable to individuals within the population with a greater potential intake under the same exposure scenario.

Potential exposures (exposure point concentrations) to chemical air releases at specific receptor locations in the SNL/NM vicinity were estimated for normal SNL/NM operations and are shown in Appendix E, Table E.3 2. The potential health risks at these specific receptor locations due to the estimated exposure levels are shown in Table 5.3.8 1. These potential health risks would be very low and no adverse health effects would be expected at these risk levels. In addition, the assessment of the hypothetical worst-case exposure scenario bounds (sets an upper value to) the analysis of health risk. The estimated upper bound values for health risk from noncarcinogenic chemical releases under the No Action Alternative are HIs of less than 1, and from carcinogenic chemicals, are ELCR values of less than 10^{-6} (see Appendix E, Table E.6 3).

Table 5.3.8 1. Human Health Impacts in the Vicinity of SNL/NM from Chemical Air Emissions Under the No Action Alternative

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI
RESIDENTIAL SCENARIOS			
Four Hills Subdivision[a]	Adult	<0.01/<0.01	$3.7x10^{-11}/2.3x10^{-11}$
	Child	<0.01/<0.01	$1.5x10^{-11}/1.5x10^{-11}$
Isleta Gaming Palace	Adult	<0.01/<0.01	$1.6x10^{-9}/1.7x10^{-11}$
	Child	<0.01/<0.01	$1.1x10^{-9}/1.3x10^{-11}$
KAFB Housing (Zia Park Housing)	Adult	<0.01/<0.01	$6.7x10^{-10}/7.0x10^{-12}$
	Child	<0.01/<0.01	$4.7x10^{-10}/5.3x10^{-12}$
VISITOR SCENARIOS			
Child Development Center-East	Child	<0.01/<0.01	$6.1x10^{-10}/6.9x10^{-12}$
Child Development Center-West	Child	<0.01/<0.01	$1.2x10^{-10}/1.4x10^{-12}$
Coronado Club	Adult	<0.01/<0.01	$1.1x10^{-9}/1.1x10^{-11}$
	Child	<0.01/<0.01	$7.4x10^{-10}/8.4x10^{-12}$
Golf Course (Clubhouse)	Adult	<0.01/<0.01	$3.8x10^{-10}/3.9x10^{-12}$
Kirtland Elementary School	Child	<0.01/<0.01	$1.0x10^{-10}/1.1x10^{-12}$
Kirtland Underground Munitions & Maintenance Storage Complex (KUMMSC)[b]	Adult	<0.01/<0.01	$3.8x10^{-10}/4.0x10^{-12}$
Lovelace Hospital	Adult	<0.01/<0.01	$3.0x10^{-10}/3.1x10^{-12}$
	Child	<0.01/<0.01	$2.1x10^{-10}/2.3x10^{-12}$
National Atomic Museum	Adult	<0.01/<0.01	$1.8x10^{-9}/1.9x10^{-11}$
	Child	<0.01/<0.01	$1.3x10^{-9}/1.4x10^{-11}$
Riding Stables	Adult	<0.01/<0.01	$3.0x10^{-10}/3.0x10^{-12}$
Sandia Base Elementary School	Child	<0.01/<0.01	$8.2x10^{-10}/9.3x10^{-12}$
Shandiin Day Care Center	Child	<0.01/<0.01	$6.9x10^{-10}/7.8x10^{-12}$
Veterans Affairs Medical Center	Adult	<0.01/<0.01	$2.9x10^{-10}/3.0x10^{-12}$
Wherry Elementary School	Child	<0.01/<0.01	$4.6x10^{-10}/5.2x10^{-12}$

Source: SmartRISK 1996
RME: reasonable maximum exposed
AEI: average exposed individual
[a] Four Hills Subdivision receptor location impacts are based on Lurance Canyon Burn Site open burning air emissions, not SNL/NM building air emissions.
[b] This receptor location was analyzed using a worker scenario, as discussed in Appendix E.5.
Notes: Calculations were completed using SmartRISK. See the beginning of Section 5.3.8 for a discussion of selection of receptor locations.

Measures of Nonradiological Health Risks

Chemicals of concern are categorized by health effect. Exposure to some chemicals can cause cancer, while others have a noncarcinogenic health effect, such as damage to a specific organ of the body (target organ). Other chemicals have the potential to induce both carcinogenic and noncarcinogenic health effects.

The risk of a noncarcinogenic health effect occurring is expressed as a Hazard Index (HI). Hazard quotients are derived for different chemicals from the ratio of the estimated exposure level to the reference exposure level expected not to cause a health effect, and then summed to get a Total HI. The hazard quotient assumes that there is a level of exposure (reference exposure) below which it is unlikely for even sensitive populations to experience adverse health effects. If the Total HI is less than 1, health effects are not expected. If an HI exceeds 1, there may be concern for potential health effects; however, it should not be interpreted as a probability for actually occurring. The level of concern does not increase linearly with HIs above 1 (EPA 1989).

Excess Lifetime Cancer Risk (ELCR) is the increased chance of getting cancer in addition to all other causes or susceptibilities in a person s life. For example, if exposures to air emissions of a specific chemical equate to a ELCR of 10^{-7}, a person has an additional 1-in-10 million lifetime chance of getting cancer from that exposure. ELCR is the product of the estimated exposure level and the chemical-specific cancer slope factor that represents the health effect per unit intake over a lifetime. ELCR values for different chemicals are summed to obtain the Total ELCR.

Under the Superfund Program, the EPA has established a 10^{-6} ELCR (1 in 1 million persons) as the point of departure for establishing remediation goals. It expresses EPA s preference for setting clean-up levels at the more protective end of the risk range (10^{-4} to 10^{-6}). Setting an acceptable risk level becomes a site-specific decision based on long-term use of the site (40 CFR Part 300). The background 1997 estimated fatal cancer rate in New Mexico is 146 per 100,000 persons (ACS 1997).

Radiation Air Release Pathways

Air releases of radionuclides from SNL/NM operations would result in low radiation exposures to people in the SNL/NM vicinity. Table 5.3.7 8 identifies the radiation dose to the potential MEI and the collective radiation dose to the population within the ROI, associated with these releases. The risk estimator of 500 fatal cancers per 1 M person-rem to the public converts radiation dose to latent fatal cancer risk. The potential maximum annual exposure to radiation from SNL/NM radiological facilities of 0.15 mrem would occur within the site boundary at the KUMMSC and increase the MEI lifetime risk of fatal cancer by $7.5x10^{-8}$ (see Table 5.3.8 2). In other words, the likelihood of the MEI developing fatal cancer from a 1-year dose from SNL/NM operations is less than 1 chance in 10 M. The annual collective dose of 5.0 person-rem to the population increases the number of fatal cancers in the entire population within the ROI by $2.5x10^{-3}$. Therefore, no LCFs would be likely to occur in the ROI population due to SNL/NM radiological air releases.

Other receptors in the SNL/NM vicinity would receive lower exposures to radiation than the MEI, based on wind direction and distance from the facility sources. Radiation doses at specific receptor locations, including schools, hospitals, and day care centers in the SNL/NM vicinity are identified in Table 5.3.7 9. The range in potential human health effects associated with the radiation doses at several of these locations are shown in Table 5.3.8 2. The increase in lifetime cancer risk at many of the specific receptor locations from a 1-year dose from SNL/NM operations is lower than the increase in lifetime cancer risk to the MEI receptor located at the KUMMSC.

Receptors in the SNL/NM vicinity could also be exposed to air releases of radionuclides by way of the indirect pathway of ingesting food that contains radionuclides. *CAP88-PC* integrates doses from this pathway in the collective dose estimation for the population within the ROI, but does not integrate it into the exposure dose estimated for the potential onsite MEI receptor. Ingesting potentially contaminated foods accounts for approximately 11 percent (0.55 person-rem of the 5.0 person-rem collective population dose) of the population dose, which means it also accounts for approximately 11 percent of the health risk value. When the same percent contribution is assumed, this pathway potentially increases the lifetime risk of fatal cancer to the MEI by 11 percent ($8.3x10^{-9}$), less than 1 chance in 10 M.

Table 5.3.8 2. Human Health Impacts in the SNL/NM Vicinity from Radiological Air Emissions Under the No Action Alternative

RECEPTOR LOCATIONS	LIFETIME RISK OF FATAL CANCER FROM A 1-YEAR DOSE
Child Development Center-East	$9.0x10^{-9}$
Child Development Center-West	$9.5x10^{-9}$
Coronado Club	$1.0x10^{-8}$
Four Hills Subdivision	$2.1x10^{-8}$
Golf Course (Clubhouse)	$3.6x10^{-8}$
Kirtland Elementary School	$9.5x10^{-9}$
KAFB Housing (Zia Park Housing)	$1.1x10^{-8}$
Kirtland Underground Munitions & Maintenance Storage Complex[a] (KUMMSC)	$7.5x10^{-8}$
Lovelace Hospital	$7.0x10^{-9}$
National Atomic Museum	$1.3x10^{-8}$
Riding Stables	$3.2x10^{-8}$
Sandia Base Elementary School	$8.5x10^{-9}$
Shandiin Day Care Center	$1.1x10^{-8}$
Isleta Gaming Palace	$1.4x10^{-8}$
Veterans Affairs Medical Center	$1.4x10^{-8}$
Wherry Elementary School	$9.0x10^{-9}$

Sources: DOE 1997e, SNL/NM 1998a
MEI: maximally exposed individual
[a] The radiological MEI receptor location for normal operations
Note: Calculations were completed using *CAP88-PC*.

Measures of Radiological Health Risks

The National Council on Radiation Protection and Measurements has adopted numerical values, known as risk estimators, that associate radiation dose to increased risk of developing fatal cancer. These values were recommended by the International Council on Radiation Protection and Measurement (ICRP 1991).

The risk estimator of 500 excess fatal cancers per 10^6 (million) person-rem, used to assess health effects to the public, takes into account children, the elderly, and other potentially sensitive receptors. The risk estimator of 400 excess fatal cancers per 10^6 (million) person-rem, used for workers, is a lower number, assuming that the worker population is a healthy adult population.

A 1 M person-rem exposure dose is equivalent to 1 million people exposed to 1 rem each. That is, 0.0005 fatal cancers per person-rem and 0.0004 fatal cancers per person-rem are multiplied by the dose to obtain the number of fatal cancers from the exposure to radiation.

For an individual, excess cancer risk is the increase in the person s chance (probability) of getting fatal cancer in a lifetime. For the population, the risk of an excess latent cancer fatality (LCF) is the additional increase in the total number of cancer fatalities in the entire ROI population from the collective population radiation dose. For all practical purposes, an LCF of less than 1 means that no additional cancer fatalities are expected.

Nonfatal Cancers and Genetic Disorders

Radiation exposures can cause nonfatal cancers and genetic disorders. The NCRP has adopted risk estimators developed by the ICRP for the public for assessing these health effects from radiation (ICRP 1991). The public dose-to-risk conversion factors recommended for nonfatal cancer and genetic disorders are 100 and 130 health effects per 1 M person-rem, respectively. The SNL/NM maximum annual dose would increase the lifetime risk of nonfatal cancers and genetic disorders to the MEI by 1.5×10^{-8} and 2.0×10^{-8}, respectively, which would be less than 1 chance in 50 M. The SNL/NM annual collective dose to the ROI population would increase the number of nonfatal cancers and genetic disorders by 5.0×10^{-4} and 6.5×10^{-4}, respectively, which is interpreted that no additional nonfatal cancers or genetic disorders would be likely to occur within the ROI due to radiological air releases from SNL/NM normal operations.

Transportation

The potential human health risks and accident fatalities associated with transporting various radiological materials for SNL/NM operations are discussed in Section 5.3.9. The ratio of the total travel distance to the distance traveled within the ROI determines the estimated dose to the population along the travel route within the ROI. The distance traveled within the 50-mile ROI is conservatively estimated as 10 percent of the total distance traveled. Therefore, 10 percent of the total radiological dose (off-link and on-link) calculated for all radiological materials transported is considered as an additional human health impact to the population along the transport route within the ROI (see Appendix G). Ten percent of the annual collective population dose from transportation activities would increase the number of LCFs by 8.3×10^{-4}, thus increasing the total number of fatal cancers in the ROI to 3.3×10^{-3}. Therefore, it is likely that no additional LCFs would occur in the ROI population due to SNL/NM radiological material transportation activities, even when impacts are summed with impacts due to SNL/NM radiological air releases.

Composite Cancer Risk

The increase in lifetime cancer risk due to SNL/NM operations is associated with both the small amounts of radionuclides and small amounts of carcinogenic chemicals emitted into the air. Composite cancer risk due to both radiation and chemical exposures at the same location was assessed. To assess a composite cancer risk capturing the greatest potential cancer risk from exposure to radiation, the sum of the radiological MEI cancer risk and the chemical cancer risk at the same location (KUMMSC) was calculated. Cancer risk from the annual dose to the MEI, accumulated over a 30-year exposure duration, would be 2.3×10^{-6}, or less than

Historic Cancer Rate

For the U.S., the 1997 cancer mortality rate was 173 deaths per 100,000 persons. For the state of New Mexico, the rate was 146 deaths per 100,000 persons.

1 chance in 434,000. Thirty years is consistent with the exposure used in calculating the chemical cancer risk at the KUMMSC; the contribution to cancer risk from exposure to chemicals would be so small that when the chemical cancer risk is added to the MEI fatal cancer risk, the value would not increase (the increased lifetime cancer risk remains $2.3x10^{-6}$). Therefore, the radiation exposure would be the majority of the risk (see Table E.6 3).

To assess a composite cancer risk capturing the highest potential cancer risk from chemicals, the upper bound value for cancer risk from chemicals, which assumes a hypothetical worst-case exposure scenario, and the radiological MEI (KUMMSC) cancer risk were summed. This is an impossible scenario because these exposures would not occur at the same location. However, it is a conservative assessment capturing the upper bound/ chemical risk (See Table E.6 3). The upper bound composite increased lifetime cancer risk would be $2.4x10^{-6}$, or less than 1 in 416,000. This would be within the EPAs established cancer risk range for the protection of human health of 10^{-6} to 10^{-4} (40 CFR Part 300). SNL/NM s potential contribution (from low exposures to chemicals and radiation) to an individual s lifetime cancer risk is very low, considering that overall in the U.S., men have a 1-in-2 lifetime risk of developing cancer, and for women the risk is 1-in-3. Approximately 1 out of every 4 deaths in the U.S. is from cancer (ACS 1997).

Worker Health and Safety

Operations at SNL/NM have to comply with DOE Orders, Federal Occupational Safety and Health Administration (OSHA) requirements, and occupational radiation protection requirements (10 CFR Part 835) for worker health and safety. These requirements regulate the work environment and minimize the likelihood of work-related chemical and radiation exposures, illnesses, and injuries. Periodic accidents, injuries, and illnesses do occur in the workforce. Most of the risks to worker health and safety are from common industrial accidents such as falls, slips, trips, contact with objects that result in sprains, cuts, abrasions, fractures, and other injuries to the body. Exposures to hazardous substances (chemical and radiological) are minimized or prevented through monitoring and using personal protective equipment. Overall, the SNL/NM injury and illness rates are much lower than those for private industry (national or local) and similar to those for the DOE as a whole (see Section 4.10).

Based on a 5-percent increase in the worker population under the No Action Alternative (Section 5.3.12) and the assumption that the SNL/NM nonfatal injury and illness rate per 100 workers would remain consistent with the 5-year average derived for 1992 through 1996, the total number of impacts to workers would increase slightly. Impacts for the entire SNL/NM workforce are projected to be zero fatalities per year, an average of 47 mrem/yr radiation dose (total effective dose equivalent [TEDE]) to the radiation-badged worker (based on the base year of 1996), approximately 311 nonfatal injuries and illnesses per year, and 1 or 2 confirmed chemical exposures annually.

Routine air emissions evaluated for potential exposures to specific receptors in the SNL/NM vicinity have the potential to impact noninvolved workers at SNL/NM. A noninvolved worker is an SNL/NM worker not associated with the operations of the facility and, therefore, not exposed during chemical or radiological work-related activities. Potential noninvolved worker exposures to airborne radiation are identified using the KUMMSC receptor location (Table 5.3.8 2). Potential noninvolved worker exposures to airborne chemicals are identified using a receptor location at the center of TA-I near the SNL/NM chemical facility sources. Based on an exposure scenario for a worker, health risks from chemicals to the noninvolved worker would be below a HI of 1 and less than 10^{-6} for an ELCR (see Appendix E, Table E.6 3).

Noninvolved Worker

A noninvolved worker is a SNL/NM worker not associated with the operations of the facility. For accidents, this worker is conservatively assumed to be located at 100 m from the accident for the entire duration of the accident in an unshielded condition. For routine operations, this worker is located nearest the source of emission.

The risk of cancer fatality from the annual average individual worker dose, annual maximum worker dose, and annual workforce collective dose for radiation workers (those working in radiation-designated areas) is shown in Table 5.3.8 3. Health risks from the annual average individual and annual maximum worker doses would be expected to remain constant for all three alternatives (based on the Radioactive Exposure

Table 5.3.8 3. Radiation Doses (TEDE)[a] and Health Impacts to Workers from SNL/NM Operations Under the No Action Alternative

RADIATION WORKER DOSE RATES	RADIATION DOSE	RISK OF CANCER FATALITY FROM A 1-YEAR DOSE
Annual Average Individual Worker Dose	47[b] (mrem/year)	$1.9x10^{-5}$
Annual Maximum Worker Dose	845[b] (mrem/year)	$3.4x10^{-4}$
RADIATION WORKER DOSE RATES	**RADIATION DOSE**	**NUMBER OF LATENT CANCER FATALITIES**
Annual Workforce Collective Dose	17 (person-rem/year)	$6.8x10^{-3}$

Source: SNL/NM 1997k
mrem: millirem
TEDE: total effective dose equivalent
[a] Average measured TEDE means the collective TEDE divided by the number of individuals with a measured dose greater than 10 mrem.
[b] Annual average individual and annual maximum worker doses are expected to remain consistent with the baseline year 1996 (see Section 4.10).
Note: Because not all badged workers are radiation workers, radiation workers refers to those badges with greater than 10 mrem above background measurements used in the calculations.

Monitoring System [REMS] database dose information for 1996) (see Appendix E, Section E.6.1.1). The annual workforce collective dose was estimated for the radiation worker population calculated under the No Action Alternative, based on the ICRP risk estimator of 400 fatal cancers per 1 M person-rem among workers, and was associated with $6.8x10^{-3}$ additional fatal cancers in the entire radiation worker population. For assessment purposes, this equates to no additional LCFs in the radiation worker population under the No Action Alternative.

Nonfatal Cancers and Genetic Disorders

The worker dose-to-risk conversion factor used to assess potential nonfatal cancers and genetic disorders is 80 health effects per 1 M person-rem. The SNL/NM annual workforce collective dose to the radiation worker population increases the number of nonfatal cancers and genetic disorders by $1.4x10^{-3}$ each. In other words, no additional nonfatal cancers or genetic disorders would be likely to occur in the radiation worker population under the No Action Alternative.

Nonionizing Radiation

Sources of nonionizing radiant energy at SNL/NM include both laser and accelerator facilities. The laser light source can damage the unprotected eye and may also damage equipment. The SAs for the SNL/NM laser facilities report that these facilities operate in accordance with American National Standards Institute (ANSI) guidelines that require that light paths be isolated from workers and from other equipment (SNL/NM 1996b). Accelerators generate electromagnetic pulse (EMP) that could present a high-voltage hazard to personnel. ANSI guidelines require mitigation measures such as shielding to block high voltage hazards from personnel and, during tests shots, exclude personnel from high-bay areas. However, based on the measurements from pulsed-power facilities, the EMP exposures to personnel outside the high-bay would be less than the AC61 standard of 100 kV/m (SNL/NM 1996b). Therefore, routine high voltage impacts to SNL/NM workers and the public would not occur.

5.3.8.2 Accidents

This section describes the potential impacts to workers and the public from accidents involving the release of radioactive and/or chemical materials, explosions, and other hazards under the No Action Alternative. The methods used to estimate the accident impacts are described in Section 5.2.9. Additional details on the accident analyses and impacts are presented in Appendix F. Mitigation measures, engineered safety features, administrative controls, and the emergency planning and preparedness programs designed to prevent and/or minimize the impacts of accidents are described in Section 5.6.

Site-Wide Earthquake

An earthquake in the Albuquerque, New Mexico, area has the potential for human injury and building damage throughout the local region. Due to differences in structural design, SNL/NM buildings and structures vary in their capabilities to withstand earthquake forces. Any magnitude earthquake has the potential to cause injury to workers in and around buildings and damage to structures from the physical forces and effects of the earthquake. Additional injury to workers and the public would be possible from explosions and from exposure to chemical and radioactive materials that could be released from buildings and storage containers. Facilities in TA-I are the predominant source of chemical materials that could be released during an earthquake. Facilities in

The Richter Scale

The Richter Scale measures the strength of an earthquake. Only people very sensitive to motion changes can detect an earthquake that measures 3.5 or less on this scale. The worst earthquake ever recorded was 8.9 on the Richter Scale. A 0.2-gravity earthquake would measure in the range of 6.2 to 6.9 on the Richter Scale. The largest earthquake in New Mexico occurred in the Socorro area on November 15, 1906 and had a magnitude equivalent to about 6.0 on the Richter scale; it was felt throughout most of New Mexico and in parts of Arizona and Texas.

TA-V are the predominant source of radioactive materials that could be released. The ECF in TA-II is the predominant source of explosive materials. Lesser quantities of radioactive materials in TAs-I and -II could also be released and cause exposures to workers and the public.

In the event of an earthquake (Uniform Building Code [UBC], 0.17 gravity [*g*]), various buildings in TA-I could be affected and various chemicals could be released (see Appendix F, Table F.7 7); larger magnitude earthquakes could cause more serious impacts. The shape and direction of released chemical plumes would depend upon local meteorological conditions and physical structures. All potential plumes and concentration levels exceeding the ERPG-2 are shown as shaded areas in Figure 5.3.8 3. Some of the potentially affected area extends offsite. Within the shaded area, to a distance of 3,800 ft, there could be as many as 5,300 persons at risk of exposure depending on the time of day and plume shape and direction. However, in the event of a chemical release, the plumes would cause exposures in excess of ERPG-2 to only a portion of the 5,300 persons at risk.

Emergency Response Planning Guideline Level 2

The ERPG-2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

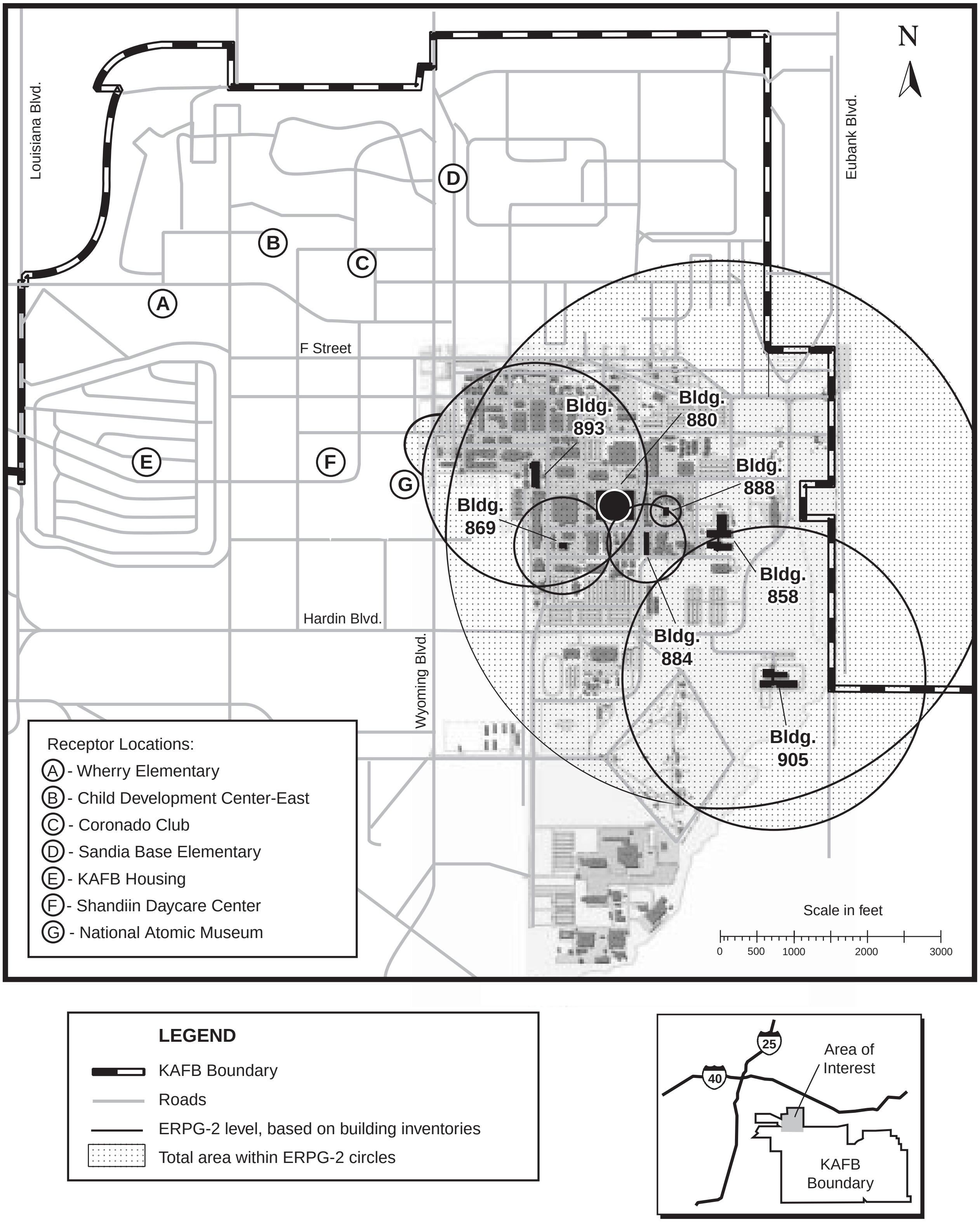
Mitigation features designed to limit chemical release from storage containers, rooms, and buildings would limit or reduce plume size, concentration levels, and exposures. Emergency procedures, sheltering, and evacuations would also minimize exposures to workers and the public.

Nuclear facilities in TAs-I, -II, and -V could also be damaged during an earthquake. The frequency of an earthquake (0.17 *g*) that could cause the release of radioactive materials from TAs -I and -II facilities is 1.0×10^{-3} per year, or 1 chance in 1,000 per year. The frequency of a more severe earthquake (0.22 *g*) that could also cause the release of radioactive materials from TAs -I (NG-1), -II (ECF-1), and -V facilities is 7.0×10^{-4} per year or 1 chance in 1,500 per year. The consequences of a 0.22-*g* earthquake are shown in Table 5.3.8 4; descriptions of the listed accidents are given later in this section and in Appendix F.2. If a 0.22-*g* earthquake was to occur, there would be less than one tenth of an additional LCF in the total population within 50 mi of the site. The largest impact to the MEI and largest impact to the noninvolved worker would be an increased probability of LCF of 6.9×10^{-6} and 3.0×10^{-2}, respectively, associated with the HC-1 accident scenario. The risks for these receptors can be estimated by multiplying these consequence values by the probability (frequency) of earthquake. If a stronger earthquake was to occur, larger releases of radioactive materials would be possible and could cause greater impacts.

A severe earthquake could also cause damage to other SNL/NM facilities and result in environmental impacts. For example, the large quantities of oil stored in external tanks and in accelerator buildings in TA-IV could potentially be spilled and cause impacts to the ecosystem and water resources. Underground natural gas lines could break and ignite, causing brush and forest fires that could further damage facilities and injure persons in the vicinity. Hydrogen storage tanks in TA-I could be damaged, causing hydrogen combustion or explosion and potential injury to persons in the vicinity. Explosives in the ECF in TA-II and smaller quantities in other facilities could also be accidentally detonated during an earthquake with injury to persons in the vicinity. Occupants of all facilities would be at risk of injury as a result of the earthquake forces and building damage.

Facility Hazards

Some of the facilities at SNL/NM contain occupational hazards with the potential to endanger the health and safety of involved workers in the vicinity of an accident.



qSource: Original
Note: See Appendix F.7, Figure F7 1

Figure 5.3.8 3. Areas Above ERPG-2 Levels from a Site-Wide Earthquake Under the No Action Alternative

The encircled areas represent locations where approximately 5,300 people are at risk of exposure to chemical concentrations above ERPG-2.

Table 5.3.8 4 Site-Wide Earthquake Radiological Impacts Under the No Action Alternative

ACCIDENT ID[a]	FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES WITHIN 50-MILES POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
			MAXIMALLY EXPOSED INDIVIDUAL[b]	NONINVOLVED WORKER[c]
TECHNICAL AREA -I				
NG-1	7.0×10^{-4}	5.1×10^{-5}	1.4×10^{-9}	3.2×10^{-6}
TECHNICAL AREA -II				
ECF-1	7.0×10^{-4}	3.0×10^{-6}	1.5×10^{-10}	1.9×10^{-7}
TECHNICAL AREA -V				
AM-2	7.0×10^{-4}	2.0×10^{-3}	2.4×10^{-7}	7.4×10^{-5}
HC-1	7.0×10^{-4}	6.4×10^{-2}	6.9×10^{-6}	3.0×10^{-2}
SP-1	7.0×10^{-4}	9.2×10^{-3}	5.8×10^{-7}	2.7×10^{-4}
AR-5	7.0×10^{-4}	5.9×10^{-3}	8.4×10^{-7}	2.2×10^{-4}

Source: Original (See also Appendix F, Tables F.7-4 and F.7-5)
[a] Facility Accident Descriptors:
Neutron Generator Facility: NG-1
Explosive Component Facilty: ECF-1
Annular Core Research Reactor-Medical Isotope Production: AM-2
Annular Core Research Reactor-Defense Programs: AR-5
Hot Cell Facility: HC-1
Sandia Pulsed Reactor: SP-1

[b] The maximally exposed individual is located at the Golf Course and the consequences can be added.
[c] Because the noninvolved worker is located 100 meters from the release point, the location varies relative to each technical area. Therefore, the consequences to the noninvolved worker can only be added for a given technical area.
Note: In the No Action Alternative, the Annular Core Research Reactor can be operated in either the medical isotopes production or Defense Programs configuration. The highest consequence (AR-5) was used.

Some of these facilities also contain hazardous materials that, in the event of an accident, could endanger the health and safety of people outside the immediate vicinity of an accident and beyond. These people include noninvolved SNL/NM workers, members of the military assigned to KAFB, and members of the public located within the KAFB boundary and offsite. Offsite consequences are determined to a 50-mile radius around the affected facility.

Explosion, radiological, and chemical accidents with the largest impacts to workers and the public have been analyzed, as discussed in the following sections. Potential accidents associated with other facility hazards such as lasers, electricity, x-rays, transformer oil, noise, explosive test debris, pyrotechnics, and compressed gases could affect the health and safety of the involved workers. However, the impacts to noninvolved workers and the public for these other accidents would be lower than the impacts from explosion, radiological, and chemical accidents described in the SWEIS (see Appendix F, Table F.6 3).

The DOE recognizes the potential adverse effects for workers, the public, and the environment that could result from the deterioration of SNL/NM equipment, structures, and facilities. However, the analysis of potential accidents discussed in this section assumes that deterioration of equipment, structures, and facilities would not affect the occurrence, progression, and effects of accidents. The basis for this assumption is that the DOE safety analysis process, specified in DOE Orders and standards, would require periodic assessments of facility safety to ensure that operations are being performed within an approved safety envelope. The process would also require an assessment of all unresolved safety questions that would result from any change in a facility or operation that could affect the operation s authorization basis. Depending on the results of the assessment, modifications to the facility and/or operational procedures would be implemented to maintain operations within the authorization basis.

Explosion Accidents

Explosive materials are stored, handled, transported, and used at some SNL/NM facilities. Administrative controls and facility design would help prevent an explosion accident and limit the impacts to personnel, if an accident was to occur. The ECF, for example, contains large quantities of explosives for use in its testing programs. Hydrogen trailers are another large source of explosive material. There are five hydrogen trailers parked near facilities or routinely transported to facilities from remote locations.

The largest quantity of hydrogen with the highest potential for consequences to both SNL/NM workers and facilities is a set of horizontally mounted cylinders, with a storage capacity of approximately 90,000 standard cubic feet (SCF), located approximately east of the CSRL, Building 893, in TA-I. An explosion at the hydrogen cylinder location near the CSRL was selected for detailed analysis to estimate the bounding impacts of an explosion accident. If a hydrogen explosion was to occur in this relatively populated area of TA-I, individuals in the area could be injured and nearby property could be damaged. Involved workers within 61 ft of an explosion could be seriously injured and would have a 50 percent chance of survival. Involved workers out to a distance of 126 ft from the explosion could receive damage to their eardrums and lungs. The resulting overpressure from this explosion and impacts to personnel and property would diminish with distance, as shown in Table 5.3.8 5.

The actual number of persons in the vicinity of an accident depends upon many factors, making the actual number of potential fatalities uncertain. Factors include the time of day (morning, lunchtime, after hours), location of the people (or the amount of relative shielding), and spread of the pressure waves within a complex arrangement of buildings, alleys, and walkways.

This bounding facility explosion was postulated to occur from an accidental uncontrolled release of hydrogen, stored in a tank outside the CSRL building, caused by human errors (such as mishandling activities) or equipment failures (such as a pipe joint failure), and the presence of an ignition source (such as a spark) near the location of release. For an uncontrolled release of hydrogen to explode, multiple failures would have to occur; therefore, this accident scenario would be extremely unlikely (that is, between $1x10^{-6}$ and $1x10^{-4}$ per year).

The human organs most vulnerable to shock explosions are the ears and lungs because they contain air or other gases. The damage would be done at the gas-tissue interface, where flaking and tearing could occur. Both the ear and the lung responses would be dependent not only on the overpressure, but also on impulse and body orientation; the shorter the pulse width, the higher the pressure the body could tolerate. An overpressure of approximately 50 psi would result in a 50 percent fatality rate; approximately 10 psi would result in eardrum rupture. These overpressure estimates are based on a square pressure wave with a pulse duration greater than 10 msec, and their effects could vary depending on body orientation to the pressure wave.

Structural damage produced by air blasts would depend on the type of structural material. An overpressure of

Table 5.3.8 5. Impacts of an Explosion Accident Under the No Action Alternative

DISTANCE TO RECEPTOR OR PROPERTY (ft)	PEAK REFLECTIVE PRESSURE (psi) (472 lbm TNT EQUIVALENT)	COMMENTS
25	650	Peak pressure.
61	50	For involved workers, there would be a 50% survival rate for pressures in excess of 50 psi.
126	10	For involved workers, there would be a 50% rate of ear rupture for pressures in excess of 10 psi. Total destruction of buildings could be expected for pressures in excess of 10 psi.
370	2.0	Pressures in excess of 2 to 3 psi would cause concrete or cinder block walls to shatter.
657	1.0	Pressures in excess of 1 psi would cause a house to be demolished.

Source: DOE 1992b [See also Appendix F, Table F4 1]
ft: feet
lbm TNT equivalent: weight in pounds of equivalent mass of trinitrotoluene
psi: pounds per square inch

1 psi would cause partial demolition of houses (rendering them uninhabitable); an overpressure of 2 to 3 psi would shatter unreinforced concrete or cinder block walls; and an overpressure in excess of 10 psi would cause total destruction of buildings.

Radiological Accidents

The largest quantities of radioactive materials at risk for radiological accidents are located in TA-V. The Manzano Waste Storage Facilities, and TAs-I, -II, and -IV also contain radioactive material, but in smaller amounts. The nuclear facilities in TA-V include the ACRR, SPR, HCF, and Gamma Irradiation Facility (GIF). The New Gamma Irradiation Facility (NGIF) is under construction in TA-V. Accident scenarios for the ACRR facility were considered and analyzed for both the medical isotopes production and DP testing configurations. The HCF has been reconfigured for medical isotopes production, and the accidents analyzed reflect this mode of operation. Accidents have also been analyzed for storage of radioactive materials in the HCF not associated with medical isotopes production.

The most serious radiological accident impacts associated with facilities under the No Action Alternative are shown in Table 5.3.8 6. The table lists a set of accidents and their consequences in terms of an increased probability of an LCF for exposed individuals and increased number of LCFs for the offsite population. Other radiological accidents could also occur at these facilities, but their impacts would be within the envelope of the selected set of accidents.

The accident scenarios shown in Table 5.3.8 6 are briefly described below and in more detail in Appendix F.2.

The following descriptions correspond to accidents presented in Tables 5.3.8 4 and 5.3.8 6.

ACRR-Medical Isotopes Production

AM-1 Airplane Crash, Collapse of Bridge Crane For the ACRR facility, release from an airplane crash would be due to the bridge crane falling into the reactor pool, impacting the reactor superstructure, and resulting in the rupture of four fuel elements in the reactor core.

AM-2 Earthquake (0.22 g) and Collapse of Bridge Crane The postulated site-wide earthquake would cause the crane to fall onto the reactor superstructure with resultant rupture of four fuel elements. The releases for this scenario were assumed to be the same as those for the airplane crash scenario (scenario AM-1).

AM-3 Fuel Element Rupture This scenario would be initiated by a pinhole leak in the cladding of a fuel element through which water would be drawn by heat-up/cool-down cycles. Steam generation during a pulse might build up internal pressure and rupture the cladding. The fission products from one fuel element were assumed to be released into the reactor pool.

AM-4 Rupture of One Molybdenum-99 Target It was postulated that one target would rupture in the core after a 21-kW, 7-day irradiation. This accident was postulated to bound accidents involving targets that might take place during irradiation. The consequences were based on the rupture of one irradiated target in the target grid assembly in the reactor core.

AM-5 Fuel Handling Accident, One Irradiated Fuel Element Rupture The accident was postulated to occur outside of the reactor pool, so there would be no pool mitigation. While being transferred from the ACRR pool to the GIF pool, an irradiated fuel element is dropped, impacts a hard surface, and ruptures.

AM-6 Airplane Crash and Fire in Reactor Room with Unirradiated Fuel and Targets Present The scenario postulates an airplane crash into the reactor building while the reactor is shut down in preparation for refueling. New fuel elements would be present in the reactor room awaiting insertion into the core. In addition, fresh targets would also be present, awaiting insertion after refueling. The airplane would penetrate the building and cause a large fire in the reactor room.

AM-7 Target Rupture During Transfer from ACRR to HCF A target rupture would occur in transit between the ACRR and the HCF as a result of an unspecified incident involving transport equipment or operation.

<u>HCF</u>

HM-1 Operator Error During Molybdenum-99 Target Processing An operator inadvertently opens the wrong valve or opens the correct valves at the wrong time. Mechanical failures of valves or transfer lines could occur, releasing the waste gases from the decay tank (cold trap).

HM-2 Operator Error During Iodine-125 Target Processing This scenario is similar to HM-1, but would occur while iodine-125 targets, rather than molybdenum-99 targets, are being processed. This scenario was postulated to occur 72 hours after

Table 5.3.8 6. Potential Impacts of Radiological Facility Accidents Under the No Action Alternative

FACILITY/MODE	ACCIDENT ID	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES TO THE 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Annular Core Research Reactor medical isotopes production configuration	***AM-1***	Airplane crash - collapse of bridge crane	6.30×10^{-6}	2.0×10^{-3}	2.4×10^{-7}	7.4×10^{-5}
	AM-3	Rupture of waterlogged fuel element	1.0×10^{-2} to 1.0×10^{-4}	4.9×10^{-4}	5.4×10^{-8}	3.8×10^{-6}
	AM-4	Rupture of one molybdenum-99 target	1.0×10^{-4} to 1.0×10^{-6}	3.9×10^{-4}	4.3×10^{-8}	3.0×10^{-6}
	AM-5	Fuel handling accident - irradiated element	1.0×10^{-4} to 1.0×10^{-6}	4.9×10^{-3}	6.1×10^{-7}	7.6×10^{-5}
	AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	6.3×10^{-6}	1.6×10^{-6}	1.0×10^{-10}	4.9×10^{-8}
	AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0 \times 10^{-6}$	3.9×10^{-4}	4.9×10^{-8}	1.4×10^{-5}
Hot Cell Facility medical isotopes production	***HM-1***	Operator error - molybdenum-99 target processing	1.0×10^{-1} to 1.0×10^{-2}	3.8×10^{-5}	3.3×10^{-9}	1.6×10^{-7}
	HM-2	Operator error - iodine-125 target processing	1.0×10^{-1} to 1.0×10^{-2}	1.6×10^{-6}	1.0×10^{-10}	4.2×10^{-9}
	HM-4	Fire in glovebox	1.0×10^{-2} to 1.0×10^{-4}	2.6×10^{-3}	2.4×10^{-7}	2.3×10^{-6}
Hot Cell Facility Room 108 storage	***HS-1***	Fire in room 108, average inventories	3.3×10^{-5}	2.1×10^{-3}	1.8×10^{-7}	2.0×10^{-7}
	HS-2	Fire in room 108, maximum inventories	2.0×10^{-7}	7.9×10^{-2}	6.6×10^{-6}	7.4×10^{-6}

Table 5.3.8 6. Potential Impacts of Radiological Facility Accidents Under the No Action Alternative (concluded)

FACILITY/MODE	ACCIDENT ID	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES TO THE 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Sandia Pulsed Reactor	***S3M-2***	Control-element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	1.2×10^{-3}	1.5×10^{-7}	2.5×10^{-4}
	S3M-3	Failure of a fissionable experiment	1.0×10^{-4} to 1.0×10^{-6}	7.9×10^{-3}	8.4×10^{-7}	3.8×10^{-3}
	SS-1	Airplane crash into North Vault storage vault	6.3×10^{-6}	9.2×10^{-3}	5.8×10^{-7}	5.5×10^{-4}
Annular Core Research Reactor Defense Programs Configuration	***AR-1***	Uncontrolled addition of reactivity	$<1.0 \times 10^{-6}$	7.3×10^{-3}	9.3×10^{-7}	1.2×10^{-4}
	AR-2	Rupture of waterlogged fuel element	1.0×10^{-1} to 1.0×10^{-2}	1.3×10^{-3}	1.7×10^{-7}	1.2×10^{-5}
	AR-4	Fire in reactor room with experiment present	1.0×10^{-4} to 1.0×10^{-6}	9.0×10^{-3}	1.0×10^{-6}	1.4×10^{-4}
	AR-6	Airplane crash - collapse of bridge crane	6.3×10^{-6}	5.9×10^{-3}	8.4×10^{-7}	2.2×10^{-4}

Source: Original
TA-V Facility Accident Descriptors:
ACRR - Medical Isotope Production: AM-1, AM-3, AM-4, AM-5, AM-6, AM-7
Hot Cell - Medical Isotope Production: HM-1, HM-2, HM-4
Hot Cell - Room 108 Storage: HS-1, HS-2
SPR: S3M-2, S3M3, SS-1
ACRR- Defense Programs: AR-1, AR-2, AR-4, AR-6

irradiation. Cold trap valves would be left open when the gas is being transferred between decay storage tanks.

HM-4 Fire in Steel Containment Box Used for Processing Targets It was postulated that a large fire in the steel containment box would result in the release of the gases in the decay tank (cold trap), as in scenario HM-1, plus the fission products from one irradiated target being processed.

HS-1 Fire in Room 108 A general combustible fire would be ignited by an event such as an electrical short, forklift incident, or other unspecified circumstance. Various radioactive materials ranging from fissile material to fission products in various forms would be stored in Room 108.

HS-2 Fire in Room 108 This scenario, discussed above under the HS-1 scenario, involves a larger consequence and lower frequency.

HC-1 Earthquake (0.22 g) and Building Collapse This scenario is an earthquake-induced building collapse, with fire in a steel containment box and in Room 108 of the HCF. The impacts are represented by the impacts for accidents HM-4 and HS-1.

SPR

S3M-2 Control Element Misadjustment Before Pulse Element Insertion Control element positions are set for each operation to produce the desired pulse size. Control element misadjustment before pulse element insertion could result in a larger-than-anticipated superprompt critical pulse. The estimated upper limit total worth insertion of reactivity would result in the nearly complete destruction of the core and subsequent release of an abnormal amount of fission products into the reactor room and the environment.

S3M-3 Failure of a Fissionable Experiment The experiment involves the rapid heating of uranium or plutonium rods to excite the fundamental oscillation modes of the material. Plutonium experiments are required to incorporate two levels of containment; however, to encompass the worst-case, the scenario assumes no containment and the complete melt of 7,000 g of plutonium.

SS-1 Airplane Crash into North Vault (NOVA) The SWEIS analysis postulated an airplane crash into the vault, causing a large fire that releases stored radioactive material. An experiment containing plutonium-239, similar to the experiment used in scenario S3M-3 and representative of other plutonium components tested at TA-V, was assumed to be stored in the NOVA.

SP-1 Earthquake (0.22 g) and Building Collapse This scenario is an earthquake-induced SPR building collapse. This accident scenario is represented by the release from SS-1.

S4-1. This scenario is the same as S3M-3, except that the accident would occur during operation of the SPR-IV reactor rather than the SPR IIIm reactor.

ACRR-DP

AR-1 Uncontrolled Addition of Reactivity An uncontrolled amount of reactivity is inserted into the core over a time frame of 80 msec. This accident is assumed to occur without regard to some initiating event or failure of a reactivity control system or violation of prescribed procedures. The absolute magnitude of the reactivity change could be caused by the addition of reactivity from either the removal of negative reactivity (control rods, transient rods, or negative worth experiment) or positive reactivity (positive worth experiment). In terms of operational capabilities, the reactivity would represent the total available in the transient bank coupled to an unplanned removal of a large negative worth experiment in the same time frame.

AR-2 Waterlogged Fuel Element Ruptures This event would be initiated by failure of a single waterlogged fuel element during a pulse from low initial power and subsequent damage to adjacent elements. The pulse would be assumed to occur when the maximum fission product inventories have built up in the core. Adjacent elements would be assumed to be damaged by the rupture of the waterlogged element. The analysis assumes failure of a total of four fuel elements, with ejection of the fuel from all four elements into the pool water.

AR-4 Fire in Reactor Room with Experiment Present A fire could affect fissionable material in an experiment, and small quantities of uranium oxide and other contaminants could be released into the local atmosphere. To bound the potential consequences of this type of scenario, the SWEIS conservatively assumed a large fire in the reactor room without specific analysis of combustible loading and ignition sources. Also, to bound the potential consequences, an experiment containing plutonium was assumed to be present in the reactor room.

AR-5 Earthquake (0.22 g) and Collapse of Bridge Crane This scenario is a seismic event that would cause the 15-ton bridge crane to fall directly on the reactor superstructure. This is assumed to damage

24 fuel elements (approximately 10 percent of the core) to the extent that their entire inventory would be released.

AR-6 Airplane Crash, Collapse of Bridge Crane In order to bound the consequences of an airplane crash, it was postulated that the crash would knock the bridge crane off its rails onto the reactor superstructure. The SWEIS analysis postulates that an airplane crash would cause collapse of the bridge crane, which would be assumed to fall directly on the reactor superstructure and damage 24 fuel elements (approximately 10 percent of the core).

NGF

NG-1 Catastrophic Release of NGF Tritium Inventory The SNL/NM SWEIS source documents provide the material at risk for this scenario in the form of facility tritium inventories of 836 Ci (SNL/NM 1998a).

ECF

ECF-1 Catastrophic Release of ECF Tritium Inventory The source documents indicate that the expected tritium inventory present at the ECF is 49 Ci. The tritium inventory is based on the amount involved in the shelf-life test (SNL/NM 1998a).

The accident for a single facility with the highest consequences to the public would be a fire in Room 108 at the HCF in TA-V (HS-2). If this accident was to occur, there would be an additional $7.9x10^{-2}$ LCFs in the offsite population within 50 mi of the site. There would be a increased probability of an LCF for an MEI and a noninvolved worker of $6.6x10^{-6}$ and $7.4x10^{-6}$, respectively. The estimated frequency of occurrence for this accident is $2.0x10^{-7}$ per year, or less than 1 chance in 5,000,000 per year.

Involved workers run the highest risk of injury or fatality in the event of many radiological accidents discussed in this section as well as the many others that could occur. Although there are protective measures and administrative controls to protect involved workers, they are usually in the immediate vicinity of the accident where they could be exposed to radioactivity.

The impacts to the other receptors would be less than for the MEI. Details on the impacts to all receptors analyzed are provided in Appendix F.2.

Chemical Accidents

Many SNL/NM facilities store and use a variety of hazardous chemicals. The quantities of chemicals vary, ranging from small amounts in individual laboratories to bulk amounts in specially designed storage areas. In addition, the effects of chemical exposure on personnel would depend upon its characteristics, and could range from minor to fatal. Minor accidents within a laboratory room, such as a spill, could result in injury to involved workers in the immediate vicinity. A catastrophic accident such as a large uncontrolled fire, explosion, earthquake, or aircraft crash could have the potential for more serious impacts to involved workers and the public. A catastrophic accident could also release various chemicals from multiple release points and increase the potential for human exposure and serious injury.

In order to assess the impacts of chemical accidents in a bounding manner, chemical inventories at facilities were estimated and ranked using a systematic procedure described in Appendix F.3; that is, a risk hazard index (RHI). The RHI is an indicator of a specific chemical s potential to cause human injury and fatality that factors in the chemical toxicity, volatility, and inventory. For the chemical with the highest RHI in each building, a catastrophic accident involving total release of the building inventory was postulated as the bounding event, then estimates were made of chemical concentrations at various distances from the accident. The results are shown in Table 5.3.8 7. Building inventory and 50 percent of the building largest single source values are shown for the source term to reflect the variability and uncertainty in the actual amount of the chemical that could be present at the time of an accident. Similarly, estimates are shown for the range of distances within which the ERPG-2 would be exceeded. The ERPG-2 is an accepted guideline for public exposure (see Appendix F.3 for an explanation of the various ERPG levels).

In the event of a severe chemical accident in TA-I, involved workers, noninvolved workers, KAFB personnel, onsite residents, and onsite members of the public would be at risk of being exposed to chemical concentrations in excess of ERPG-2 levels. The number of individuals at risk during normal business hours is shown in Table 5.3.8 8. Although Table 5.3.8 8 shows the maximum number of people at risk, the actual number exposed would depend on the time of day, location of people, wind conditions, and other factors, and would be much less than that shown.

As shown in Table 5.3.8 7, the worst-case chemical accident would be a catastrophic release of arsine from Building 893 in TA-I. If this accident was to occur and 20 lb of arsine was released, individuals within 2,640 ft

Table 5.3.8 7. Potential Impacts of Chemical Accidents under the No Action Alternative

BUILDING	CHEMICAL	SOURCE TERM		ERPG-2 LEVEL (ppm)	ERPG-2 EXCEEDANCE DISTANCE		FREQUENCY (per year)
		BUILDING INVENTORY (lb)	50% OF BUILDING LARGEST SINGLE SOURCE (lb)		BUILDING INVENTORY (ft)	50% OF BUILDING LARGEST SINGLE SOURCE (ft)	
823	Nitrous oxide	32.17	15.26	125	348	237	$1.0x10^{-3}$ to $1.0x10^{-4}$
858	Chlorine	106.4	53.2	3	3,726	2,598	$1.0x10^{-3}$ to $9.7x10^{-5}$
869	Nitric acid	18.6	9.3	15	666	465	$1.0x10^{-3}$ to $1.0x10^{-4}$
878	Nitrous oxide	50	25	125	438	309	$1.0x10^{-3}$ to $3.2x10^{-5}$
880	Hydrofluoric acid	2	1	20	219	153	$1.0x10^{-3}$ to $1.0x10^{-4}$
883	Phosphine	6.8	3.4	2.5	1,440	1,002	$1.0x10^{-3}$ to $1.0x10^{-4}$
884	Hydrofluoric acid	10	5	20	504	351	$1.0x10^{-3}$ to $1.0x10^{-4}$
888	Fluorine	0.07	0.04	1	207	93	$1.0x10^{-3}$ to $1.0x10^{-4}$
893	Arsine	65	20	1	4,884	2,640	$1.0x10^{-3}$ to $1.0x10^{-4}$
897	Chlorine	4.4	2.2	3	699	486	$1.0x10^{-3}$ to $6.6x10^{-5}$
905	Thionyl chloride	101.1	50.5	5	2,067	1,434	$1.0x10^{-3}$ to $9.0x10^{-5}$

Sources: DOE 1996f, NSC 1995 [See also Appendix F, Tables F.3 4 and F5 2]
ERPG: Emergency Response Planning Guideline
ft: feet
lb: pound
ppm: parts per million
TA: technical area
Note: Frequency ranges from $1.0x10^{-3}$ for an earthquake in TA-I to $1.0x10^{-4}$ for an airplane crash into a generic building.

Table 5.3.8 8. Maximum Impacts of Chemical Accidents on Individuals Within KAFB Under the No Action Alternative

BUILDING	CHEMICAL NAME	RELEASE (lb)	ALOHA RADIUS REQUIRED TO REACH ERPG-2 LEVEL (ft)	NUMBER OF PEOPLE WITHIN ERPG-2
823	Nitrous Oxide	32.17	348	844
858	Chlorine	106.41	3,726	3,783
869	Nitric Acid	18.6	666	1,511
878	Nitrous Oxide	50	438	880
880	Hydrofluoric Acid	2	219	529
883	Phosphine	6.8	1,440	3,743
884	Hydrofluoric Acid	10	504	800
888	Fluorine	0.07	207	0
893	Arsine	65	4,884	8,254
897	Chlorine	4.4	699	625
905	Thionyl Chloride	101.1	2,067	1,356

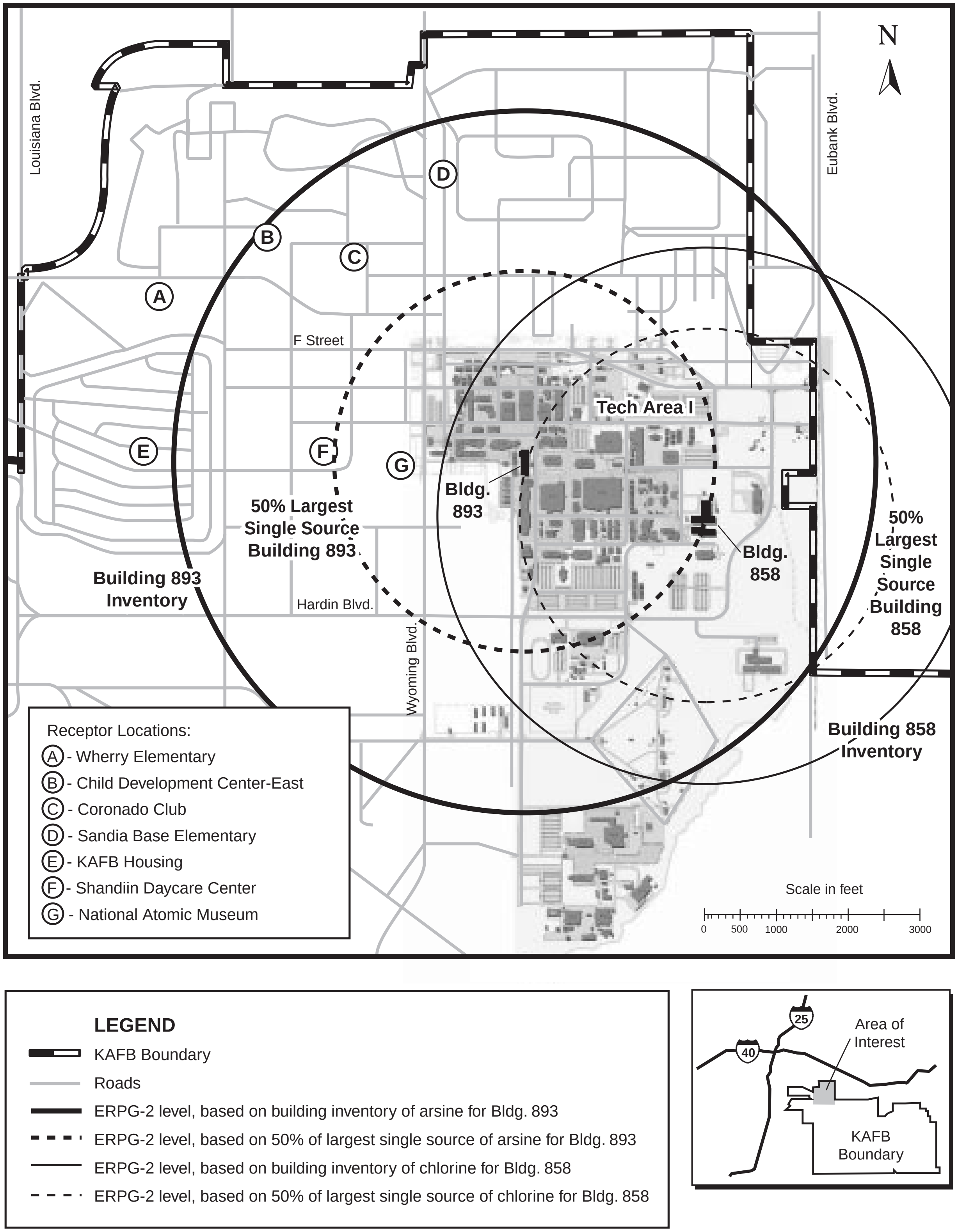
Source: Bleakly 1998c (See also Appendix F, Table F3 6)
ALOHA: Areal Location of Hazardous Atmosphere (model)
ERPG: Emergency Response Planning Guideline
ft: feet
lb: pound

of the point of release would receive exposures that exceed the ERPG-2. If the building arsine inventory (65 lb) was released, individuals within a distance of 4,884 ft from the point of release would receive exposures that exceed the ERPG-2. Figure 5.3.8 4 illustrates the KAFB locations that would be affected by these worst-case chemical accident scenarios involving the release of arsine or chlorine from Buildings 893 and 858, respectively. The circles on the figure correspond to the distances within which the ERPG-2 would be exceeded. However, the actual affected area within the circles would depend upon wind conditions, and only a small portion of the circular area would be affected. In the event of a release, the area exceeding the ERPG-2 would be shaped by the wind and nearby buildings, perhaps affecting 1/16th to 1/10th of the circular area out to the indicated distance. Some individuals within the ERPG-2 circle close to the release point could experience or develop irreversible or other serious health effects or symptoms that could impair their abilities to take protective action. For any release, the seriousness of an exposure would generally decrease for distances further from the point of release.

In the event of an aircraft crash or earthquake involving buildings with various chemical inventories, multiple chemicals would be released. Although the impacts of mixed chemicals could be greater than individual chemicals, their behavior, dispersion, and health effects can be complex and have, therefore, not been considered quantitatively. An earthquake could also cause the release of like chemicals from multiple buildings and lead to increased concentrations where individual plumes overlap. The potential and impacts for overlapping plumes are discussed in Appendix F.7.

Aircraft Crash

Military, civilian, and commercial aircraft with various cargo land and take off on runways adjacent to KAFB. These aircraft could potentially crash into or in the vicinity of SNL/NM facilities. If such an accident were to occur, it could act as an initiator of other events at a facility that could lead to the release of hazardous radioactive and/or chemical materials. The frequency of an aircraft crash into a facility at SNL/NM and the extent of injury to personnel and damage to property and the environment depend upon many factors. Factors include aircraft size, type, speed, and impact angle; air traffic patterns and take-off/landing frequencies; and the dimensions of the facility and the robustness of its construction. Estimates of an aircraft crash into



Source: Original
Note: See Table 5.3.8 8

Figure 5.3.8 4. Projected Extent of ERPG-2 Levels from Accidental Release of Arsine (Bldg. 893) and Chlorine (Bldg. 858)

Circled areas represent the distances within which an ERPG-2 level would be exceeded for an accidental release of arsine (Building 893) and/or chlorine (Building 858) under the No Action Alternative.

SNL/NM facilities have been made and are discussed in Appendix F, Section F.5. Aircraft crash frequencies were used where applicable as facility accident initiating events.

Other Accidents

Other types of potential accidents would have impacts that were not measured in terms of LCFs or chemical concentrations. These could cause serious injury or fatality for humans or impacts to the nonhuman environment such as the ecology, historic properties, or sensitive cultural sites.

Brush Fires Small fires are expected and planned for during outdoor testing that involves propellants and explosives. The potential exists for brush and forest fires when hot test debris or projectiles come in contact with combustible elements in the environment. One such incident was reported in 1993 in TA-III when a rocket motor detonated during a sled track impact test and resulted in a 40-ac brush fire. An accident at the Aerial Cable Facility in the Coyote Test Field resulted in a fire that swept up the side of a mountain before being extinguished by SNL/NM workers. Many others have occurred that were contained in the immediate vicinity of the test area. Measures would be taken to prevent fires and, should a fire occur, the effects would be mitigated by activating fire fighting facilities in the test area (DOE 1995a, SNL/NM 1993d, SNL/NM 1998i).

Natural Phenomena Naturally occurring events such as tornadoes, lightning, floods, and heavy snow, as documented in existing SNL/NM safety documentation, were considered for their potential to initiate the accidental release of radioactive, chemical, and other hazardous materials that affect workers and the public. Any of these events, should they occur, could also lead to serious injury or fatality as a result of the physical and destructive forces associated with the events. The risks of such events to workers and the public would be equivalent to everyday risks from naturally occurring events to the general public wherever they work and reside.

Spills and Leaks The potential would exist throughout SNL/NM for the accidental spill of radioactive, chemical, or other hazardous materials. The effects of such spills on workers and the public through airborne pathways were considered earlier in this section. The impacts from pathways other than airborne would normally be bounded by exposure from airborne pathways. Any spill of a hazardous substance would have the potential for impacts to the nonhuman elements of the environment. A spill could make its way into surface and groundwater systems, affecting water quality and aquatic life. Spills of flammable substance could cause fires that damage plant and animal life and other land resources. There have been spills of hazardous substances at the SNL/NM site that had the potential to affect the nonhuman elements of the environment. In 1994, over 100 gal of oil were spilled at the Centrifuge Complex in TA-III when a hydraulic pump failed during a centrifuge test, causing a potential impact to the nonhuman elements of the environment. Also in 1994, a small spill of transformer oil occurred from an oil storage tank in TA-IV when a gasket failed and, at the Coyote Test Field, a leaking underground storage tank containing ethylene glycol was discovered.

Radiological and Chemical Contamination Some accidents analyzed in this section, and others that were considered but not analyzed, could potentially impact the nonhuman elements of the environment. Any accidentally released chemicals would result in concentrations that would typically decrease with increasing distance from the point of release. While chemical concentrations would diminish over distance to a point where a human hazard would no longer be present, the concentrations could still affect other elements of the environment such as the ecology, water quality, and cultural resources. Radiological releases could also affect nonhuman elements of the environment. After an accident, SNL/NM, through their spill and pollution control and radiological emergency response plans, are required to assess the potential for ground contamination; if contamination exceeds guidance levels, plans will be developed for remediation.

Industrial In addition to radioactive and chemical materials and explosives, many SNL/NM facilities conduct operations and use materials and equipment that could also be potentially hazardous to workers. These hazards are typically referred to as normal industrial hazards, not unlike similar hazards that workers are exposed to throughout the nation, and include working with electricity, climbing ladders, welding, and driving forklifts. The SWEIS acknowledges the existence of, but does not analyze, normal industrial hazards. All operations and activities at SNL/NM facilities, as well as all DOE facilities, would be subject to administrative procedures and safety features designed to prevent accidents and mitigate their consequences should they occur.