Sandia National Laboratories/New Mexico
Environmental Restoration Project

DRAFT
RISK-BASED END STATE VISION

October 2003

United States Department of Energy
Sandia Site Office

EXECUTIVE SUMMARY

This document describes how risk based end states have been incorporated into the past ten years of Environmental Restoration (ER) activity at Sandia National Laboratories/New Mexico. (SNL/NM) It is to some degree a re-representation of information that is available in the reports discussed in Section 1.0. These reports cover the actual risk-based cleanups and accomplishments at more than 200 ER sites ranging from large landfills and explosive test areas, to small septic tanks and drainfields, and which are the result of years of coordination with regulators and stakeholders.

SNL/NM is located on the Kirtland Federal Complex (KFC) in Bernalillo County. The KFC is the physical and geographical area that encompasses approximately 52,223 acres in southeast Albuquerque, and contains the facilities and infrastructure of the DOE and the U.S. Air Force and more than 100 other tenants. The KFC is bounded on the north and northwest by the growing City of Albuquerque, on the east by the Cibola National Forest, on the south by the Isleta Indian Reservation, and on the west by land owned by the State of New Mexico and the Albuquerque International Sunport. The population of the city is expected to continue to increase, with the result that development is beginning to surround the KFC. This regional context is shown in maps and discussed in Section 2.0.

The major ongoing mission of SNL/NM is to ensure that the U.S. nuclear arsenal is safe, secure, and reliable. There continues to be significant federal investment in both infrastructure and programs at the KFC and SNL/NM. The details of the SNL/NM Technical Areas and program areas are briefly described in Section 1.2. These Technical Areas are operated in compliance with current environmental laws, and thus have minimal impact to the environment. The majority of the ER sites requiring restoration are a legacy of work conducted in the past. The Technical Areas and Solid Waste Management Units (SWMUs), as well as their relation to the ecological and human use and ownership, are depicted on maps in Section 3.0

The number of SNL ER sites to be addressed on the KFC grew from 117 in 1987 to the current number of 268 (including 203 SWMUs and 65 AOCs) which needed to be addressed at the SN/NM facility on Kirtland Air Force Base (KAFB). There are three SWMUs and two AOCs that are in active use and that are not scheduled for immediate cleanup. The majority of these sites have been cleaned up; no major fieldwork remains at any site. Four major landfills and numerous smaller sites have been remediated without significant injury.

No Further Action (NFA) proposals have been submitted to the regulators for 195 of the remaining 200 SWMUs. The regulators have approved 149 of these, and the other 47 risk-based NFA proposals are at various stages of the regulatory review and approval process. Fieldwork is more than 90% complete and draft NFA proposals are in progress for three of the five SWMUs for which NFA proposals have not yet been submitted. One of these SWMUs is the Chemical Waste Landfill, which is regulated under a closure plan that requires alternative closure documentation. The remaining cleanups involve removal of relatively small areas of contaminated surface and near-surface soils. Further details of the cleanup status are given in Section 1.3. Remediation is complete at all of the AOCs although some reporting requirements remain.

The SNL/NM ER Project made this progress because it had excellent teaming relationships with the regulators and substantial interaction with stakeholders. Public outreach began with quarterly public meetings in 1992, which continue to be conducted. A Citizens' Advisory Board (CAB) was created in the spring of 1995 and functioned until 2000, and provided valuable insight into community values and preferences associated with environmental restoration work at SNL. The CAB provided substantial input into the future-land-use designations described below. The CAB evolved into the Community Resource Information Office that serves as a coordinator for citizens groups to continue to provide input on specific topics such as the RBES initiative.

All significant ER sites have been cleaned up to risk-based levels. A risk-assessment methodology was negotiated with the New Mexico Environment Department (NMED) while active fieldwork for site characterization was underway. A probabilistic risk approach using a Sandia-developed software tool was proposed to NMED, but was rejected because they felt a probabilistic approach was too complicated and not approved by the EPA. Beginning in 1994, the human health risk assessments were conducted in accordance with the Risk Assessment Guidance for Superfund (RAGS), with agreement from EPA Region 6. The risk approach used by SNL/NM is detailed in Section 1.3.

The use of risk assessment requires definition of appropriate future-land-use scenarios. Future-land-use designations for all areas of the KFC were developed in 1995 by a stakeholders group which included representatives of SNL, DOE, the U.S. Air Force, the U.S. Forest Service, and the U.S. Environmental Protection Agency (EPA), as well as local government officials and citizens. This group considered the issues, opportunities, and constraints of all the KFC tenants, and formalized their agreement in a Baseline for Future Use Options document which fully describes the end state and future land use, as well as the use of risk assessment for cleanup end states. The future-land-use designations in this document formed the key assumption for determining the risk-based cleanup levels at all significant ER sites.

By the fall of 2002, the ER Project had addressed the vast majority of the sites. The ER Project is currently in the process of finalizing regulatory post-closure requirements for many sites. A Long Term Environmental Stewardship (LTES) Plan was written in 2001 with citizen input, and has been revised to include current status in 2003. A Transition Plan has been written to transfer LTES responsibilities, such as remaining long-term monitoring, to other, permanently funded departments within Sandia National Laboratories.

In 2003 a Compliance Order on Consent was negotiated with the NMED to establish a fixed schedule for completion of regulatory activities, including definition of groundwater requirements and submittal of regulatory documentation associated with completion of the corrective action process for all Solid Waste Management Units and Areas of Concern managed by the ER Project. The agreed-upon schedule aligns with both the Project's Performance Management Plan and with the SNL ER Project FY 2004 baseline. Regulators have expressed a desire for SNL to adhere to this schedule regardless of new DOE initiatives such as RBES. This Compliance Order has an appropriate risk basis section that is based on future land use. Per this document, the regulators continue to accept risk-based end states for all sites being submitted for NFA.

Three main categories of environmental hazards remain from past operations at SNL/NM - 1) the materials or residuals left in the engineered units, 2) the low levels of contamination detected in four groundwater areas, and 3) the residual contaminants at the NFA sites which were cleaned up to industrial or recreational risk levels only, and did not meet the residential risk criteria. Potential exposure to KAFB residents or ecological receptors is minimal, as shown in the pertinent Conceptual Site Models. These hazards are discussed in greater detail in Section 4.0.

There are currently no known variances, but may be potential future variances, given the status of work at SNL. For sites that have been removed from the permit, the current state is exactly the end state. The four sites that have a small amount of fieldwork remaining, and have a regulator-approved field plan in place, are in essentially the same situation. Sites which are currently in the Corrective Measures Evaluation stage, but have not yet attained a decision, may be required to do more fieldwork than is currently envisioned. Instances where the actual cleanup level exceeded the target industrial or recreational level may have occurred because of the use of heavy equipment for soil removal, or the recalculation of residential risk using less stringent assumptions, per new NMED guidance. Sites under active use that have not yet been cleaned up will remain a liability for DOE. These issues are discussed further in Section 5.0.

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ACRONYMS AND ABBREVIATIONS

BBER	Bureau of Business and Economic Research
CAB	Citizens' Advisory Board
CAMU	Corrective Action Management Unit
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	curie(s)
CMS	Corrective Measures Study
COC	constituent of concern
CSM	Conceptual Site Model
CWL	Chemical Waste Landfill
cy	cubic yard(s)
DOE	U.S. Department of Energy
DOE/AL	DOE Albuquerque Operations Office
DU	depleted uranium
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ft	foot (feet)
HE	high explosive(s)
HRS	Hazard Ranking System
IC	institutional control
KAFB	Kirtland Air Force Base
KFC	Kirtland Federal Complex
LE	Landfill Excavation
LLW	low-level waste
LTES	Long Term Environmental Stewardship
LTTD	low temperature thermal desorption
MSA	Metropolitan Statistical Area
MWL	mixed waste landfill
NFA	no further action
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NPL	National Priority List
PCE	trachloroethene
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SNL/NM	Sandia National Laboratories/New Mexico
sq mi	square mile
ST	stabilization
SWMU	Solid Waste Management Unit
TA	Technical Area
TCE	trichloroethylene
UNM	University of New Mexico
USAF	U.S. Air Force

ACRONYMS AND ABBREVIATIONS (Concluded)

UXO	unexploded ordnance
VCM	voluntary corrective measure
VE	vapor extraction
VZMS	vadose zone monitoring system
WMD	weapons of mass destruction
§	Section

1.0 INTRODUCTION

The Sandia National Laboratories/New Mexico ER Project is responsible for the assessment and, if necessary, the remediation of inactive waste sites. This assessment began formally in 1984 for SNL/NM, when DOE's Albuquerque Operations Office (DOE/AL) initiated the Comprehensive Environmental Assessment and Response Program (CEARP) to identify, assess, and remediate potentially hazardous waste sites. The project was designed to comply with Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Phase I of the CEARP, "The Installation Assessment," (DOE September 1987) which identified 117 sites at SNL/NM, was submitted to U.S. Environmental Protection Agency (EPA) by SNL/NM in September 1987.

A similar investigation was conducted by the EPA Region VI in April 1987 during the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA). (EPA April 1987) These programs ultimately defined a working inventory of Solid Waste Management Units (SWMUs) to be investigated during the course of the ER program at SNL/NM.

In 1987, SNL/NM sites were evaluated by the EPA under the EPA's CERCLA Hazard Ranking System (HRS), a risk-based system for prioritizing site cleanups. (DOE September 1987) Based on the HRS ranking, no SNL/NM sites qualified for cleanup under the CERCLA National Priority List (NPL). For federal facilities that are not listed on the NPL, CERCLA requires compliance with state laws concerning removal and remedial actions.

In 1990, the U.S. Department of Energy (DOE) began to fund Sandia National Laboratories (SNL) to conduct environmental restoration (ER) work for all locations for which SNL might be responsible. When the ER Project was formally established in 1992, the work was projected to be completed by 2020; 117 sites had been identified for attention. As the ER Project began, minor scoping sampling had been conducted at a few sites, and several groundwater monitoring wells had been installed at two landfill locations. Rapport with regulators and other stakeholders had yet to be established.

Ten years later, the ER Project is planned for completion in 2006. The expected life-cycle cost has been reduced by more than $200M. The number of sites to be addressed on KAFB grew to 268, (including 203 SWMUs and 65 AOCs) and were included on the HSWA module of SNL's RCRA permit. (EPA August 1993) There are three SWMUs and two AOCs in active use that are not scheduled for immediate cleanup. No Further Action (NFA) proposals have been submitted to the regulators for 195 of the remaining 200 SWMUs. The regulators have approved 149 of these, and the other 47 (risk-based) NFA proposals are at various stages of the regulatory review and approval process. Fieldwork is more than 90% complete on the five SWMUs where NFA proposals have not yet been submitted, and draft NFA proposals are in progress for three of these five SWMUs. One of these SWMUs is the Chemical Waste Landfill, which is regulated under a closure plan that requires alternative closure documentation. Remediation is complete at all AOCs.

Four major landfills and numerous smaller sites have been remediated without significant injury. All sites have been characterized, as have four areas of low-concentration groundwater contamination. This progress was due to SNL's excellent teaming relationships with the regulators and substantial interaction with stakeholders. The Project has received several SNL quality awards, seven consecutive years of top ratings from the DOE customer (1995-2001), and awards from the New Mexico Environment Department (NMED) in 2001 and 2002 for environmental excellence.

In 1991, the ER Project initiated a study to determine whether an Environmental Assessment (EA) or an Environmental Impact Study was appropriate for the ER work. The ER Project began work on an ER-specific EA in 1994; the EA was approved and issued in March 1996. ((DOE March 1996) Coincident with this effort, a Program Implementation Plan (SNL/NM Feb 1994) was developed, which included an evaluation of the similarities and differences of RCRA and CERCLA and identification and evaluation of all laws and statutes that needed to be considered as ARARs (Applicable or Relevant and Appropriate Requirements) for all SNL ER sites. The need for definition of any environmental constraints (because of the requirements of the National Environmental Protection Act [NEPA]) was identified. Biological and cultural-resource surveys were conducted in 1991 and 1995, respectively. (Hoagland Feb 1995)

Public outreach began with quarterly public meetings in 1992, and they continue to be conducted. In the early years of the Project, as environmental concerns associated with SNL achieved higher visibility, negative attention from the media and public became more frequent. In response, the ER Project extended invitations to individuals and groups to tour the ER sites and to participate in citizens' groups on specific topics. Early success with involving the stakeholders was achieved through two of these groups – one focused on site prioritization, and one convened to define future land use.

Future land-use designations for all of the ER sites located on land comprising KAFB (including the land withdrawn from the U.S. Forest Service) were developed by 1997 by a stakeholders group which included representatives of SNL, DOE, the U.S. Air Force, the U.S. Forest Service, and the U.S. Environmental Protection Agency (EPA), as well as local government officials and local citizens. These future land use designations were formalized in the Baseline for Future Use Options document. (DOE et al Sept 1995) This was the first of several successful stakeholder groups convened by the ER Project.

Public participation played a critical role in the eventual permitting (under RCRA) and construction of the first CAMU in the DOE Complex. In 1993, the EPA issued the "CAMU Rule", which established the option of using a CAMU to facilitate remediations that were hampered by the existing time limits for off-site waste disposal. The ER Project quickly grasped the potential of this rule, and in 1995, established a CAMU Working Group with membership from SNL, DOE, EPA, the NMED, and representatives of numerous stakeholder groups, including the most energetic activists. This group met monthly for almost a year, establishing a set of group values, debating the pros and cons of various on-site and off-site waste-disposal options, and ultimately reaching agreement on a recommendation to pursue permitting and construction of a CAMU. The CAMU began accepting waste in January 1999**.**

As the ER Project matured, the national setting for public participation on environmental matters moved toward Site-Specific Advisory Boards, to include members from regulatory agencies, local governments, and citizen stakeholders. The implementation of this concept for SNL was the Citizens' Advisory Board (CAB), which was created in the spring of 1995. The CAB, the membership of which varied from 15 to 20 individuals, served as a sounding board for many of ER's activities between 1995 and the fall of 2000, and provided valuable insight into community values and preferences associated with environmental restoration work at SNL. The CAB evolved into the Community Resource Information Office which serves as coordinator and clearing-house for topic-specific citizens groups to continue to provide input to the ER Project.

By the fall of 2002, the ER Project had addressed the vast majority of the sites. The ER Project consolidated management and reduced its staff to increase efficiency and facilitate focusing on the four Project initiatives. These initiatives are landfills, drains and septic sites, groundwater, and miscellaneous sites. The ER Project is currently in the process of finalizing regulatory post-closure requirements for many sites. A Long Term Environmental Stewardship (LTES) Plan (SNL Aug 2001) was written in 2001 with citizen input, and has been revised to include current status in 2003. A Transition Plan (SNL Oct 2003) has been written to transfer LTES responsibilities, such as remaining long term monitoring, to other, permanently funded departments within Sandia National Laboratories.

In 2003 a Compliance Order on Consent was negotiated with the NMED to establish a fixed schedule for completion of regulatory activities including definition of groundwater requirements and submittal of regulatory documentation associated with completion of the corrective action process for all Solid Waste Management Units and Areas of Concern managed by the ER Project. The agreed upon schedule aligns with both the Project's Performance Management Plan and with the SNL ER Project FY 2004 baseline.

1.1 Organization of the Report

The introduction of this report briefly covers the pertinent activities completed by SNL/NM's ER Project which place this document in context. The past, current, and future site missions and activities of Sandia National Laboratories are discussed in the following section, 1.2. The hazards and extent of the environmental contamination resulting from these activities are also summarized. The status of the cleanup program conducted by SNL/NM's ER Project is discussed in Section 1.3. The site cleanup strategy used to remediate approximately 200 sites is explained, and remaining fieldwork is delineated.

The next three sections consist of maps showing the Regional Context (Section 2.0), the Site-Specific context (Section 3.0), and the Hazard-Specific Context (Section 4.0). The Regional Context includes the city of Albuquerque and other population centers and lands surrounding the Kirtland Air Force Base, of which Sandia National Laboratories is a tenant. The Site-Specific Context covers the Technical Areas and remote test areas that make up Sandia National Laboratories.

The Hazard-Specific section has been divided into three sub-categories. Section 4.1 covers the Engineered Units, Section 4.2 covers the Groundwater Units, and Section 4.3 covers the other sites which have already had No Further Action proposals completed. Conceptual site models and explanatory text are included where appropriate.

Section 5.0 discusses known and potential variances between the end state that is expected to result from the presently scheduled ER work and the appropriate risk-based end-state.

Appendix A contains a detailed list of SNL/NM SWMUs that required investigation under the HSWA module of SNL's RCRA permit.

Appendix B contains a list of the major documents produced by the Environmental Restoration Project.

References are provided for further detail.

1.2 Site Mission

Past, Current, and Future Site Missions

Sandia was established on Kirtland Air Force Base in 1945 during the Manhattan Project as a division of the Los Alamos Laboratory to provide engineering, design, production, assembly, and field testing of the non-nuclear components of nuclear weapons. Sandia became an independent laboratory on Nov. 1, 1949, and opened its facilities in Livermore, Calif., in 1956. Sandia is managed by Sandia Corporation, a subsidiary of Lockheed Martin Corporation, for the Department of Energy's National Nuclear Security Administration.

Sandia's current strategic areas of focus include:

- Nuclear Weapons—ensuring the safety of the nuclear weapons stockpile
- Nonproliferation and Assessments—reducing our nation's vulnerability to threats of proliferation and weapons of mass destruction
- Military Technologies and Applications—developing high-impact responses to emerging national security threats
- Energy and Infrastructure Assurance—enhancing the surety of energy and other critical resources

Sandia's primary mission is ensuring the U.S. nuclear arsenal is safe, secure, reliable, and can fully support our Nation's deterrence policy. Sandia also develops technologies and systems that safeguard nuclear materials and monitor the globe for nuclear weapon activities.

Sandia's Nonproliferation and Assessments program reduces U.S. vulnerability to weapons of mass destruction (WMD). These include nuclear, biological, and chemical weapons, as well as non-conventional WMDs such as the high-jacked civilian airlines used to commit acts of war against our nation.

The Military Technologies and Applications program develops high-impact responses to national security challenges. Sandia's integrated science expertise allows us to develop technologically superior weapons and security systems. From basic research to global intelligence, Sandia supports numerous government and industry agencies in combating terrorism and threats against our armed forces and homeland.

The Energy and Infrastructure Assurance program supports Sandia's core purpose of helping our nation secure a peaceful and free world through technology. Our goal is to enhance the surety (safety, security, and reliability) of energy and other critical infrastructures.

Strides are being made in the areas of energy research, earth sciences, transportation systems, risk management technologies, environmental stewardship, and nuclear waste management. Sandia is also actively working to improve the nation's critical infrastructure surety. We are focusing on infrastructure elements in the areas of transportation, electric power grid, oil and gas distribution, telecommunications, finance and banking, and vital human services.

Sandia sees its mission responsibilities growing in several areas beyond Sandia's primary nuclear weapons mission, which is always foremost. This growth is in support of other important national security initiatives to meet the current and future threats from the world we exist in today. Sandia's ongoing and future mission is to become the laboratory that the U.S. turns to first for technology solutions to the most challenging problems that threaten peace and freedom for our nation and the globe.

Site Operations, Associated Hazards, and Extent of Environmental Contamination

Sandia/NM operations are conducted on Department of Energy-owned property assigned for Sandia use, non-Department of Energy-owned property permitted from other Federal Agencies, and privately-owned leased property. Sandia/NM's sites located on Department of Energy-owned property comprise 2,937 acres and include five Technical Areas. The sites located on non-Department of Energy-owned property include 5,648 acres of land permitted from the U.S. Air Force, a portion of which are on land withdrawn from the United States Forest Service.

SNL/NM consists of five technical areas and several additional test areas. Each area has its own distinctive operations. A description of each technical area and potential hazards is given below:

- Technical Area 1 (TA 1) has an employee population of approximately 5000, the largest at SNL/NM. This area is dedicated primarily to the design, research, and development of weapon systems, limited production of weapon system components, and energy programs. It also includes the main library and offices, laboratories, and shops used by administrative and technical staff. Generally, the only potential radioactive releases in TA 1 are tritium from two laboratory sources and activation products, such as argon-41, nitrogen-13, and oxygen-15, from two small accelerators. In accordance with DOE requirements, only small quantities of activation products are released from these stacks annually. Potential sources for nonradioactive effluent include the paint shops, process development laboratory, emergency diesel generator plant, solvent spray booth, foundry, and steam plant. There are 18 ER sites located in this area.

- Technical Area 2 (TA 2) is a 45-acre (1.8 km^2) facility that was established in 1948 for the assembly of chemical high-explosive (HE) main charges for nuclear weapons and later for production-scale assembly of nuclear weapons. Located in TA 2 are a small radioactive material decontamination and storage facility (Building 906), and a storage facility designed to temporarily hold PCB-contaminated material to be transported to an EPA-licensed disposal facility. An inactive low-level waste (LLW) disposal site and a classified waste landfill has been remediated. There are 18 ER sites located in this area.

- Technical Area 3 (TA 3), located 5 miles (8 km) south of TA 1, is composed of approximately 20 extensive test facilities, including sled tracks, centrifuges and a radiant heat facility, which simulate a variety of extreme environmental conditions. No radioactive effluent is released through normal operations in the area. Other facilities in TA 3 include a paper incinerator, an inactive LLW and mixed waste disposal site, a large melt facility, and a melting and solidification laboratory. There are 37 ER sites located in this area, including the Chemical Waste and Mixed Waste Landfills, and the Corrective Action Management Unit (CAMU).

- Technical Area 4 (TA 4), located 2 miles south of TA 1, consists of several inertial confinement fusion research and pulsed power research facilities. One large accelerator, the Particle Beam Fusion Accelerator-II, was completed in 1985. A large accelerator facility, the Simulation Technology Laboratory, houses seven pulsed power accelerators.

- Technical Area 5 (TA 5) houses several electron beam accelerators, three research reactors in two reactor facilities, an intense gamma irradiation facility, and a hot cell facility. The only airborne releases are air activation products from reactor operations primarily composed of argon-41 and xenon-133.

SNL/NM has additional test areas outside of the five technical areas listed above. These areas are located south and east of TA 3 and in the canyons on the west side of the Manzano Mountains. Thunder Range and Coyote Canyon Test Field are such areas. Depleted uranium (DU) was used in the past for explosive testing in some of the test areas, and was scattered across the soil surface. In some cases the test areas were surveyed following each test, and contaminated materials were collected and disposed of in accordance with DOE requirements.

The SNL ER Project is responsible for 203 SWMUs and 65 Areas of Concern (AOCs) requiring investigation under the HSWA module of SNL's RCRA permit. The SWMUs on the HSWA permit included sites within the Technical Areas as well as in the remote explosive test areas of KAFB. Types of sites include five old landfills (Chemical Waste Landfill, Mixed Waste Landfill, Classified Waste Landfill, Radioactive Waste Landfill, and the SWMU 78 Gas Cylinder Disposal Pit), 14 underground storage tanks, and numerous firing sites associated with past explosive testing. These firing sites contained features such as surface impoundments and scrap yards, burn pits, shallow subsurface dumps, and surface soil contamination. The AOCs are mostly septic tanks and drainfields. The details of the cleanup for these sites are described in the following section, Section 1.3. Three active sites that are not scheduled for immediate cleanup are SWMU 83, the Long Sled Track, SWMU 84, the Gun Facilities, and SWMU 240, the Short Sled Track.

Unexploded ordnance (UXO), metal and concrete debris, and abandoned test equipment have been removed from many sites. A large variety of hazardous and non-hazardous items were removed during the remediation of the landfills. Surface and subsurface soils have been remediated at many sites, but due to the low levels of COCs present in groundwater which do not pose a risk, no groundwater remediation has yet been necessary. Contaminants of concern (COCs) which have been successfully remediated from soil include radioactive materials, (mainly depleted uranium) metals, explosives, VOCs, SVOCs, asbestos, and PCBs.

The only hazards which remain are 1) the materials or residuals left in the engineered units, 2) the low levels of contamination detected in four groundwater areas, and 3) the residual contaminants at the NFA sites which were cleaned up to industrial or recreational risk levels, and did not meet the residential risk criteria. Details of these hazards are given in Section 4.0 of this document.

1.3 Status of Cleanup Program

Status of Work / Current State / End State

The ER Project is planned to complete in 2006. There were a total of 268 sites (including 203 SWMUs and 65 AOCs) which needed to be addressed at the SNL New Mexico facility on Kirtland Air Force Base (KAFB). There are three SWMUs and two AOCs that are in active use and that are not scheduled for immediate cleanup. No Further Action (NFA) proposals have been submitted to the regulators for 195 of the remaining 200 SWMUs. The New Mexico Environment Department has approved 149 of these NFA proposals. There are 47 (risk-based) NFA proposals at various stages of the regulatory review and approval process. Draft NFA proposals are in progress for three of these five SWMUs. One of these SWMUs is the Chemical Waste Landfill, which is regulated under a closure plan that requires alternative closure documentation. Eighteen of the AOCs have had assessment reports submitted to the NMED, and one has been removed from the permit. The rest of the AOC documents are scheduled for completion in the next year or so.

All SWMUs and AOCs have been characterized, as have an additional four areas of low-concentration groundwater contamination. Four major landfills and numerous smaller sites have been remediated without significant injury. Fieldwork is more than 90% complete on the four SWMUs (8, 58, 68 and 91) where NFA proposals will be submitted. These SWMUs are shown in Figure 1.3-1. The small amount of remaining fieldwork has been scheduled for FY04, and Voluntary Corrective Action Plans for these areas are now being generated with regulator and stakeholder input. The remaining cleanups involve removal of relatively small areas of contaminated surface and near-surface soils. Remediation is complete at all of the AOCs.

The ER Project is in the process of finalizing the regulatory post-closure requirements for many sites. In 2003 a Compliance Order on Consent has been negotiated with the NMED to establish a fixed schedule for completion of regulatory activities, including definition of groundwater requirements and submittal of regulatory documentation associated with completion of the corrective action process for all Solid Waste Management Units and Areas of Concern managed by the ER Project. The agreed-upon schedule aligns with both the Project’s Performance Management Plan and with the SNL ER Project FY 2004 baseline.

A Long Term Environmental Stewardship (LTES) Plan was written in 2001 with citizen input, and has been revised to include current status in 2003. A Transition Plan has been written to transfer LTES responsibilities, such as remaining long term monitoring, to other permanently funded departments within Sandia National Laboratories.

Cleanup Strategy

“One-Pass” Process

A “one-pass” process was incorporated in ER’s HSWA Module in 1997. Significant effort was invested in the interactions with regulatory staff at all levels, and the productivity of the ER Project (in terms of sites completed and NFA proposals submitted) soared.

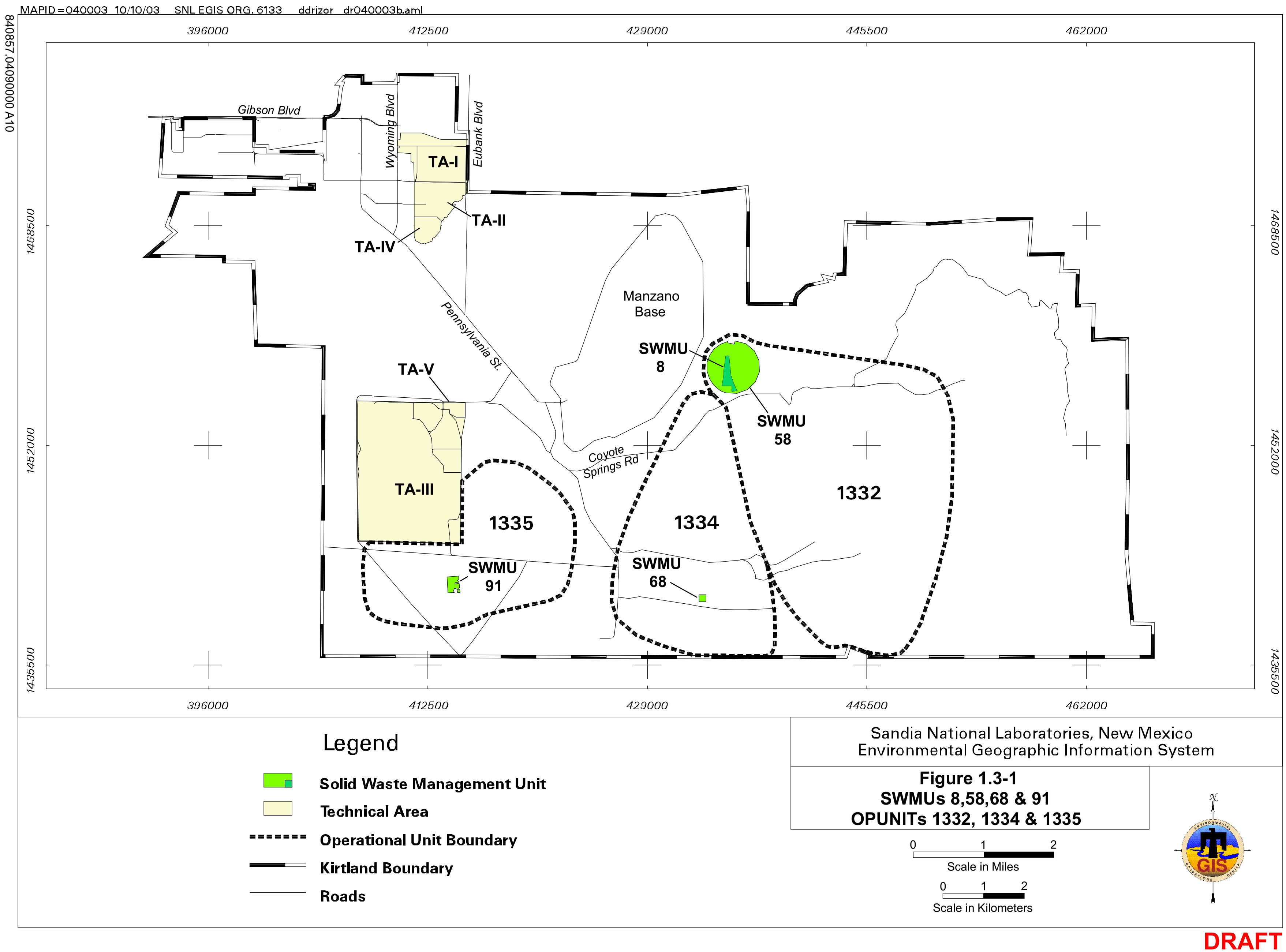

Figure 1.3-1
SWMUs 8,58,68 & 91
OPUNITs 1332, 1334 & 1335

On the surface, the "one-pass" process is deceptively simple. The goal is to eliminate all of the standard RCRA documents and review cycles, and replace them with a voluntary process that, in most cases, produces no more than two documents for delivery to the regulators (a Voluntary Corrective Action Plan and an NFA proposal) for regulatory review. The simplicity of the process is deceptive because, although it is straightforward, it relies heavily on rapport and real-time interactions with regulatory staff in order to avoid disconnects in adequacy of sampling, sufficiency of data, agreement on remediation goals, etc.

Obtaining Approval of Risk-Based "No Further Action" Proposals

In order to present a successful proposal for NFA for a contaminated site, several technical "framework" pieces are required. Teaming up-front with the regulators to finalize technical approach and therefore minimize wasted effort and fieldwork, several key documents were generated which the regulators then formally accepted.

Background concentrations of all naturally occurring contaminants, definition of the hydrogeologic framework, and an agreed-upon risk-assessment methodology (requiring the definition of future land use) were required for use in support of risk-based NFA proposals. Work on each of these was initiated during 1992 and 1993. Agreement on the suite of naturally occurring contaminants for both soil and groundwater was reached with the NMED by 1994, and a formally documented set of background concentrations for all of these materials was complete by 1997. The site-wide hydrogeologic project completed definition of the geologic, structural, and hydrologic setting of KAFB by 1997 as well.

Negotiating a risk-assessment methodology was somewhat more time-consuming, and was accomplished while active fieldwork for site characterization was underway. A probabilistic risk approach using a Sandia-developed software tool was proposed to NMED, but was rejected because they felt a probabilistic approach was too complicated and not approved by the EPA. Beginning in 1994, the human health risk assessments were conducted in accordance with the Risk Assessment Guidance for Superfund (RAGS), with agreement from EPA Region 6.

Future land-use designations for all of the land comprising KAFB (including the land withdrawn from the U.S. Forest Service) were developed in 1997 by a stakeholders group which included representatives of SNL, DOE, the U.S. Air Force, the U.S. Forest Service, and the U.S. Environmental Protection Agency (EPA), as well as local government officials and local citizens. These future land use designations were formalized in the Baseline for Future Use Options document. (DOE et al Sept 1995) These land use designations were then used in the risk assessments for ER sites. Agreement on human-health risk assessment was achieved in 1997, and final agreements on ecological risk assessment were achieved in 1999. Of the 196 NFA proposals submitted to the regulators, most have been risk-based.

Risk Assessment Methodology

All of the available analytical data were included in the risk evaluation, regardless of sample depth. In order to provide conservatism in this risk assessment, the calculation used only the maximum concentration value of each COC found anywhere on the site, and assumed that level for the entire site. The potential current and future receptors for each site were established based on the "Baseline for Future Use Options" (DOE et al, Sept 1995). For SNL/NM, the potential receptors included industrial, recreational, and residential. The industrial and recreational land uses were the most predominant.

The exposure pathways that were evaluated are ingestion of soil, inhalation of VOCs and dust, and ingestion of homegrown produce (for a residential receptor only). The water table at SNL/NM is deep and there are no on-site production wells, therefore exposure to groundwater is not evaluated for most of the sites. In addition, no dermal contact with soil was evaluated for the risk analysis. The exposure parameters were taken from EPA guidance (EPA, 1989 and 1991). These values are upper-bound values generally 90th or 95th percentile values, depending on the data available for each parameter.

The ecological risk assessments methodology was developed in accordance with existing EPA and NMED guidance (EPA, 1997 and 1998; IT July 1998) with final concurrence from NMED. General information regarding this complex calculation can be found in a summary document, The History of Risk Assessment in Sandia's ER Project (Nagy 2003). ADD REFERENCE

Several additional key SNL risk assessment methodology documents were developed and approved by NMED during this same time period. These include the following:

- "RESRAD Input Parameter Assumptions and Justification" (SNL/NM February 1998) which summarized all of the exposure parameters used to evaluate the human health radiological risk for implementation into the RESRAD computer code.

- "Request for Supplemental Information: Background Concentrations Report, SNL/KAFB" (Dinwiddie September 1997) summarized approved SNL/NM background screening levels for metals and radionuclides in surface and subsurface soils for various geographical areas.

- "Department of Energy/Sandia National Laboratories Response to the NMED Request for Supplemental Information for the Background Concentrations of Constituents of Concern to the Sandia National Laboratories/New Mexico Environmental Restoration Project and the Kirtland Air Force Base Installation Restoration Program Report" (Zamorski December 1997) summarized approved SNL/NM background screening levels for metals and radionuclides in surface and subsurface soils for the Canyons Study Area.

In 2002/2003 NMED requested several changes to the SNL/NM human health risk assessment methodology in order to meet their requirements. These revisions are summarized below.

- The inorganic analytes were screened against background concentrations and those that exceeded the approved SNL/NM background screening levels (Dinwiddie September 1997; Zamorski December 1997) for the area were considered to be COCs.

- For chemicals with significant risk, the upper confidence levels of the mean concentrations are calculated using EPA approved computer software (for both human health and ecological chemicals) and the risks are re-calculated using these concentrations to more accurately represent the concentrations occurring at the site.

- Residential risks are quantified and the results are discussed in the human health risk assessment (including any decision making sections).

- Dermal contact with soil for all potential land uses is evaluated as an exposure pathway.
- The ingestion of homegrown produce pathway will no longer be evaluated.

A summary document, The History of Risk Assessment in Sandia's ER Project (Nagy 2003), gives more technical detail of the changes.

Future Land Use

Future land use designations were formalized in the Baseline for Future Use Options document developed by a stakeholders group which included representatives of SNL, DOE, the U.S. Air Force, the U.S. Forest Service, and the U.S. Environmental Protection Agency (EPA), as well as local government officials and citizens. (DOE Sept 1995) The purpose of this document was to "define appropriate short and long term future uses for DOE land and facilities by including significant public input." Citizens were able to provide input regarding cleanup decisions, existing and new DOE activities. The CAB played a key role as a contributor of public input to the DOE for the evaluation of options for future use of the DOE lands and facilities located in the KFC. The focus of the CAB was to provide input to DOE regarding projected future land uses as they relate to cleanup level.

Communities' preferences were considered as answers to the questions were pursued:

- What are the priorities for site cleanup?
- What are the technological options for cleanup and waste disposal?
- What are the preferred land-use options and are they compatible with U.S. EPA cleanup levels?
- What could be done to protect the quality of the community's water and air?
- How clean is clean?"

In order to divide a very large volume of information about the DOE facilities and ER sites into more easily managed portions, the facilities/sites were grouped into sixteen sectors according to geographic and project areas. The sectors were then distributed among seven management areas based primarily on current land use, which were described in a series of workbooks. These workbooks contained history and background of the various facilities and ER sites, as well as current use.

The EPA and NMED then considered the CAB's preferred use options, ER project date, DOE/SNL mission and other site-specific factors as part of the cleanup level negotiation process.

Expanding Use of Preliminary Remediation Goals

As is common for many environmental projects nation-wide, preliminary remediation goals are established with the regulator prior to initiating a remediation. SNL ER extended this practice to the characterization step. For example, the ER Project has 84 drain and septic systems to address. Rather than approaching each system individually, sampling it, then checking with the regulator to determine if more work is needed, a different strategy was employed. The SNL staff responsible for these systems negotiated a strategy with the NMED that defined quantitative analytical results as "go-no-go" criteria for each step of the characterization process. In addition, each individual site was visited by a team of SNL and NMED staff and evaluated to pre-define sampling locations. As a result of these cooperative negotiations, an agreement was reached on when characterization would be complete and fieldwork could stop. All sites now have undergone shallow soil sampling and/or passive soil vapor sampling. The agreement stipulated that 150-ft deep vapor wells would be installed for additional deeper characterization of the "worst" 10% of the systems based on the shallow soil and soil vapor sampling results. Analytical results for samples from these vapor wells were well below the levels that would require additional work, therefore, no additional characterization is planned for these sites. The up-front planning and negotiation enabled substantial efficiencies to be achieved in all aspects of work on these sites.

Risk assessments will be performed for each of these sites based primarily on the analytical results of environmental samples that have been collected at each location. It is assumed that the results of the risk assessments will conclusively demonstrate that the sites do not pose a threat to human health or the environment, and that the corresponding Assessment Reports which propose No Further Action will be approved by the NMED.

Variable Approach to Characterization and Cleanup

A decision was made not to lock the Project into a single approach to characterization and cleanup. Early in the Project, all ER sites were grouped into Operable Units, and the effort began to draft RCRA Facility Investigation Workplans that described how to assess each of these groups as a whole. In some cases, this approach seemed workable. However, it became apparent that many sites would be better handled individually, or even jointly with single sites in other Operable Units for efficiency. From the time of this realization, Operable Units continued to exist only for the purposes of budgeting and tracking; the field work was designed around any combination, however large or small, that made logistical sense.

The following are the highlights of the accomplishments of the ER Project to date:

- Future land use designations established with regulator and stakeholder input (1995)
- Risk Assessments used in NFA proposals, in conjunction with future land use, since 1995
- Active stakeholder participation through CAB and CRIO, beginning 1995
- Submittal of 195 NFA proposals for the SNL/NM facility.
- Long Term Environmental Stewardship Plan submitted to DOE/HQ August 2001

2.0 SNL REGIONAL CONTEXT

The Sandia National Laboratories facilities are surrounded by the Kirtland Federal Complex, (Kirtland Federal Complex refers to Kirtland Air Force Base and all the other federal agencies located at Kirtland Air Force Base) and includes some co-use agreements on United States Air Force (USAF) property. An area of the Manzano Mountains in the eastern portion of the approximately 80 square-mile (sq mi) Kirtland Federal Complex has been withdrawn from the USFS for the exclusive use of the USAF and the Department of Energy.

Located to the north and west of the Kirtland Federal Complex, Albuquerque is the largest population center in Bernalillo County. The 2000 census figure shows an Albuquerque population of 448,607. The greater Albuquerque area, including Rio Rancho and Corrales, has approximately 556,678 inhabitants. The 2000 Metropolitan Statistical Area (MSA) population, which includes Bernalillo County, Valencia County, and Sandoval County, is 712,738. The Isleta Indian Reservation borders the Kirtland Federal Complex on the south. The Pueblo of Isleta, located approximately 8 miles southwest of the base, had a population of 3,166 in 2000.

The Bureau of Business and Economic Research (BBER) at the University of New Mexico (UNM) creates population projections based on statistics they keep for the state of New Mexico. They estimate that by the year 2025 Bernalillo county will have a population of 729,750. The MSA population which includes Bernalillo, Valencia and Sandoval counties is estimated to grow to 1,028,341 by 2025. It is assumed that this population growth may change the use of the lands bordering the KFC, which may put pressure on the KFC boundaries, and may begin to encroach or surround the complex. The current and end state regional physical and surface interface maps are shown in Figures 2.1a and 2.1b.

Kirtland Federal Complex is located on a high, arid mesa about five miles east of the Rio Grande in Bernalillo County, New Mexico. The mesa is cut by the east-west trending Tijeras Arroyo, which drains into the Rio Grande. The east side of the Kirtland Federal Complex north of Tijeras Arroyo is bounded by the southern end of the Sandia Mountains and south of Tijeras Arroyo by the Manzanita Mountains (foothills of the Manzano Mountains). Most of the area is relatively flat, sloping gently westward toward the Rio Grande. However, the eastern portion of the Complex extends into the canyons of the Manzanita Mountains. The western slope of the Manzanita Mountains facing the base is precipitous and rough and has numerous arroyos. Elevations range from 4920 feet (ft) at the Rio Grande to 7988 ft at the Manzano Lookout Tower in the Manzano Mountains. The mean elevation of the Kirtland Federal Complex is 5348 ft. The current and end state regional human and ecological land use interface maps are shown in Figures 2.2a and 2.2b.

[NOTE: All population statistics came from the Bureau of Business and Economic Research (BBER) at the University of New Mexico website: http://www.unm.edu/~bber/.]

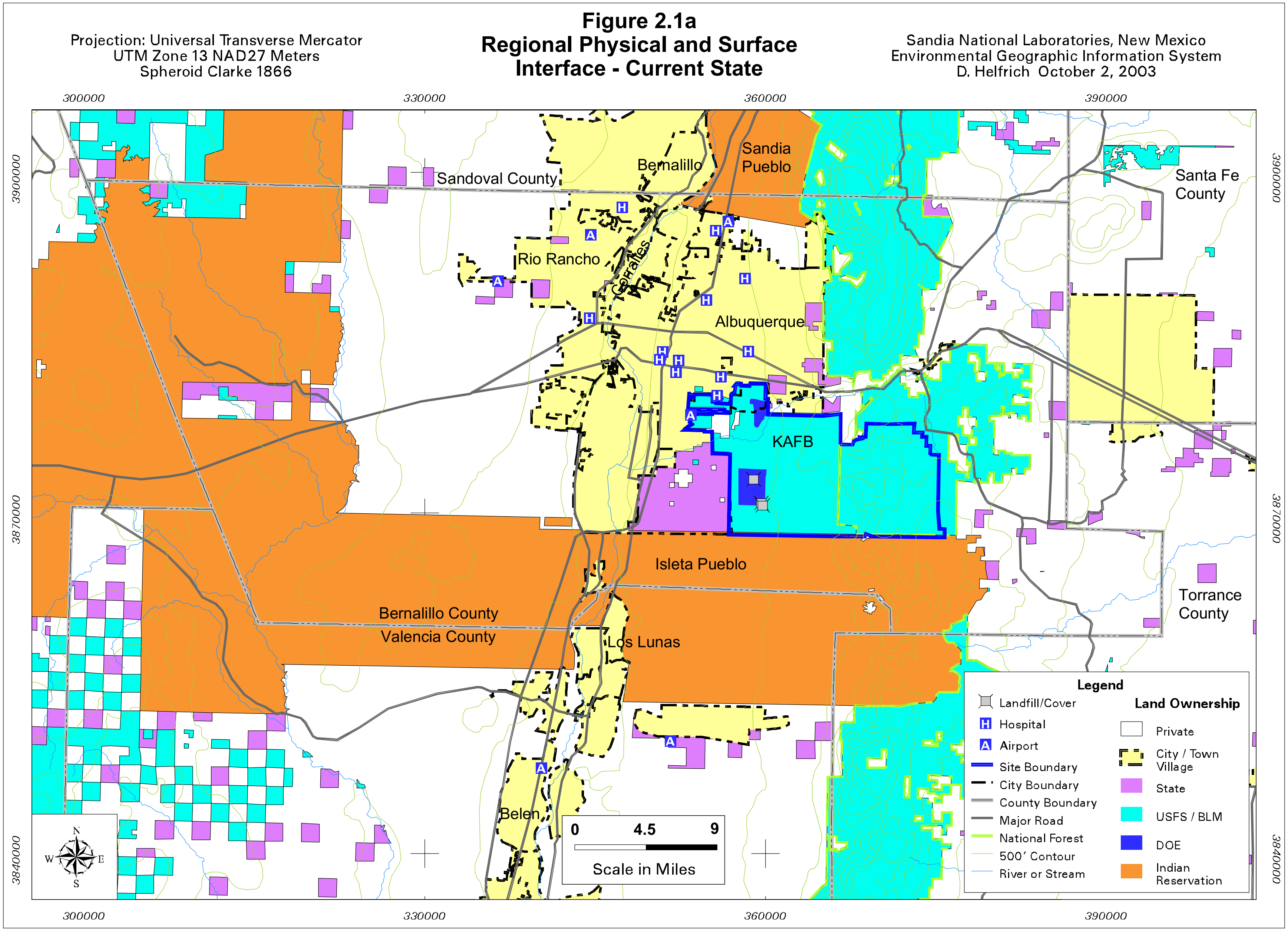

Figure 2.1a Regional physical and surface interface - current state

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Figure 2.1b
Regional Physical and Surface Interface - End State

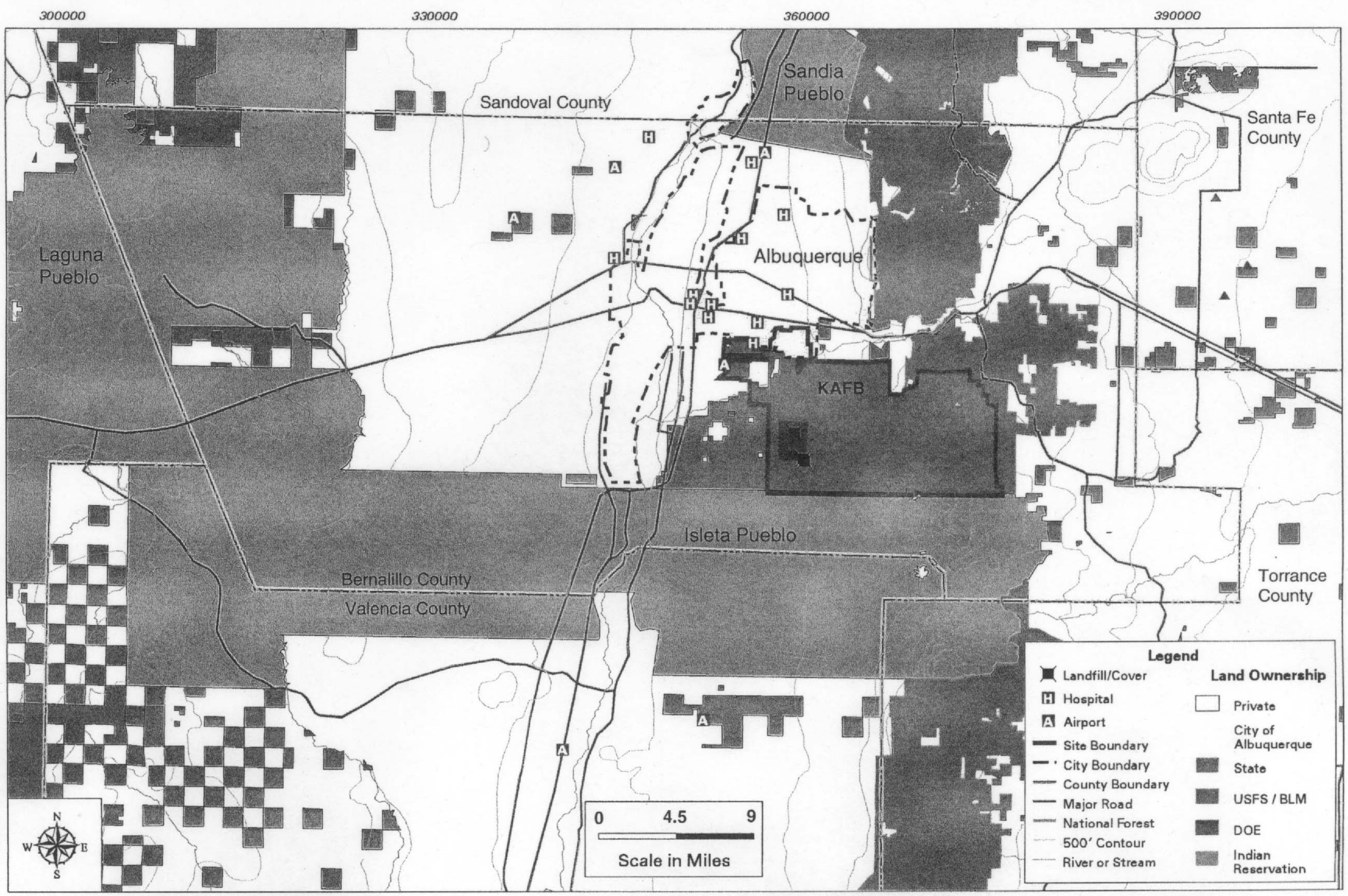

Figure 2.1a. Regional physical and surface interface - RBES

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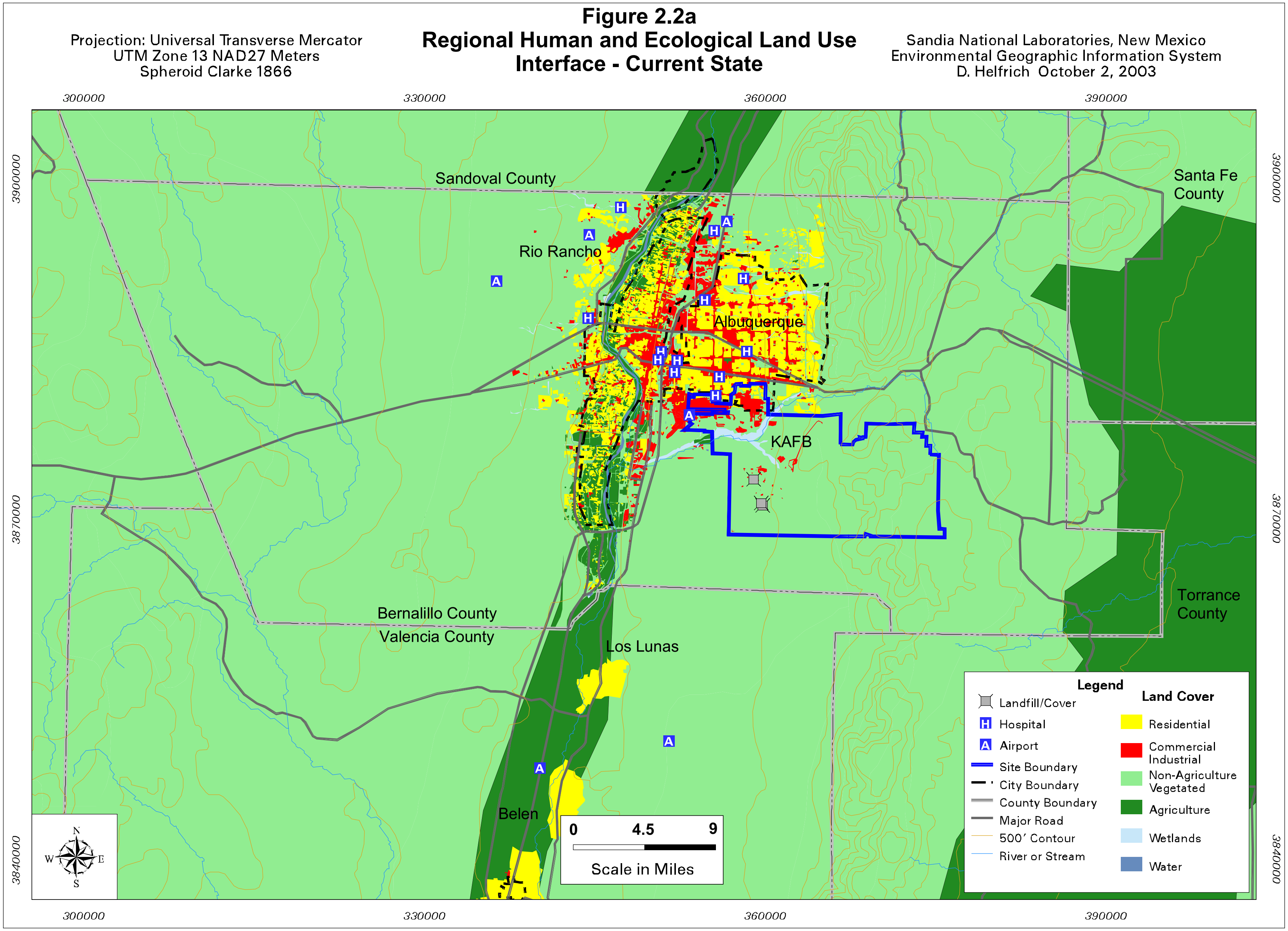

Figure 2.2a Regional human and ecological land use interface - current state

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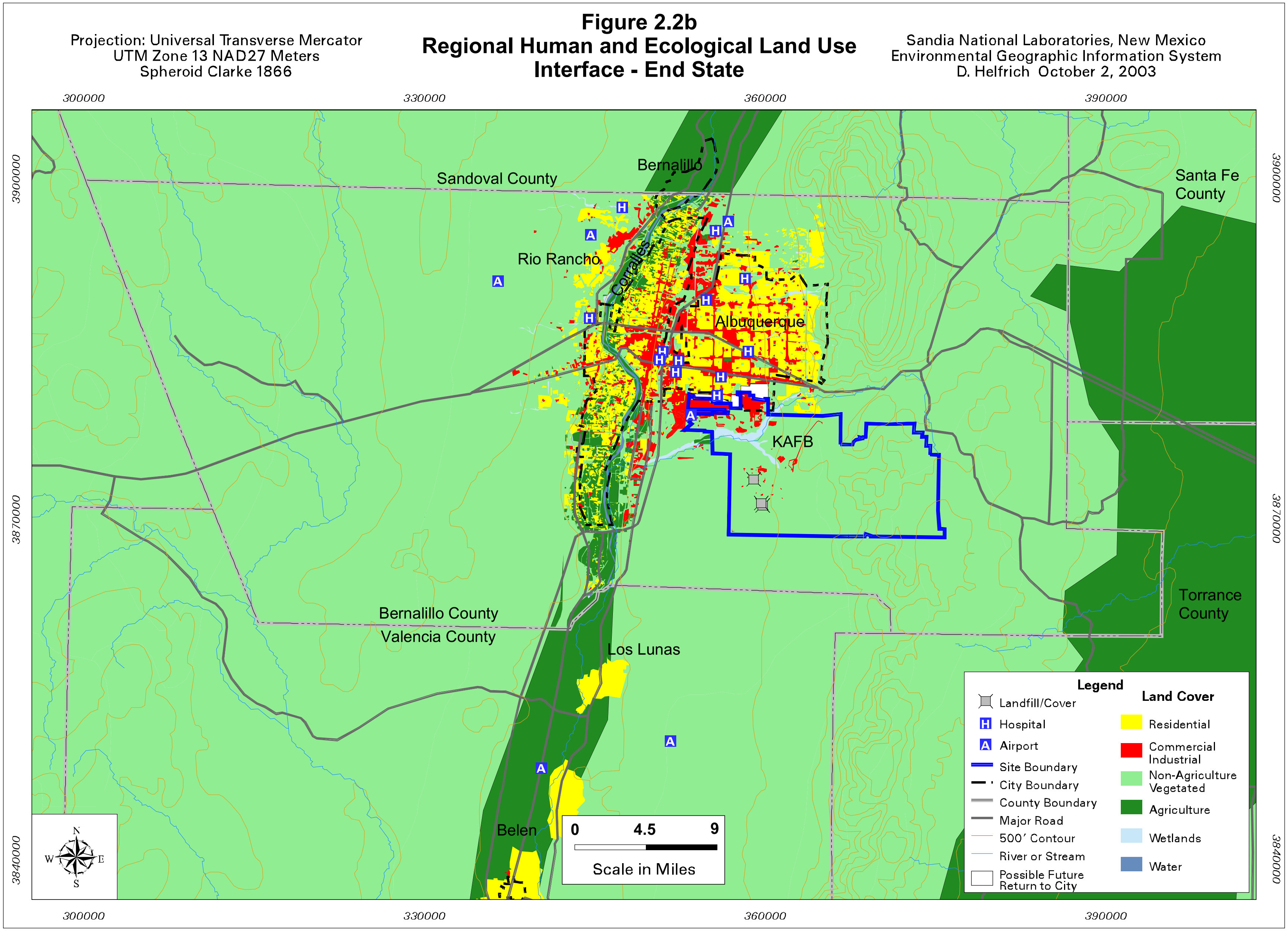

Figure 2.2b Regional human and ecological land use interface - end state - RBES

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3.0 SNL SITE CONTEXT

The Sandia National Laboratories facilities are surrounded by the Kirtland Federal Complex. The SNL ER Project is responsible for more than 200 ER sites located within the Technical Areas and remote areas of KAFB. The Technical Areas are found within the populated portion of the Air Force Base and the central area of the DOD owned property. The physical and surface interface end state differs from the current state in that only the active ER sites are shown, and the boundary of KAFB may reflect change in property ownership. This is reflected in Figures 3.1a and 3.1b.

Kirtland Federal Complex is located on a high, arid mesa about five miles east of the Rio Grande in Bernalillo County, New Mexico. The mesa is cut by the east-west trending Tijeras Arroyo, which drains into the Rio Grande. The east side of the Kirtland Federal Complex north of Tijeras Arroyo is bounded by the southern end of the Sandia Mountains and south of Tijeras Arroyo by the Manzanita Mountains (foothills of the Manzano Mountains). Arroyo del Coyote runs through the central portion of the Air Force Base with Tijeras Arroyo joining Arroyo del Coyote in the Northwestern portion of the Base.

Most of the area is relatively flat, sloping gently westward toward the Rio Grande. However, the eastern portion of the Complex extends into the canyons of the Manzanita Mountains. The western slope of the Manzanita Mountains facing the base is precipitous and rough and has numerous arroyos. Elevations range from 4920 feet(ft) at the Rio Grande to 7988 ft at the Manzano Lookout Tower in the Manzano Mountains. The mean elevation of the Kirtland Federal Complex is 5348 ft. Figures 3.2a and 3.2b show the human and ecological interface, with the previously discussed potential boundary change.

SNL Environmental Restoration Sites are located on lands which have varying use permits, as shown in Figures 3.3a and 3.3b.

Figure 3.1a
Site Context Physical and Surface Interface - Current State

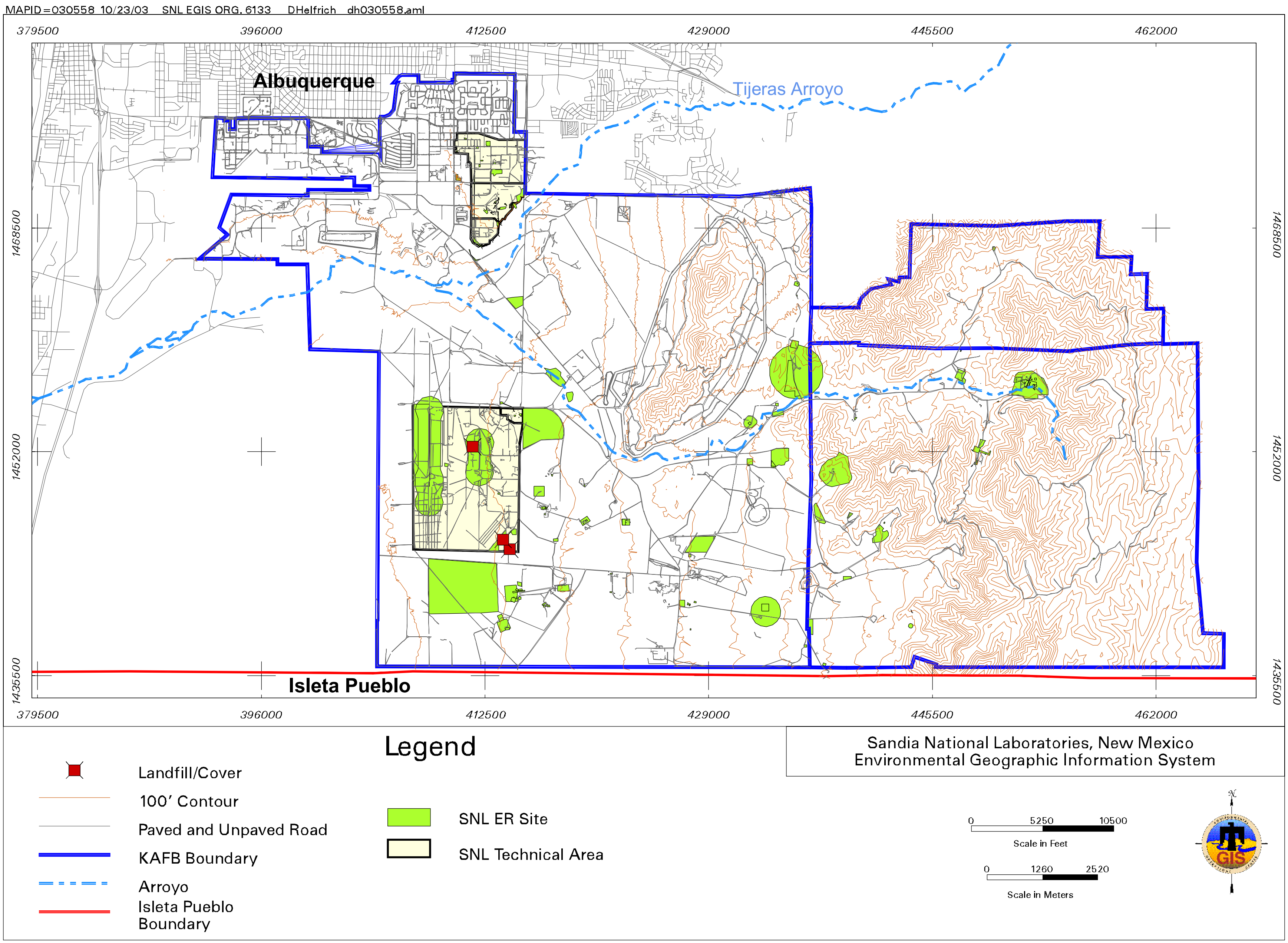

Figure 3.1a. Site physical and surface interface - current state

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Figure 3.1b
Site Context Physical and Surface Interface - End State

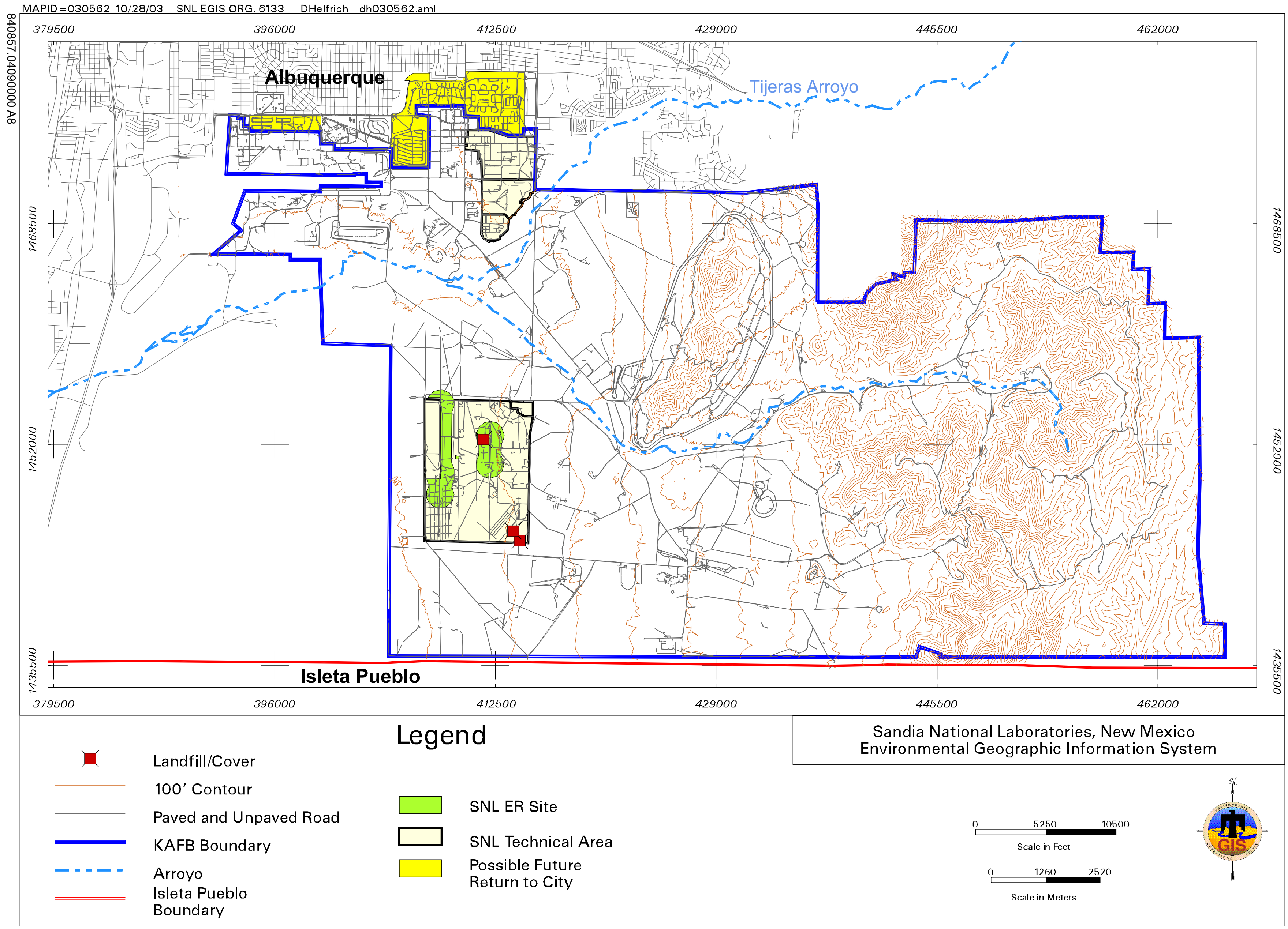

Figure 3.1b. Site physical and surface interface - rbes

Figure 3.2a
Site Context Human and Ecological Interface - Current State

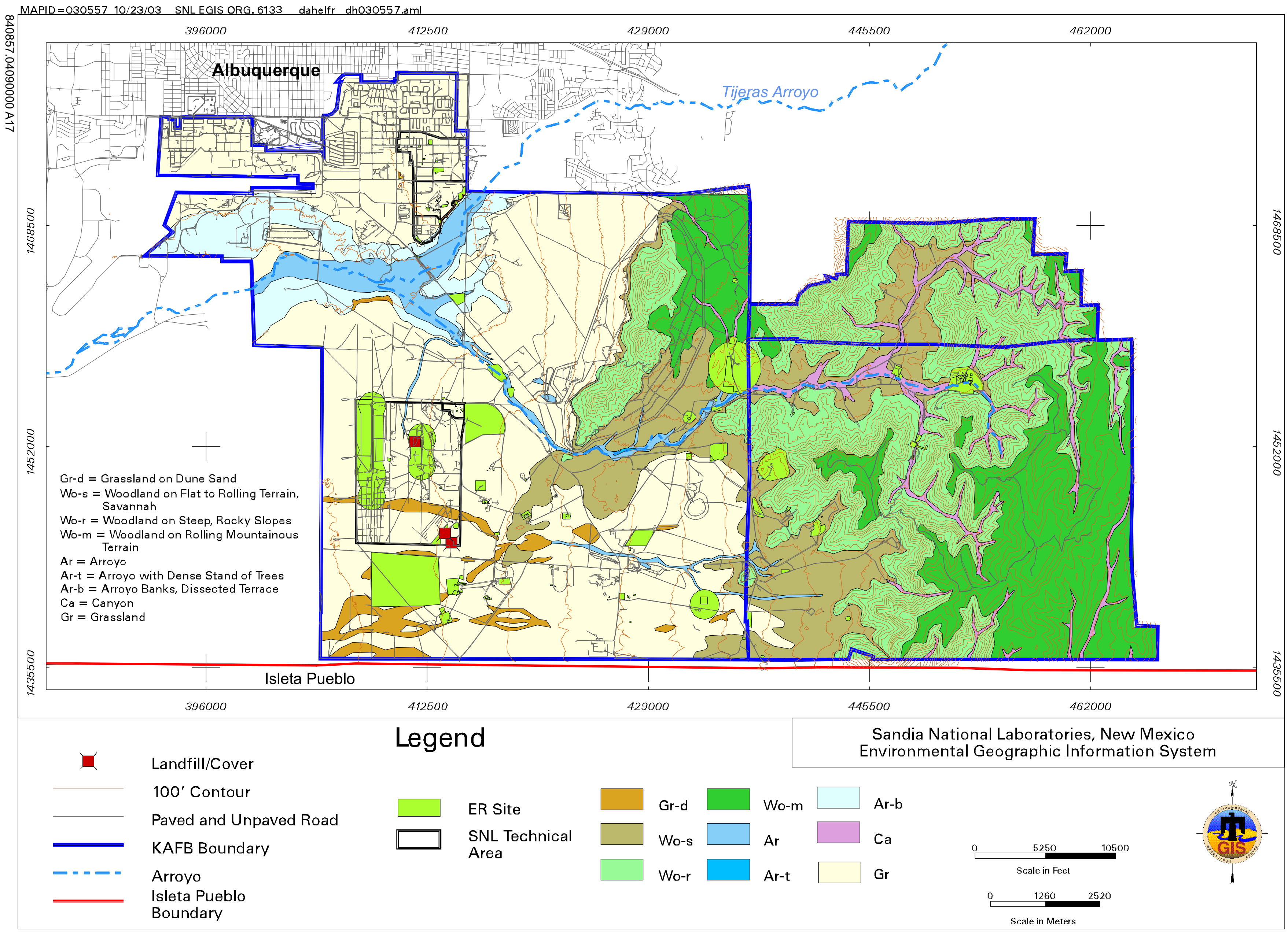

Figure 3.2a. Site human and ecological land use - current state

Figure 3.2b
Site Context Human and Ecological Interface - End State

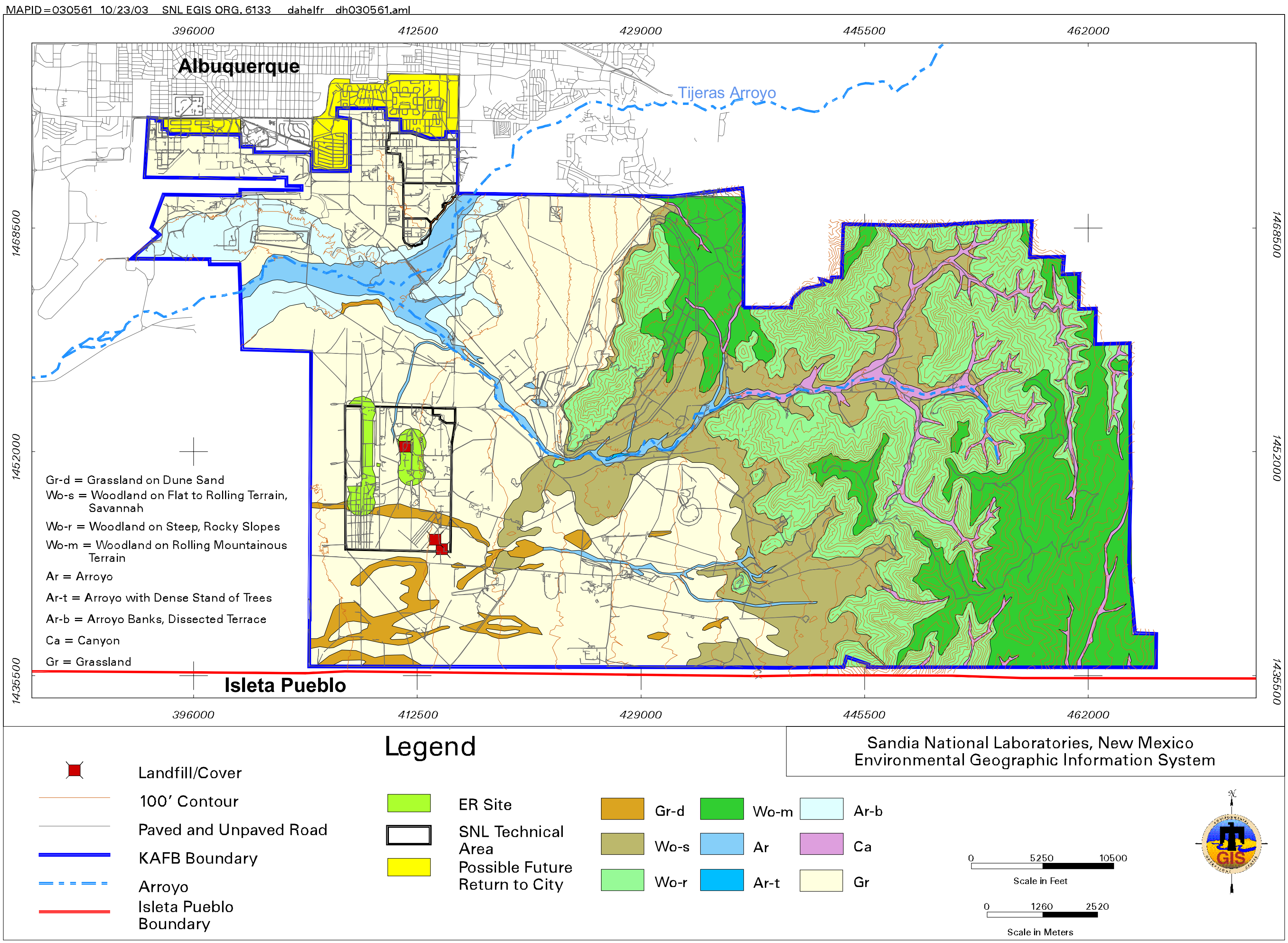

Figure 3.2b. Site human and ecological land use - rbes

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Figure 3.3a
Site Context Legal Ownership - Current State

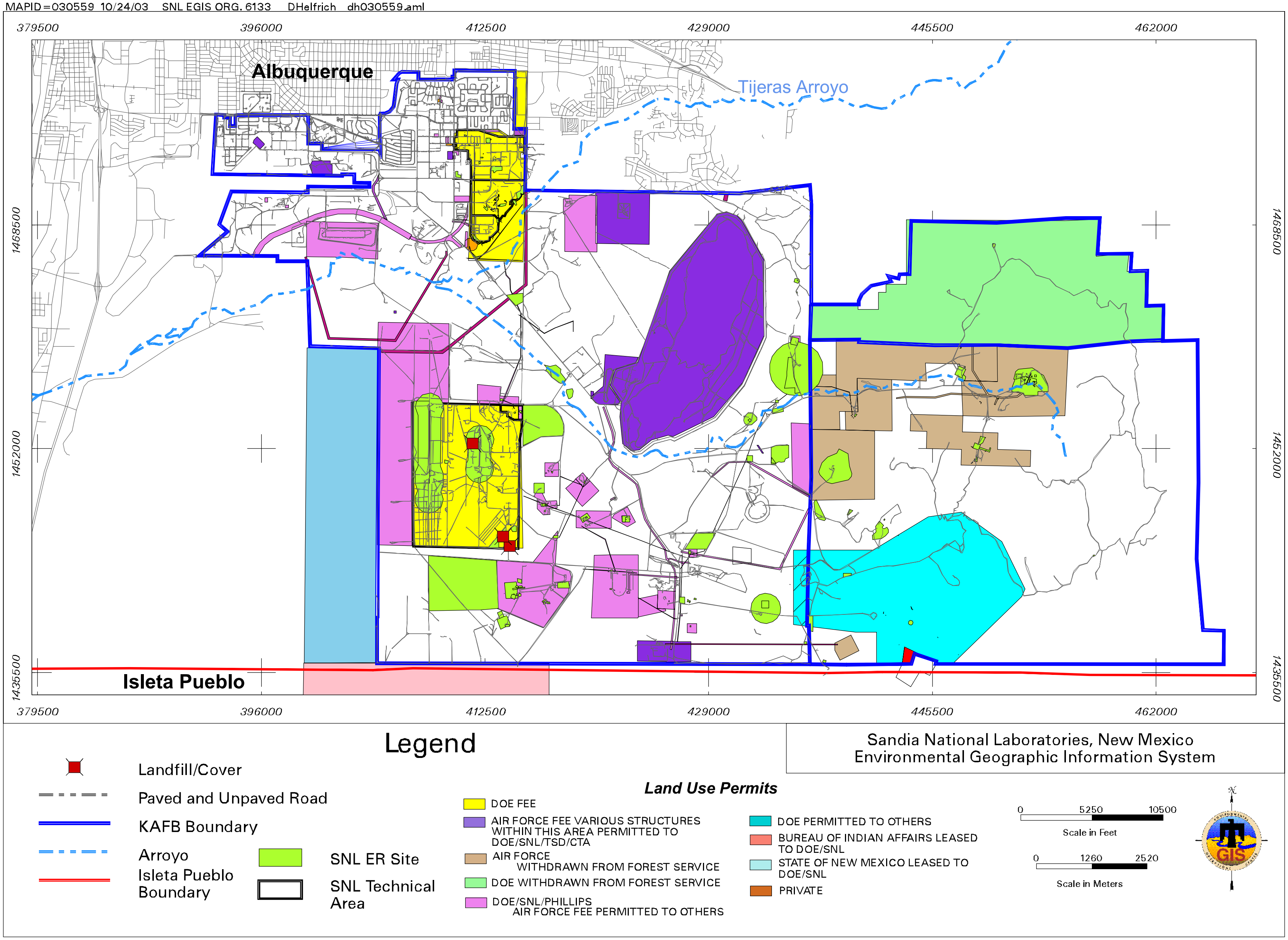

Figure 3.3a. Site legal ownership - current state

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Figure 3.3b
Site Context Legal Ownership - End State

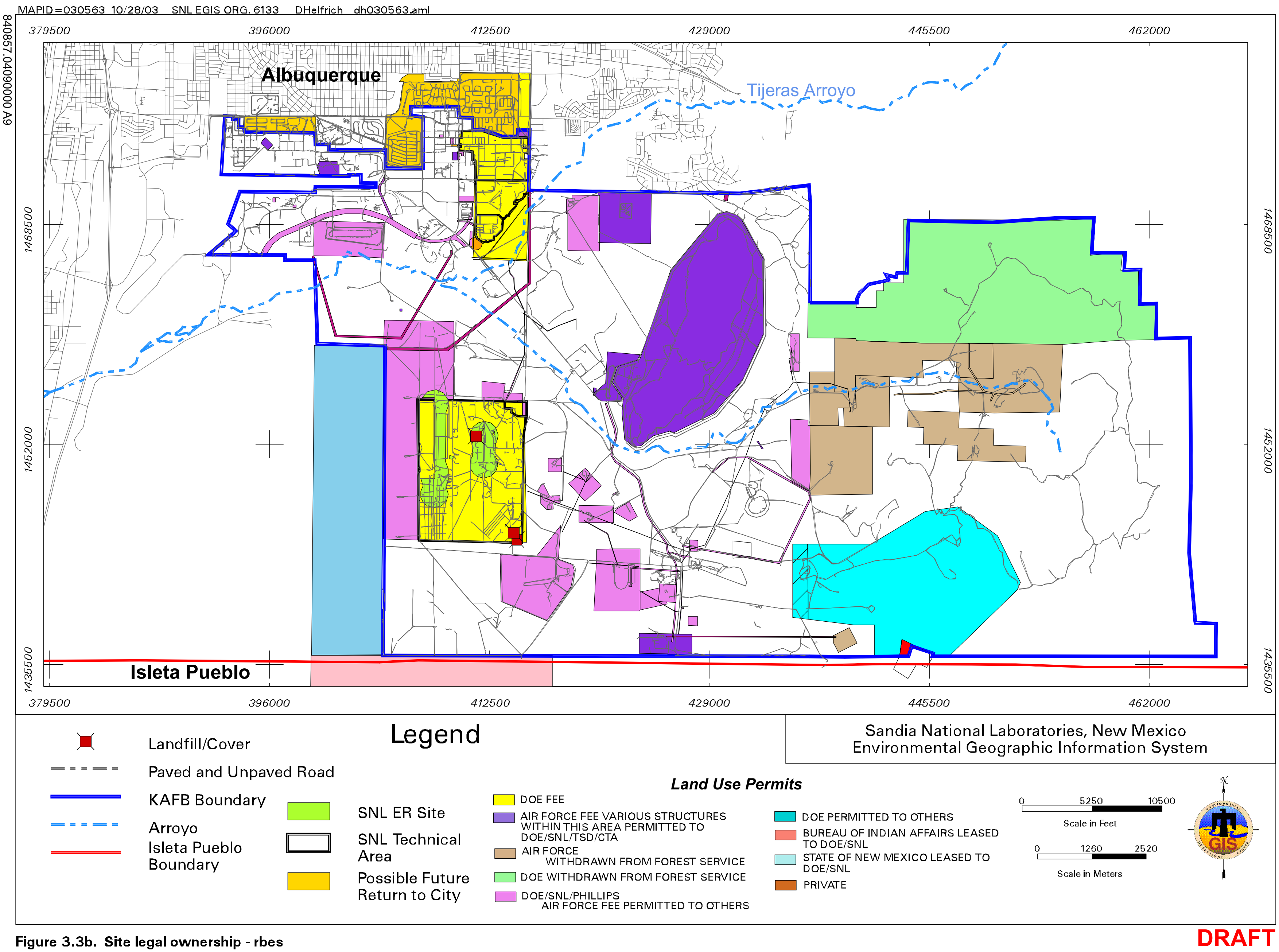


Figure 3.3b. Site legal ownership - rbes

4.0 HAZARD-SPECIFIC DISCUSSION

Three categories of environmental hazards remain from past operations at SNL/NM; 1) the materials or residuals left in the engineered units, 2) the low levels of contamination detected in four groundwater areas, and 3) the residual contaminants at the NFA sites which were cleaned up to industrial or recreational risk levels only, and did not meet the residential risk criteria. Risks to human health or the environment from these hazards are minimal. These hazards are described in greater detail in Sections 4.1-4.3.

4.1 Engineered Units

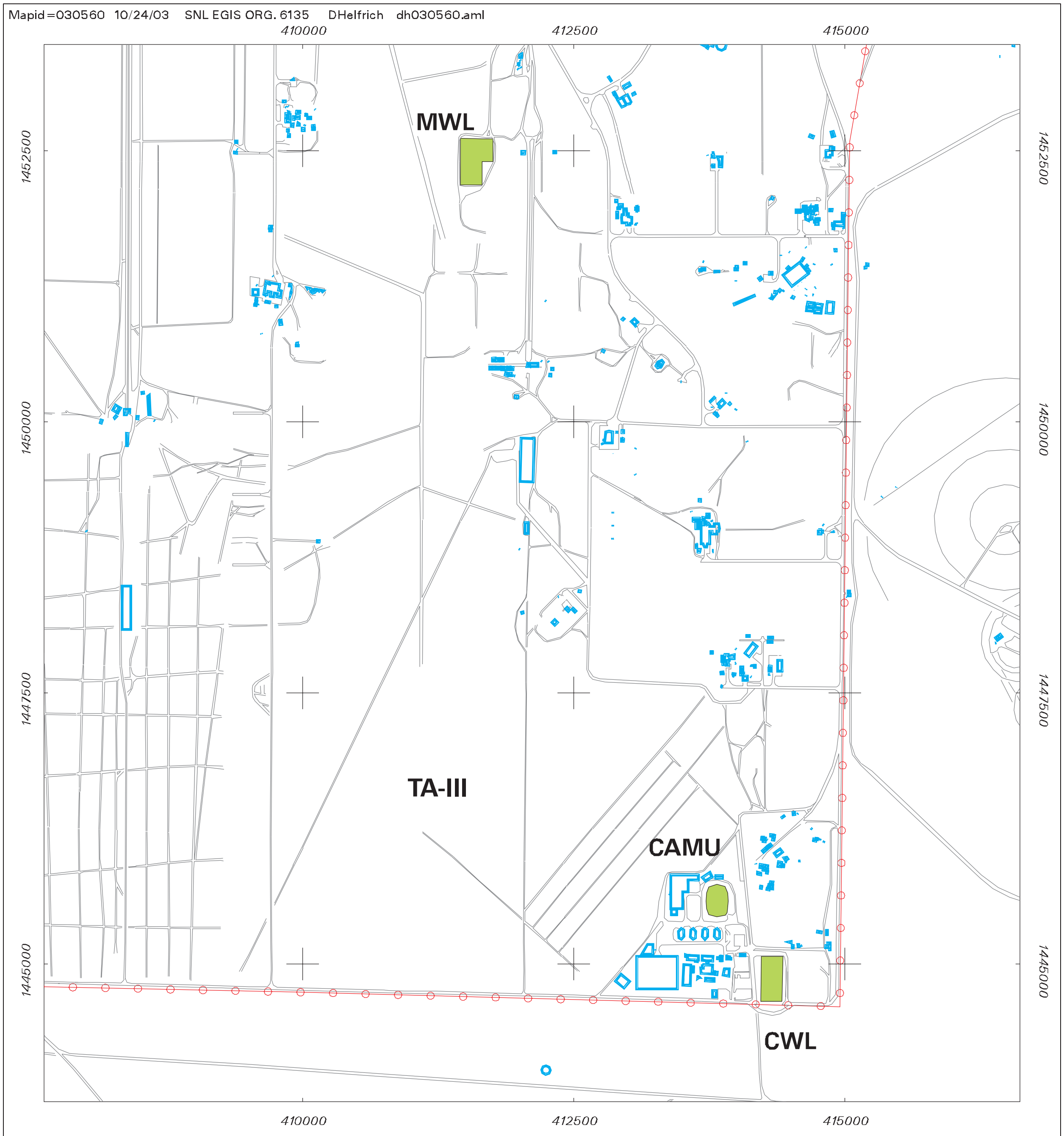
4.1.1 Introduction

Sandia National Laboratories, New Mexico (SNL/NM) environmental Restoration Project (ER) includes three engineered units. These include the Chemical Waste Landfill (CWL), the Mixed Waste Landfill (MWL), and the Corrective Action Management Unit (CAMU). All three units are located in SNL/NM Technical Area 3 (TA-3), which is approximately 5 miles southeast of Albuquerque International Sunport and 4 miles south of Sandia National Laboratories/New Mexico (SNL/NM) Technical Area (TA)-1.

The CWL is a 1.9-acre interim status landfill being closed under 20.4.1.600 New Mexico Administrative Code (NMAC), incorporating 40 Code of Federal Regulations (CFR) 265 Subpart G and the Closure Plan (SNL/NM December 1992). The CWL is located in the southeastern corner of TA-3 (Figure 4.1.1-1 – big map showing all three EUs). The CWL was used for the disposal of chemical, radioactive, and solid waste generated by SNL/NM research activities from 1962 until 1985 (liquid disposal ceased in 1981), and as a hazardous waste drum-storage facility from 1981 to 1989. After 1989 the CWL was no longer used as a hazardous waste drum-storage facility.

The MWL occupies 2.6 acres in the north-central portion of TA-3. The location of the MWL is shown on Figure 4.1.1-1. (– big map showing all three EUs). The MWL accepted containerized and uncontainerized low-level radioactive waste and minor amounts of mixed waste from SNL/NM research facilities and off-site generators from March 1959 to December 1988. The site was used as an above-ground mixed waste drum storage facility in the 1990's. Approximately 100,000 cubic feet of low-level radioactive waste (excluding packaging, containers, demolition and construction debris, and contaminated soil) containing 6,300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL. The Resource Conservation and Recovery Act (RCRA) investigative process identified tritium as the primary contaminant of concern at the MWL. Tritium has been a consistent finding at the MWL since environmental studies were initiated in 1969. Tritium occurs in surface and near-surface soil in and around the classified area of the landfill.

The CAMU is a 19-acre site currently undergoing closure as required by 20 New Mexico Administrative Code (NMAC) 4.1.500 incorporating Title 40 of the Code of Federal Regulations (40 CFR) Section (§) 264.552 and the Closure Plan (SNL/NM, October 2002). The CAMU, located in the southeastern corner of TA-3 (Figure 4.1.1-1 – big map showing all three EUs), was used for the staging, treatment, and containment of hazardous remediation waste generated during the excavation of the CWL.



Legend

Building / Structure

Paved and Unpaved Road

TA-III Boundary / Fence

Hazard: Landfill / Cover

Figure 4.1.1-1
Map of All Three Engineered Units,
Environmental Restoration Project,
Sandia National Laboratories

0 750 1500
Scale in Feet

0 180 360
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

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All three of these units have undergone extensive work and are very nearly at their final risk-based industrial end state. There is still some remaining work necessary to achieve the final risk-based end state for each of the three units. The documents describing the risk-based end states for these units have all been submitted to the regulatory agencies and are all either approved as a regulatory permit or are currently being reviewed and commented on by the regulatory personnel. Remaining work at the sites is limited to the implementation of the proposed or approved end states.

The CAMU has stored, treated and placed waste in the containment cell. The final cover has been installed and the unit is undergoing regulatory closure. The regulators have approved the end state documents for this site. The work remaining to achieve the risk-based end state for this unit includes the final site grading and removal of a few temporary structures and storage buildings, the removal of the remaining waste (predominantly leachate collected from the containment cell), records management, and the reporting and submission of final regulatory deliverables. Monitoring of this unit is required by the permit and is included in the costs of closure until 2006. Although not anticipated, contingency analysis has identified a risk to this end state if any leak detections are encountered during this monitoring or any other evidence of cell failure is encountered between now and 2006.

The CWL was remediated by the implementation of two voluntary corrective measures: vapor extraction and excavation. The process of selecting and installing the final remedy is in the last stages of the regulatory system. The final remedy proposed is installation of a simple vegetative cover to be completed at grade. Since this landfill is not a waste-in-place closure, the cover at grade satisfies the requirements for minimal long term maintenance. This cover has been designed and proposed to the NMED in a Class 3 final remedy selection document along with a post-closure care plan and permit application that details long term monitoring of the groundwater. The NMED is currently reviewing this design package and is expected to issue comments at the end of October 2003. Once comment resolution occurs and the public comment period expires, the cover will be installed and the site will be graded and detour roads will be removed. In the meantime, the excavation backfilling is proceeding, after receiving regulatory input and verbal approval to proceed. Some waste still remains at the site and some demobilization of site equipment, supplies, and temporary structures are in progress. Although not anticipated based on discussions with NMED personnel, significant changes to the final remedy or post-closure care requirements may be deemed necessary by the NMED. This contingency has been identified as a risk to the expected end state.

The MWL poses acceptable risk without remedial action (assuming groundwater and vadose zone monitoring) and is currently in the CMS process with a final waste-in-place remedy as the preferred alternative. This remedy was detailed in a Correctives Measures Study Report, delivered to the NMED earlier this year. This final remedy selection document proposes a vegetative cover with a monitoring network installed in the cover to detect the migration of any contaminants. The final selection, including extensive public comment and regulatory input, and construction of this cover is expected to occur in the next two years.

The conceptual site models for each of these engineered units are distinct and will be presented separately in the following sections.

4.1.2 CWL Conceptual Site Model

Figure 4.1.2-1 presents the Conceptual Site Model (CSM) for the CWL in its current state. The CSM is documented in detail in the risk assessment presented in the LE VCM Final Report

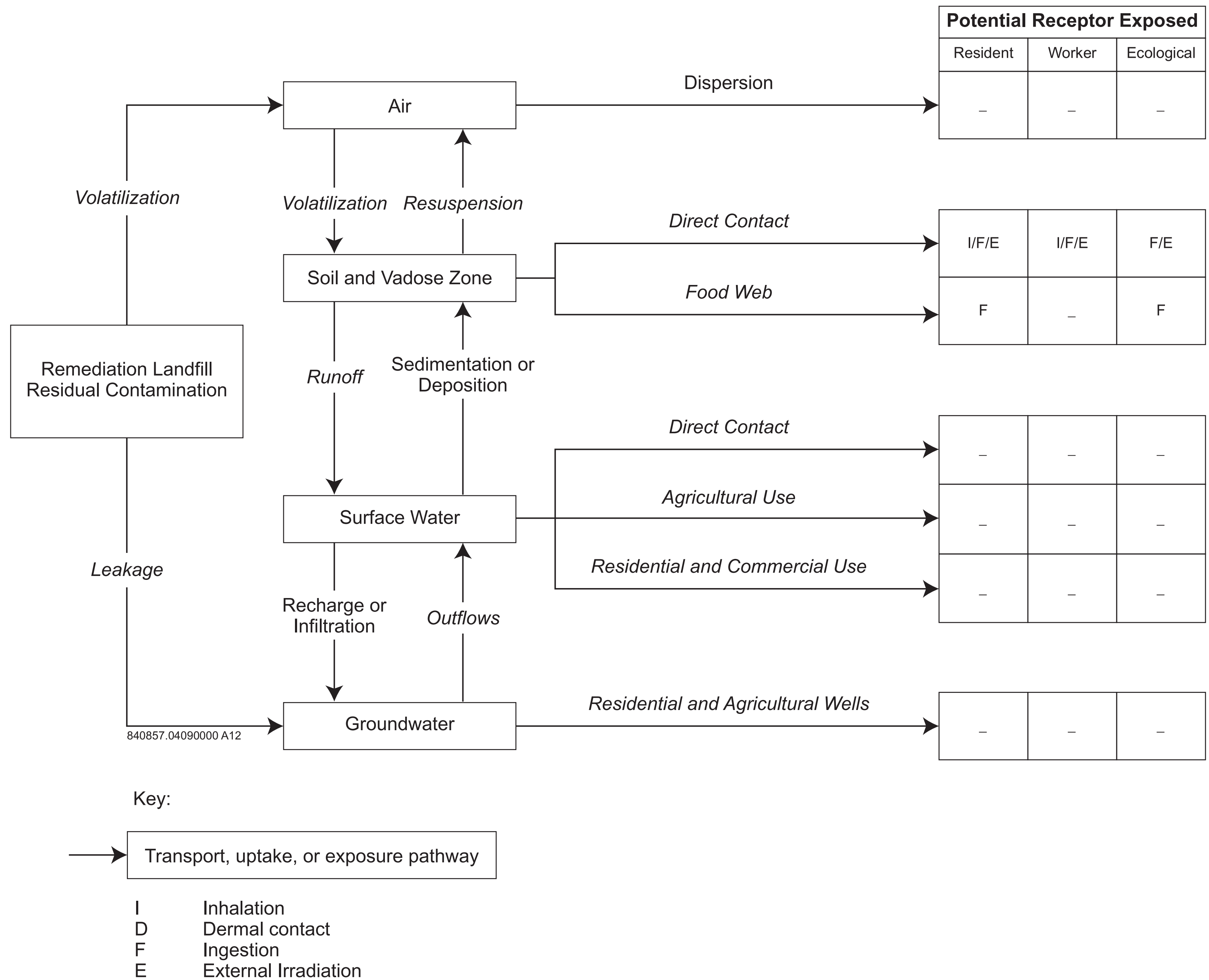

Figure 4.1.2-1
CWL CSM - Current State

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(SNL/NM April 2003), which demonstrates that the CWL meets the NMED-approved risk-based cleanup standards designed to protect human health and the environment (SNL/NM August 2000). This CSM provides a visual presentation of site exposure pathways at the CWL that currently connect a source of contamination to possible human and ecological receptors. When used in conjunction with the End-State Vision, this CSM shows how current exposure conditions at the CWL could be eliminated, mitigated or controlled.

4.1.2.1 Description (Hazard Area Summary)

The CWL hazard area is comprised of residual soil contamination and a subsurface VOC vapor that originated from the disposal of organic liquids during the operation phase of the CWL. Liquid organic waste was disposed at the CWL from 1962 until 1981. As the result of two interrelated Voluntary Corrective Measures (VCMs), the VOC vapor plume was significantly reduced and the original buried waste and associated highly contaminated soil was excavated. More VCM information is provided in Section 4.2.2.5. Remaining hazards at the site include residual organic and inorganic soil contamination surrounding the former CWL disposal areas in the subsurface, and a greatly reduced VOC vapor plume in the vadose zone beneath the CWL. Figures 4.1.2-2 and 4.1.2-3 show the CWL current state hazards.

4.1.2.2 Primary and Secondary Sources

Primary sources have been removed from the CWL and only two secondary sources remain. Residual organic and inorganic soil contamination(Figure 4.2.2-2). In addition, a greatly reduced VOC vapor plume is present in the vadose zone beneath the CWL (Figure 4.2.2-2). Residual soil contamination and low-level radiological soil contamination are described in detail in the “Chemical Waste Landfill - Landfill Excavation Voluntary Corrective Measure Final Report” (SNL/NM April 2003), which also includes a risk assessment. The VOC vapor plume is described in detail in the “Chemical Waste Landfill - Vapor Extraction Voluntary Corrective Measure Final Report” (SNL/NM May 2000).

4.1.2.3 Release Transport or Exposure Mechanisms

Transport and exposure pathways are addressed in the risk assessment presented in the “Chemical Waste Landfill - Landfill Excavation Voluntary Corrective Measure (LE VCM) Final Report” (SNL/NM April 2003). The following information is taken directly from the referenced report.

The potential source of constituents of concern (COCs) at the CWL are backfilled and unexcavated soil with residual levels of contamination. Wind, water, and biota are natural mechanisms of transport for these COCs. The potential for wind and surface-water transport is temporally limited because the contaminated soil will be exposed only at the surface until backfilling is complete and the site is covered to grade with clean soil and revegetated. During this time, however, some transport of contaminated soil by wind is possible.

Water at the CWL is received as precipitation (rain or occasionally snow). The annual precipitation for the area, as measured at Albuquerque International Sunport, is 8.1 inches and will either evaporate at or near the point of contact, infiltrate into the soil, or form runoff.

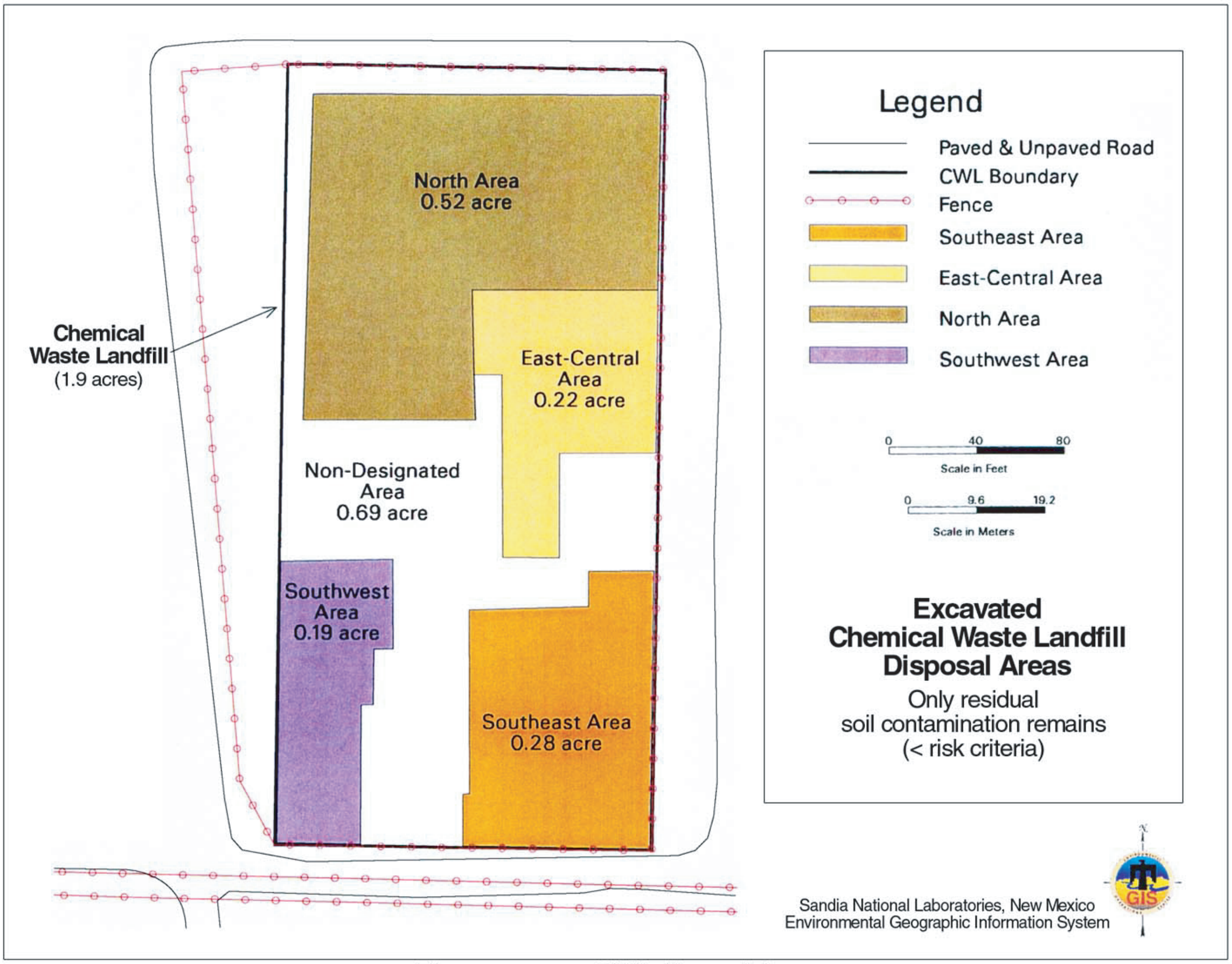

Figure 4.1.2-2 CWL Hazard Area

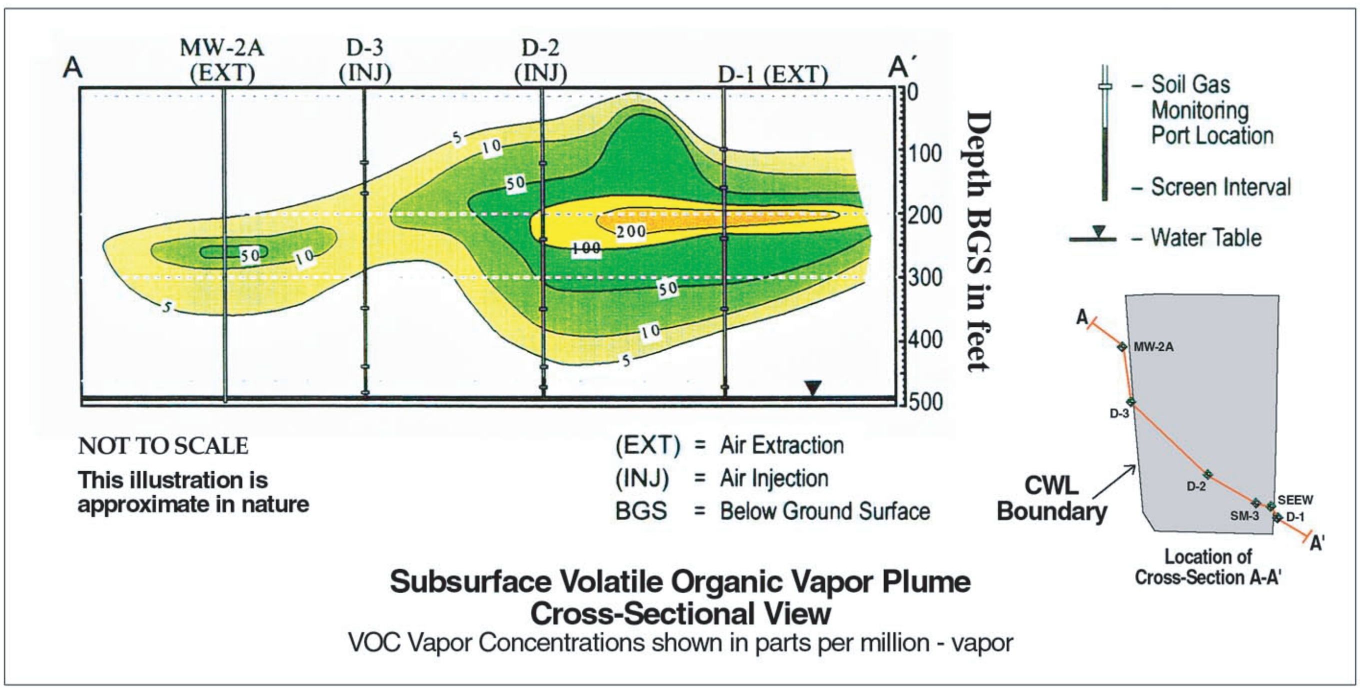

Figure 4.1.2-3 CWL Hazard Area

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Because both run-on and runoff at the CWL are controlled by a surrounding swale, surface water is not a potential transport mechanism for COCs at this site during the period of backfilling, and no residually contaminated soil will be exposed to surface-water transport following completion of the VCM.

Water that infiltrates into the soil will continue to percolate through the soil until field capacity is reached. COCs desorbed from the soil particles into the soil solution may be leached into the subsurface soil with this percolation. Because the estimates of evapotranspiration for the KAFB area range from 95 to 99 percent of the annual rainfall, virtually all of the moisture associated with infiltration is expected to evaporate. Groundwater at this site is approximately 485 feet bgs; therefore, the potential for COCs to reach groundwater through the unsaturated zone above the water table is very limited.

The site has been highly disturbed by the excavation and backfilling operations and is essentially devoid of vegetative cover. For this reason, biota uptake and food chain transfer are not potential transport mechanisms for COCs at this site. Food chain uptake is not expected to be a potential transport mechanism in the future because the site will ultimately be covered with clean soil and revegetated.

The COCs at the CWL include both inorganic and organic analytes. The inorganic COCs are elemental in form and therefore are generally not considered to be degradable. Radiological COCs, however, undergo decay to stable isotopes or radioactive daughter elements. Other transformations of inorganic constituents may include changes in valence (oxidation/reduction reactions) or incorporation into organic forms (e.g., the conversion of selenite or selenate from soil to seleno-amino acids in plants). The rate of such processes will be limited by the arid environment at this site. Degradation processes for organic COCs may include photolysis, hydrolysis, and biotransformation. Photolysis requires light, and therefore takes place in the air, at the ground surface, or in surface water. Hydrolysis includes chemical transformations in water and may occur in the soil solution. Biotransformation (i.e., transformation due to plants, animals, and microorganisms) may occur; however, biological activity may be limited by the arid environment at this site.

Table 4.1.2-1 summarizes the fate and transport processes that may occur at the CWL. COCs at this site occur as residual contaminants in unexcavated and backfill soil, and include both inorganic constituents (metals and radionuclides) and organic constituents. Wind is a potential mechanism for transport of these COCs until backfilling is complete and the site is covered with clean soil; however, transport by surface water is controlled by a swale surrounding the site. Leaching of COCs into the groundwater at this site is highly unlikely due to the low rainfall, high evaporation rate, and depth to groundwater. Essentially no uptake into the food chain is expected at this site because of the highly disturbed nature of the habitat, and the potential for future uptake of COCs by biota will be eliminated by the final covering of clean soil. For inorganic COCs, the potential for degradation is low. Decay of radiological COCs is insignificant due to their long half-lives (except for H-3). Degradation and/or biotransformation of some organic COCs may be a more significant mechanism of loss.

4.1.2.4 Temporary Barriers and Controls

In its present state, the CWL has several mechanisms in place that address the potential exposure pathways to current and future receptors. The primary barrier is the current layer of clean fill over the CWL excavation, which is ~40% backfilled. Backfilling will be completed in

Table 4.1.2-1
Summary of Fate and Transport at the CWL

Transport and Fate Mechanism	Existence at the CWL	Significance
Wind	Yes	Low
Surface runoff	No	None
Migration to groundwater	No	None
Food chain uptake	No	None
Transformation/degradation	Yes	Moderate to low

CWL = Chemical Waste Landfill.

FY04 and after the final cover is approved and installed, there will be a minimum of 5 feet of clean fill covering residual contamination at depth in the CWL. The currently proposed final cover will minimize the infiltration of surface water and also minimize the potential for exposure of onsite workers and future industrial receptors to residual contamination at depth at the CWL.

Additional controls include existing access restrictions to the CWL, which will remain in place for the post-closure care period to limit human access and inadvertent human intrusion. These access controls include the CWL hazard area fence, as well as controls for access into TA-3 and Kirtland Air Force Base. Access into TA-3, where the CWL is located, is strictly controlled. TA-3 is a locked, property control area that requires access through an electronically-controlled security gate for entry. Finally, TA-3 is located within the Kirtland Air Force Base Boundary, with its own strict access controls and closely-guarded perimeter.

4.1.2.5 Remediation, Mitigation and Other Interventions

Based upon the site characterization work performed between 1992 and 1995, a VOC vapor plume was determined to be the source of the elevated levels of TCE in the groundwater (SNL/NM October 1995). In 1996, an expedited approach to the CWL Corrective Action program was proposed to accelerate risk reduction through source removal; mitigate groundwater impacts; and reduce the complexity, schedule, and cost of final closure. The expedited strategy included two interrelated VCMs: vapor extraction (VE) and landfill excavation (LE). The original waste in the landfill was the source for the VOC vapor plume. Therefore, the two VCMs were developed to address the two main sources of contamination, and to mitigate the impact to groundwater beneath the CWL.

The VE VCM was performed from May 1997 to July 1998 and was successful in significantly reducing the concentrations of subsurface VOC vapor contamination such that groundwater concentrations of TCE were reduced below the regulatory limit. The LE VCM was performed from September 1998 to February 2002. All former disposal areas and associated highly contaminated soil were completely excavated, involving the removal of over 52,000 cubic yards (cy) of contaminated soil and debris. More detailed information is presented in the two following VCM final reports, which were submitted to the NMED:

- “Chemical Waste Landfill - Vapor Extraction Voluntary Corrective Measure Final Report” (SNL/NM May 2000)
- “Chemical Waste Landfill - Landfill Excavation Voluntary Corrective Measure Final Report” (SNL/NM April 2003)

4.1.2.6 Receptors

The potential current and future human health receptors for each site were established based on the "Baseline for Future Use Options" (DOE September 1995). For SNL, the categories for potential receptors included industrial, recreational, and residential. The industrial and recreational land uses were the most predominant. However, for all sites a residential receptor was evaluated. For a detailed description of the potential receptors at the CWL refer to the LE VCM Final Report (SNL/NM April 2003).

As described in detail in "Predictive Ecological Risk Assessment Methodology, Environmental Restoration Program, Sandia National Laboratories, New Mexico" (IT July 1998) the ecological receptors include a nonspecific perennial plant that was selected as the receptor to represent plant species at the site. The deer mouse (*Peromyscus maniculatus*) and the burrowing owl (*Speotyto cunicularia*) were used to represent wildlife use. Because of its opportunistic food habits, the deer mouse was used to represent a mammalian herbivore, omnivore, and insectivore. The burrowing owl was used to represent a top predator at this site.

4.1.2.7 Additional Information

The risk assessment presented in the LE VCM Final Report (SNL/NM April 2003) evaluates: 1) the adequacy of the backfill materials; and 2) the adequacy of the extent of the excavation, using the criteria established in the previously approved risk-based approach (SNL/NM August 2000). Previous investigations have addressed soil contamination and VOC vapor-phase contamination in the area beneath the current excavation and the surrounding subsurface, which are detailed in the following reports:

- Chemical Waste Landfill - Unsaturated Zone Contaminant Characterization Report (SNL/NM November 1993)
- Chemical Waste Landfill - Groundwater Assessment Report (SNL/NM October 1995)
- Chemical Waste Landfill - Vapor Extraction Voluntary Corrective Measure Final Report (SNL/NM May 2000)
- CWL Quarterly Progress Reports (SNL/NM 1991 to present)

Installation of the final CWL cover will occur after the Remedial Action Proposal (SNL/NM May 2003b) is approved by the NMED. Proposed post-closure care monitoring and surveillance and maintenance are detailed in the CWL Post-Closure Care Plan and Permit Application (SNL/NM May 2003c), and will be implemented after NMED approval. The Post-Closure Care Plan also addresses land-use restrictions associated with the CWL.

4.1.3 MWL Conceptual Site Model

Figure 4.1.3-1 presents the Conceptual Site Model (CSM) for the MWL in its current state. The CSM is documented in detail in the Risk Assessment for the Mixed Waste Landfill, Appendix I of the Mixed Waste Landfill Corrective Measures Study Final Report (SNL/NM May 2003). This CSM provides a visual presentation of site exposure conditions at the MWL that currently connect a source of contamination to possible human and ecological receptors. When used in conjunction with the End-State Vision, this CSM shows how current exposure conditions at the MWL could be eliminated, mitigated or controlled.

4.1.3.1 Description (Hazard Area Summary)

The MWL accepted containerized and uncontainerized low-level radioactive waste and minor amounts of mixed waste from SNL/NM research facilities and off-site generators from March 1959 to December 1988 (Figure 4.1.3-2). Approximately 100,000 cubic feet of low-level radioactive waste (excluding packaging, containers, demolition and construction debris, and contaminated soil) containing 6,300 curies (Ci) of activity (at the time of disposal) were disposed of at the MWL. Disposal cells at the landfill are unlined and were backfilled and compacted to grade with stockpiled soil.

There are two distinct disposal areas at the MWL: the classified area (occupying 0.6 acres) and the unclassified area (occupying 2.0 acres) (Figure 4.1.3-3). Wastes in the classified area were disposed of in a series of vertical, cylindrical pits (Figure 4.1.3-4). Historical records indicate that early pits were 3 to 5 feet in diameter and 15 feet deep; later pits were 10 feet in diameter and 25 feet deep. Once pits were filled with waste, they were backfilled with soil and capped with concrete. Wastes in the unclassified area were disposed of in a series of parallel, north-south trenches (Figure 4.1.3-5). Records indicate that trenches were 15 to 25 feet wide, 150 to 180 feet long, and 15 to 20 feet deep. Trenches were backfilled with soil on a quarterly basis and, once filled with waste, were capped with the original soil that had been excavated and locally stockpiled.

The classified area contains wastes that present the greatest security, worker safety, and environmental concerns. Wastes in the classified area include military hardware, radioactive constituents (e.g., cobalt-60, cesium-137, tritium, radium-226), activation products (e.g., cobalt-60), multiple fission products (e.g., cesium-137, strontium-90), high specific-activity wastes (e.g., tritium, cobalt-60), plutonium, thorium, and depleted uranium.

All pits and trenches contain routine operational and miscellaneous decontamination waste including gloves, paper, mop heads, brushes, rags, tape, wire, metal and polyvinyl chloride piping, cables, towels, quartz cloth, swipes, disposable lab coats, shoe covers, coveralls, high-efficiency particulate air filters, prefilters, tygon tubing, watch glasses, polyethylene bottles, beakers, balances, pH meters, screws, bolts, saw blades, Kleenex, petri dishes, scouring pads, metal scrap and shavings, foam, plastic, glass, rubber scrap, electrical connectors, ground cloth, wooden shipping crates and pallets, wooden and lucite dosimetry holders, and expended or obsolete experimental equipment.

Containment and disposal of routine waste commonly occurred using tied, double polyethylene bags, sealed A/N cans (military ordnance metal containers of various sizes), fiberboard drums, wooden crates, cardboard boxes, and 55-gallon steel and polyethylene drums. Larger items, such as glove boxes, spent fuel shipping casks, and contaminated soils, were disposed of in

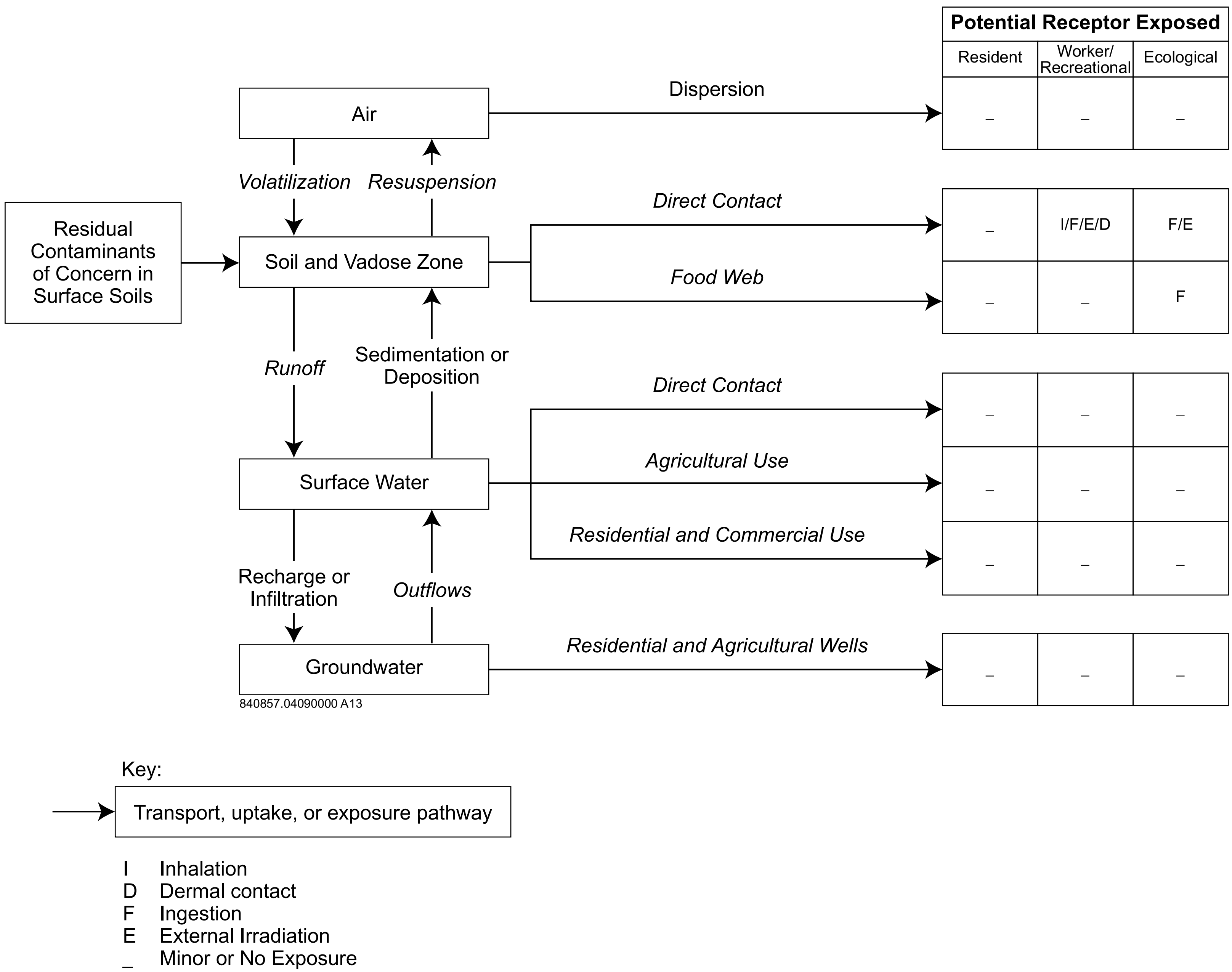

Figure 4.1.3-1
MWL CSM - Current State

Figure 4.1.3-2
Containerized Waste from Mixed Waste Landfill

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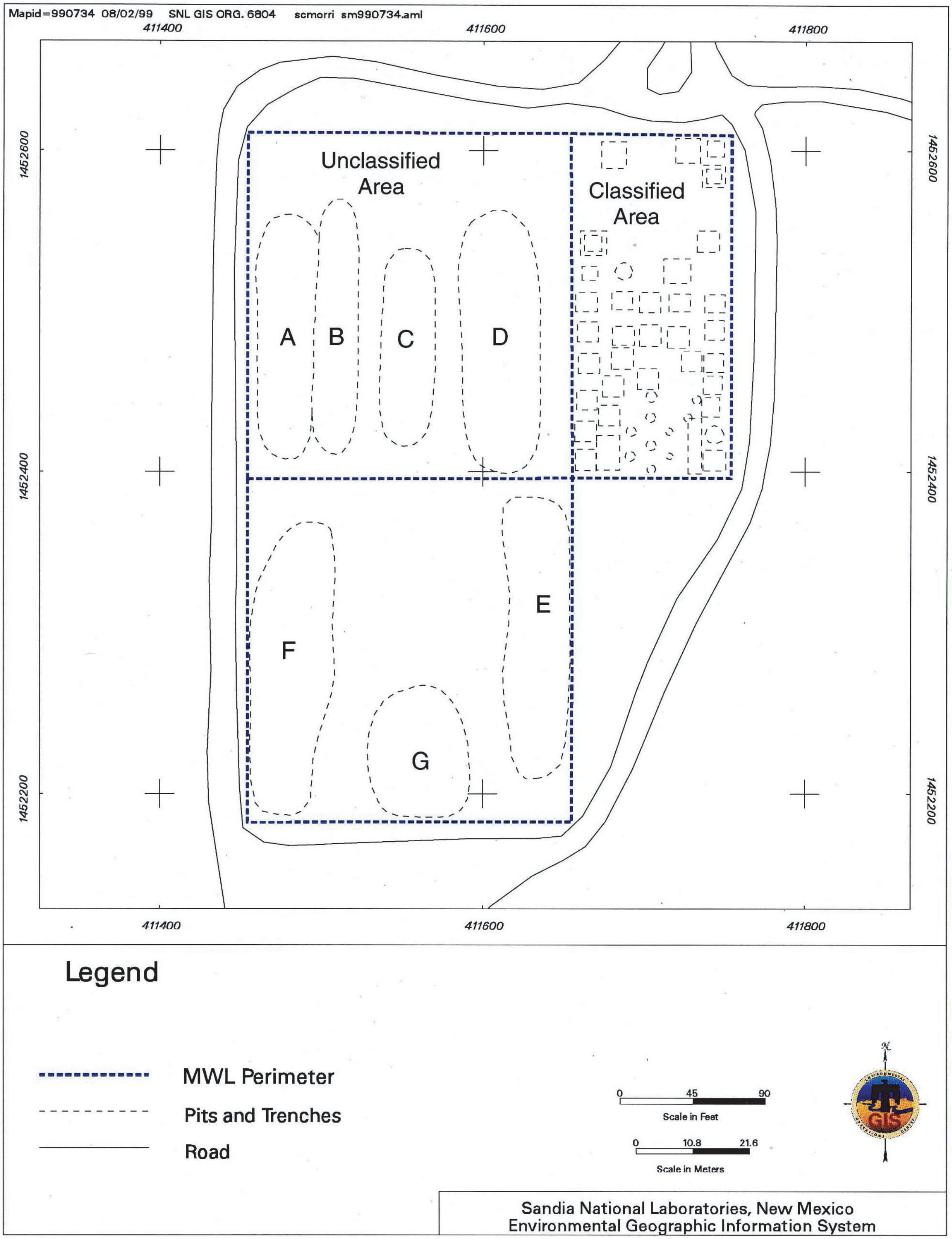

Figure 4.1.3-3
Map of the Mixed Waste Landfill

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Figure 4.1.3-4
Disposal of Waste in Vertical, Cylindrical Pits,
Mixed Waste Landfill
(Classified Area)

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Figure 4.1.3-5
Disposal of Waste in Trenches,
Mixed Waste Landfill
(Unclassified Area)

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bulk without containment. Disposal of free liquids was not allowed at the MWL. Liquids such as acids, bases, and solvents were solidified with commercially available agents including Aquaset, Safe-T-Set, Petroset, vermiculite, or yellow powder before containerization and disposal. Historically, questions have been raised about disposal of liquids at the landfill. Drilling and sampling evidence from the MWL Phase 1 and Phase 2 RFIs demonstrate that uncontainerized liquids were not disposed of at the landfill.

A detailed MWL waste inventory, by pit and trench, is provided in the Environmental Restoration (ER) Project "Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation, June 15, 1998" (SNL/NM June 1998).

4.1.3.2 MWL Primary and Secondary Sources

The primary contaminant sources at the MWL are the buried low-level radioactive and mixed wastes within the pits and trenches of the landfill. A secondary contaminant source at the MWL is the tritium which has migrated from the pits and trenches, and which occurs in surface and near-surface soils in and around the classified area of the landfill. Figure 4.1.3-6 shows tritium activities in surface soils at the MWL. Tritium levels range from 1100 picocuries/gram in surface soils to 206 picocuries/gram in subsurface soils. The highest tritium levels are found within 30 feet of the surface in soils adjacent to and directly below classified area disposal pits. Figure 4.1.3-7 shows the bearings of cross sections A-A' and B-B' at the MWL, and Figures 4.1.3-8 and 4.1.3-9 show tritium activities in subsurface soils along these cross sections. Tritium also occurs as a diffuse air emission from the landfill releasing 0.294 Curies/year to the atmosphere. Additional information on the primary and secondary sources of contaminants at the MWL is presented in the Report of the Phase 1 RCRA Facility Investigation of the Mixed Waste Landfill (SNL/NM September 1990) and the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation (Peace, Goering and McVey September 2002).

4.1.3.3 MWL Release Transport or Exposure Mechanisms

The potential for release of COCs to the subsurface soil is directly associated with wastes buried in the MWL disposal cells. COCs may also be released through diffusion and vapor transport of tritium. Releases caused by erosion and degradation of the operational cover can also occur.

Wind, surface runoff, and biota are natural mechanisms of COC transport. Wind can transport soil particles with adsorbed COCs (or COCs in particulate form) as suspended dust, capable of dry or wet deposition away from the MWL. High winds may move larger (sand-sized) particles by saltation. The area around the MWL is moderately vegetated with ruderals and early successional grasses, and is susceptible to wind and water erosion.

Water percolating through the soil is the primary mechanism for the transport and migration of COCs in the subsurface. Water at the MWL is received as precipitation (rain or occasionally snow). The average annual precipitation in this area is approximately 8 inches (NOAA 1990). Water rarely infiltrates more than a few feet, and typically returns to the atmosphere via evapotranspiration. However, COCs desorbed from the soil particles into the soil solution may be leached into the subsurface soil with this percolation. Extensive field investigations and analytical studies undertaken in TA-3 and at the MWL provide data that address the potential extent of COC migration by this process. Data collected from boreholes, groundwater

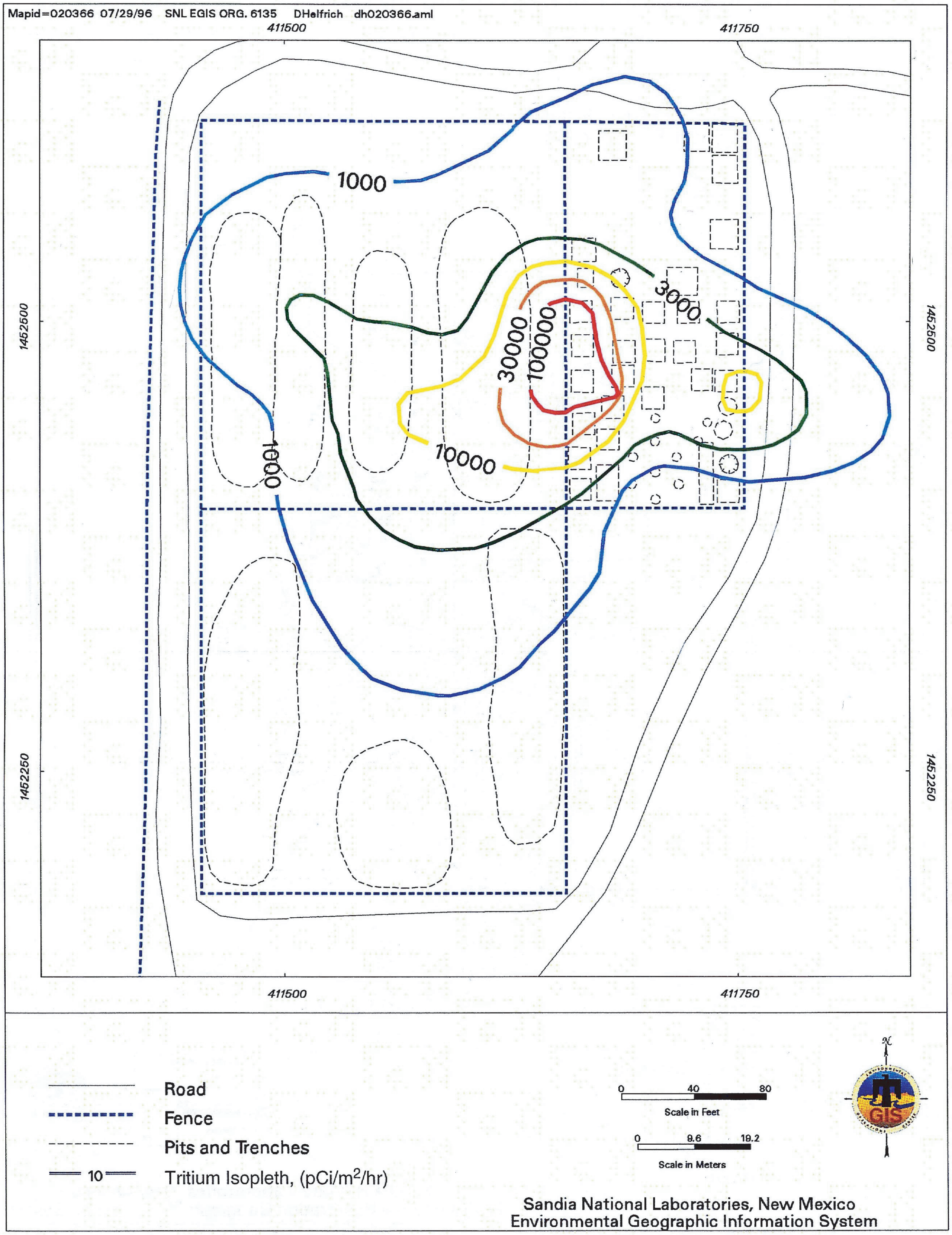

Figure 4.1.3-6
1993 Tritium Flux

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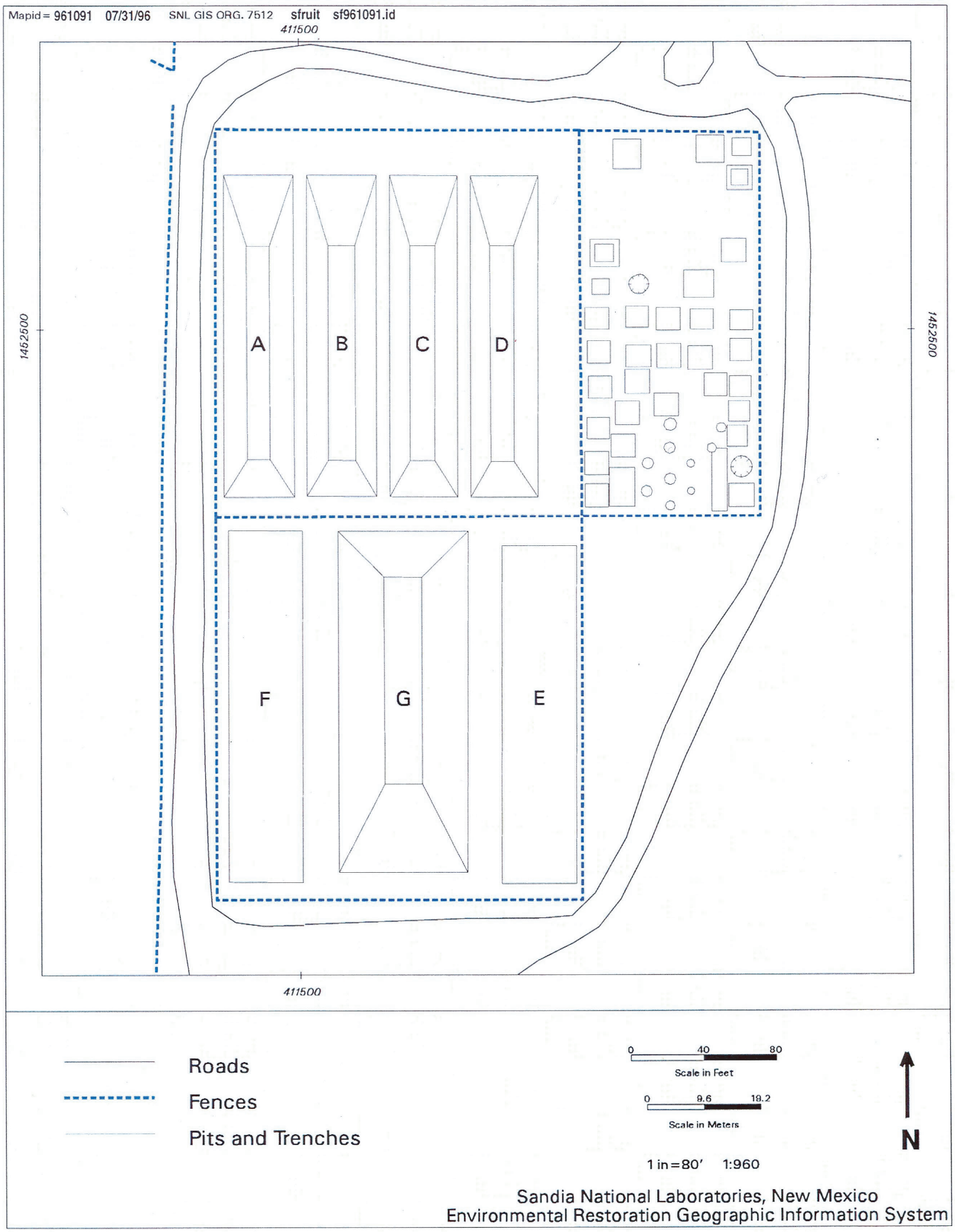

Figure 4.1.3-7
MWL Engineering Design Map 91342

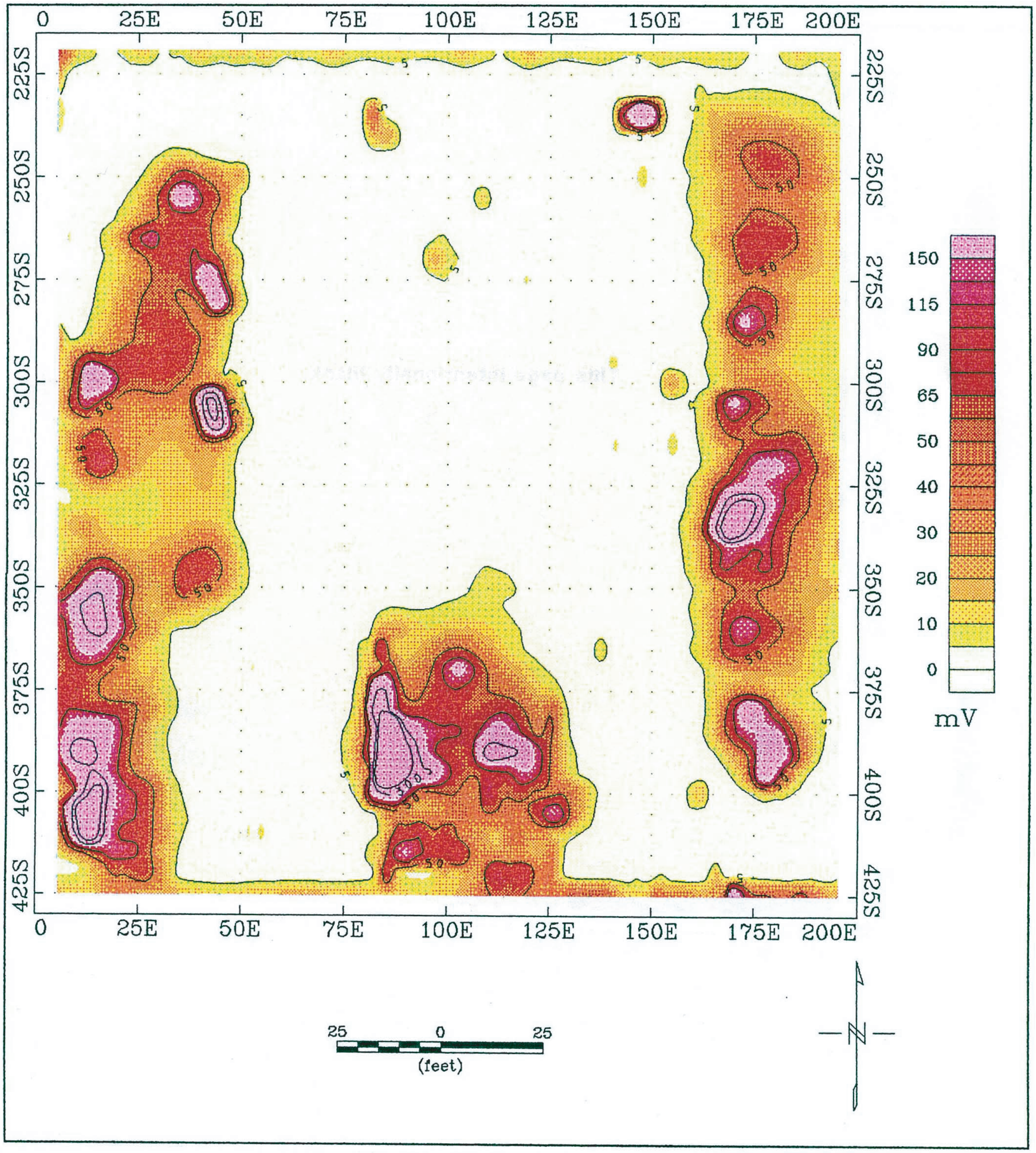

Figure 4.1.3-8
MWL Geophysics 1

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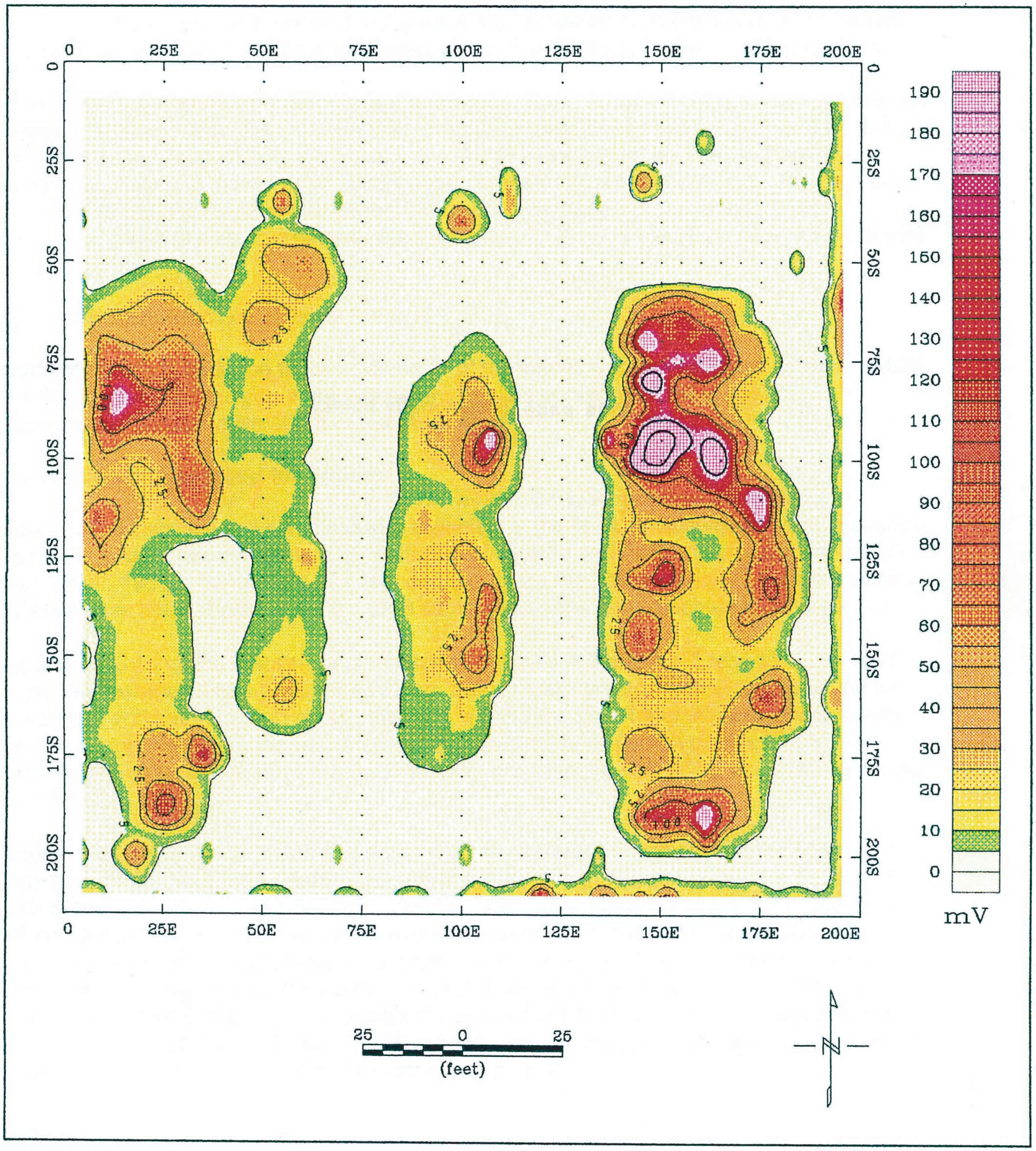

Figure 4.1.3-9
MWL Geophysics 2

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monitoring wells, and instantaneous profile tests measure saturated and unsaturated zone characteristics and include volumetric water content, saturated and unsaturated hydraulic conductivity, bulk density, and isotopic chloride content. These data are summarized in the MWL Phase 2 RFI report (Peace et al September 2002). Based upon these data, recharge is negligible and most of the water from precipitation returns to the atmosphere via evapotranspiration.

It has further been estimated that 95 percent of the total rainfall received at SNL/NM is lost through evapotranspiration (Thomson and Smith 1985). This conclusion is supported by the MWL Phase 2 RFI characterization data, which show no evidence of significant water migration past the root zone of plants or the upper 2 feet of soil (Peace et al. September 2002). Vegetation, although sparse at the MWL, will increase the rate of water loss from the subsurface soil through transpiration. As water evaporates from the soil surface, it can be expected that the direction of COC movement near the surface may be reversed with capillary rise of the soil water.

Because of the arid nature of the environment at the MWL, characterized by low rainfall and high potential evapotranspiration estimates, recharge to the water table at the MWL is insignificant under current climatic and vegetative conditions (Peace et al. September 2002). Because groundwater beneath the MWL is approximately 500 feet bgs, the potential for COCs to reach groundwater through the unsaturated zone above the water table is very low.

COCs that are in the soil solution can enter the food chain via uptake by plant roots. This may be a passive process, but active uptake (i.e., requiring energy expenditure on the part of the plant) or exclusion of some constituents in the soil solution may also take place. COCs taken up by plant roots may be transported to the aboveground tissues which can take up adsorbed constituents directly from the air or by contact with dust particles. Organic constituents in plant tissues may be metabolized or released through volatilization. That which remains in the tissue may be consumed by herbivores or eventually returned to the soil as litter. Aboveground litter is capable of transport by wind until consumed by decomposer organisms in the soil. Constituents in plant tissues that are consumed by herbivores may be either absorbed into tissues or returned to the soil as litter (at the MWL or transported from the MWL in the herbivore). The herbivore may be eaten by a carnivore or scavenger and the constituents held in the consumed tissues will repeat the sequence of absorption, metabolization, excretion, and consumption by higher predators, scavengers, and decomposers. The potential for transport of the constituents within the food chain is dependent upon both the mobility of the species that comprise the food chain and the potential for the constituent to be transferred across the links in the food chain.

Degradation of COCs at the MWL may result from biotic or abiotic processes. Inorganic COCs at the MWL are elemental in form and are, therefore, not considered to be degradable. Radiological COCs, however, undergo decay to stable isotopes or radioactive daughter elements. Other transformations of inorganic constituents may include changes in valence (oxidation/reduction reactions) or incorporation into organic forms (e.g., the conversion of selenite or selenate from soil to seleno-amino acids in plants). Degradation processes for organic COCs may include photolysis, hydrolysis, and biotransformation. Photolysis requires light and, therefore, takes place in the air, at the ground surface, or in surface water. Hydrolysis includes chemical transformations in water and may occur in the soil solution. Biotransformation (i.e., transformation caused by plants, animals, and microorganisms) may occur; however, biological activity may be limited by the arid environment at the MWL.

Table 4.1.3-1 summarizes the fate and transport processes that may occur at the MWL. COCs include a variety of inorganic constituents (e.g., metals and radionuclides) and organic constituents (both volatile and semivolatile) in surface and subsurface soil. Because the topography of the site is relatively flat and the soil is fine-grained, the potential for surface-water transport is low. Because winds in the Albuquerque area can be fairly strong in late winter and early spring, the potential for transport by wind of COCs in surface soil is moderate. In both cases, however, the significance of these transport mechanisms is limited by the fact that the principal releases of COCs (e.g., tritium) occurred to the subsurface soil. Because of the arid climate, significant movement of water through the subsurface soil is unlikely and migration to groundwater is not expected to occur. The potential for food chain uptake is low because of the relatively small size of the MWL (2.6 acres), the disturbed nature of the habitat, and the depth of the buried waste. In general, transformation of organic constituents will be slow because of the aridity of the environment, and degradation of the inorganic COCs will be insignificant. The decay of radiological COCs is also insignificant because of long half-lives.

Table 4.1.3-1
Summary of Fate and Transport at the MWL

Transport and Fate Mechanism	Existence at the MWL	Significance
Wind	Yes	Moderate
Surface runoff	Yes	Low
Migration to groundwater	No	None
Food chain uptake	Yes	Low
Transformation/degradation	Yes	Low

MWL = Mixed Waste Landfill.

4.1.3.4 Temporary Barriers and Controls for the MWL

In its present state, the MWL has several mechanisms in place which address the potential exposure pathways to current at-risk receptors. The primary barrier is the current operational cover of the MWL. This consists of up to several feet of soil overlying the wastes in the pits and trenches. Based on characterization data collected during the Phase 2 RFI, this operational cover minimizes infiltration through the wastes, and also minimizes the potential for exposure of onsite workers to buried waste at the MWL.

Additional controls include existing access restrictions to the MWL, which will remain in place for a minimum of 100 years to limit human access and inadvertent human intrusion. These access controls include the MWL hazard area and security fences, as well as controls for access into Technical Area 3 (TA-3) and Kirtland Air Force Base. Although they may be reconfigured (e.g., as a continuous perimeter fence) during implementation of corrective measures, the MWL fences currently include a standard 4 ft high fence around the unclassified area, and an 8-ft high security fence topped by gnarly-looking barbed wire strands around the classified area. Access into TA-3, where the MWL is located, is strictly controlled. TA-3 is a locked, property control area that requires access through an electronically controlled security gate for entry. In addition, the MWL and TA-3 are located within the Kirtland Air Force Base Boundary, with its own strict access controls and closely-guarded perimeter.

4.1.3.5 Remediation, Mitigation, and Other Interventions

On October 11, 2001, the New Mexico Environment Department (NMED) directed the U.S. Department of Energy (DOE) and SNL/NM to conduct a Corrective Measures Study (CMS) for the MWL. A CMS Workplan (SNL/NM December 2001) was written by the SNL/NM Environmental Restoration Project in accordance with requirements set forth in Module IV (Hazardous and Solid Waste Amendments) of the DOE and SNL/NM RCRA Permit. The CMS Workplan included a description of the general approach of the investigation and potential remedies, a definition of the overall objectives of the study, specific plans for evaluating remedies, schedules for conducting the study, and the proposed format for the presentation of information. The CMS Workplan was approved with conditions by the NMED on October 10, 2002.

On May 21, 2003, SNL/NM completed the Mixed Waste Landfill Corrective Measures Study Final Report and submitted it to the NMED (SNL/NM May 2003). The purpose of the CMS was to identify, develop, and evaluate corrective measures alternatives and recommend the corrective measure(s) to be taken at the MWL. The DOE and SNL/NM implemented a streamlined approach to remedy selection. The CMS establishes corrective action objectives for the MWL that are designed to protect human health and the environment and identifies corrective measures alternatives that will achieve the corrective action objectives.

In establishing corrective measures objectives and alternatives for the CMS, it was assumed that institutional controls (ICs) would be maintained at the MWL for at least the next 100 years. ICs are implicit in all proposed alternatives and include environmental monitoring, site surveillance and maintenance, and access controls. Corrective action objectives are based upon occupational (site worker), public health, and environmental exposure criteria; U.S. Environmental Protection Agency (EPA) guidance; and applicable state and federal regulations. Corrective action objectives developed for the MWL are designed to protect human health and the environment and take into consideration source areas, pathways, and receptors. The corrective action objectives developed for the MWL consist of the following: 1) minimize exposure to site workers, the public, and wildlife; 2) limit migration of contaminants to groundwater such that regulatory limits are not exceeded; 3) minimize biological intrusion into buried waste and any resulting release and redistribution of contaminants to potential receptors; and 4) prevent or limit human intrusion into buried waste over the long term.

Corrective measures alternatives are based upon the results of the MWL Phase 1 RCRA Facility Investigation (RFI) (SNL/NM September 1990), the Phase 2 RFI (Peace et al September 2002), MWL groundwater monitoring (Goering, Haggerty, Van Hart, and Peace December 2002), environmental studies conducted at the MWL since 1969, and public input. Corrective measures alternatives rely upon preferred technologies identified by the EPA's scientific and engineering evaluations of performance data on technology implementation at similar sites. Preferred technologies are screened using three primary criteria: 1) responsiveness to corrective action objectives, 2) implementability, and 3) performance.

Corrective measures alternatives developed for the MWL make use of individual technologies or various combinations of technologies based upon engineering practice to determine which of the candidate technologies are suitable for the site. Alternatives are developed to reduce the large number of candidate technologies to a manageable number of alternatives for detailed evaluation. EPA guidance recommends that three general criteria be used in the development of alternatives: 1) effectiveness, 2) implementability, and 3) cost.

Four corrective measures alternatives were found suitable for the MWL and evaluated in detail. These alternatives include three containment alternatives and one excavation alternative:

1. Alternative I.a—No Further Action (NFA) with ICs;
2. Alternative III.b—Vegetative Soil Cover;
3. Alternative III.c—Vegetative Soil Cover with Bio-Intrusion Barrier; and
4. Alternative V.e—Future Excavation.

Each alternative is technically reliable and meets the corrective action objectives established in the CMS for the MWL.

Based upon detailed evaluation and risk assessment using guidance provided by the EPA and the NMED, one candidate corrective measures alternative clearly presents the overall lowest risk to human health and the environment while minimizing costs and meeting MWL corrective action objectives. This alternative is Alternative I.a—NFA with ICs, which was originally proposed for the MWL in September 1996 after completion of the RCRA investigative process.

In September 1997, NMED required that a cover be constructed over the MWL. Therefore, the DOE and SNL/NM recommend Alternative III.b—Vegetative Soil Cover—as the preferred corrective measure for the MWL. Relative to Alternative I.a, Alternative III.b offers additional protection against exposure to waste in landfill disposal cells, further minimizes infiltration of water, and mitigates bio- and human intrusion into buried waste without significant added cost in construction and long-term monitoring, surveillance and maintenance, and access controls.

Under Alternative III.b, a vegetative soil cover would be deployed on the existing landfill surface. The cover would be of sufficient thickness to store precipitation and support a healthy vegetative community and perform with minimal maintenance by emulating the natural analogue ecosystem. There would be no intrusive activities at the site and therefore no potential for exposure to waste. This alternative also poses minimal risk to site workers implementing ICs associated with environmental and groundwater monitoring as well as routine maintenance and surveillance of the site.

Alternative III.b is consistent with EPA directives regarding presumptive remedies for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) municipal waste and military landfills. Presumptive remedies are preferred technologies for common categories of sites, and are expected to ensure consistent selection of remedial actions and to be used at all appropriate sites except under unusual site-specific circumstances. The EPA is committed to consistency of results between RCRA corrective action and Superfund remedial action programs, and any revisions to the CERCLA remedial expectations or the CERCLA remedy selection process will likely be incorporated into RCRA corrective action.

In recommending Alternative III.b as the preferred corrective measure for the MWL, the DOE and SNL/NM are demonstrating their commitment to protect the environment, preserve the health and safety of the public and their employees, and serve as responsible corporate citizens in meeting the community's environmental goals.

4.1.3.6 Receptors

The potential current and future human health receptors for each site were established based on the "Baseline for Future Use Options" (DOE September 1995). For SNL, the potential categories of receptors included industrial, recreational, and residential. The industrial and recreational land uses were the most predominant. However, for all sites a residential receptor was evaluated. For a detailed description of the potential receptors at the MWL, refer to the MWL Risk Assessment presented in Appendix I of the Mixed Waste Landfill Corrective Measures Study Final Report (SNL/NM May 2003).

As described in detail in “Predictive Ecological Risk Assessment Methodology, Environmental Restoration Program, Sandia National Laboratories, New Mexico” (IT July 1998) the ecological receptors include a nonspecific perennial plant that was selected as the receptor to represent plant species at the site. The deer mouse (*Peromyscus maniculatus*) and the burrowing owl (*Speotyto cunicularia*) were used to represent wildlife use. Because of its opportunistic food habits, the deer mouse was used to represent a mammalian herbivore, omnivore, and insectivore. The burrowing owl was used to represent a top predator at this site.

4.1.3.7 Additional Information

Groundwater at the MWL lies nearly 500 ft below ground surface. Groundwater monitoring at the MWL has been conducted since September 1990, with more than 27 combined quarterly, semi-annual, and annual sampling events conducted. Groundwater has been characterized for major ion chemistry and analyzed for numerous COCs that occur in the MWL disposal inventory. These COCs include VOCs, SVOCs, additional Appendix IX compounds, metals, nitrate, perchlorate, uranium, tritium, plutonium, strontium-90, cobalt-60, and cesium-137. Based upon the plethora of analytical data collected to date, SNL/NM has determined that groundwater beneath MWL is free of contamination from the landfill. Additional information on groundwater quality at the MWL and on the regional aquifer is presented in the Mixed Waste Landfill Groundwater Report, 1990 through 2001 (Goering et al, December 2002).

4.1.4 CAMU Conceptual Site Model

Figure 4.1.4-1 presents the Conceptual Site Model (CSM) for the CAMU in its current state. The CSM is documented in detail in the “Risk Assessment for Corrective Action Management Unit” (SNL/NM July 2003), which demonstrates that the CAMU meets risk-based criteria. This CSM provides a visual presentation of site exposure pathways at the CAMU that currently connect a source of contamination to possible human and ecological receptors. When used in conjunction with the End-State Vision, this CSM shows how current exposure conditions at the CAMU could be eliminated, mitigated or controlled.

4.1.4.1 Description (Hazard Area Summary)

The CAMU hazard area is comprised of the remediation waste that has been placed in the CAMU containment cell. The containment cell incorporates an engineered liner system and final cover system that are designed to prevent the migration of hazardous constituents from the encapsulated waste to the environment. Further information regarding the containment cell design is presented in the “Class III Permit Modification for the Management of Hazardous Remediation Wastes in the Corrective Action Management Unit, Technical Area III, Sandia

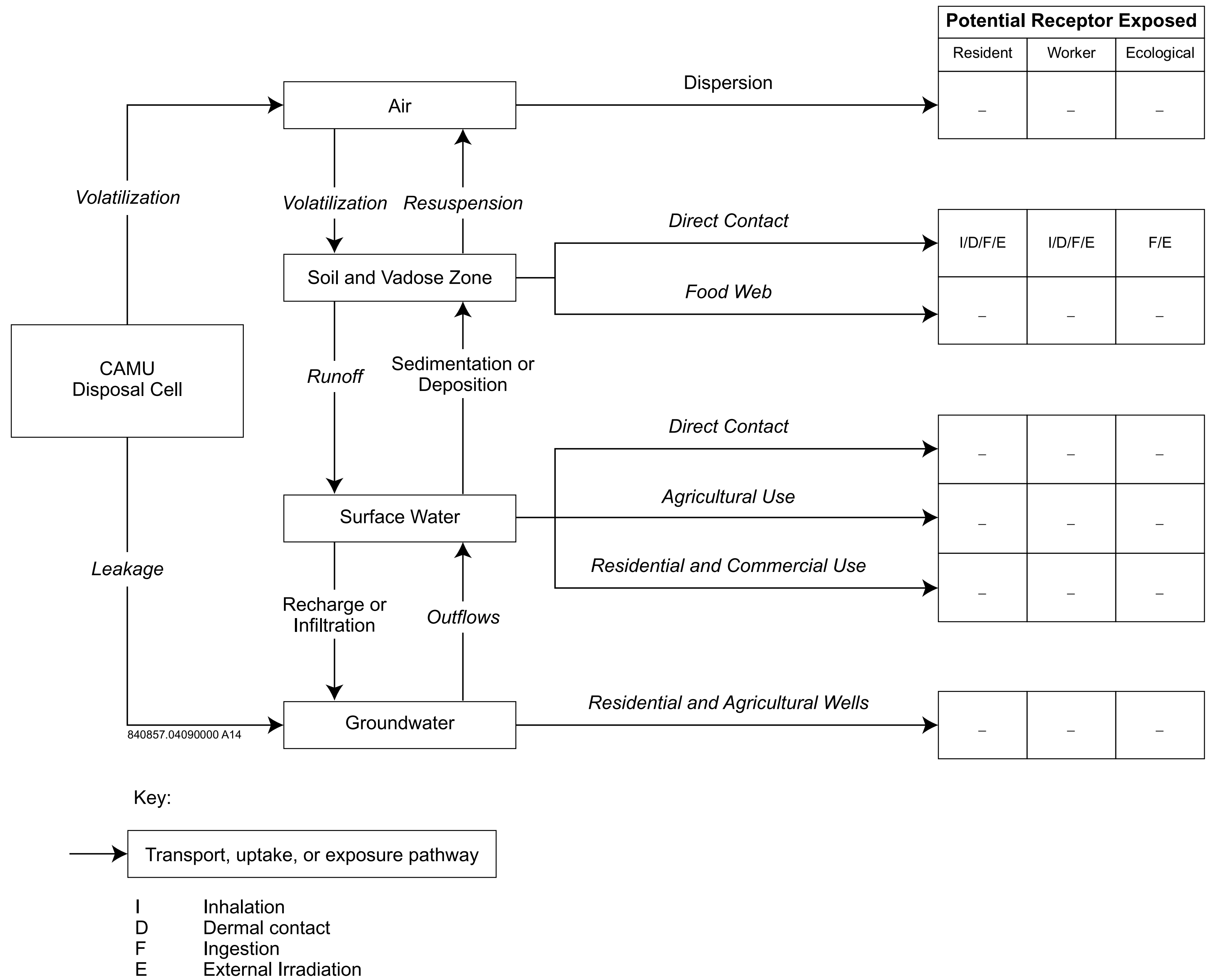

Figure 4.1.4-1
CAMU CSM - Current State

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National Laboratories/New Mexico Environmental Restoration Project," as modified (SNL/NM, September 1997), hereafter referred to as the CAMU Permit. Figure 4.1.4-2 shows the CAMU current-state hazards.

4.1.4.2 Primary and Secondary Sources

The primary source at the CAMU consists of the remediation waste encapsulated within the containment cell. Because the cell incorporates an engineered liner system, no secondary sources are present.

4.1.4.3 Release Transport or Exposure

The containment cell of the CAMU incorporates an engineered liner system and final cover system that was designed to prevent the migration of hazardous constituents to the environment from leachate, contaminated runoff, and hazardous waste decomposition products generated during CAMU waste placement operations and the post-closure care period. The liner system includes both bottom and sidewall liner components that will be chemically resistant to the waste and to potentially generated leachate. The final cover system effectively encapsulates the soil waste in the containment cell and is designed to minimize water infiltration. Construction of the final cover system was completed in June 2003. The cover system design incorporates a capillary barrier and vegetation cover for primary hydraulic control. A high-density polyethylene liner positioned at the base of the final cover system provides reinforced hydraulic control. Due to these engineered controls, no transport of COCs is expected to occur from the containment cell to the environment.

Water at the CAMU is currently received as precipitation (approximately 8.1 inches annually). Precipitation will either evaporate at or near the point of contact, infiltrate into the soil, or form runoff. Infiltration at the site is enhanced by the sandy texture of the soil. COCs in the soil can be leached deeper into the subsurface soil with the percolation of water through the soil; however, it is estimated that 95 to 99 percent of the annual precipitation in this area is lost through evapotranspiration. Therefore, the potential for significant downward movement of COCs through leaching is very limited. Because groundwater at this site is approximately 485 feet bgs, and because a liner system is in place, the potential for COCs to reach groundwater through the unsaturated zone above the water table is extremely small. Surface runoff from the site has the potential to carry soil particles, but the upper liner prevents this transport, therefore, would be of minimal significance as a potential mechanism for COCs to be transported from the site.

COCs can enter the food chain through uptake by plant roots. COCs taken up by plant roots can be transported to aboveground tissues where they can be consumed by herbivores, which can in turn be eaten by predators. Once in the food web, COCs can be transported from the site by the movements of the organisms that contain them or other surficial transport mechanisms. However, because the CAMU occupies only a small area (1.4 acre), food chain transport is expected to be of low potential significance at this site.

The COCs at the CAMU include both inorganic and organic analytes. The nonradiological inorganic COCs are elemental in form, and are not considered to be degradable. Transformations of these inorganics could include changes in valence (oxidation/reduction

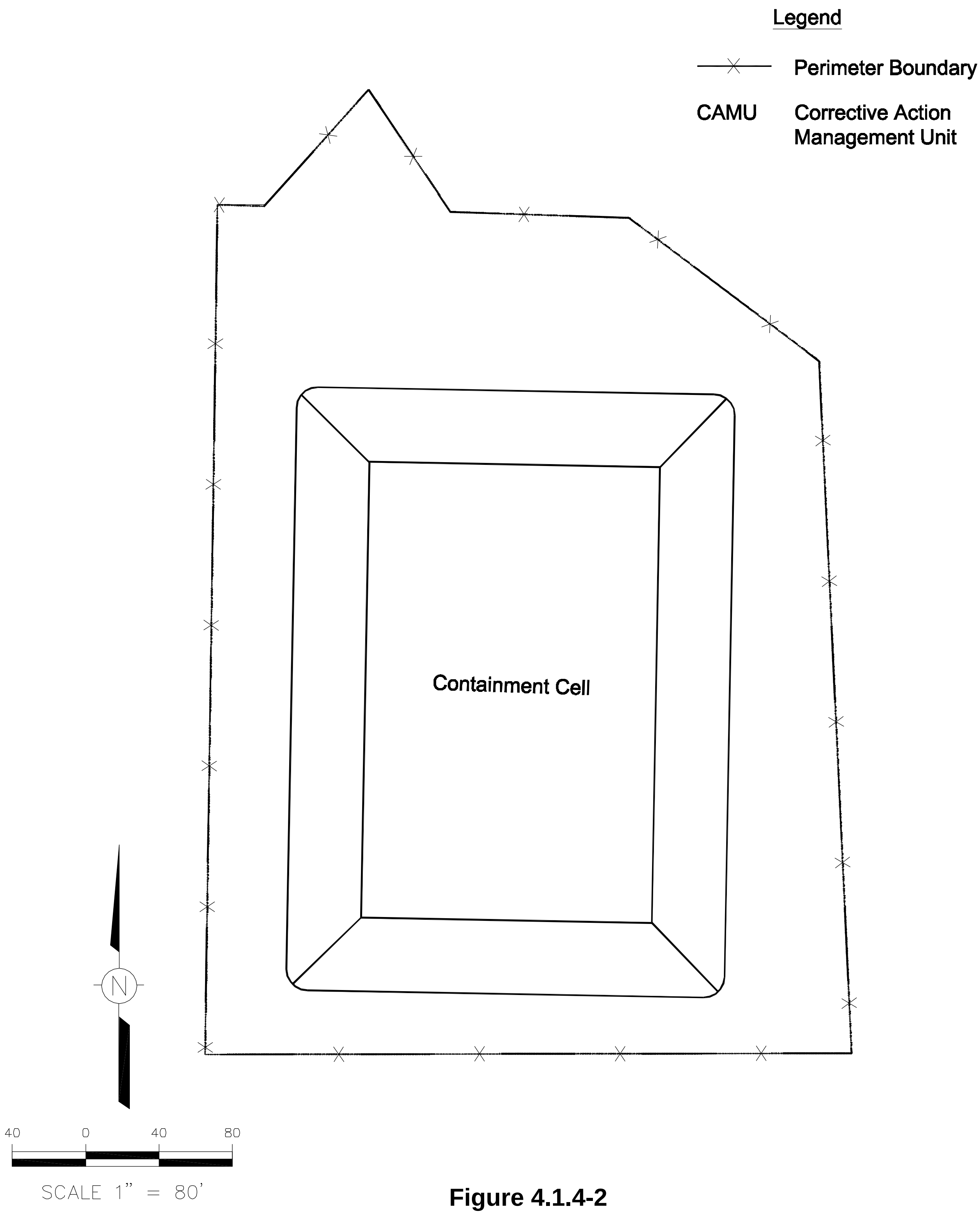

Figure 4.1.4-2
Current-state Hazards at the Corrective Action Management Unit

reactions) or incorporation into organic forms (e.g., the conversion of selenite or selenate from soil to seleno-amino acids in plants). However, because of the aridity of the environment at this site, and the lack of potential contact with biota, none of these mechanisms is expected to result in significant losses or transformations of the inorganic COCs.

The organic COCs at the CAMU may be degraded through photolysis, hydrolysis, and biotransformation. Photolysis requires light, and therefore takes place in the air, at the ground surface, or in surface water. Hydrolysis includes chemical transformations in water, and may occur in the soil solution. Biotransformation (i.e., transformation due to plants, animals, and microorganisms) may occur; however, biological activity may be limited by the aridity of the environment at this site.

Tritium is the only radiological COC present at the CAMU and it is only present in concentrations that are acceptable in drinking water (20,000 pCi/L in soil moisture). This radiological COC will undergo decay to stable isotopes or radioactive daughter elements and has a half-life of 12.3 years. Therefore radiological COCs are expected to be of low significance at the CAMU.

Table 4.1.4-1 summarizes the fate and transport processes that can occur at the CAMU. No significant transport to the environment outside of the containment cell is expected to occur due to the protectiveness of the cover and liner installed at the site. The potential for transformation of inorganics is low. For some organics, loss through volatilization and eventual degradation could be of moderate significance.

Table 4.1.4-1
Summary of Fate and Transport at the CAMU

Transport and Fate Mechanism	Existence at the CAMU	Significance
Wind	Yes	None
Surface runoff	Yes	None
Migration to groundwater	No	None
Food chain uptake	Yes	None
Transformation/degradation	Yes	Moderate to low

CAMU = Corrective Action Management Unit.

4.1.4.4 Temporary Barriers and Controls

The CAMU containment cell final cover system was completed in July 2003, effectively encapsulating all remediation waste that had been placed. The engineered liner system and final cover system are considered a permanent controls.

Presently, a 4-strand barbed-wire fence with one main gate surrounds the CAMU containment cell. The gate is locked and only authorized SNL/NM personnel control the keys to the lock.

Additional controls include existing access restrictions to the CAMU, which will remain in place for the post-closure care period to limit human access and inadvertent human intrusion. These access controls include access into TA-3 and Kirtland Air Force Base. Access into TA-3, where the CAMU is located, is strictly controlled. TA-3 is a locked, property control area that requires access through an electronically-controlled security gate for entry. Finally, TA-3 is located within the Kirtland Air Force Base Boundary, with its own strict access controls and closely-guarded perimeter.

4.1.4.5 Remediation, Mitigation and Other Interventions

A total of approximately 32,000 cubic yards of remediation waste were placed into the CAMU containment cell. Waste material that met CAMU containment standards, as defined in the CAMU Permit, were placed directly into the containment cell. If necessary, waste material was treated prior to placement using low temperature thermal desorption (LTTD) and/or stabilization (ST) treatment technologies. Further information regarding LTTD treatment operations is presented in the "Class 2 Permit Modification Request for Low Temperature Thermal Desorption Treatment Operations at the Corrective Action Management Unit, Technical Area III," (SNL/NM, June 2002). Further information regarding ST treatment operations is presented in the "Class II Permit Modification Request for Temporary Unit Treatment Operations at the Corrective Action Management Unit, Technical Area III," (SNL/NM, May 2002). Waste material that did not meet the containment standards was shipped to an off-site disposal facility.

The containment cell includes an engineered liner system and final cover system that is designed to prevent the migration of hazardous constituents to the environment from leachate, contaminated runoff, and hazardous waste decomposition products generated during CAMU operations and the postclosure period.

In accordance with 40 CFR §264.310(a)(1-5), the final cover of the containment cell was constructed to:

- Provide long-term minimization of migration of liquids through the closed containment cell.
- Function with minimum maintenance.
- Promote drainage and minimize erosion or abrasion of the containment cell cover.
- Accommodate for settling and subsidence so that the integrity of the containment cell cover is maintained.
- Have an unsaturated hydraulic conductivity that is less than or equal to that of the bottom liner system and/or natural subsoil.

In addition to the containment cell liner system and final cover, a vadose zone monitoring system (VZMS) is in place under the containment cell. Additional information regarding the VZMS is provided in Appendix E of the CAMU Permit.

4.1.4.6 Receptors

The potential current and future human health receptors for each site were established based on the "Baseline for Future Use Options" (DOE September 1995). For SNL, the potential receptors included industrial, recreational, and residential. The industrial and recreational land uses were the most predominant. However, for all sites a residential receptor was evaluated.

For a detailed description of the potential receptors at the CAMU refer to the Risk Assessment for Corrective Action Management Unit (SNL/NM July 2003).

As described in detail in “Predictive Ecological Risk Assessment Methodology, Environmental Restoration Program, Sandia National Laboratories, New Mexico” (IT July 1998) the ecological receptors include a nonspecific perennial plant that was selected as the receptor to represent plant species at the site. The deer mouse (*Peromyscus maniculatus*) and the burrowing owl (*Speotyto cunicularia*) were used to represent wildlife use. Because of its opportunistic food habits, the deer mouse was used to represent a mammalian herbivore, omnivore, and insectivore. The burrowing owl was used to represent a top predator at this site.

4.1.4.7 Additional Information

Closure activities at the CAMU, which were initiated on January 27, 2003, included identification and removal of stained areas, decontamination, and sampling. These activities were conducted using a phased approach, as operational conditions permitted sequential closure of individual areas within the CAMU. The staging, treatment, and support areas at the CAMU were clean-closed under the RCRA provisions as outlined in the “Closure Plan for the Corrective Action Management Unit, Technical Area III, Sandia National Laboratories/New Mexico Environmental Restoration Project,” (SNL/NM October 2002), and all hazardous waste and hazardous waste residues were removed. The CAMU containment cell was closed. The containment cell and supporting infrastructure are subject to the post-closure requirements established in the “Post-Closure Care Plan for the Corrective Action Management Unit, Technical Area III, Sandia National Laboratories/New Mexico Environmental Restoration Project,” (SNL/NM, June 2003), when approved by the New Mexico Environment Department (NMED). Figure 4.1.4-3 delineates the area subject to post-closure care.

A closure certification for the CAMU was submitted to the NMED on October 2, 2003, and the acknowledgement of the receipt of that certification occurred the week of October 20, 2003. All closure activities, including decontamination, sample collection, and data validation, are documented in the “Closure Report for the Corrective Action Management Unit, Sandia National Laboratories/New Mexico Environmental Restoration Project,” draft in progress, which is scheduled for completion by November 2003.

4.2 Groundwater

4.2.1 Groundwater Introduction

The hydrogeology at Sandia National Laboratories is well characterized, especially where the Middle Rio Grande basin underlies the property (SNL/NM March 1994, March 1995, March 1996, and February 1998). SNL/NM has an arid, high-elevation (5200 – 7700 feet above mean sea level) desert climate and receives approximately 8 inches of rain per year. SNL/NM is on the eastern margin of the Middle Rio Grande Basin (Bartolino 2002). The margin is identified by a complex of faults that form a distinct hydrogeologic boundary between the aquifer within the basin (approximately 500 ft below ground surface [bgs]) and the aquifer systems within the uplifted areas (generally between 50 to 250 ft bgs). East of the fault complex, a thin layer of

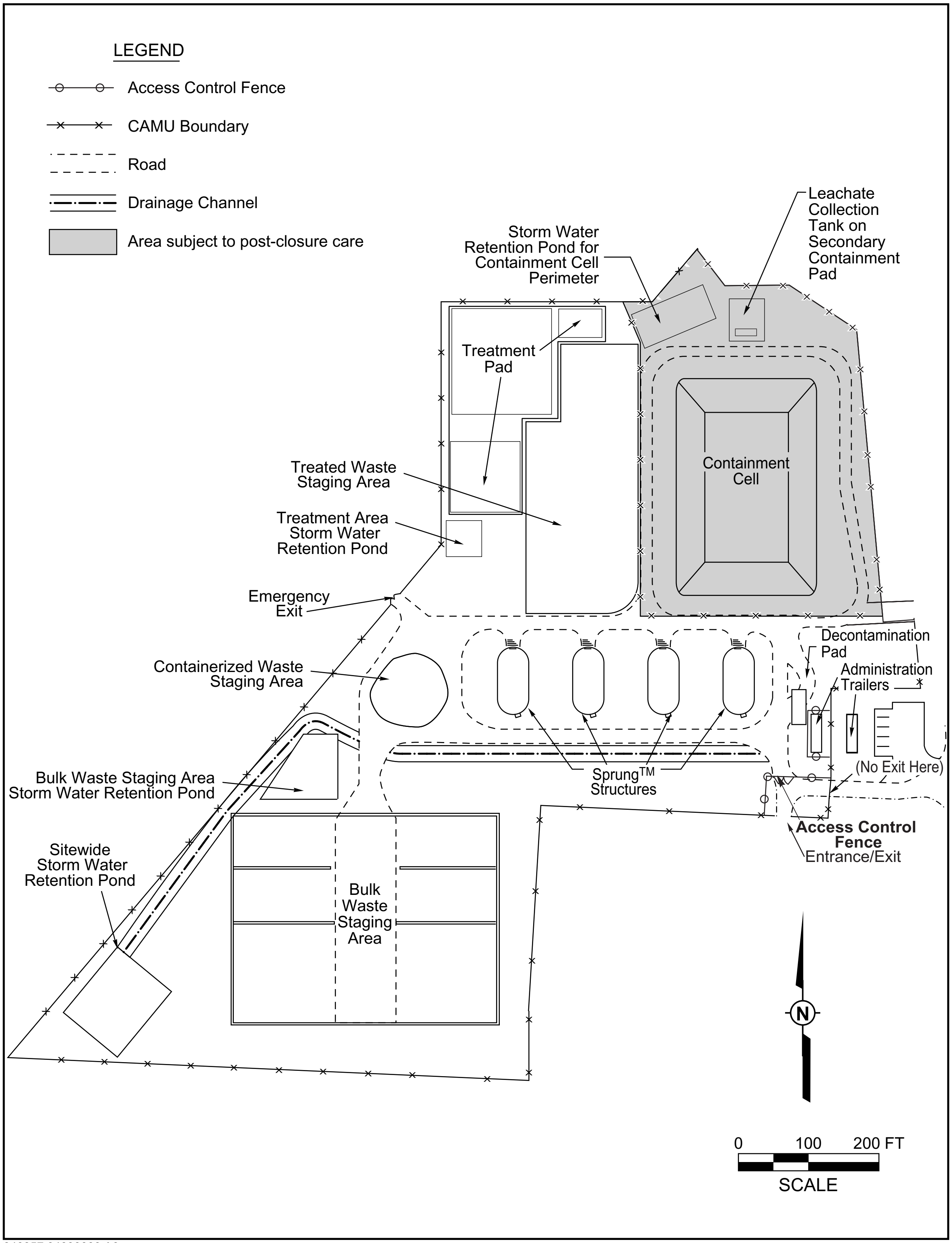

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Figure 4.1.4-3

Pre-Closure Areal Configuration of the Corrective Action Management Unit (CAMU) Showing Area Subject to Post-Closure Care

alluvium covers bedrock. Most of the wells east of the faults are completed in fractured bedrock. Most monitoring wells on the basin side of the faults are completed at approximately 500 feet below surface. The rest are completed in a localized perched groundwater system in the northern area of SNL/NM. This localized perched system is approximately 200 above the basin aquifer, is not presently used for drinking water supply and is not well-connected to the aquifer below.

The hydrogeology of the Middle Rio Grande basin at Sandia National Laboratories is dominated by two distinct depositional environments: the ancestral Rio Grande deposits and, from the mountains, alluvial fan deposits. The north-south-oriented ancestral Rio Grande deposits are typically coarse-grained and well sorted. The bedding is relatively continuous and thicker than five feet. As such, these fluvial deposits present moderate to high hydraulic conductivities and make excellent municipal water supply well locations. In contrast, the east-west-oriented alluvial fan deposits have lower hydraulic conductivities given that they are finer grained, poorly sorted, less continuous, and thinner. The perched system is found in the alluvial fan deposits. The City of Albuquerque altered the natural westerly groundwater flow direction under Sandia National Laboratories when it completed groundwater supply wells in the 1960s in the ancestral Rio Grande deposits north of Sandia National Laboratories. Today groundwater flows from the east and turns to the north toward those City wells. The only sources of recharge to basin at SNL/NM are mountain-front and arroyo recharge. Water levels in, or adjacent to, the ancestral Rio Grande deposits at SNL/NM have been falling 1 – 3 feet per year.

Understanding impacts to the Middle Rio Grande Basin is important because the City of Albuquerque and Kirtland Air Force Base rely exclusively on this basin for drinking water. SNL/NM's activities have not impacted drinking water wells. However, there are some isolated areas with groundwater contamination from trichloroethylene (TCE), tetrachloroethene (PCE), and nitrate that do not pose substantive risk to the Middle Rio Grande basin and its users (SNL/NM February 2001).

4.2.2 Groundwater Conceptual Site Model

The Conceptual Site Model flow diagram for Groundwater is illustrated in Figure 4.2.2-1. As described above, past activities at SNL/NM resulted in some isolated areas with groundwater contamination from TCE, PCE, and nitrate; these areas do not pose substantive risk to the Middle Rio Grande basin and its users. There is no current or potential receptor well within the vicinity of these minor releases; and, therefore, there are no complete groundwater pathways. Also, some source removals have been accomplished. Therefore, the CSM flow diagram for groundwater begins with the groundwater contamination that currently exists. The only release mechanism from these areas of groundwater contamination to the receptors would be the result of groundwater flow to a receptor/production well. Secondary sources of groundwater contamination may include the capillary fringe and transport of chemicals through the soil.

The end state vision CSM for groundwater at SNL/NM will be nearly the same as the current except that the groundwater contamination concentrations are expected to go down with time. Concentration reductions are expected due to either Monitored Natural Attenuation or a combination of Bioremediation and Monitored Natural Attenuation. Monitored Natural Attenuation and Bioremediation evaluations will be prepared and presented to the regulator and public as part of a Corrective Measures Evaluation that is due in September 2005. Currently a preliminary technology survey is available (Ho 2003) that reviews the applicability of treatment technologies to groundwater projects at SNL/NM.

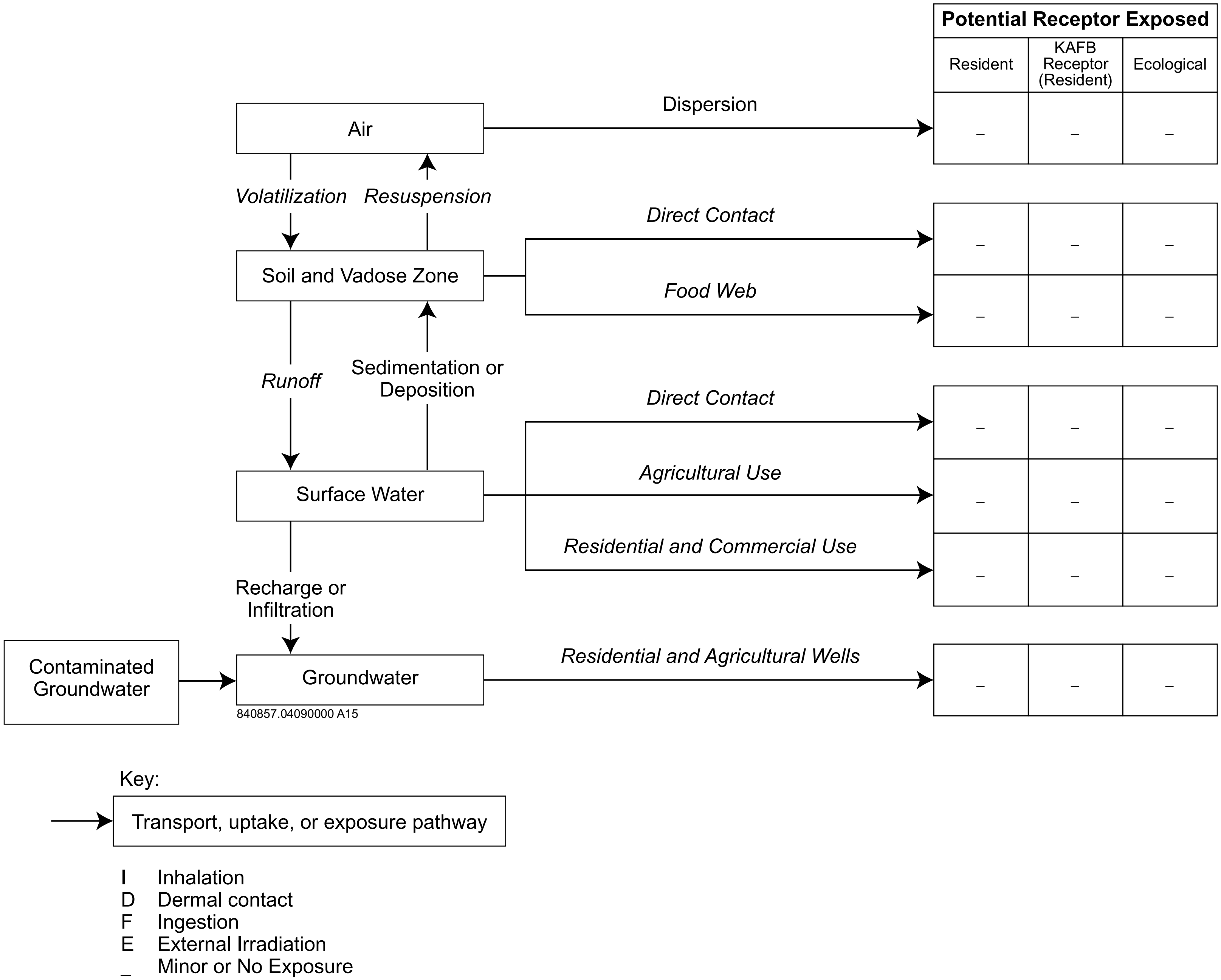

Figure 4.2.2-1
Groundwater CSM

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In summary, there are no complete current or future exposure pathways for the limited contamination found in groundwater at SNL/NM.

4.2.2.1 Groundwater Description (Hazard Area Summary)

The SNL/NM Environmental Restoration Project owns and routinely collects groundwater samples from 65 single-completion monitoring wells with 20-foot long screens. Forty-three are monitoring wells are screened in the Middle Rio Grande basin aquifer between 450 – 620 feet below the ground surface. Fifteen wells are screened in a perched groundwater system approximately 200 feet above the aquifer. The remaining seven monitoring wells are east of the Middle Rio Grande basin in either a complex fault or bedrock system, neither of which is well-connected to the Middle Rio Grande Basin aquifer.

Groundwater monitoring at SNL/NM began in 1985 when five wells were installed at the Chemical Waste Landfill. As the Environmental Restoration Project progressed in its investigations of Solid Waste Management Units and site-wide hydrogeology, a total of six areas of concern were identified for groundwater investigations. They are

- The Chemical Waste Landfill;
- The Mixed Waste Landfill;
- Tijeras Arroyo;
- Technical Area V;
- Canyons; and
- Drains and Septic Systems.

Four of these six areas were found to have groundwater contamination above the MCL due to past activities by SNL/NM. Shown on Figure 4.2.2-2, they are:

- The Chemical Waste Landfill;
- Tijeras Arroyo;
- Technical Area V; and
- Canyons.

4.2.2.2 Groundwater Primary and Secondary Sources

The following is a summary of the primary sources and COPCs that exceeded MCLs for the each area summarized above:

- The Chemical Waste Landfill: The TCE source was sufficiently removed (by vapor extraction and landfill excavation). Chemical Waste Landfill groundwater saw a reduction in TCE concentrations and a Corrective Measures Study and Post Closure Care Plan were submitted to the NMED for approval in May 2003 (Sandia National Laboratories May 2003a).

- Tijeras Arroyo area: PCE and TCE contamination is in a perched groundwater system that is 200 feet above the portion of the Middle Rio Grande basin aquifer used for water supply. PCE is found in one well above the MCL of 5 ppb. TCE is found in 2 wells above the MCL of 5 ppb; one of these wells is the one with PCE. This perched groundwater is not well-connected to the supply water and is moving

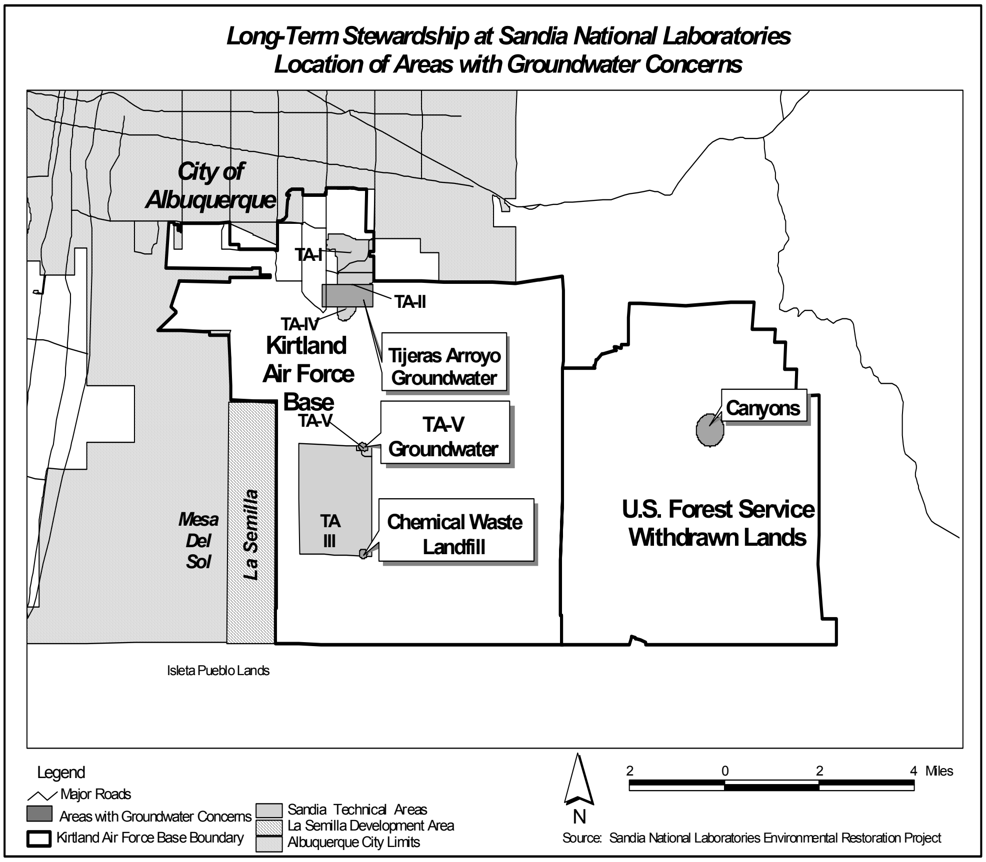

Figure 4.2.2-2
Long-Term Stewardship at Sandia National Laboratories
Location of Areas with Groundwater Concerns

in a direction away from water-supply wells. The maximum concentrations of PCE and TCE found in this perched system in Fiscal Year 2002 were 8.1 and 7.5 micrograms/liter respectively. Nitrate contamination has been found in a few locations adjacent to the Tijeras Arroyo in both deep and shallow groundwater. The maximum concentration in Fiscal Year 2002 was 49 milligrams/liter. NMED approved a groundwater investigation workplan (SNL/NM June 2003) for this project in September 2003. A Corrective Measures Evaluation is scheduled for completion in September 2005.

- Technical Area V: Groundwater contamination has remained adjacent to the Technical Area V and is surrounded by sentry wells. The maximum TCE concentration in Fiscal Year 2002 was 18.1 micrograms/liter. The maximum PCE concentration measured in Fiscal Year 2002 was 7.5 micrograms/liter. Nitrate (as nitrogen) groundwater concentration was measured in one well above the MCL at 12.7 milligrams/liter maximum in Fiscal Year 2002. NMED verbally approved a sampling and analysis plan for monitored natural attenuation parameters in October 2003 (Dettmers October 2003). A Corrective Measures Evaluation is scheduled for completion in September 2005.

- Canyons Area: The Canyons Area is in a complex bedrock system a mile or more east of, but not well-connected to, the Middle Rio Grande Basin aquifer system. A source excavation of petroleum product was completed in the Canyons Area. There is no organic contamination above the MCL in the Canyons Area. The maximum concentration of nitrate (as nitrogen) measured in Fiscal Year 2002 at the Burn Site was 22.5 milligrams/liter. A Corrective Measures Evaluation is scheduled for completion in September 2005.

4.2.2.3 Groundwater Release Transport or Exposure Mechanisms

All SNL/NM areas with groundwater impacted by past SNL/NM activities are either cleaned up, stationary, or a mile or more east of the Middle Rio Grande basin aquifer. Therefore, there are no potential transport or groundwater exposure mechanisms for potential release to an onsite receptor.

4.2.2.4 Groundwater Temporary Barriers and Controls

There are no current or planned future groundwater barriers or areas of flow control due to the overall depth of the water table.

4.2.2.5 Groundwater Remediation, Mitigation and Other Interventions

The end state for groundwater at SNL/NM will be selected via a Corrective Measures Evaluation. Early indications are that the alternatives considered in the three remaining corrective measures evaluations (Tijeras Arroyo, Technical Area V, and Canyons Area) may include (1.) monitored natural attenuation, (2.) bioremediation with monitored natural attenuation, (3.) and no further action with long-term monitoring. The third alternative, no further action, was verbally rejected by the NMED in May 2003. In order for bioremediation to be successful at SNL/NM, it would need to be more effective both technically and in cost than Monitored Natural Attenuation. Any groundwater solution has to be in harmony with public values.

A Corrective Measure Study for the Mixed Waste Landfill was delivered to the NMED in May 2003 (Sandia National Laboratories May 2003b). The Mixed Waste Landfill is currently in an annual groundwater sampling cycle.

Preliminary data show that the drains and septic systems did not impact groundwater. Groundwater sampling is expected to be completed in fiscal year 2004. Reports for the Drains and septic systems will follow but ultimately must be delivered by the end of Fiscal Year 2006.

4.2.2.6 Groundwater Receptors

The potential current and future human health receptors were established based on the "Baseline for Future Use Options" (DOE September 1995). For SNL/NM, the potential receptors included industrial, recreational, and residential. The industrial and recreational land uses were the most predominant. However, the groundwater in the vicinity of SNL/NM will not be used by these potential receptors (there are no complete exposure pathways). Nonetheless the Corrective Measures Evaluations will need to consider the untapped groundwater as a potential resource.

As described in detail in "Predictive Ecological Risk Assessment Methodology, Environmental Restoration Program, Sandia National Laboratories, New Mexico" (IT July 1998) the ecological receptors include, a nonspecific perennial plant was selected as the receptor to represent plant species at the site. The deer mouse (*Peromyscus maniculatus*) and the burrowing owl (*Speotyto cunicularia*) were used to represent wildlife use. Because of its opportunistic food habits, the deer mouse was used to represent a mammalian herbivore, omnivore, and insectivore. The burrowing owl was used to represent a top predator at this site. There is no current or future surface release of the groundwater found in the vicinity of SNL/NM and therefore, there are no complete ecological exposure pathways for contact with groundwater.

4.2.2.7 Groundwater Variance Discussion

The end state vision for groundwater is based on a preliminary technology survey and verbal discussions with the regulator. A Corrective Measures Evaluation will be delivered in September 2005. If Monitored Natural Attenuation (MNA) is chosen as the corrective measure, and no additional remediation is required, then the current state will differ little from the end state vision. The differences seen would likely be contaminant concentration reductions.

The evaluation for Monitored Natural Attenuation will include following the EPA protocol for Monitored Natural Attenuation. This protocol lends itself best to anaerobic groundwater systems. The groundwater at SNL/NM is aerobic. To mitigate the difficulty of applying an aerobic system to the EPA protocol, SNL/NM is using some expertise used at Idaho National Laboratories for their deep aerobic groundwater with TCE contamination.

The NMED has not reviewed many Monitored Natural Attenuation evaluations. SNL/NM is working with the NMED in teamwork fashion early in the process to smooth the progress of their decision making. Also SNL/NM is seeking ways to accelerate delivery of the Corrective

Measures Evaluation again to give the NMED sufficient information as early as possible for decision making.

All groundwater decisions for SNL/NM will be based on assumptions regarding the current groundwater supply network. As long as there are no substantive changes to groundwater supply in the area of SNL/NM these assumptions and decisions hold. However, a significant change in groundwater flow conditions can occur if, for example, the City of Albuquerque stops using the well field north of SNL/NM, the Ridgecrest wells. Future groundwater supply changes will be an important long-term stewardship issue.

4.3 NFA Sites Passing Industrial or Recreational Risk

4.3.1 Introduction

DOE/SNL/NM has submitted a total of 195 NFA documents to the EPA and/or the NMED for approval. The NMED has developed NFA criteria that are used during the investigation and remediation (if necessary) of SWMUs and that are used to determine the appropriateness of proposing NFA for any particular SWMU. During investigation of the SWMUs at SNL/NM, it was determined that RCRA solid or hazardous wastes and/or constituents or other Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (1980) hazardous substances were never managed (generated, treated, stored, or disposed of) at some sites identified as SWMUs. Other SWMUs could not be located, did not exist, were duplicates of other SWMUs, or were included in investigations of other SWMUs. In addition, some SWMUs never had a release to the environment and future releases were also determined to be unlikely. These SWMUs are not considered to contain hazards, and are not included in the discussion in this section.

Finally, some SWMUs were characterized and remediated in accordance with current applicable state and/or federal regulations, and confirmatory data indicate that remaining contaminant concentrations pose acceptable levels of risk to human health and the environment under current and projected future land uses. Sites which passed the residential risk criteria are not considered to contain hazards, and so are also excluded from this section.

Sandia National Laboratories, New Mexico (SNL/NM) Environmental Restoration Project (ER) includes 22 No Further Action (NFA) sites which are known to not pass the residential risk, and therefore have been closed under industrial or recreational land use. Another 24 No Further Action (NFA) sites will have risk assessments re-run under the new guidance from NMED, and may not pass at the residential level. For the purpose of this section, the term “NFA Sites” refers to these industrial or recreational risk sites.

The hazard discussed in this section is the residual contamination remaining at the NFA sites which were cleaned up to industrial or recreational risk levels only, and which did not meet the residential risk criteria. Risks to human health or the environment from these residuals are minimal.

4.3.2 NFA Conceptual Site Model

Figure 4.3.2-1 presents the generic Conceptual Site Model (CSM) for the NFA Sites that have been cleaned up to only industrial or recreational risk levels. This generic CSM provides a visual presentation of site exposure pathways at the sites that currently connect a source of contamination to possible human and ecological receptors. A site-specific CSM is documented in greater detail for each of the NFA Sites in the risk assessments presented in the NFA for each site. These risk assessments demonstrate that the sites meet the current and projected future land uses which were determined as discussed in the previous sections.

Description (Hazard Area Summary)

The NFA sites hazard areas are comprised of residual soil contamination that originated from the SNL/NM operations. In some cases, characterization showed that the soils contained residuals which were sufficient to pass a risk assessment assuming an industrial or recreational land use scenario. Other sites were remediated only to the industrial or recreational level. The NFA sites are located in Technical Areas as well as in the more remote firing sites and large explosive test areas. Risks to human health or the environment from these residuals are minimal.

4.3.2.1 Primary and Secondary Sources

COCs at these sites are due to SNL/NM operations and occur as residual contaminants in surface and subsurface soils, and include both inorganic constituents (metals and radionuclides) and organic constituents.

4.3.2.2 Release Transport or Exposure Mechanisms

Transport and exposure pathways are addressed in the risk assessment presented for each of the NFA Sites. The following information is generic in nature and can, for the most part, be attributed in general to the NFA Sites.

The potential source of constituents of concern (COCs) at the sites is soil with residual levels of contamination. Wind, water, and biota are natural mechanisms of transport for these COCs. For sites with surface soil sources, some transport of contaminated soil by wind is possible. This is a minor transport mechanism for subsurface sources.

Water at the sites is received as precipitation (rain or occasionally snow). The annual precipitation for the area, as measured at Albuquerque International Sunport, is 8.1 inches and will either evaporate at or near the point of contact, infiltrate into the soil, or form runoff. Both run-on and runoff at most of the NFA Sites is not a potential transport mechanism for COCs due to the limited rainfall within the area.

Water that infiltrates into the soil will continue to percolate through the soil until field capacity is reached. COCs desorbed from the soil particles into the soil solution may be leached into the subsurface soil with this percolation. Because the estimates of evapotranspiration for the KAFB area range from 95 to 99 percent of the annual rainfall, virtually all of the moisture associated

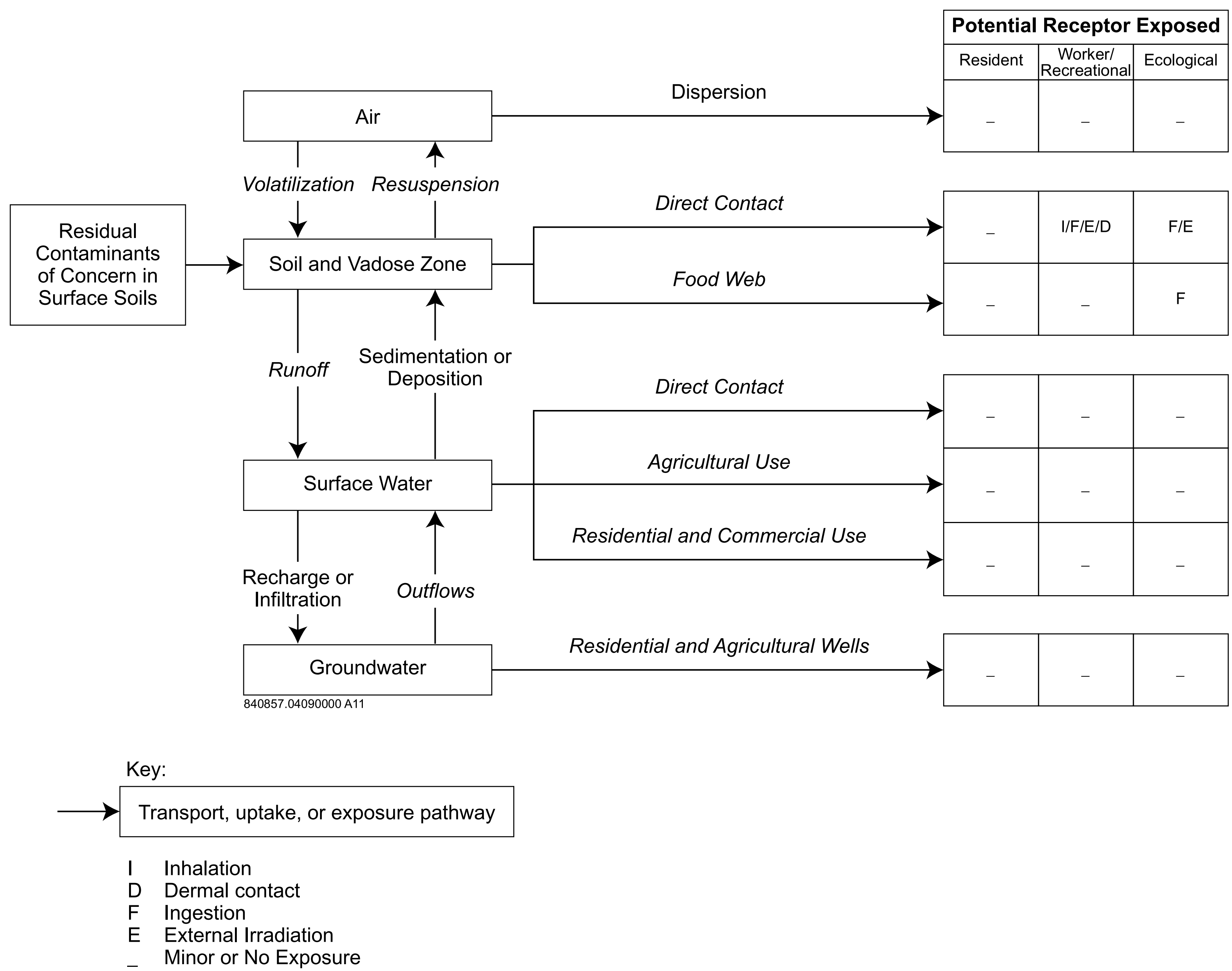

Figure 4.3.2-1

Industrial/Recreational NFA Sites CSM - Current and End State

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with infiltration is expected to evaporate. Groundwater at SNL/NM is deep, therefore, the potential for COCs to reach groundwater through the unsaturated zone above the water table is very limited.

Biota uptake and food chain transfer for COCs vary at the NFA Sites depending on vegetation, and size of the site.

The COCs include both inorganic and organic analytes. The inorganic COCs are elemental in form and therefore are generally not considered to be degradable. Radiological COCs, however, undergo decay to stable isotopes or radioactive daughter elements. Other transformations of inorganic constituents may include changes in valence (oxidation/reduction reactions) or incorporation into organic forms (e.g., the conversion of selenite or selenate from soil to seleno-amino acids in plants). The rate of such processes will be limited by the arid environment at this site. Degradation processes for organic COCs may include photolysis, hydrolysis, and biotransformation. Photolysis requires light, and therefore takes place in the air, at the ground surface, or in surface water. Hydrolysis includes chemical transformations in water and may occur in the soil solution. Biotransformation (i.e., transformation due to plants, animals, and microorganisms) may occur; however, biological activity may be limited by the arid environment at this site.

Table 4.3.2-1 summarizes the fate and transport processes that may occur. COCs at these sites occur as residual contaminants in surface and subsurface soils, and include both inorganic constituents (metals and radionuclides) and organic constituents.

Table 4.3.2-1
Summary of Fate and Transport at the NFA Sites

Transport and Fate Mechanism	Existence at the NFA	Significance
Wind	Yes (for surface soils)	Low to moderate
Surface runoff	No	None
Migration to groundwater	No	None
Food chain uptake	Varies	Low to high
Transformation/degradation	Yes	Low to moderate

4.3.2.3 Temporary Barriers and Controls

Sites cleaned up to industrial or recreational risk levels do not contain any temporary barriers or controls.

4.3.2.4 Remediation, Mitigation and Other Interventions

A variety of cleanup activities have already been completed at the sites which meet industrial or recreational risk levels. The details of these activities are included in the NFA document for the individual site.

4.3.2.5 Receptors

The potential current and future human health receptors for each site were established based on the “Baseline for Future Use Options” (DOE September 1995). For SNL, the potential receptors included industrial, recreational, and residential land users. The industrial and recreational land uses were the most predominant. However, for all sites a residential receptor was evaluated for comparison purposes. For a detailed description of the potential receptors at the sites refer to the individual NFA documents.

As described in detail in “Predictive Ecological Risk Assessment Methodology, Environmental Restoration Program, Sandia National Laboratories, New Mexico” (IT July 1998) the ecological receptors include, a nonspecific perennial plant was selected as the receptor to represent plant species at the site. The deer mouse (*Peromyscus maniculatus*) and the burrowing owl (*Speotyto cunicularia*) were used to represent wildlife use. Because of its opportunistic food habits, the deer mouse was used to represent a mammalian herbivore, omnivore, and insectivore. The burrowing owl was used to represent a top predator at this site.

5.0 VARIANCE DISCUSSION

While there are currently no known variances between the end state that is expected to result from the presently scheduled ER work and the appropriate risk-based end state, potential future variances may occur at individual sites that have not yet been approved by the NMED. Since risk based end states have driven cleanup levels for nearly ten years at SNL/NM, and have been applied to all major cleanups, any variance is expected to be minimal.

For sites that have been removed from SNL's RCRA permit, the current state is exactly the end state. The four sites that have a small amount of fieldwork remaining, (Sites 8, 58, 68, and 91) but have regulatory concurrence with the cleanup approach, are in essentially the same situation. Although there is always the possibility of surprises in the field, these cleanups have been planned on the basis of preliminary site characterization data, and thus are fairly well defined.

Instances where the actual cleanup level attained at a site exceeded the target industrial or recreational level may have occurred because of the use of heavy equipment for soil removal, or the recalculation of residential risk using less stringent assumptions, per new NMED guidance. This unintended result is beneficial since it reduces the amount of stewardship required in the future.

The CWL remediation is complete except for backfilling the excavation and handling the waste, which is scheduled to complete in 2004. The current state is therefore very nearly the end state. The post-closure requirements for the CAMU are being finalized with the regulators, and the responsibility for compliance is being transitioned to a permanently funded department of SNL.

Sites which are currently in the Corrective Measures Study or Evaluation stage, but have not yet attained a decision, may be required to do more fieldwork than is currently envisioned. If the SNL/NM preferred alternative is chosen, and no additional remediation is required at the groundwater sites, or the MWL, then the current state is the same as the end state with the exception that end state contaminant concentrations may be lower than current contaminant concentrations.

The end state vision for groundwater is based on a preliminary technology survey and verbal discussions with the regulator. A Corrective Measures Evaluation will be delivered to the regulator and public in September 2005. If Monitored Natural Attenuation (MNA) is chosen as the corrective measure, and no additional remediation is required, then the current state will differ little from the end state vision. The differences seen would likely be contaminant concentration reductions

Sites and AOCs under active use that have not yet been cleaned up will remain a liability for SNL/NM and DOE. The main sites under active use are the Long Sled Track (Site 83), Short Sled Track (Site 84), and the Gun Facility (Site 240). While these sites remain environmental liabilities, they are also considerable DOE assets because of their test capabilities. The AOCs under active use are all septic systems that will ultimately be decomissioned along with the facilities they support.

A final disconnect is the lack of transition guidance or process between EM and NNSA as ER fieldwork is completed and the ER Project attempts to define and hand off stewardship responsibilities to NNSA. SNL/ER has attempted to bridge this gap by beginning to transition responsibilities internally to a permanently funded SNL/NM department.

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APPENDIX A
Detailed List of SNL/NM SWMUs Requiring Investigation Under the HSWA Module of SNL's RCRA Permit

Draft

Detailed List of SNL/NM SWMUs Requiring Investigation Under the HSWA Module of SNL's RCRA Permit

Site #	Site Name	Operable Unit
Solid Waste Management Units (SWMUs)		
1	Radioactive Waste Landfill	1303
2	Classified Waste Landfill	1303
3	Chemical Disposal Pits	1303
4	LWDS Surface Impoundments	1307
5	LWDS Drainfield	1307
6	Gas Cylinder Disposal Pit (Bldg. 9966)	1335
7	Gas Cylinder Disposal Pit	1309
8	Open Dump (Features 8Y and 58B) - Phase 1	1332
9	Burial Site: Open Dump	1334
10	Burial Mounds (N of Pendulum Site)	1333
11	Explosive Burial Mounds	1334
13	Oil Surface Impoundment	1333
14	Burial Site (Bldg. 9920)	1335
15	Trash Pits (Frustration Site)	1332
16	Open Dumps	1309
18	Concrete Pad	1306
19	TRUPAK Boneyard Storage Area	1332
20	Schoolhouse Mesa Burn Site	1334
21	Metal Scrap (Coyote Springs)	1334
22	Storage Burn (West of DEER)	1334
23	Disposal Trenches	1309
25	Burial Site (South of TA-I)	1302
26	Burial Site	1306
27	Bldg 9820 Animal Disposal Pit	1332
30	Reclamation Yard	1302
31	Transformer Oil Spill	1306
32	Steam Plant Oil Spill (TA-I)	1302
33	Motor Pool Oil Spill	1302
34	Centrifuge Oil Spill	1306
35	Vibration Facility Oil Spill	1306
36	HERMES Oil Spill	1306
37	PROTO Oil Spill	1306
38	Oil Spills (BLDG 9920)	1335
39	Oil Spill - Solar Facility	1335
40	Oil Spill	1309
41	Building 838 Mercury Release (TA-I)	1302
42	Building 870 Water Treatment Facility (TA-I)	1302
43	Radioactive Materials Storage Yard	1303
44	Decontamination Site and	1303
45	Liquid Discharge	1309
46	Old Acid Waste Line Outfall	1309
47	Unmanned Seismic Observatory	1334
48	Bldg. 904 Septic System	1303
49	Bldg 9820 Drains	1295

Detailed List of SNL/NM SWMUs Requiring Investigation Under the HSWA Module of SNL's RCRA Permit (Continued)

Site #	Site Name	Operable Unit
50	Old Centrifuge Site	1309
51	Bldg 6924 Pad, Tank, and Pit	1306
52	LWDS Holding Tanks	1307
53	Bldg. 9923 Storage Igloo	1335
54	Pickax Site (Thunder Range)	1335
55	Red Towers Site (Thunder Range)	1335
56	Old Thunderwells (Thunder Range)	1335
58	Coyote Canyon Blast Area	1332
59	Pendulum Site	1333
60	Bunker Area	1333
62	Greystone Manor Site	1334
64	Gun Site (Madera Canyon)	1333
66	Boxcar Site	1332
67	Frustration Site	1332
68	Old Burn Site	1334
69	Old Borrow Pit	1334
70	Explosives Test Pit (Water Towers)	1334
71	Moonlight Shot Area	1334
72	Operation Beaver Site	1333
73	Hazardous Waste Repackaging/Storage (Building 895)	1302
74	Chemical Waste Landfill Closure Plan	1267
76	Mixed Waste Landfill	1289
77	Oil Surface Impoundment	1309
78	Gas Cylinder Disposal Pit	1306
82	Old Aerial Cable Site Scrap	1332
83	**Long Sled Track (Active Site)**	**1306**
84	**Gun Facilities (Active Site)**	**1306**
85	Firing Site (Bldg 9920)	1335
86	Firing Site (Bldg 9927)	1335
87	Building 9990 Firing Site	1332
90	Beryllium Firing Site (Thunder Range)	1335
91	Lead Firing Site (Thunder Range)	1335
92	Pressure Vessel Test Site	1333
96	TA-I Storm Drain System	1302
98	Building 863, TCA and Photochemical Releases (also was 185 until 11/93)	1302
100	Bldg 6620 Drain/Sump	1306
101	Explosive Contaminated Sumps, Drains (Bldg. 9926)	1295
102	Radioactive Disposal Area	1306
103	Scrap Yard	1335
104	PCB Spill, Computer Facility	1302
105	Mercury Spill @ Bldg 6536	1306
107	Explosives Test Area	1306
108	Firing Site (BLDG 9940)	1335
109	Firing Site (BLDG 9956)	1335

Detailed List of SNL/NM SWMUs Requiring Investigation Under the HSWA Module of SNL's RCRA Permit (Continued)

Site #	Site Name	Operable Unit
111	Bldg 6715 Sump/Drain	1306
112	Explosive Contaminated Sump	1335
113	Area II Firing Sites	1303
114	Explosive Burn Pit (Area II)	1303
115	Firing Site (BLDG 9030)	1335
116	Building 9990 Septic System	1295
117	Trenches (BLDG 9939)	1335
135	Bldg. 906 Septic System	1303
136	Bldg. 907 Septic System	1303
137	Bldg 6540/6542 Septic System	1295
138	Bldg 6630 Septic System	1295
139	Bldg. 9964 Septic System	1295
140	Bldg. 9965 Septic System (Thunder Range)	1295
141	Bldg. 9967 Septic System (Thunder Range)	1295
142	Bldg. 9970 Septic System	1295
143	Bldg. 9972 Septic System	1295
144	Bldg. 9980 Septic System	1295
145	Bldgs. 9981/9982 Septic System	1295
146	Bldg 9920 Drain System	1295
147	Bldg 9925 Septic Systems	1295
148	Bldg 9927 Septic System	1295
149	Bldg 9930 Septic System	1295
150	Bldg 9939/9939A Septic Systems	1295
151	Bldg 9940 Septic Systems	1295
152	Bldg 9950 Septic Systems	1295
153	Bldg 9956 Septic Systems	1295
154	Bldg 9960 Septic Systems	1295
155	Bldg 6597 25,000 Gallon Tank (TA-V)	Archival/1300
159	Bldg. 935 Septic System	1303
160	Bldg 9832 Septic Systems	1295
161	Bldg 6636 Septic Systems	1295
165	Bldg. 901 Septic System	1303
166	Bldg. 919 Septic System	1303
167	Bldg. 940 Septic System	1303
168	Bldg 901 UST (TA-II)	Archival/1300
169	Bldg 910 UST (TA-II)	Archival/1300
170	Bldg 911 UST (TA-II)	Archival/1300
171	Bldg 912 UST (TA-II)	Archival/1300
172	Bldg 888 UST (TA-I)	Archival/1300
173	Bldg 6525 UST (TA-III)	Archival/1300
174	Bldg 6581 UST (TA-IV)	Archival/1300
175	Bldg 6588 UST (TA-IV)	Archival/1300
176	Bldg 605 UST (TA-I)	Archival/1300
178	Bldg 6587 UST (TA-III)	Archival/1300

Detailed List of SNL/NM SWMUs Requiring Investigation Under the HSWA Module of SNL's RCRA Permit (Continued)

Site #	Site Name	Operable Unit
179	Bldg 7570 UST	Archival/1300
180	Bldg 6503 UST (TA-III)	Archival/1300
181	Bldg 6500 UST (TA-V)	Archival/1300
186	Building 859 TCE Disposal	1302
187	TA-I Sanitary Sewer Lines	1302
188	Bldg 6597 Aboveground Spill Containment	1306
190	Steam Plant Tank Farm	1302
191	Equus Red	1335
192	TA-I Waste Oil Tank	1302
193	Sabotage Test Area	1335
194	Gen. Purpose Heat Source Test Area	1335
195	Experimental Test Pit	1306
196	TA-V Cistern Bldg 6597	1306
211	Building 840 Former UST	1302
226	TA-I Former Acid Waste Line	1302
227	Bunker 904 Outfall	1309
229	Storm Drain System Outfall	1309
230	Storm Drain System Outfall	1309
231	Storm Drain System Outfall	1309
232	Storm Drain System Outfall	1309
233	Storm Drain System Outfall	1309
234	Storm Drain System Outfall	1309
235	Storm Drain System Outfall	1309
240	**Short Sled Track (Active Site)**	**1306**
241	TA-V Storage Yard	1306
275	TA-V Seepage Pits	1306
12A	Open Arroyo (Lurance Canyon)	1333
12B	Buried Debris in Graded Area	1333
17A-H	Scrap Yards/Open Dump	1335
228A	Centrifuge Dump Site	1309
228B	Centrifuge Dump Site	1309
28-1	Mine Shafts - 28A (IPABS)	1332
28-10	Mine 28J (IPABS)	1332
28-2	Mine 28B (IPABS)	1332
28-3	Mine 28C (IPABS)	1332
28-4	Mine 28D (IPABS)	1332
28-5	Mine 28E (IPABS)	1332
28-6	Mine 28F (IPABS)	1332
28-7	Mine 28G (IPABS)	1332
28-8	Mine 28H (IPABS)	1332
28-9	Mine 28I (IPABS)	1332
57A	Workman Site: Firing Site	1334
57B	Workman Site: Target Area	1334
61A	Schoolhouse Mesa Test Site: Blast Area	1334

Detailed List of SNL/NM SWMUs Requiring Investigation Under the HSWA Module of SNL's RCRA Permit (Continued)

Site #	Site Name	Operable Unit
61B	Schoolhouse Mesa Test Site: Cratering Area	1334
61C	Schoolhouse Mesa: Schoolhouse Building	1334
63A	Balloon Test Area: PDSP Site	1333
63B	Balloon Test Area: Balloon/Helicopter Site	1333
65A	Small Debris Mound	1333
65B	Primary Detonation Area	1333
65C	Secondary Detonation Area	1333
65D	Near Field Dispersion Area	1333
65E	Far Field Dispersion Area	1333
6A	Gas Cylinder Disposal Pit	1335
81A	Catcher Box/Sled Track	1333
81B	Impact Pad	1333
81C	Former Burial Location	1333
81D	Northern Cable Area	1333
81E	Gun Impact Area	1333
81F	Scrap Yard	1333
88A	Firing Site: Ranch House	1334
88B	Firing Site: Instrumentation Pole	1334
89A-C	Shock Tube Site (Thunder Range)	1335
93A,B,C	Madera Canyon Rocket Launcher	1333
94A	Above Ground Tanks	1333
94B	Debris/Soil Mound	1333
94C	Bomb Burner Discharge Line	1333
94D	Bomb Burner Discharge Pit	1333
94E	Small Surface Impoundment	1333
94F	LAARC Discharge Pit	1333
94G	Scrap Yard	1333
	Total SWMUs: 203	
Miscellaneous AOCs		
TNT	TNT Site	1335
94H	Fuel Spill at Open Pool Test Area, Lurance Canyon Burn Site	1333
277	New Firing Site East of Optical Range	1332
278[a]	Building 828 (TA-I)	1302
	Total AOCs: 4	
Drains & Septic Systems AOCs (DSS)[b]		
276	Former Bldg. 829X Silver Recovery Sump (TA-I)	1295
1001	Bldg. 898 Septic System (TA-I)	1295
1003	Former Bldg. 915/922 Septic System (TA-II)	1295
1004	Bldg. 6969 Septic System (Robotic Vehicle Range)	1295
1006	Bldg. 6741 Septic System (TA-III)	1295
1007	Bldg. 6730 Septic System (TA-III)	1295
1008	Bldg. 6750 Septic System (TA-III)	1295

Detailed List of SNL/NM SWMUs Requiring Investigation Under the HSWA Module of SNL's RCRA Permit (Continued)

Site #	Site Name	Operable Unit
1009	Bldg. 6620 Internal Sump (TA-III)	1295
1010	Bldg. 6536 Septic System and Seepage Pit (TA-III)	1295
1014	Former T-12, T-42, and T-43 Septic System (TA-V)	1295
1015	Former MO 231-234 Septic System (TA-V)	1295
1020	MO-146, MO-235 and T-40 Septic System (TA-III)	1295
1024	MO 242-245 Septic System (TA-III)	1295
1025	Bldg. 6501East Septic System (TA-III)	1295
1026	Bldg. 6501West Septic System (TA-III)	1295
1027	Bldg. 6530 Septic System (TA-III)	1295
1028	Bldg. 6560 Septic System (TA-III)	1295
1029	Bldg. 6584 North Septic System (TA-III)	1295
1030	Bldg. 6587 Septic System (TA-III)	1295
1031	Bldgs. 6589 and 6600 Septic System (TA-III)	1295
1032	Bldg. 6610 Septic System (TA-III)	1295
1033	Bldg. 6631 Septic System (TA-III)	1295
1034	Bldg. 6710 Septic System (TA-III)	1295
1035	Bldg. 6715 Septic System (TA-III)	1295
1036	Bldg. 6922 Septic System (TA-III)	1295
1052	Bldg. 803 seepage pit (TA-I)	1295
1072	T-52 and Former Bldg. 6500 septic system (TA-V)	1295
1073	Bldg. 6580 seepage pit (TA-V)	1295
1077	Bldg. 6920 septic system (TA-III)	1295
1078	Bldg. 6640 septic system (TA-III)	1295
1079	Bldg. 6643 septic system (TA-III)	1295
1080	Bldg. 6644 septic system (TA-III)	1295
1081	Bldg. 6650 septic system (TA-III)	1295
1082	Bldg. 6620 septic system (TA-III)	1295
1083	Bldg. 6570 septic system (TA-III)	1295
1084	Bldg. 6505 septic system (TA-III)	1295
1086	Bldg. 6523 septic system (TA-III)	1295
1087	Bldg. 6743 seepage pit (TA-III)	1295
1089	Bldg. 6734 seepage pit (TA-III)	1295
1090	Bldg. 6721 septic system (TA-III)	1295
1091	Bldg. 6720 septic system (TA-III)	1295
1092	MOs 228-230 septic system (TA-III)	1295
1093	Bldg. 6584 West septic system (TA-III)	1295
1094	Live Fire Range East septic system (Lurance Canyon)	1295
1095	Bldg. 9938 seepage pit (Coyote Test Field)	1295
1096	Bldg. 6583 septic system (TA-V)	1295
1098	TA-V Plenum Rooms drywell (TA-V)	1295
1101	Bldg. 885 septic system (TA-I)	1295
1102	Former Bldg. 889 septic system (TA-I)	1295
1104	Bldg. 6595 seepage pit (TA-V)	1295
1105	Bldg. 6596 drywell (TA-V)	1295

Detailed List of SNL/NM SWMUs Requiring Investigation Under the HSWA Module of SNL's RCRA Permit (Continued)

Site #	Site Name	Operable Unit
1108	Bldg. 6531 Seepage Pits (TA-V)	1295
1110	Bldg. 6536 Drain System (TA-III)	1295
1111	Bldg. 6720 Drywell (TA-III)	1295
1112	Bldg. 6590 Reactor Sump Drywell, TA-V	1295
1113	Bldg. 6597 Drywell (TA-V)	1295
1114	Bldg. 9978 Drywell (Coyote Test Field)	1295
1115	Former Offices Septic System (Solar Tower Complex)	1295
1116	Bldg. 9981A Seepage Pit (Solar Tower Complex)	1295
1117	Bldg. 9982 Drywell (Solar Tower Complex)	1295
1120	Bldg. 6643 Drywell (Solar Tower Complex)	1295
	Total DSS Sites: 61	
	Total All Sites: 268	

Note: **Bold** indicates active site.
[a]Site 278 was assigned after most activities complete, more commonly known as Building 828.
[b]There may be some discrepancy in the DSS site names due to changes implemented to more accurately describe sites.

APPENDIX B
Major Environmental Restoration Documents

Major Environmental Restoration Documents

The list below includes the major documents produced by the Environmental Restoration Project. There are two locations available for viewing these documents. Project Implementation Plan (1995) consisting of:

- Program Management Plan
- Quality Assurance Program Plan
- Health and Safety Program Plan
- Information Management Plan
- Community Relations Management Plan

RCRA Facility Investigation Work Plans:

- Chemical Waste Landfill (OU 1267)
- Kauai Test Facility (OU 1281)
- Mixed Waste Landfill (OU 1289)
- Septic Tanks and Drain fields (OU 1295)
- TA-I (OU 1302)
- TA-II (OU 1303)
- TA-III and V (OU 1306)
- Liquid Waste Disposal System (LWDS) (OU 1307)
- Tijeras Arroyo (OU 1309)
- Foothills Test Area (OU 1332)
- Canyons Test Area (OU 1333)
- Central Coyote Test Area (OU 1334)
- Southwest Test Area (OU 1335)
- Tonopah Test Range (OU 1338)
- Fuel Oil Spill (OU 1351)
- Navy Landfill (OU 1352)
- Miscellaneous Sites (OU 1353)

ER SNL/NM Background Concentrations Report
OU and Site-Specific Health and Safety Plans
ER Site-Wide Hydrogeologic Characterization Report (1995)
Environmental Assessment for SNL ER Project, 1996
No Further Action Proposals/VCM Reports
Future Land Use Workbooks (7 sectors, each with land use recommendations)
Class II Permit Modification Request for Temporary Unit Treatment Operations at the Corrective Action Management Unit, Technical Area III
Class III Permit Modification Request for the Management of Hazardous Remediation Waste in the Corrective Action management Unit, Technical Area III