DOE/EA-1404

Department of Energy
Carlsbad Field Office

U.S. Department of Energy

Environmental Assessment for the Actinide Chemistry and Repository Science Laboratory

Draft

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

ACRSL	Actinide Chemistry and Repository Science Laboratory
CBFO	DOE Carlsbad Field Office
CEMRC	Carlsbad Environmental Monitoring and Research Center
CEMRC EA	*Environmental Assessment of the Carlsbad Environmental Monitoring & Research Center Facility*
CFR	Code of Federal Regulations
CH-TRU	contact-handled transuranic
DOE	U.S. Department of Energy
EA	environmental assessment
EIS	environmental impact statement
EM-50	DOE Office of Science and Technology
EPA	U.S. Environmental Protection Agency
E/Q	atmospheric dispersion factor
FEIS	*Final Environmental Impact Statement for the Waste Isolation Pilot Plant*
FY	fiscal year
HEPA	high-efficiency particulate air
LANL	Los Alamos National Laboratory
LANL SWEIS	*Final Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico*
MEI	maximally exposed individual
NEPA	National Environmental Policy Act
PM_{10}	particulate matter less than 10 microns
RCRA	Resource Conservation and Recovery Act
RH-TRU	remote-handled transuranic
ROD	Record of Decision
ROI	region of influence
SEIS-I	*Final Supplement Environmental Impact Statement for the Waste Isolation Pilot Plant*
SEIS-II	*Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*
TA	Technical Area
TEEL	Temporary Emergency Exposure Level
TRU	transuranic
WIPP	Waste Isolation Pilot Plant

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CHAPTER 1

INTRODUCTION AND STATEMENT OF PURPOSE AND NEED

The U.S. Department of Energy (DOE) is proposing to construct and operate an Actinide Chemistry and Repository Science Laboratory (ACRSL) to support chemical research activities related to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. The laboratory would be located on New Mexico State University property adjacent to the existing Carlsbad Environmental Monitoring and Research Center (CEMRC) in Carlsbad, New Mexico. Figure 1-1 shows the locations of the CEMRC and WIPP sites and the community of Los Alamos within the state of New Mexico. DOE has prepared this environmental assessment (EA) to assess the potential environmental impacts associated with the proposed laboratory and reasonable alternatives. The EA was prepared pursuant to the National Environmental Policy Act (NEPA) of 1969, 42 USC 4321 *et seq.*, and DOE NEPA-implementing regulations, Title 10 of the Code of Federal Regulations (CFR) Part 1021.

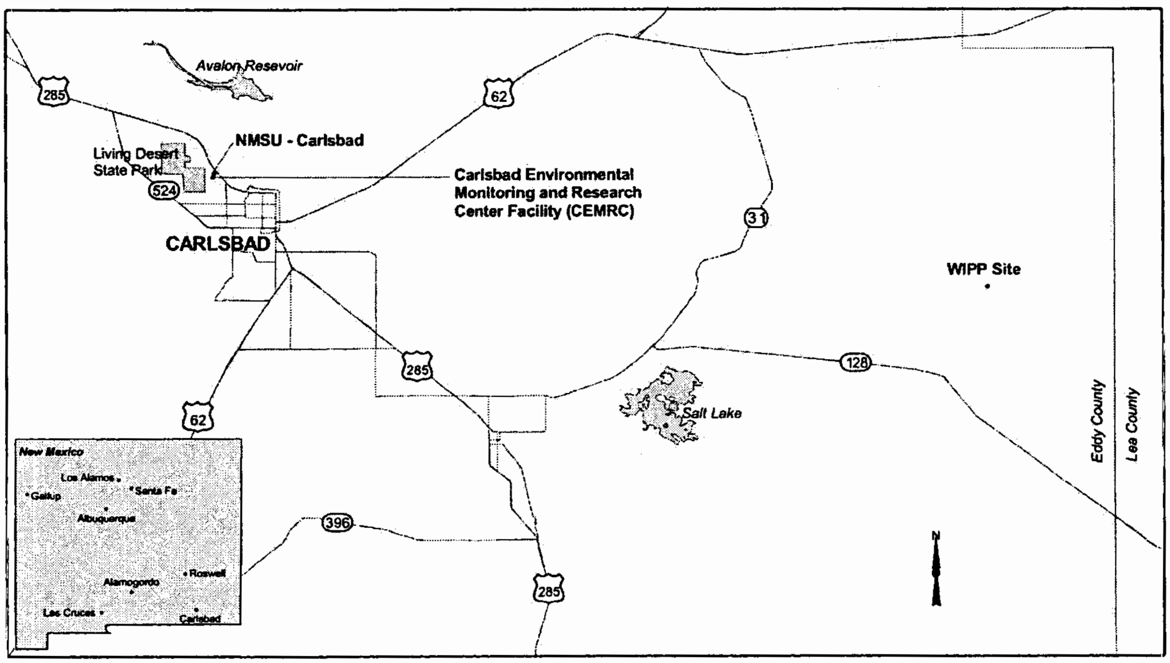

Figure 1-1. Locations of the CEMRC, the WIPP Site, and Los Alamos

1.1 PURPOSE AND NEED FOR AGENCY ACTION

WIPP is the only facility licensed to dispose of transuranic (TRU) waste generated by DOE defense activities. The mission of WIPP is to isolate and dispose of defense TRU waste in a manner that protects public health and the environment. In March 1999, WIPP received its first shipment of TRU waste, and the 500th shipment arrived in January 2002.

TRANSURANIC (TRU) WASTE

TRU waste is defined as "waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes, per gram of waste, with half-lives greater than 20 years, except for (A) high-level radioactive waste; (B) waste that the Secretary [of Energy] has determined, with concurrence of the Administrator [of the Environmental Protection Agency], does not need the degree of isolation required by the disposal regulations; or (C) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with part 61 of Title 10, Code of Federal Regulations" (WIPP Land Withdrawal Act, Public Law 102-579). All TRU elements are heavier than uranium, have several isotopes, and are typically man-made. Key radionuclides found in TRU waste include americium-241 and several isotopes of plutonium (plutonium-238, plutonium-239, plutonium-240, and plutonium-241). The half-lives of many are considerably longer than 20 years. For instance, the half-life of one isotope of plutonium is 24,000 years.

TRU waste is further classified as contact-handled (CH)-TRU waste or remote-handled (RH)-TRU waste. CH-TRU waste has radioactivity levels that are low enough to permit workers to directly handle the containers in which the waste is kept. This level of radioactivity is specified as a dose rate of no more than 200 millirem (mrem) per hour at the outside surface of the container. RH-TRU waste has a surface dose rate greater than 200 mrem per hour, so workers use remote manipulators to handle containers of RH-TRU waste. TRU mixed waste is CH-TRU or RH-TRU waste that also contains hazardous materials such as lead or organic solvents that are regulated by the Resource Conservation and Recovery Act.

To ensure the continued safe handling and management of TRU waste, DOE needs to address specific scientific and technical issues related to waste characterization, repository performance, and enhanced operations of the repository. In addition, DOE is required to demonstrate compliance with standards for disposal of TRU waste in accordance with criteria codified in 40 CFR Part 194. The U.S. Environmental Protection Agency (EPA) certified DOE's compliance with the disposal standards in 1998; in order to continue to receive shipments of TRU waste, EPA must recertify DOE in 2004 and every 5 years thereafter. Information to be provided to EPA for the upcoming and future recertification processes will likely require data from focused radiological and non-radiological chemistry experiments. Planned and potential experiments to support WIPP operations and recertification could include: the effects of WIPP-relevant materials (such as reductants) and potential radiolysis by-products (for example, hypochlorite and peroxide) on the oxidation states and speciation of plutonium, americium, uranium, thorium, and neptunium; the effects of organic ligands on the mobility of plutonium and other actinide elements in WIPP-relevant brines; the demobilization of actinides by borehole fill materials; and the efficacy of oxidation state analogs for predicting the behavior of the actinides (Mercer 2002). Appendix A contains additional information on potential laboratory experiments.

In the past, WIPP-related chemical research activities have been performed at several different laboratories located around the country. For example, a variety of radiochemistry experiments have been conducted at Los Alamos National Laboratory (LANL), actinide oxidation/reduction experiments were conducted at Argonne National Laboratory, actinide complexing experiments were conducted at Florida State University, and plutonium solubility experiments were performed at the Pacific Northwest National Laboratory. Now, with the exception of the LANL location, WIPP has ended experiments at other sites. DOE has determined that it would be much more efficient and cost-effective to consolidate these activities in a local Carlsbad facility

ACTINIDES

The actinides are the 15 chemical elements with atomic numbers 89 to 103, inclusively. The group consists of actinium, thorium, protactinium, uranium, neptunium, plutonium, americium, curium, berkelium, californium, einsteinium, fermium, mendelevium, nobelium, and lawrencium. Eleven of the fifteen actinides (neptunium through lawrencium) are transuranic and therefore meet the quantitative definition of TRU waste contaminants. Because all of the actinides share certain physical and chemical characteristics, research on the fate, effects, and mobility of these elements provides data that are applicable to an understanding of the fate, effect, and mobility of the TRU waste that has been and will be disposed of at WIPP.

that does not present the difficulties inherent with the distances currently involved or the security requirements at laboratories that primarily perform weapons-related work. To address both near- and long-term scientific issues related to WIPP performance, DOE has identified a need to enhance and consolidate the repository's experimental program at one facility. Such a program would also facilitate support for WIPP's international programs by providing a central location for conducting actinide chemistry experiments of interest to waste disposal programs in other countries.

Development of this program will require a highly credible environmental assay and actinide chemistry laboratory that is capable of supporting work with very low to high levels of radioactive materials. Currently, no such facility exists in Carlsbad. DOE proposes to design, construct, and operate a multi-user laboratory (the ACRSL) adjacent to the existing CEMRC facility in Carlsbad (hereafter referred to as the Proposed Action in this EA). This laboratory could be (1) an existing mobile laboratory that was constructed with DOE Office of Science and Technology (EM-50) funds, has been relocated to Carlsbad, and is functional, but is not equipped for experiments at the levels of radioactivity desired for the ACRSL; (2) a newly constructed facility; or (3) a combination of the existing mobile facility and a new facility. Locating the laboratory next to the CEMRC would leverage the existing CEMRC infrastructure and licenses at a significant savings in time and cost.

Alternatives to the Proposed Action include the No Action Alternative (continuing to conduct actinide chemistry experiments at existing LANL laboratories) and the WIPP Alternative (locating the new laboratory at the WIPP site). DOE also considered but did not analyze other alternatives because they were not reasonable given technical and cost considerations. The Proposed Action and alternatives are described in Chapter 2.

1.2 BACKGROUND

DOE is responsible for the management and ultimate disposition of TRU waste generated at DOE sites by defense operations. Pursuant to this responsibility and as directed by Congress, DOE constructed and operates WIPP as a permanent geological repository for the disposal of TRU waste. WIPP is located at a depth of 655 meters (2,150 feet) in Eddy County in southeastern New Mexico, about 50 kilometers (30 miles) east of Carlsbad. Congress authorized WIPP at its current location in 1979, and the Construction and Salt Handling Shaft was drilled in 1981. In 1984, DOE and the State of New Mexico agreed that WIPP must comply with all state, federal, and local laws and regulations, including those imposed by EPA. Facility construction and initial mine excavation phases were completed in 1988. In 1992, Congress passed the WIPP Land Withdrawal Act, which withdrew 41 square kilometers (10,240 acres) of federal land from public use for exclusive WIPP use. In 1993, EPA issued compliance standards for WIPP certification and recertification (see 40 CFR 191) and, in 1996, issued criteria to certify and determine WIPP's compliance with these standards (see 40 CFR Part 194). In 1998, the Agency certified that WIPP had met all applicable federal nuclear waste disposal standards. In 1999, the State of New Mexico issued a Hazardous Waste Facility Permit that allowed WIPP to receive and dispose of mixed waste.

The CEMRC, a division of the College of Engineering at New Mexico State University, was established in 1991 through a grant from DOE to the University. The goals of the CEMRC are to (1) establish a permanent center of excellence to anticipate and respond to emerging health and environmental needs, and (2) function as a nucleus of research excellence supported through grant funding and service contracts. Figures 1-1 and 1-2 show the location of the Center and an aerial view of it, respectively; the aerial view also depicts a simulated extension of the existing building to show where the proposed laboratory would be located.

The CEMRC was funded initially for a 7-year period (1991–1998), and the grant was subsequently extended to 2008. Funding for the CEMRC included approximately $7 million for construction of a 2,415-square-meter (26,000-square-foot) facility to house low-level radiochemistry and environmental science laboratories, an *in vivo* bioassay facility, computing operations, and offices. Construction of this facility was completed in December 1996.

Figure 1-2. Aerial View of the CEMRC and Proposed ACRSL Facility

The primary focus of the CEMRC radiochemistry program is the measurement of radioactive substances in various media at environmental background levels. To achieve this task, the CEMRC was designed as a low-level radiation facility. The media of interest include, but are not limited to, aerosols, soil, surface water and sediment, ground- and drinking water, and biota and biological materials. The radioanalytical group performs low-level measurement of actinides, fission products, activated corrosion products, and naturally occurring radionuclides. Approximately 158 square meters (1,700 square feet) of space are allocated to the radioanalytical program, including a primary radioanalytical laboratory and separate tracer and counting laboratories. The instrumentation laboratory is equipped for the low-level measurement of actinides, fission products, activated corrosion products, and naturally occurring radionuclides.

1.3 LICENSING AND REGULATORY REQUIREMENTS

The current CEMRC research program involves the use of radioactive materials. Pursuant to the New Mexico Radiation Protection Act of 1978 and the Radiation Protection Regulations Subpart 3, the CEMRC applied for, received, and maintains a Type A Specific License of Broad Scope for radioactive materials. This license allows for the laboratory use and possession of by-product, source, and special nuclear materials at the CEMRC. The current CEMRC license, as amended, would allow the quantities of radioactive materials required for the scientific activities to be conducted in the proposed actinide laboratory. As the manager of the proposed new facility, the CEMRC would comply with regulations governing the management and disposal of hazardous, low-level radioactive wastes by shipping such wastes off the site in accordance with the existing generator regulations that govern waste management at the CEMRC. The CEMRC has appointed a hazardous and radiological waste coordinator to ensure

operations are conducted safely in accordance with New Mexico Environment Department requirements. Current levels of hazardous and radioactive wastes generated at the CEMRC would double with the addition of the proposed ACRSL. However, the new quantity and types of wastes would be well within the capabilities of commercial disposal companies already used at the CEMRC.

1.4 NATIONAL ENVIRONMENTAL POLICY ACT PROCESS

1.4.1 Previous WIPP NEPA Compliance Activities

In 1980, DOE prepared the *Final Environmental Impact Statement for the Waste Isolation Pilot Plant* (FEIS) (DOE 1980) to assess the potential environmental effects of developing WIPP and of alternatives for disposing of or managing TRU waste. The FEIS proposed a two-phased approach to the development of WIPP: (1) a site and preliminary design validation program, and (2) full construction. This approach was adopted in a Record of Decision (ROD) issued in 1981 (46 Fed. Reg. 9162 [1981]).

After construction of most of the WIPP facilities, DOE prepared the *Final Supplement Environmental Impact Statement for the Waste Isolation Pilot Plant* (SEIS-I) (DOE 1990) to update the environmental record established in the FEIS. The SEIS-I ROD, published by DOE in 1990, chose to continue the phased approach to developing WIPP by beginning an underground test phase (55 Fed. Reg. 25689 [1990]). The SEIS-I ROD also committed the Department to prepare a second supplement disposal phase environmental impact statement (EIS).

The *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (SEIS-II) was issued in September 1997. The SEIS-II ROD was issued on January 16, 1998 (63 Fed. Reg. 3623 [1998]). In that document, DOE announced its decision to dispose of TRU waste generated by defense activities at WIPP (DOE 1997).

DOE has also prepared two other EAs for activities related to TRU waste disposal. The *Environmental Assessment of the Carlsbad Environmental Monitoring and Research Center Facility* (DOE 1995c) was prepared to determine if continued DOE funding of the CEMRC, or alternative actions, would have significant environmental impacts. A finding of no significant impact was issued in October 1995. DOE also prepared the *Environmental Assessment for the Construction and Operation of the Sand Dunes to Ochoa Powerline Project* (DOE 1995b).

1.4.2 Stakeholder Outreach and Involvement Activities

NEPA requires that federal, state, and local agencies with jurisdiction or special expertise regarding environmental impacts be consulted and involved in the NEPA process. Agencies involved include those with the authority to issue permits, licenses, and other regulatory approvals. Other agencies include those responsible for protecting significant resources such as endangered species or wetlands. A list of persons and agencies consulted is provided in Chapter 5.

This EA is being prepared in draft and will be distributed for public comment for a period of 30 days. During the public comment period, DOE will hold a public meeting to provide information regarding the Proposed Action and to solicit public comments. Following receipt and consideration of all public comments, DOE will issue a final EA and will determine whether to issue a finding of no significant impact or to proceed with the preparation of an EIS.

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CHAPTER 2

PROPOSED ACTION AND ALTERNATIVES

The WIPP facility, in addition to serving its primary mission as a TRU waste disposal site, needs to perform a variety of actinide chemistry experiments to (1) support WIPP's recertification efforts, (2) address scientific questions important to WIPP, (3) improve TRU waste characterization techniques, and (4) improve DOE's understanding of how the waste interacts with the natural environment in order to better understand waste isolation performance. In the past, WIPP-related actinide chemistry experiments have taken place at DOE laboratory facilities at other DOE sites such as LANL. However, due to reductions in travel budgets and additional security requirements being imposed on DOE weapons laboratories, DOE believes it would be better able to maintain the budget, schedule, and quality of experiments conducted in support of the WIPP program if they were performed in Carlsbad.

DOE is preparing this document to inform decision makers about the potential environmental impacts of the actinide chemistry experiments associated with the Proposed Action, one alternative laboratory location, and a no action alternative, each of which are described in more detail in this chapter. Under the Proposed Action, DOE would construct and operate the ACRSL facility adjacent to the CEMRC in Carlsbad. An alternative is to construct and operate a new actinide chemistry laboratory on the WIPP site. The No Action Alternative is to continue experimental activities in actinide chemistry at existing laboratory facilities at LANL.

The descriptions of the design, construction, and operation of the proposed ACRSL facility were obtained from the proposal submitted by the CEMRC (2000). The descriptions of the actinide chemistry research program and range of potential experiments that may be conducted in the ACRSL were obtained from WIPP project personnel (Mercer 2002).

2.1 PROPOSED ACTION (NEW ACTINIDE LABORATORY AT CEMRC)

Under the Proposed Action, DOE would construct and operate an ACRSL facility in Carlsbad to support actinide chemistry experiments for WIPP. The ACRSL would be located adjacent to the existing laboratory operated by the CEMRC (see Figure 1-2), which would manage the proposed new facility. The new laboratory could either be a mobile laboratory facility, a newly constructed permanent laboratory facility, or a combination of these two facilities (currently, it appears that DOE would begin actinide experiments in the mobile facility and use the newly constructed permanent laboratory building for additional experiments when funding for the new building became available). The new permanent laboratory would be a freestanding building, but it would be located close enough to the CEMRC to be connected by a walkway. Thus, the new building would look like another wing of the CEMRC (Figure 1-2). DOE would make the actinide chemistry laboratory available to third-party users to perform work in support of the WIPP mission.

The proposed ACRSL facility would be approximately 725 square meters (7,800 square feet). The parameters of the conceptual design of the proposed facility are provided in Table 2-1. The design assumes that the infrastructure already present at the CEMRC is not replicated in the ACRSL facility. The proposed ACRSL facility would use existing CEMRC infrastructure such as meeting rooms, administrative offices, reception area, parking, land, access road, fiber optic line, utilities, and sewer. The proposed ACRSL would also have the support of the CEMRC administrative personnel (for example, director, fiscal specialist, buyer, and computer technicians). In addition, the ACRSL would not provide permanent office space for facility users; instead, cubicle space would be provided for non-resident technical work outside the laboratories.

Table 2-1. ACRSL Facility Conceptual Design

Description	Area in square meters (square feet)
Functional Net Space	
High-level radiochemistry	84 (900)
Wet chemistry	56 (600)
Sample preparation	84 (900)
Instrumentation	84 (900)
Waste management	46 (500)
Miscellaneous (e.g., cubicle space, reception, etc.)	139 (1,500)
Subtotal	**493 (5,300)**
Building gross space (e.g., corridors, walls, mechanical, etc.)	232 (2,500)
Building Gross Area	**725 (7,800)**

Source: CEMRC 2000

The CEMRC would be funded by DOE to construct and maintain the facility, and DOE would purchase the movable equipment; however, it would be a multi-user facility. Most of the staff at the facility would consist of personnel on long-term assignments from LANL, Sandia National Laboratories, and Westinghouse TRU Solutions LLC. Most of this staff would probably reside permanently in Carlsbad. Some of the staff could consist of personnel on short-term assignments from other DOE laboratories; other federal agencies; American universities or companies; or foreign governments, universities, or companies. These individuals would probably not reside permanently in Carlsbad. The total long- and short-term staff would comprise between 15 and 25 people. Efforts would begin in fiscal year (FY) 2002, with construction likely beginning in FY2003. The existing facilities at Carlsbad would be used to the maximum extent possible. The program would collaborate with the CEMRC by setting up new capabilities at the CEMRC in FY2002 and by supporting some of the existing capabilities and personnel.

2.1.1 Range of Potential Experiments

The activities that would be performed in the proposed ACRSL can be generally described as directed research and development in actinide chemistry involving tracer levels of radioactive materials. The activities may involve reactions in the solid state and in aqueous and non-aqueous liquid media (varying with programmatic requirements). No production or process lines or routine waste treatment operations would be carried out in the facility. This would be a multi-user facility in which long- and short-term projects would be carried out as defined in the associated hazard control plans. Categorization of experimental activities according to their levels of radioactive materials would help mitigate most hazards.

The maximum amount of radioactive material housed at the combined CEMRC and proposed ACRSL would not exceed 2 curies. Because of the diverse hazards and operations in the proposed ACRSL, special physical and administrative access controls would be in place. For example, physical controls would include double high-efficiency particulate air (HEPA) filters at a minimum on all exhaust airflows. An additional local HEPA filter in the exhaust would be provided for glove boxes or high-activity fume hoods, so the airflow would be treated by triple-HEPA filtration before discharge to the environment. There would be no radioactive releases to the sanitary sewer. As part of the administrative controls, facility-specific training would be required for workers who would need unescorted access to the facility to perform any of the operations covered by the active hazard control plans. Activities would include the handling of alpha-emitting actinide elements (for example, uranium-233, neptunium-237, plutonium-239, plutonium-238, plutonium-242, americium-241, americium-243, and curium-248), and beta-emitting

elements (for example, cesium-137, strontium-86, strontium-90, technetium-99, technetium-95, sodium-22, europium-152, cerium-141, and cerium-144). Experiments could include solubility and speciation studies, microbial studies, electrochemistry, and calorimetry at ambient and elevated temperature and pressure conditions. Experiments would be carried out in various types of containers (for example, beakers, flasks, vessels), both open and closed, made of various materials (for example, titanium, glass, and Teflon). All experiments involving samples of TRU elements would be handled using appropriate containment in solid and solution forms. All experiments involving solid TRU samples would be performed in HEPA-filtered glove boxes.

The proposed ACRSL would focus on special nuclear material (specifically, plutonium-238, plutonium-239, plutonium-240, plutonium-241, plutonium-242, neptunium-237, curium-248, curium-244, americium-241, and americium-243, in quantities that would never be sufficient to form critical mass); source material (for example, uranium and thorium series); and by-product material (for example, technetium-99, yttrium-90, strontium-90, and cesium-137). All of the research activities would be permitted under the existing broad-scope license possessed by the CEMRC. The CEMRC's license has recently been amended to allow for the total radioactivity on site to be 2 curies. At these quantities, an emergency plan for responding to the release of radioactive material and an evaluation of demonstrating offsite doses would not be required under the State of New Mexico Radiation Protection Regulations. However, the CEMRC license does limit the size of a single source to 30 microcuries for special nuclear material, 2 millicuries for source material, and 2 millicuries for byproduct material. If the ACRSL were constructed, it is likely that the single source limit would have to be increased. The total site limit at the CEMRC would not be increased beyond 2 curies. In addition, a decommissioning plan to determine financial assurance requirements may be necessary.

DOE is proposing to conduct several experimental studies of issues relevant to WIPP operations and EPA recertification in the proposed ACRSL. These studies would help DOE address specific scientific and technical issues related to waste characterization, repository performance, and enhanced operations of the repository. Planned and potential experiments to support WIPP operations and recertification include, but are not necessarily limited to: (1) the effects of WIPP-relevant materials (such as reductants) and potential radiolysis by-products (for example, hypochlorite and peroxide) on the oxidation states and speciation of plutonium, americium, uranium, thorium, and neptunium; (2) the effects of organic ligands on the mobility of plutonium and other actinide elements in WIPP-relevant brines; (3) the demobilization of actinides by borehole fill materials; and (4) the efficacy of oxidation state analogs for predicting the behavior of the actinides. These studies would require the use of the radioactive isotopes of plutonium, americium, uranium, thorium, and neptunium, and perhaps cesium and strontium. Specific issues that may be addressed include (not necessarily in order of priority):

1. The occurrence of plutonium(V) and plutonium(VI) in some of the Actinide Source-Term Waste Test Program experiments;

2. The effects of alpha radiolysis of WIPP-relevant brines on the oxidation states of plutonium, uranium, and neptunium;

3. Reduction of oxidized actinides such as plutonium(V) and plutonium(VI) to plutonium(III) and plutonium(IV), respectively, by steel, other iron-base metals, and perhaps aluminum;

4. The effects of actinides and (perhaps) other heavy metals, magnesium oxide and other relevant materials, basic pH, and radiolysis on microbial activity;

5. Possible microbial reduction of plutonium(V), plutonium(VI), uranium(VI), and neptunium(V);

6. Effects of reactions between WIPP brines and various waste forms on brine chemistry, especially Eh and pH;

7. An integrated thermodynamic and kinetic redox model for plutonium under expected WIPP conditions;

8. Co-precipitation and sorption of plutonium, americium, uranium, thorium, and neptunium by magnesium oxide and other relevant materials such as cements;

9. The extent to which colloids could increase the solubilities of plutonium, americium, uranium, thorium, and neptunium by forming complexes with these elements in WIPP brines; and

10. The extent to which organics could increase the solubilities of plutonium, americium, uranium, thorium, and neptunium.

The types of experiments that could be performed in the proposed ACRSL facility are expected to fall within five major categories of research. Appendix A contains specific examples of the types of experiments within each of the five major research categories that could be conducted at the ACRSL.

DOE could also conduct two other categories of study: (1) experimental studies of issues relevant to the characterization of TRU waste, and (2) studies for possible funding by other DOE projects, other federal agencies, private American companies, or even foreign governments or companies. These studies could require the use of radioactive elements other than those listed previously.

Experiments conducted in the proposed ACRSL are expected to initially involve only simulated contact-handled (CH)-TRU or remote-handed (RH)-TRU waste rather than actual CH-TRU or RH-TRU waste. Researchers would specify which radioisotopes would be required and the quantities of each radioisotope required. Solubility experiments require dissolved radioactive element concentrations that are high enough to stabilize radioactive element-bearing solids and enough of these solids for post-test characterization by methods such as X-ray diffraction analysis. Currently, it is anticipated that solubility (or similar) experiments would require glove boxes with atmospheres at a pressure slightly lower than ambient for containment of these radioactive elements, but they would not require shielded hot cells with remote-controlled (robotic) apparatus.

2.1.2 Facility Coordination and Management

The CEMRC would acquire all permits and licenses necessary to construct and operate the facility. Under the Proposed Action, the CEMRC would establish an ACRSL user group with members from DOE, CEMRC, LANL, and Sandia National Laboratories. The ACRSL user group would select a design team, which would likely consist of laboratory consultants, health physics consultants (for glove box design and monitoring requirements), architects, mechanical and electrical engineers, and equipment planners. As indicated in Chapter 1, the current CEMRC license, as amended, would allow the quantities of radioactive materials required for the proposed scientific activities for the proposed ACRSL facility.

The CEMRC would provide overall project management for construction of the ACRSL facility. Once constructed, the CEMRC would be responsible for managing owner occupancy activities (for example, testing of building systems and equipment). During construction, the CEMRC would arrange for major fixed and movable building-related equipment (such as glove boxes and fume hoods), minor movable equipment (telephones, radiation monitors, etc.), and furnishings (bench stools, cubicles, etc.). However, specification, procurement, and maintenance of scientific instrumentation would be the responsibility of

the ACRSL facility users. The proposed ACRSL building would be constructed to accommodate a wide variety of scientific equipment and instrumentation.

2.1.3 Facility Operations

The proposed ACRSL facility, once constructed, would be owned by New Mexico State University and operated by the CEMRC under contract to DOE. The CEMRC would operate the facility as a multi-user research laboratory, providing basic usage coordination, physical plant operation, and environmental, safety, and health compliance management (including radioactive materials licensing). Long- and short-term research projects to support the operation of WIPP would be performed by research entities (such as LANL and Sandia National Laboratories) identified by the Carlsbad Field Office (CBFO), and the CEMRC would facilitate such projects through the operations contract. The ACRSL would be administered as an integrated program of the CEMRC to avoid duplication of administrative costs and to capitalize on opportunities for collaborative efforts.

A major responsibility of the CEMRC would be to provide a safe working environment for all users. To ensure a safe working environment, all activities performed in the proposed ACRSL facility would be conducted in accordance with the requirements of the CEMRC's Radioactive Materials License, Radiation Control Manual, and Chemical Hygiene Plan, under direct supervision of the Radiation Safety Officer and Chemical Hygiene Officer. These requirements would apply to any user present or experiment being conducted at the ACRSL. The CEMRC would provide all safety-related infrastructure support (for example, training and orientation, contamination surveys, fume hood audits, chemical and waste inventory tracking). The CEMRC would also manage the proposed ACRSL facility's chemical and radioactive material and waste inventories to ensure compliance with the CEMRC's Radioactive Materials License, Radiation Control Manual, Chemical Hygiene Plan, and other applicable state and federal regulations. The proposed ACRSL and CEMRC would continue to be regulated and audited by the New Mexico Environment Department, Hazardous and Radioactive Materials Bureau in accordance with the CEMRC's Type A Specific License of Broad Scope for radioactive materials.

The CEMRC would be responsible for the management and disposal of industrial, hazardous and low-level, Class A, radioactive waste generated from experiments conducted in the proposed ACRSL. No user would generate mixed waste without prior approval by the CEMRC Radiation Safety Officer and Chemical Hygiene Officer, who would require the user to provide a plan for expedient disposal or removal from the proposed ACRSL. User organizations would be responsible for the disposal of any mixed waste or radioactive waste (other than Class A) that is generated from experiments conducted at the ACRSL. These wastes would be removed from the proposed ACRSL by the responsible organization within 1 year of generation (or less if required by applicable regulations). None of these wastes would be discharged to the Carlsbad sewer system.

Sanitary and solid waste disposal for the proposed ACRSL facility would be handled through existing CEMRC connections and subscriptions with the City of Carlsbad. Sanitary waste would be disposed of through the existing sewer connection for the CEMRC. Non-hazardous solid waste would be included with the existing CEMRC subscription to the City of Carlsbad for solid waste disposal.

2.2 ALTERNATIVE FOR NEW ACTINIDE LABORATORY AT WIPP

Under this alternative, DOE would design, construct, and operate a new actinide chemistry laboratory at WIPP. The most likely location for this new laboratory would be in the northeast corner of the WIPP site inside the fence (Figure 2-1). Although the design of the laboratory would be similar to the design of the ACRSL facility for the Proposed Action, the new laboratory at WIPP would be a larger building. The new building would include meeting rooms, administrative offices, and a reception area, and would

require connections for utilities and sewer. A new actinide chemistry laboratory at WIPP would also require new hires for administrative support (for example, director, fiscal specialist, buyer, and computer technicians).

2.3 NO ACTION ALTERNATIVE FOR EXISTING ACTINIDE LABORATORY AT LANL

Under the No Action Alternative, DOE would continue experimental activities in actinide chemistry at the existing laboratory facilities at LANL. Currently, these experiments are conducted primarily in Technical Area (TA) 48 (shaded area in Figure 2-2), with most of the experiments in the Radiochemistry Laboratory (TA-48-1, shaded area in Figure 2-3). The Radiochemistry Laboratory is designed as an actinide chemistry and metallurgy building with full capabilities for performing special nuclear material analytical chemistry and materials science (DOE 1999). Previously, critical WIPP-related research activities were performed at many separate laboratories around the country. Now, with the exception of the LANL location, WIPP has ended those experiments at other sites. This alternative would not allow DOE to meet its goal of enhancing the efficiency and cost-effectiveness of the actinide chemistry program or of eliminating the difficulties associated with the security requirements at laboratories that primarily perform weapons-related work.

2.4 ALTERNATIVES CONSIDERED BUT NOT ANALYZED

Two alternatives to the Proposed Action were considered but not analyzed. One possible alternative would be to build a new actinide chemistry laboratory in a different area of the country. However, this alternative was not analyzed because it would not meet DOE's objective to consolidate experiments near WIPP. Another possible alternative would be to discontinue all WIPP-related actinide chemistry experiments. This alternative was not analyzed because it would not meet DOE's need to perform a variety of actinide chemistry experiments to (1) support WIPP's recertification efforts, (2) address scientific questions important to WIPP, (3) improve TRU waste characterization techniques, and (4) improve DOE's understanding of how the waste interacts with the natural environment in order to better understand waste isolation performance.

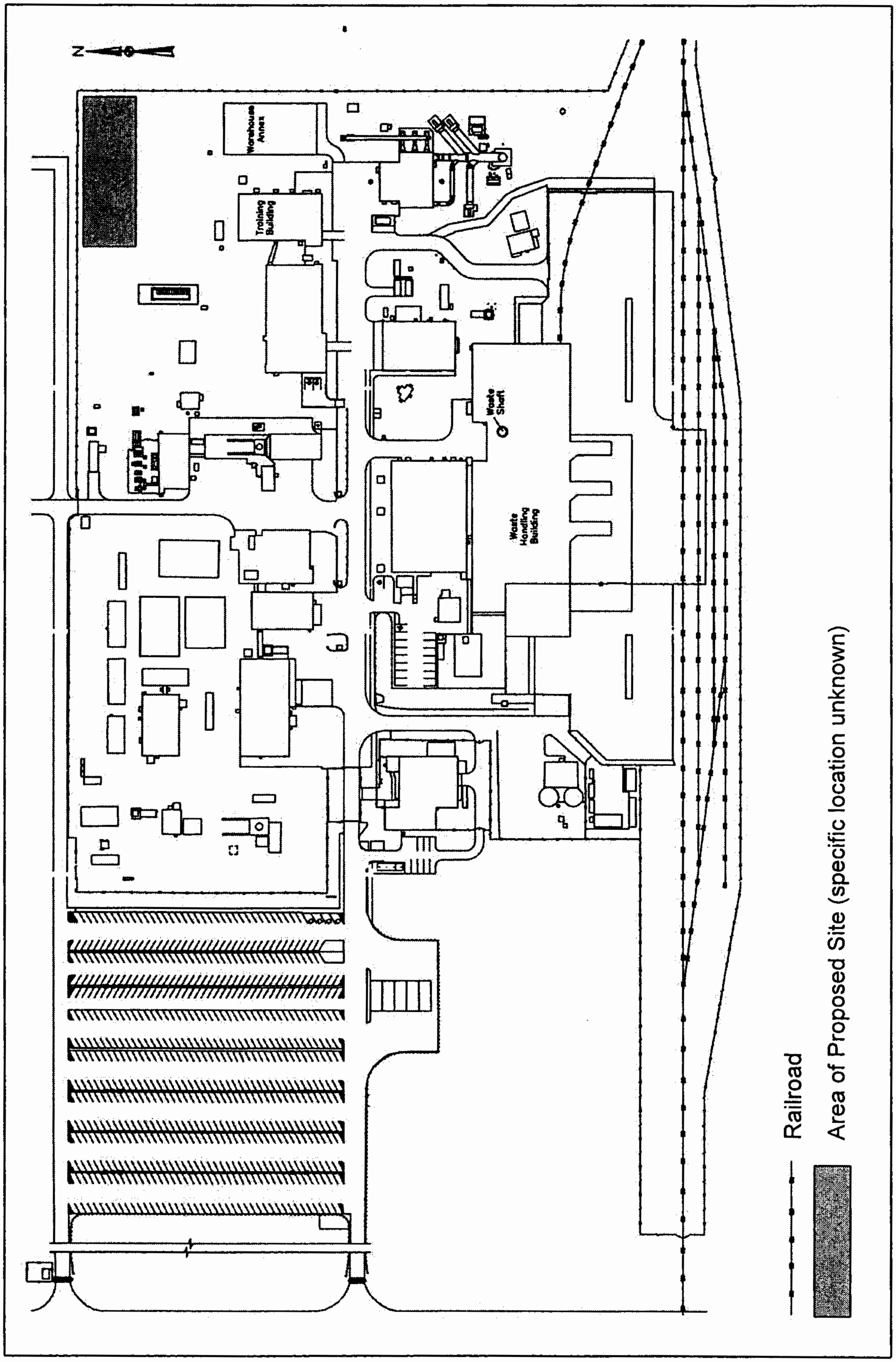
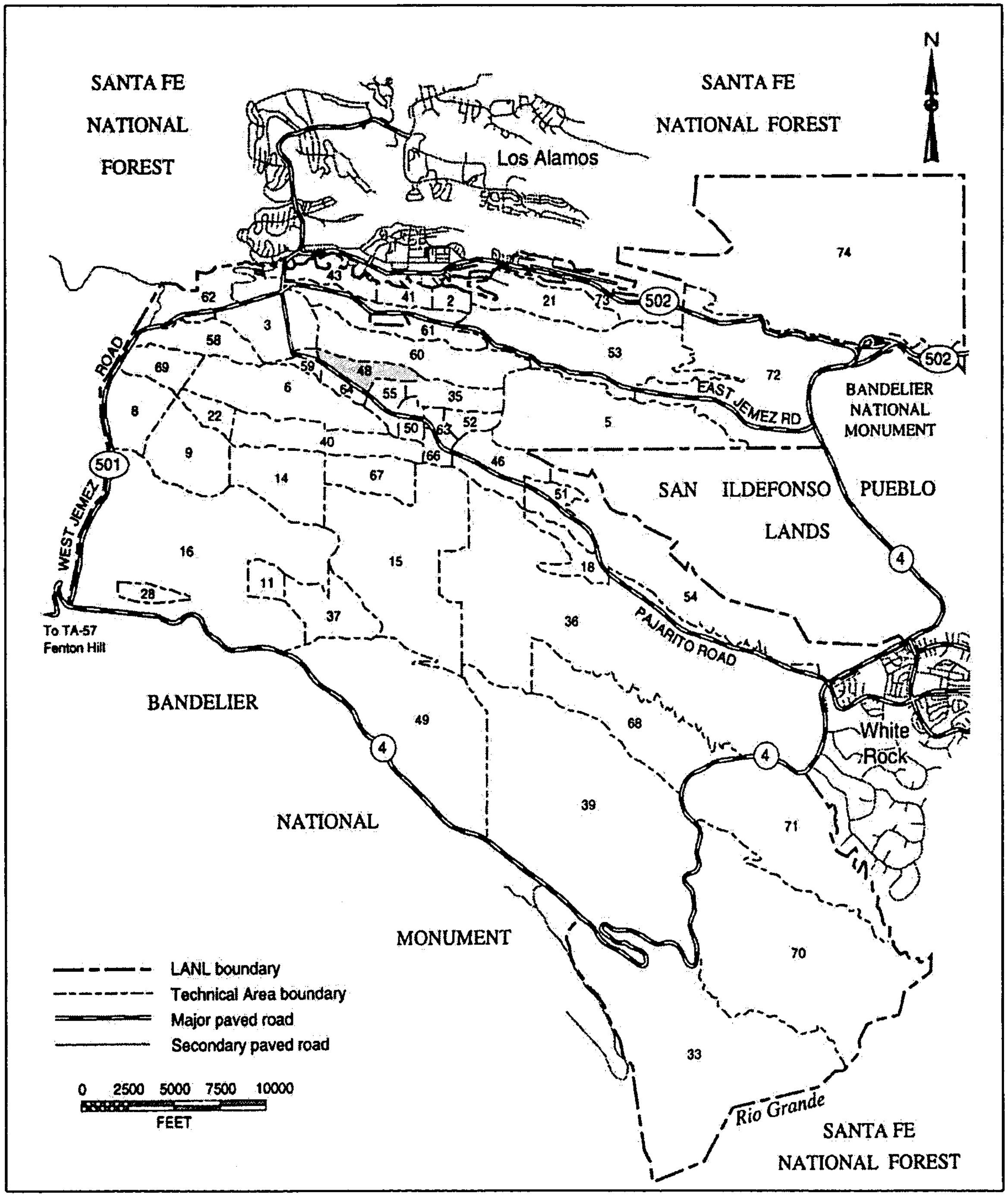
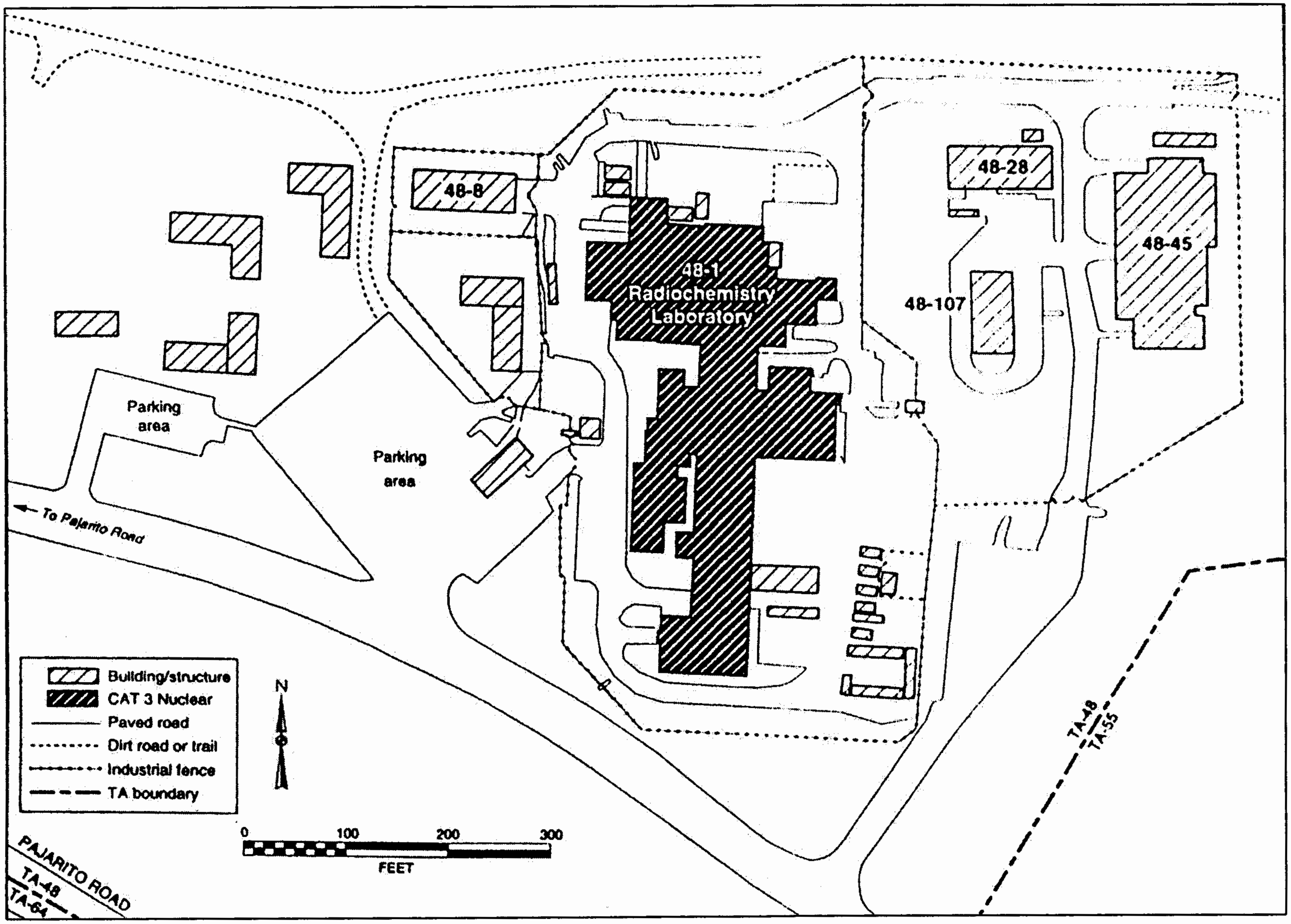


Figure 2-1. Potential Location of the New Actinide Chemistry Laboratory on the WIPP Site



Source: DOE 1999

Figure 2-2. Location of TA-48 at LANL



Source: DOE 1999

Figure 2-3. Location of the Radiochemistry Laboratory (TA-48-1) at LANL

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CHAPTER 3

EXISTING ENVIRONMENT

This chapter describes the existing environment at the three sites under consideration in this EA: the CEMRC in Carlsbad (the location where research activities would occur under the Proposed Action), the WIPP site (the location where research activities would occur under the WIPP Alternative), and LANL (the location where research activities would continue under the No Action Alternative). Descriptions of the CEMRC site were obtained from the CEMRC EA (DOE 1995c). Descriptions of the WIPP site were obtained from SEIS-II (DOE 1997) and the *Final Environmental Assessment for Conducting Astrophysics and Other Basic Science Experiments at the WIPP Site* (DOE 2001a). Finally, descriptions of the LANL site were obtained from the *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 1999). The information in this chapter was used as the basis for the human health and environmental analyses presented in Chapter 4.

3.1 REGIONAL SETTING AND LAND USE

This section describes the regional setting and land use at the CEMRC, WIPP, and LANL sites.

3.1.1 CEMRC Site

The CEMRC building (to which the proposed ACRSL would be joined) is located within the city limits of Carlsbad in Eddy County, New Mexico (see Figure 1-1). The CEMRC property is adjacent to the southern portion of the New Mexico State University campus and is approximately 200 meters (656 feet) west of U.S. Highway 285 (also named West Pierce Street). Guadalupe Medical Center, commercial establishments, residences, and the Living Desert State Park are all located within a 0.8-kilometer (0.5-mile) radius of the CEMRC building.

The CEMRC property is somewhat trapezoidal in shape and encompasses approximately 8.9 hectares (22 acres) of moderately disturbed desert scrub habitat. About 725 square meters (7,800 square feet) of land adjacent to the CEMRC building would be impacted by construction of the proposed ACRSL. The northern border of the site is contiguous with the New Mexico State University campus in Carlsbad. Along the common border that runs between these two properties is an arroyo that drains several medium-sized hills and a mesa approximately 0.5 kilometer (0.13 mile) west of the CEMRC property. Atop the mesa, near the head of the arroyo, is a gravel thoroughfare that extends toward the Living Desert State Park, which is located directly northwest of the site.

Land to the west of the CEMRC property is vacant, and land to the south is essentially single-family residential property that includes small tract homes varying in age from 30 to 80 years. Land located between the CEMRC and U.S. Highway 285 is zoned for commercial use. Although the proposed site and surrounding area were once rangeland, none of the land adjacent to or near the proposed site is now used for agricultural purposes.

3.1.2 WIPP Site

The dominant use of the land within 16 kilometers (10 miles) of the WIPP site is grazing (two ranches are located within this distance), with lesser amounts used for oil and gas extraction and potash mining. The closest town, Loving, New Mexico, is 29 kilometers (18 miles) from the site. The federal government and the State of New Mexico administer most of the land within 50 kilometers (30 miles) of WIPP.

Within 80 kilometers (50 miles) of the site, land uses include dryland farming, irrigated farming along the Pecos River, forest, wetland, and urban areas (DOE 1980, 2001a).

A land withdrawal boundary, which defines the WIPP site, encompasses 16 sections (4,146 hectares [10,240 acres]) of federal land in Township 22 South, Range 31 East. This boundary was delineated to extend at least 1.6 kilometers (1 mile) beyond any WIPP underground development (DOE 1990).

On October 30, 1992, the President signed into law the Land Withdrawal Act (Public Law 102-579); it was amended in 1996 (Public Law 104-201). This Act transferred responsibility for management of the WIPP withdrawal area from the Secretary of the Interior to the Secretary of Energy. The land is permanently withdrawn from all forms of entry, appropriation, and disposal under the public land laws and is reserved for uses associated with the purposes of WIPP. However, EPA has determined that the exercise of existing rights under oil and gas leases within the Land Withdrawal Area would not affect WIPP performance and that, therefore, some oil and gas exploration below 1,800 meters (6,000 feet) is allowed under the Land Withdrawal Act. The Act also establishes certain rights and responsibilities, one of which was the preparation of a Land Management Plan (DOE 1993a). The WIPP Land Management Plan established a goal of multiple-use management for the surface area, as well as opportunities for participation in land use planning by the public and by federal, state, and local agencies.

The site has been divided into four areas under DOE control. A chain-link fence surrounds the innermost Property Protection Area, which includes the surface facilities. Surrounding this inner area is the Exclusive Use Area, set off by a barbed-wire fence. Enclosing these areas is the Off-Limits Area, which is unfenced to allow livestock grazing but, like the other two, is patrolled and posted against trespass or other land uses. Beyond the Off-Limits Area, but within the 16-section WIPP site, the land is managed under the public land-use concept of "multiple use." Mining and drilling for purposes other than support of the WIPP project, however, are restricted (DOE 1997). The type of land use surrounding WIPP has not changed substantially since the preparation of SEIS-II, although the level of development has increased.

The proposed location for the new ACRSL on the WIPP site is shown in Figure 2-1.

3.1.3 LANL Site

LANL is located in north-central New Mexico, 40 kilometers (25 miles) northwest of Santa Fe, and 32 kilometers (20 miles) southwest of Española in Los Alamos and Santa Fe Counties. The Santa Fe National Forest, which includes the Dome Wilderness Area, lies to the north, west, and south of the laboratory. The American Indian Pueblo of San Ildefonso and the Rio Grande border the site on the east, and the Bandelier National Monument and Wilderness Area lie directly south.

Land use in this region is linked to the economy of northern New Mexico, which depends heavily on tourism, recreation (such as skiing and fishing), agriculture, and the state and federal governments for its economic base. In general, area communities are small (for example, the town of Los Alamos has under 12,000 residents) and primarily support urban uses such as residential, commercial, light industrial, and recreational facilities. The region also includes American Indian communities such as the lands of the Pueblo of San Ildefonso on LANL's eastern border and six other pueblos clustered nearby.

LANL occupies an area of approximately 111 square kilometers (43 square miles), 86 percent of which is located within Los Alamos County and 14 percent within Santa Fe County. In this western portion of Santa Fe County, development is very limited, occurring primarily on American Indian lands within the Rio Grande Valley. A small isolated portion of Sandoval County borders LANL on the east and is composed entirely of undeveloped lands belonging to the Pueblo of San Ildefonso. A small portion of

Sandoval County also borders LANL on its southwest boundary, with the remainder of the county located to the south, west, and north. In the LANL area, Sandoval County is generally undeveloped and is primarily U.S. Forest Service and U.S. National Park Service lands.

LANL is divided into forty-nine separate TAs, which reflect the site's historical development patterns, regional topography, and functional relationships (Figure 2-2). TA-48 includes the Radiochemistry Facility (TA-48-1) (see Figure 2-3), which is currently conducting experimental activities in actinide chemistry for WIPP.

3.2 GEOLOGY AND HYDROLOGY

This section describes the surface geology and hydrology at the CEMRC, WIPP, and LANL sites.

3.2.1 CEMRC Site

The CEMRC property is situated on a bench of the Ocotillo Hills that slopes to the east toward the Pecos River. The topography of the CEMRC property is typified by a slight west-east downslope and several very shallow, dry washes punctuated by a deeper arroyo running between the proposed ACRSL and the New Mexico State University campus.

The Carlsbad area is classified in the *Uniform Building Code* (ICBO 1990) as Seismic Risk Zone 1. This classification means there is little seismic activity in the region. With the exception of the extreme southeast corner of New Mexico, which is on the western edge of a large region of seismic activity that extends south and east into Texas, there have been very few recorded earthquakes near Carlsbad. On April 14, 1995, an earthquake centered near Alpine, Texas, registered 5.3 on the Richter scale and was felt in Carlsbad and as far north as Roswell, New Mexico. The most prominent concentration of earthquake activity in New Mexico occurs in the Rio Grande rift between Socorro and Belen and north of Los Alamos in central and north-central New Mexico.

The nearest perennial water source is the Pecos River, which is downhill and less than 2 kilometers (1 mile) from the CEMRC. The Pecos River basin represents about one-half of the drainage area of the Rio Grande Water Resources Region. Due to inflow from brine springs (from the Rustler Formation) and slight exceedance of water quality levels of certain heavy metals over water quality standards (DOE 1996), river water is not used for human consumption. Irrigation and livestock watering are the primary uses of the water from the Pecos (DOE 1997). The largest recorded flood on the Pecos River occurred on August 23, 1966, near Malaga, New Mexico, about 58 kilometers (36 miles) from Carlsbad.

3.2.2 WIPP Site

The WIPP site is located in southeastern New Mexico, in the Pecos Valley Section of the Great Plains Physiographic Province. The terrain throughout the province varies from plains and lowlands to rugged canyons. In the immediate vicinity of WIPP, numerous small mounds formed by windblown sand characterize the land surface. A high plains desert environment characterizes the area. Due to the seasonal nature of the rainfall, most surface drainage is intermittent. The Pecos River, 20 kilometers (12 miles) southwest of the WIPP boundary, is a perennial river and the master drainage for the region. Prominent local physiographic features include Nash Draw (a shallow, 8-kilometer- [5-mile-] wide valley open to the southwest and located west of the WIPP site) and the San Simon Swale (a broad depression about 24 kilometers [15 miles] east of the WIPP site) (DOE 1997).

No surface displacement or faulting younger than early Permian has been reported, indicating that tectonic movement since then, if any, has not been noteworthy. The most recent earthquake recorded at

the WIPP site occurred on April 14, 1995; its epicenter was located approximately 240 kilometers (150 miles) south of the site in Alpine, Texas. It was assigned a magnitude of 5.3 and had no effect on any structures at WIPP (DOE 1997).

The Pecos River is the main surface water resource in the WIPP area (Section 3.2.1). The WIPP site has a few small intermittent creeks, the only westward-flowing tributaries of the Pecos River within 32 kilometers (20 miles) north or south of the site (DOE 1997).

3.2.3 LANL Site

LANL and the communities of Los Alamos and White Rock are located on the Pajarito Plateau. The Pajarito Plateau is 13 to 26 kilometers (8 to 16 miles) wide and 48 to 64 kilometers (30 to 40 miles) long, lying between the Sierra de los Valles to the west and the Rio Grande to the east (Purtymun et al. 1995). The Sierra de los Valles lies between the Jemez Mountains and the Pajarito Plateau. The crest of this north-south range of peaks and ridges forms a surface-water divide. The surface of the Pajarito Plateau is divided into numerous narrow, finger-like mesas separated by deep east-to-west oriented canyons that drain toward the Rio Grande (DOE 1999).

A historical catalog has been compiled of earthquakes that have occurred in the LANL area from 1873 to 1991 (Wong et al. 1995). A review of these earthquakes indicates that only six having an estimated magnitude of 5 or greater on the Richter scale have occurred in the LANL region. The most significant seismic event in this period was the 1918 Cerrillos earthquake. This earthquake had an estimated Richter magnitude of 5.5 and was centered approximately 50 kilometers (30 miles) southeast of LANL.

Water is scarce in the semi-arid climate of northern New Mexico where precipitation is variable and stems primarily from summer thunderstorms and winter snowfall. During most of the year in the LANL region, surface water is present only in the Rio Grande and Rito de los Frijoles and in reservoirs. Naturally perennial surface water reaches also are located in Ancho, Pajarito, and Chaquehui Canyons. The canyon-bottom streams within LANL boundaries are mostly dry, and only portions of some streams contain water year-round. Flash floods can occur from the Sierra de Los Valles to the Rio Grande. Sediments moved by stormwater events from upstream, hillsides, or mesa tops occur along most of LANL canyons. Flash floods move the sediments from the canyon bottoms to downstream locations such as Cochiti Lake.

3.3 BIOLOGICAL RESOURCES

This section describes the biological resources at the CEMRC, WIPP, and LANL sites.

A site's biological resources refer to the plant and animal species resident to the area and their supporting habitat. Special concern is given to species whose reproductive populations are dwindling and are in danger of local and possibly global extinction. Federal and state lists of endangered, threatened, and sensitive species are updated regularly for each county of the United States. Resource agencies have developed guidelines for proper surveillance for these species. Should threatened or endangered species be found at a site, mitigation measures must be implemented under consultation with the appropriate agencies.

3.3.1 CEMRC Site

The CEMRC is geographically located within the Chihuahuan Desertscrub Biotic Community. Two arroyos border the property on the north and the south. The northern arroyo, which is well developed and vegetated, lies adjacent to the south-facing slope below the Living Desert State Park. This arroyo consists

predominantly of limestone gravel and bedrock and runs west to north past the entrance to New Mexico State University. The southern arroyo lies between the proposed construction site and the residential area at the southern boundary of the site. This arroyo, although well vegetated, is shallower, much less rocky, and topographically heterogeneous. Dominant soil conditions throughout the area are desert pavement, dry coarse-textured soil, and gravel. The upslope area along the western boundary of the CEMRC area has sparse shrub cover and consists predominantly of limestone rock with sparse gravel and shallow topsoil.

A 100-percent biological survey of the 89,000-square-meter (22-acre) property was conducted for threatened, endangered, and sensitive species of plants and animals. The surveyed area included all connecting roadway, power lines, and arroyos. A 100-percent survey was necessary to determine the presence, distribution, and critical habitat characteristics of all species of special concern listed by federal and State of New Mexico environmental resources agencies. ("Species of special concern" is a collective term used to distinguish species that are threatened, endangered, sensitive, or protected by federal or state regulation, and those species whose presence is rare for the geographic area.) The Endangered Species Act defines critical habitat as that geographic area within the area occupied by the species at the time of its listing, and the habitat that the U.S. Fish and Wildlife Service determines to be essential to the conservation of the species and requires special management consideration or protection.

The 100-percent survey was useful for locating threatened, endangered, sensitive, or unique species of plants that would be affected by construction. The survey also was useful for determining general habitat characteristics of species associated with different elevations, topography, and drainage basin conditions in the arroyos, which are not affected by construction activities, except for those species that flower later in the year such as varieties of the Pincushion cacti (*Coryphanta*, spp.).

In addition, although many species of migrating birds had already left the area at the time of the biological survey, suitable nesting, perching, roosting, and foraging habitats for avian species were recorded. All lesser game and nongame species of wildlife were recorded by visual observation of individual animals or by the presence of tracks, scat, burrow systems, or nests. Bones in carnivore scat and those found associated with woodrat nests are particularly good indicators of the small mammal species composition in the local area.

In accordance with recommendations by the New Mexico Department of Game and Fish, all major wildlife communities and unique wildlife habitat within the proposed survey area were delineated, including the presence and distribution of lesser faunal and floral species and their sensitive habitats (for example, travel corridors, foraging areas, and nesting sites).

Of the plant species of special concern that could be potentially present, no threatened, endangered, or sensitive species of plants were observed. Dominant shrubby vegetation associated with the CEMRC site included catclaw (*Acacia greggii*), white thorn (*Acacia constricta*), little leaf sumac (*Rus microphylla*), and algerita (*Berberis trifiolata*). Dominant grass species included sporobulus grass (*Sporobulus* spp.) and muhly grass (*Muhlenbergia* spp.).

There were dense populations of various species of cacti distributed throughout the area, especially along the slopes and shallow drainage of the northern-most arroyo where, in some areas, densities of the Texas rainbow cactus (*Echinocereus dasyacanthus* var. *dasyacanthus* Eng.) reached two plants per square meter (11 square feet). Turk's head cactus (*Echinocactus horizonthalonius*) and robust hedgehog cactus (*Echinocereus fasciculatus*) also were common throughout the proposed construction site.

Of animal species of special concern potentially occurring throughout Eddy County, four taxa (8 percent) were documented. These taxa included primarily small-to large-sized raptoral bird species, including the

turkey vulture (*Cathartes aura*), Northern harrier (*Circus cyaneous*), loggerhead shrike (*Lanius ludovicianus*), and American kestrel (*Falco sparverius*).

- Turkey vulture (*Cathartes aura*) (Federal protection under the Migratory Bird Treaty Act; State of New Mexico Protected Raptor) — During the biological survey, two birds were observed soaring overhead. Sensitivity of this species is considered to be low because the species is common and wide-ranging throughout the Southwest, and because of the small number of individual birds observed at the site. In addition, similar construction activities in north- and south-central New Mexico historically have not resulted in documented adverse effects on the biology or ecology of the species.

- Northern harrier (*Circus cyaneous*) (Federal protection under Migratory Bird Treaty Act; State of New Mexico Protected Raptor) — One bird was observed soaring over the proposed project area.

- American kestrel (*Falco sparverius*) (Federal protection under Migratory Bird Treaty Act; State of New Mexico Protected Raptor) — One bird was observed during the biological survey. This species was not common at the site but was observed in association with the powerline bisecting the construction site.

- Loggerhead shrike (*Lanius ludovicianus*) (Federal protection under Migratory Bird Treaty Act and a Category 2 Candidate; no State of New Mexico status) — One bird was observed during the biological survey.

The latter three species are not common to the proposed construction site; however, they were observed at the northern-most border of the property adjacent to the Living Desert. Sensitivity of these species is considered to be low because of the more abundant natural habitat associated with the nearby Living Desert and the small number of birds observed at the site. Further, similar construction activities in north- and south-central New Mexico historically have not resulted in documented adverse effects on the biology, reproduction, or ecology of these or similar species.

Of the plant and animal species present, none is listed as threatened, endangered, or sensitive. Table 3-1 provides a complete list of the threatened and endangered species in Eddy County. Currently, the U.S. Fish and Wildlife Service lists five federally endangered, five federally threatened, and two candidate species for Eddy County (FWS 2001). The New Mexico Department of Game and Fish currently lists 11 endangered and 21 threatened animal species (NMDG&F 2001a), while the New Mexico Rare Plant Technical Council lists 7 endangered and 17 state-sensitive plant species for Eddy County (NMRPTC 1999) (Table 3-1).

3.3.2 WIPP Site

The vegetation at the WIPP site is dominated by shinnery oak (*Quercus havardii*), mesquite (*Prosopsis grandulosa*), sand sage (*Artemisia filifolia*), and smallhead snakeweed (*Gutierrezia microcephala*) (DOE 1990).

Ninety-eight species of birds are known to inhabit or migrate through the area (DOE 1993b, 1994, and 1995a). The Harris hawk (*Parabuteo unicinctus*), loggerhead shrike (*Lanius ludovicianus*), and black-throated sparrow (*Anphispiza bilineata*) are resident birds.

Table 3-1. State of New Mexico Threatened and Endangered Species (Eddy County)

Scientific Name	Common Name	Status
Birds		
Haliaeetus leucocephalus	Bald eagle	Federal and state threatened
Sterna antillarum	Interior least tern	Federal and state endangered
Strix occidentalis lucida	Mexican spotted owl	Federal threatened
Falco femoralis septentrionalis	Northern aplomado falcon	Federal and state endangered
Empidonax traillii extimus	Southwest willow flycatcher	Federal and state endangered
Pelecanus occidentalis carolinensis	Brown pelican	Federal and state endangered
Phalacrocorax brasilianus	Neotropic cormorant	State threatened
Falco peregrinus anatum	American peregrine falcon	State threatened
Charadrius melodus circumcinctus	Piping plover	Federal threatened, state endangered
Columbina passerina pallescens	Common ground dove	State endangered
Cynanthus latirostris magicus	Broad-billed hummingbird	State threatened
Vireo bellii	Bell's vireo	State threatened
Vireo vicinior	Gray vireo	State threatened
Ammodramus bairdii	Baird's sparrow	State threatened
Passerina versicolor	Varied bunting	State threatened
Tympanuchus pallidicinctus	Lesser prairie chicken	Federal candidate
Mammals		
Vulpes velox velox	Swift fox	Federal candidate
Cynomys ludovicianus arizonensis	AZ Black-tailed prairie dog	Federal candidate
Cryptotis parva	Least shrew	State threatened
Reptiles		
Pseudemys gorzugi	Western river cooter	State threatened
Sceloporus arenicolus	Sand dune lizard	State threatened
Lampropeltis alterna	Gray-banded kingsnake	State endangered
Nerodia erythrogaster transversa	Blotched water snake	State endangered
Thamnophis proximus diabolicus	Arid land ribbon snake	State threatened
Crotalus lepidus lepidus	Mottled rock rattlesnake	State threatened
Fish		
Notropis simus pecosensis	Pecos bluntnose shiner	Federal and state threatened
Gambusia nobilis	Pecos gambusia	Federal and state endangered
Astyanax mexicanus	Mexican tetra	State threatened
Cycleptus elongatus	Blue sucker	State endangered
Moxostoma congestum	Gray redhorse	State threatened
Cyprinodon pecosensis	Pecos pupfish	State threatened
Etheostoma lepidum	Greenthroat darter	State threatened
Percina macrolepida	Bigscale logperch	State threatened
Invertebrates		
Popenaias popeii	Texas hornshell	State endangered
Pyrgulopsis pecosensis	Pecos pyrg snail	State threatened
Vertigo ovata	Ovate vertigo snail	State threatened
Plants		
Coryphantha (Escobaria) sneedii var. *leei*	Lee pincushion cactus	Federal threatened, state endangered
Amsonia tharpii	Tharp's bluestar	State endangered
Coryphantha scheeri	Scheer's pincushion cactus	State endangered
Echinocereus lloydii	Lloyd's hedgehog cactus	State endangered
Echinocereus fendleri var. *kuenzleri*	Kuenzler hedgehog cactus	Federal endangered
Coryphantha sneedii var. *sneedii*	Sneed pincushion cactus	Federal endangered
Eriogonum gypsophilum	Gypsum wild buckwheat	Federal threatened, state endangered
Hexalectris nitida	Shining coral-root	State endangered

Table 3-1. State of New Mexico Threatened and Endangered Species (Eddy County) (continued)

Scientific Name	Common Name	Status
Plants (continued)		
Hexalectris spicata	Crested coral-root	State endangered
Aquilegia chrysantha var. chaplinei	Chapline's columbine	State sensitive
Astragalus gypsodes	Gypsum milkvetch	State sensitive
Astragalus waterfallii	Waterfall milkvetch	State sensitive
Chaetopappa hersheyi	Hershey's cliff daisy	State sensitive
Ericameria nauseosus ssp. *texensis*	Guadalupe rabbitbrush	State sensitive
Eustoma exaltatum	Catchfly gentian	State sensitive
Hedeoma apiculata	McKittrick pennyroyal	State sensitive
Justicia wrightii	Wright's justicia	State sensitive
Penstemon cardinalis spp. *regalis*	Guadalupe penstemon	State sensitive
Philadelphus hitchcockianus	Hitchcock's mockorange	State sensitive
Polygala rimulicola	Guadalupe milkwort	State sensitive
Proboscidea sabulosa	Dune unicorn plant	State sensitive
Pseudocymopterus longiradiatus	Desert parsley	State sensitive
Sibara grisea	Gray sibara	State sensitive
Sophora gypsophila var. *guadalupensis*	Guadalupe mescal bean	State sensitive
Streptanthus sparsiflorus	Guadalupe jewelflower	State sensitive
Valeriana texana	Texas tobacco root	State sensitive

Source: FWS 2001, NMDG&F 2001a, NMRPTC 1999

Small mammals that are common at the WIPP site include the black-tailed jackrabbit (*Lepus californicus*), the desert cottontail (*Sylvilagus auduboni*), and Ord's kangaroo rat (*Dipodomys ordii*). Mule deer (*Odocoileus hemionus*) and pronghorn (*Antilocapra americana*) are among the larger mammals that occur at the site. Stock watering ponds and tanks provide aquatic habitat for yellow mud turtles (*Kinosteron flarescens*) and tiger salamanders (*Ambystoma tigrinum*) (DOE 1993b, 1994, 1995a).

In SEIS-I (DOE 1990), DOE concluded that there was no critical habitat at the site for terrestrial species identified as endangered, threatened, or candidate species by either the U.S. Fish and Wildlife Service or the New Mexico Department of Game and Fish.

In 1996, DOE conducted a survey on the WIPP Land Withdrawal Area and associated lands to investigate the potential for impacts to rare, threatened, endangered, or sensitive plant or animal species as a result of the potential actions presented in SEIS-II (DOE 1997). The 1996 survey included an assessment of suitable habitats for these species. No federal- or state-listed species were found on the WIPP Land Withdrawal Area during the survey. Ongoing wildlife research projects and general wildlife management programs are conducted by personnel at Westinghouse TRU Solutions LLC to ensure disturbance and encroachment on wildlife habitat are minimized (DOE/WIPP 2001).

3.3.3 LANL Site

LANL is located in a region of diverse landform, elevation, and climate—features that have contributed to producing in New Mexico one of the world's most diversified plant and animal communities. The combination of features, including past and present human use, has given rise to correspondingly diverse, and often unique, biological communities and ecological relationships in Los Alamos County and the region as a whole. Plant communities range from urban and suburban areas to grasslands, wetlands, shrublands, woodlands, and mountain forest, and provide habitat for a wealth of animal life. This richness of animal life includes herds of elk and deer, bear, mountain lions, coyotes, rodents, bats, reptiles, amphibians, invertebrates, and a myriad of resident, seasonal, and migratory bird life. In addition, numerous threatened and endangered species, species of concern, and other sensitive species use

LANL resources. Because of restricted access to LANL lands and management of the contiguous Bandelier National Monument for natural biological systems, much of the region provides a refuge for wildlife.

The interfingering of deep, steep-sided canyons with narrow mesas that descend the east slopes of the Jemez Mountains and an inversion of the normal altitudinal distribution of vegetation communities along the canyon floors result in many transitional overlaps of plant and animal communities and increased biological diversity. It is this dominant feature of the Pajarito Plateau, in combination with an elevational descent of almost 1.6 kilometers (1 mile) from mountain ridges to the Rio Grande, that has made a major contribution to the richness and diverse ecological relationships of the species that characterize the Pajarito Plateau.

From the western crest of the Pajarito Plateau to the Rio Grande, the six vegetation zones that characterize the LANL region consist of montane grasslands, spruce-fir forest, mixed-conifer forest (with aspen forest), ponderosa pine forest, pinion-juniper woodland, and juniper savannah. The montane grassland, spruce-fir, and mixed conifer vegetation zones are located primarily west of LANL with little representation on the LANL site. The vegetation zones and associated ecotones provide habitat, including breeding and foraging territory, and migration routes for a diversity of permanent and seasonal wildlife species. This diversity is illustrated by the presence of over 900 species of vascular plants; 57 species of mammals; 200 species of birds, including 112 species known to breed in Los Alamos County; 28 species of reptiles; 9 species of amphibians; over 1,200 species of arthropods; and 12 species of fish (primarily found in the Rio Grande, Cochiti Lake, and the Rito de los Frijoles). No fish species have been found within LANL boundaries.

Currently, the U.S. Fish and Wildlife Service lists two federally endangered, two federally threatened, and one federal candidate species for Los Alamos County (FWS 2001). The New Mexico Department of Game and Fish currently lists two endangered and six threatened animal species (NMDG&F 2001b), while the New Mexico Rare Plant Technical Council lists one state-sensitive plant species for Los Alamos County (NMRPTC 1999) (Table 3-2). LANL has a biology team that works with DOE to maintain the Laboratory's compliance with environmental legislation. This team maintains an active monitoring program that records listed species found on LANL lands. A Habitat Management Plan has been developed, minimizing impacts on threatened and endangered species as well as streamlining the compliance process.

Table 3-2. State of New Mexico Threatened and Endangered Species (Los Alamos County)

Scientific Name	Common Name	Status
Birds		
Haliaeetus leucocephalus	Bald eagle	Federal and state threatened
Strix occidentalis lucida	Mexican spotted owl	Federal threatened
Empidonax traillii extimus	Southwest willow flycatcher	Federal and state endangered
Falco peregrinus anatum	American peregrine falcon	State threatened
Cynanthus latirostris magicus	Broad-billed hummingbird	State threatened
Vireo vicinior	Gray vireo	State threatened
Coccyzus americanus	Yellow-billed cuckoo	Federal candidate
Grus americana	Whooping crane	Federal and state endangered
Mammals		
Euderma maculatum	Spotted bat	State threatened
Amphibians		
Plethodon neomexicanus	Jemez Mountains salamander	State threatened
Plants		
Delphinium sapellonis	Sapello Canyon larkspar	State sensitive

Source: FWS 2001, NMDG&F 2001b, NMRPTC 1999

3.4 CULTURAL RESOURCES

This section describes the cultural resources at the CEMRC, WIPP, and LANL sites.

Cultural resources are any prehistoric or historic sites, buildings, structures, districts, or other places or objects considered as being important to a culture, subculture, or community for scientific, traditional, or religious purposes. Regulatory guidelines for the identification and evaluation of cultural resources are found in the *National Historic Preservation Act* and its implementing regulations, 36 CFR Part 800 (revised). Standards and criteria for evaluating potential impacts to cultural resources in the environmental analysis process are based on the system developed for the National Register of Historic Places. The National Register is a listing of architectural, historical, archaeological, and cultural sites that have been designated as having local, state, or national importance.

Each of the proposed alternatives would occur at existing sites and facilities; therefore, baseline cultural resources conditions for areas that would be potentially impacted by the proposed ACRSL facility were derived from recent NEPA documentation for each site. In addition, the most recent New Mexico Historic Preservation Department listings of state and national registered sites for Los Alamos and Eddy Counties were checked.

3.4.1 CEMRC Site

A cultural resources field inventory was completed for the entire CEMRC property prior to construction of the facility. No prehistoric or historic archaeological sites or other cultural resources were encountered other than some instances of recent historic trash scatter. The historic trash was not considered eligible for the National Register of Historic Places, and the property was deemed to be free of cultural resources (DOE 1995c).

3.4.2 WIPP Site

The cultural resources affected environment at WIPP is summarized in SEIS-II (DOE 1997) and updated in the Astrophysics EA (DOE 2001a). Previous cultural resources investigations at the WIPP Land Withdrawal Area have been conducted for a little over one-third of the property; sixty prehistoric and historic archaeological sites and ninety-one isolated artifact occurrences have been recorded. Several of the archaeological sites have been evaluated as being eligible for listing on the National Register of Historic Places. To date, no Native American traditional cultural properties or other resources with traditional value have been identified at WIPP.

All of the previously recorded archaeological sites are located at a distance from the fenced WIPP site in which the new ACRSL facility would be built. This specific area was determined to be free of significant cultural resources properties prior to WIPP construction.

3.4.3 LANL Site

The cultural resources affected environment at LANL is summarized in the LANL SWEIS (DOE 1999). Management of cultural resources at LANL is complex because the area was intensively occupied throughout the prehistoric period and continues to hold important cultural values for the many Native American communities in the area. Similarly, the historic period nuclear energy resources, including the town of Los Alamos and LANL itself, are considered very significant in U.S. history. LANL was listed on the National Register of Historic Places in 1966 and on the New Mexico State Register in 1968.

Archaeological surveys have been conducted for about 75 percent of the LANL property, resulting in the recording of nearly thirteen hundred prehistoric and historic archaeological sites. A large majority of these have been evaluated as either eligible or potentially eligible for inclusion on the National Register of Historic Places. Native American groups have also identified more then fifty traditional cultural properties during the consultation between DOE and tribes.

Resources associated with the World War II-Manhattan Project and subsequent Cold War periods are presently being inventoried and evaluated at LANL. Building TA-48-1, the location of the ACRSL under the No Action Alternative, was constructed in 1957 and is included in a programmatic agreement between LANL and the New Mexico State Historic Preservation Office and Advisory Council on Historic Preservation as one that needs to be evaluated and placed into a historic thematic context. According to the LANL Cultural Resource Management Team (Masse 2002), TA-48-1 would likely be found significant because other similar buildings that have been evaluated have been associated with important research activities at the Laboratory.

3.5 SOCIOECONOMIC RESOURCES

This section describes the socioeconomic resources at the CEMRC, WIPP, and LANL sites. For the LANL description, the most recent source of data was the 1990 U.S. Census; however, that discussion will be updated if more recent data are published before the EA is finalized.

3.5.1 CEMRC Site

Both the Proposed Action to put the new ACRSL facility adjacent to the CEMRC and the alternative to locate the new facility at WIPP would take place in Eddy County, New Mexico. Thus, a description of the socioeconomic resources in Eddy County prepared as part of the Astrophysics EA (DOE 2001a) is directly relevant to both the Proposed Action and the WIPP Alternative.

The 2000 population estimate for Eddy County was 51,658, of which approximately 42 percent were minorities. For Eddy County, the 1997 (model-based) median household money income was approximately $31,228. The 1997 (model-based) population of Eddy County living below the poverty level was about 18.6 percent.

Economic figures for Eddy County in 1997 indicate a county-wide workforce of 16,368 employees, the majority of which were employed in the mining (17 percent), manufacturing (10 percent), retail trade (22 percent), or services (28 percent), especially health services (12.5 percent) industries. Payroll income for the county was approximately $416 million, the majority of which was earned in the mining (27 percent), manufacturing (16 percent), retail trade (11 percent), transportation and public utilities (13 percent), and service (19.5 percent) industries. More than half of the income in service industries came from the health services sector, and two-thirds of the income in transportation came from the trucking sector (U.S. Bureau of the Census 2000).

3.5.2 WIPP Site

Both the alternative to locate the new facility at the WIPP and the Proposed Action to put the new ACRSL facility adjacent to the CEMRC would take place in Eddy County, New Mexico; therefore, the description of the socioeconomic resources presented above for Eddy County (Section 3.5.1) is directly relevant to the WIPP Alternative. However, the WIPP Alternative is also very close to Lea County. Thus, a description of the socioeconomic resources in Lea County prepared as part of the Astrophysics EA (DOE 2001a) is also relevant to the WIPP Alternative.

The 2000 population estimate for Lea County was 55,511, of which approximately 46 percent were minorities (U.S. Bureau of the Census 2002). For Lea County, the 1997 (model-based) median household money income was approximately $31,337. The 1997 (model-based) population of Lea County living below the poverty level was about 20.7 percent (U.S. Bureau of the Census 2002).

Economic figures for Lea County in 1997 indicate a county-wide workforce of 15,759 employees, the majority of which were employed in the oil and gas (13 percent), retail trade (23 percent), or services (28 percent) industries. Payroll income for the county was approximately $358 million, the majority of which was earned in the oil and gas (19 percent), transportation and public utilities (13 percent), retail trade (13 percent), and service (23 percent) industries. About 40 percent of the income in service industries came from the health services sector (U.S. Bureau of the Census 2000).

3.5.3 LANL Site

The geographic area most affected by changes at LANL is the region comprising Los Alamos, Rio Arriba, and Santa Fe Counties. Approximately 90 percent of LANL-affiliated employees reside in the counties of Los Alamos, Rio Arriba, and Santa Fe. This tri-county region includes the following (LANL 1996):

- The communities of Los Alamos and White Rock;
- The cities of Santa Fe and Española;
- The American Indian Pueblos of San Ildefonso, Santa Clara, San Juan, Nambe, Pojoaque, Tesuque, and part of the Jicarilla Apache Indian Reservation; and
- Several small villages, unincorporated communities, and widely dispersed farm and ranch holdings.

The 2000 populations for the three counties around LANL were 18,343 for Los Alamos; 41,190 for Rio Arriba; and 129,292 for Santa Fe (U.S. Bureau of the Census 2002). In 2000, the percentage of minorities for each of these same three counties was 17.9 percent for Los Alamos, 86.4 percent for Rio Arriba, and 54.5 percent for Santa Fe.

For each of the three counties around LANL, the 1997 (model-based) median household money income and the 1997 (model-based) population of Lea County living below the poverty level were (U.S. Bureau of the Census 2002):

- Los Alamos County – median household income was $74,253 and percentage of persons living below poverty level was 2.7 percent
- Rio Arriba County – median household income was $25,036 and percentage of persons living below poverty level was 22.5 percent
- Santa Fe County – median household income was $37,882 and percentage of persons living below poverty level was 11.9 percent

In 1989, Los Alamos had the highest family and per capita incomes of all New Mexico counties. In fact, the median family income in Los Alamos was the highest of all counties in the United States (DOC 1996). In 1989, approximately 2 percent of Los Alamos County, 13 percent of Santa Fe County, and nearly 28 percent of Rio Arriba County populations lived below the poverty line, which had a threshold of $12,674 for a family of four (DOC 1993). Since 1989, the percentage of those living below

the poverty line is believed to have remained the same in Los Alamos and Santa Fe Counties and to have risen slightly in Rio Arriba County. The 1996 poverty threshold was $15,600 for a family of four and $7,740 for an unrelated individual (61 Fed. Reg. 42) (DOE 1999).

3.6 AIR QUALITY

This section describes the air quality at the CEMRC, WIPP, and LANL sites. The Clean Air Act requires EPA to set National Ambient Air Quality Standards for pollutants that are considered harmful to public health and the environment. The Act establishes two types of air quality standards, primary and secondary. Primary standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Pursuant to the Clean Air Act, EPA established National Ambient Air Quality Standards for six pollutants considered to be key indicators of air quality: carbon monoxide, nitrogen dioxide, ozone, lead, sulfur dioxide, and particulate matter (that is, airborne particles including dust, smoke, fumes, mist, sprays, and aerosols). These six air quality indicators are called criteria pollutants. The EPA also established separate National Ambient Air Quality Standards for two categories of particulate matter: (1) particles with an aerodynamic diameter less than 10 micrometers (PM_{10}), and (2) particles with an aerodynamic diameter less than 2.5 micrometers ($PM_{2.5}$).

Areas that meet the National Ambient Air Quality Standards are said to be in "attainment." The air quality in attainment areas is managed under the Prevention of Significant Deterioration Program of the Clean Air Act. The goal of this program is to maintain a level of air quality that continues to meet the standards. Areas that do not meet one or more of the standards are designated as "nonattainment" areas. For regulatory purposes, remote or sparsely populated areas that have not been monitored for air quality are listed as "unclassified" and are considered to be in attainment.

The State of New Mexico has also established ambient air quality standards for carbon monoxide, sulfur dioxide, nitrogen dioxide, total suspended particulates (not PM_{10}), hydrogen sulfide, and total reduced sulfur. The State also has established guidelines for toxic air pollutants in the New Mexico Air Quality Regulations, Title 20 (Environmental Protection), Chapter 2 (Air Quality Standards-Statewide), Part 72 (Construction), Subpart 400 (Permits for Toxic Air Pollutant Emissions-Preamble) (NMED 2002).

3.6.1 CEMRC Site

EPA has classified Eddy County, New Mexico, including the city of Carlsbad (where the CEMRC is located), as an attainment area for all six criteria pollutants under the National Ambient Air Quality Standard (DOE 2001a). Carlsbad is also in a Class II Prevention of Significant Deterioration area, and any new sources of emissions would have to adhere to the standards for such an area.

Carlsbad is in the EPA Pecos-Permian Basin Intrastate Air Quality Control Region. Air quality regulations are administered by the New Mexico Environment Department. According to the Department's Air Quality Control Regulation 706, *Air Quality Management Areas,* the region is in compliance with State air quality standards (DOE 1995c).

If the proposed ACRSL facility were to become operational, routine laboratory sample processing may generate small quantities of chemical emissions in addition to those currently emitted by the existing CEMRC laboratory. Chemical emissions are regulated by the New Mexico Environment Department's Air Quality Bureau, and radiological emissions are regulated by the Department's Hazardous and Radioactive Materials Bureau. The New Mexico Environment Department has preconstruction notification requirements and operating permit requirements for facilities that have the potential to exceed

toxic air pollutant emission standards or for radiological emissions expected to exceed 10 millirem (mrem) per year or 1 x 10^{-5} Sievert per year. Based on calculations in the CEMRC EA (DOE 1995c), the use rates of volatile solvents and reagents do not result in emission rates or concentrations that would require permitting under air quality regulations. Similarly, although the CEMRC is permitted to emit very low levels of radionuclides, it has never reported any release of radionuclides to the atmosphere.

3.6.2 WIPP Site

As indicated above, EPA has classified Eddy County (where WIPP is located) as an attainment area for all six criteria pollutants under the National Ambient Air Quality Standards (DOE 2001a). WIPP is also in a Class II Prevention of Significant Deterioration area, and any new sources of emissions would have to adhere to the standards for such an area.

Air quality monitoring data collected since 1990 are summarized in annual WIPP site environmental reports. On October 30, 1994, DOE, after notifying EPA, ceased to monitor criteria air pollutants at WIPP because there was no longer a regulatory requirement to do so. WIPP has completed inventories of potential pollutants and emissions in accordance with EPA and New Mexico Air Quality Control Regulations. Based on these inventories, WIPP has no permitting or reporting requirements at this time except for those applying to two primary backup diesel generators. An operating permit was issued under the New Mexico Air Quality Control Regulations for the two diesel generators in 1993 (DOE 1995a). These diesel generators are assumed to emit four pollutants (nitrogen dioxide, sulfur dioxide, carbon monoxide, and PM_{10}) and have strict limits on emissions for these pollutants.

3.6.3 LANL Site

According to the LANL SWEIS (DOE 1999), EPA has classified Los Alamos County, New Mexico (where LANL is located) as an attainment area for all six criteria pollutants under the National Ambient Air Quality Standards. Criteria pollutants released from LANL operations are emitted primarily from combustion sources such as boilers, emergency generators, and motor vehicles. Toxic air pollutant emissions from LANL activities are released primarily from laboratory, maintenance, and waste management operations. Unlike a production facility with well-defined operational processes and schedules, LANL is a research and development facility with great fluctuations in both the types of chemicals emitted and their emission rates. DOE has a program to review all new operations for their potential to emit toxic air pollutants. Because past reviews demonstrate that LANL's toxic air pollutant emissions are below the state's permitting threshold limits, DOE is not required to monitor LANL's toxic air pollutant emissions. However, toxic air estimates were made based on chemical uses at LANL and assumed stack and building parameters.

Only a limited amount of monitoring of the ambient air has been performed for non-radiological air pollutants within the LANL region. The New Mexico Environment Department operated a DOE-owned ambient air quality monitoring station adjacent to Bandelier National Monument between 1990 and 1994 to record sulfur dioxide, nitrogen dioxide, ozone, and PM_{10} levels. LANL and the New Mexico Environment Department discontinued operation of this station in FY95 because recorded values were well below applicable standards.

Some LANL operations may result in the release of radioactive materials to the air from point sources such as stacks or vents or from nonpoint (or area) sources such as the radioactive materials in contaminated soils. The concentration of radionuclides in point-source releases is continuously sampled or estimated based on knowledge of the materials used and the activities performed. Non-point-source emissions are directly monitored, sampled, or estimated from airborne concentrations outdoors.

Radionuclide emissions from LANL point and non-point sources include several radioisotopes such as tritium, uranium, strontium-90, and plutonium.

Radiological air emission requirements are specified in 40 CFR 61, Subpart H, "National Emissions Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities." Upon enactment of Subpart H, LANL began assessing its existing air monitoring program in light of these new regulations (enacted in December 1989) and investigating the means to achieve compliance with those regulations. Between 1996 and 1999, DOE and the University of California operations at LANL were in full compliance.

3.7 WASTE GENERATION AND DISPOSAL

Construction and operation of an actinide chemistry laboratory would lead to new waste generation. These waste forms would range from the sanitary solid and liquid wastes that would be associated with any facility to the hazardous and radioactive wastes that would be generated from the actinide chemistry experiments. These wastes could result in an added burden to the existing storage and disposal systems that are currently emplaced. Sanitary wastes are generally disposed of via municipal sewers and treated at municipal waste treatment facilities. Care must be taken to ensure hazardous and radioactive wastes do not enter these systems as they could disrupt the waste treatment processes and pose public exposure issues. Hazardous and radioactive waste storage and disposal is highly regulated on municipal, state, and federal levels, and the chosen alternative must meet many licensing and permit criteria. This section describes existing waste generation and disposal at the CEMRC, WIPP, and LANL sites.

3.7.1 CEMRC Site

This section describes the waste generation and disposal practices at the CEMRC.

3.7.1.1 Sanitary and Solid Wastes

Disposal of sanitary waste and solid waste is provided by the City of Carlsbad. The CEMRC is connected to the Municipal Sewage Treatment Facility, which has an excess capacity of approximately 3.8 million liters (1 million gallons) per day and manages the wastewater discharge of 6,600 liters (1,750 gallons) per day by the CEMRC.

The CEMRC subscribes to the City of Carlsbad for solid waste disposal services of an estimated 5,200 kilograms (11,500 pounds) of sanitary solid waste annually. Some paper and cardboard are recycled. The estimated quantity of non-hazardous solid waste is only a small percentage of the waste handled monthly by the City of Carlsbad and does not include wastes that are regulated in accordance with the hazardous waste regulations of the New Mexico Environment Department (Webb 2002b).

3.7.1.2 Hazardous and Radiological Wastes

Routine laboratory operations generate small quantities of chemical and low-level radiological wastes. These materials are managed and handled in accordance with established New Mexico State University procedures to satisfy New Mexico Environment Department regulatory requirements. None of these wastes is discharged to the Carlsbad city sewer system. Typical sources of wastes include residues from empty containers, analyses and samples, off-specification analytical standards, sample intermediates, cleaning solutions, and photographic chemicals (DOE 1995c).

Typical waste generation at the CEMRC is 150 kilograms (330 pounds) per year radioactive waste, 250 kilograms (551 pounds) per year industrial waste (non-Resource Conservation and Recovery Act

[RCRA]), and 35 kilograms (77 pounds) per year hazardous waste (Webb 2002b). These amounts are managed by conventional waste-handling means; for example, wastes are packaged appropriately and transported by a commercial hazardous waste disposal service to an EPA- or state-permitted disposal site.

Currently, the maximum quantities of hazardous wastes the CEMRC can accumulate, which are based on an estimate in which approximately one-half of the total chemical inventory would be used and then disposed of as hazardous waste every 6 months, are:

- 136 kilograms (300 pounds) of solvents
- 27 kilograms (60 pounds) of chloroform and carbon tetrachloride
- 9 kilograms (20 pounds) of hydrofluoric acid
- 182 kilograms (401 pounds) of organic/inorganic acids

These quantities are conservative because most chemicals are consumed or neutralized in sample processing or analytical procedures. Sulfuric acid, for example, is highly reactive and is neutralized during acid digestion of sample constituents (DOE 1995c).

A 6-month waste accumulation would consist of three 55-gallon drums and three 5-gallon containers as follows:

- Solvents in one 55-gallon drum
- Chloroform and carbon tetrachloride in two 5-gallon containers
- Hydrofluoric acid in one 5-gallon container
- Organic and inorganic acids in two 55-gallon drums

At this generation rate, the CEMRC qualifies as a Conditionally Exempt Small Quantity Generator. Such generators are exempt from most formal reporting requirements, such as obtaining a waste generator registration number from the New Mexico Environment Department, but they are required to manage waste in accordance with requirements specified in the Department's regulations.

The CEMRC also generates small quantities of radiological waste. The amount of radiological waste is dependent upon the number and types of procedures performed at the CEMRC. If the total activity levels for all radionuclides are combined, approximately 35 microcuries of radioactive waste are disposed of each year. Liquids are allowed to evaporate to minimize the quantity of waste that would require disposal. A permitted radiological waste disposal service transports this material to a permitted disposal site.

The CEMRC has appointed a hazardous and radiological waste coordinator to ensure operations are conducted safely in accordance with New Mexico Environment Department requirements. The coordinator has established a plan that includes the following components:

- A hazardous waste management plan that incorporates radiological waste handling in accordance with the CEMRC's Radiation Safety Manual;

- A recordkeeping system that includes information on manifesting, marking and labeling containers, and tracking waste;

- A storage/accumulation area in a convenient, accessible location in the laboratory; and

- A storage area with spill-containment equipment, packing and absorption materials, spill-control materials, fire extinguishers, and personal protective equipment.

Bioassay analyses may involve the collection of 24- to 48-hour urine specimens and collection of various plant and animal tissues. These types of samples do not meet the definition of regulated medical wastes according to the EPA definition found in 40 CFR Part 259 (EPA 1991). These wastes are disposed of as part of the sanitary and solid wastes generated by the CEMRC.

3.7.2 WIPP Site

This section describes the waste generation and disposal practices at WIPP.

3.7.2.1 Sanitary and Solid Wastes

The WIPP facility has a New Mexico Environment Department Discharge Permit for a wastewater lagoon facility. The daily discharge limit to the lagoon is 87,000 liters (23,000 gallons) per day of domestic wastewater, 7,570 liters (2,000 gallons) per day of miscellaneous non-hazardous water, and 30,283 liters (8,000 gallons) per day of miscellaneous non-hazardous brine and water. WIPP currently does not require National Pollutant Discharge Elimination System permitting. There is no point source discharge to waters in the United States. A National Pollutant Discharge Elimination System storm water permit would be needed for construction activities on sites larger than 2 hectares (5 acres). The WIPP site generated 751 cubic meters (982 cubic yards) of sanitary solid waste during FY1999 (DOE 2001b).

3.7.2.2 Hazardous and Radiological Wastes

In FY1999, 30 cubic meters (39 cubic yards) of RCRA hazardous waste was generated; this was a reduction from 80 cubic meters (105 cubic yards) generated in 1998 (DOE 2001b). These wastes typically included absorbed liquids from spills and routine usage of maintenance products, including oils, coolants, and solvents. Safe storage of these materials and their associated hazards are administered by the Site Generated Non-Radioactive Hazardous Waste Management, the Industrial Safety Program, and the WIPP Emergency Management Program. A Hazardous Waste/Material Storage Facility is provided for storage of various types of incoming and outgoing hazardous materials prior to shipment to a Treatment, Storage, and Disposal Facility (DOE 1995d).

When used as a fire suppressant, water is the largest potential source of liquid radioactive waste. Another source would be liquid used for decontamination. In an unlikely fire event, suspect liquids would be sampled and tested for radioactivity. If the liquid exceeds the uncontrolled release limit of Order DOE 5400.5, it is collected and made acceptable for disposal at WIPP. All non-fire water radioactive waste is collected in portable tanks or drums and handled in accordance with procedure in WP 05-WH1036, *Site-Derived Mixed Waste Handling* (DOE 2001b).

The solid radioactive waste system provides for the collection and packaging of site-derived radioactive waste. It is anticipated that all site-derived waste would be contact-handled, due to its low activity and the potential for sources of site-derived solid waste in the WIPP facility. A conservative estimated volume of solid radioactive waste generated at WIPP is 12 cubic meters (424 cubic feet) (DOE 2001b).

3.7.3 LANL Site

This section provides descriptions of the waste generation and disposal practices at LANL.

3.7.3.1 Sanitary and Solid Wastes

Sanitary liquid wastes at LANL are delivered by dedicated pipelines to the Sanitary Wastewater Systems Consolidation Plant at TA-46. The plant has a design capacity of 2.27 million liters (600,000 gallons) per

day and, in 1995, processed a maximum of about 1.5 million liters (400,000 gallons) per day. Some septic tank pumpings are delivered periodically to the plant for treatment via tanker truck. Sanitary waste is treated by an aerobic digestion process (that is, a digestion process which uses living organisms in the presence of oxygen). After treatment, the liquid from this process is recycled to the TA-3 power plant for use in cooling towers or is discharged to Sandia Canyon adjacent to the power plant under a permit by the National Pollutant Discharge Elimination System and groundwater discharge plan. Under normal operating conditions, the solids from this process are dried in beds at the Sanitary Wastewater Systems Consolidation Plant and applied as fertilizer as authorized by the existing National Pollutant Discharge Elimination System permit.

According to the LANL Utilities and Infrastructure Group, the TA-3 sewer lines between Pajarito Road and Diamond Drive and between Diamond Drive and the Sanitary Wastewater Systems Consolidation Plant connection are 40 years old, and the current capacity is 58 to 68 percent of the original capacity due to deterioration and infiltration. The S-Site wastewater collection system is also 40 years old, and repair or replacement of 3,600 meters (12,000 feet) of this line is also needed.

In addition to the Sanitary Wastewater Systems Consolidation Plant, there are thirty-six approved septic systems still in use at facilities located in sixteen TAs.

Both LANL and Los Alamos County use the same county landfill that is located on DOE property. The Española area solid waste disposal site has been closed. Los Alamos has also contracted with Española to receive selected waste from that community. The Los Alamos landfill received about 20 million kilograms (22,000 tons) of solid waste from all sources from July 1995 to June 1996, with LANL contributing about 22 percent; the city of Española, 32 percent; and Los Alamos County, 46 percent. At the current rate of input, the anticipated life of the landfill is estimated to be about 18 years (Zimmerman 1996).

3.7.3.2 Hazardous and Radiological Wastes

LANL generates radioactive and hazardous waste as a result of operations and maintenance and construction activities. Annual waste generation rates have varied due to the level of operations at the various facilities, suspension of operations at various times in these facilities, construction activities, changes in the types of operations, and implementation of waste minimization initiatives. Waste generation across the key facilities was examined from 1990 through 1995; the years during this period that had atypical interruptions or operations were ignored, and the remaining years were used to establish an average waste generation rate for use as the "baseline" generation rate. Waste generation rates for the non-key facilities were averaged for the 5-year period for use as baseline for these facilities. Table 4.9.3.3-1 of the LANL SWEIS (DOE 1999) shows the range of waste generation rates over this period by facility and "baseline" generation rates used for the purposes of waste projections.

Radioactive liquid waste generation is not measured at all facilities; therefore, the amounts received historically at TA-50 were examined. These influents indicated a waste generation range of 16.5 million to 21.9 million liters (4.36 million to 5.79 million gallons) per year.

In addition to the waste generation rates presented in this section, LANL has a backlog of previously generated waste that is being stored on the site. It consists of 759 cubic meters (27,096 cubic feet) of low-level radioactive mixed waste and 9,014 cubic meters (321,800 cubic feet) of TRU waste.

Finally, LANL has historically received small quantities of waste (low-level or TRU) from offsite locations (average of about five shipments a year from 1991 to 1996). Typically, these are wastes generated by LANL activities at other locations (for example, at the Nevada Test Site). However, there

have also been cases where low-level or TRU wastes generated at DOE locations without an onsite disposal capability send such waste to LANL for disposal. In recent years these sites have included the Pantex Plant in Amarillo, Texas; the Kansas City Plant; and DOE facilities on Kirtland Air Force Base in Albuquerque, New Mexico. Such offsite waste shipments would be expected to continue in the future at about the same rate as has been experienced in recent years (five to ten low-level and TRU waste shipments per year). These shipments, although not specifically listed in the waste generation rates and waste shipments analyzed, are within the quantities and shipment numbers projected due to the conservatism in these projections and the relatively small amounts of offsite waste anticipated for shipment to LANL.

3.8 ENVIRONMENTAL JUSTICE

In Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, President Clinton required federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental impacts of federal programs, policies, and activities on minority and low-income populations. The order also requires agencies to ensure greater public participation in their decision-making practices. For the purpose of this EA, "minority" refers to people who classified themselves in the 1990 U.S. Census as African Americans, Asian or Pacific Islanders, American Indians, Hispanics of any race or origin, or other non-White races. A "minority population" refers to an area where minority individuals comprise 25 percent or more of the population (DOC 1990).

This section includes the most recent environmental justice data available for the three sites of concern. For the LANL description, the most recent source of data was the 1990 U.S. Census; however, that discussion will be updated if more recent data are published before the EA is finalized.

3.8.1 CEMRC Site

Both the Proposed Action to put the new ACRSL facility adjacent to the CEMRC and the alternative to locate the new facility at WIPP would take place in Eddy County, New Mexico. Thus, a description of environmental justice prepared as part of the Astrophysics EA (DOE 2001a) has information relevant to both the Proposed Action and the WIPP Alternative. Even though WIPP is located approximately 50 kilometers (30 miles) east of the CEMRC, Eddy County is the primary county and Carlsbad is the primary city for the environmental justice region-of-influence (ROI) associated with both alternatives.

Under the Proposed Action, environmental justice refers to the potential for minority and low-income populations to bear a disproportionate share of high and adverse environmental impacts from activities at the CEMRC. The environmental justice ROI covers all populations within an 80-kilometer (50-mile) radius of the CEMRC. This region includes parts of four counties in New Mexico (Chaves, Eddy, Lea, and Otero) and parts of two counties in Texas (Culberson and Loving).

Recent data estimates on low-income and minority populations are available at the county level (U.S. Bureau of the Census 2002). Tables 3-3 and 3-4 show estimated county-level low-income and minority data, respectively, for the affected counties in the ROI for both the Proposed Action and the WIPP Alternative.

Table 3-3. ROI County Estimates for Low-Income Populations

County	ROI County for Proposed Action	ROI County for WIPP Alternative	Percent Estimate[a]
New Mexico			
Eddy	X	X	18.6
Lea	X	X	20.7
Otero	X		17.7
Chaves	X	X	23.1
Texas			
Andrews		X	15.8
Culberson	X	X	32.6
Gaines		X	20.6
Loving	X	X	22.9
Reeves		X	27.5
Ward		X	19.4
Winkler		X	16.8

a. Estimates model 1997 income reported in the March 1998 Current Population Survey (U.S. Bureau of the Census 2002).

Table 3-4. ROI County Estimates for Minority Populations

County	ROI County for Proposed Action	ROI County for WIPP Alternative	Percent Estimate
New Mexico			
Eddy	X	X	42.3
Lea	X	X	46.0
Otero	X		44.3
Chaves	X	X	47.9
Texas			
Andrews		X	43.7
Culberson	X	X	75.4
Gaines		X	39.2
Loving	X	X	10.4
Reeves		X	76.2
Ward		X	47.8
Winkler		X	46.7

Source: U.S. Bureau of the Census 2002.

3.8.2 WIPP Site

Both the alternative to locate the new facility at the WIPP and the Proposed Action to put the new ACRSL facility adjacent to the CEMRC would take place in Eddy County, New Mexico; therefore, the description of environmental justice presented above (Section 3.8.1), which was prepared as part of the Astrophysics EA for the WIPP site (DOE 2001a), is directly relevant to the WIPP Alternative. The environmental justice ROI for WIPP includes parts of three counties in New Mexico (Chaves, Eddy, and Lea) and parts of seven counties in Texas (Andrews, Culberson, Gaines, Loving, Reeves, Ward, and Winkler). Seventy-five percent of the ROI lies within New Mexico, and the remaining 25 percent lies within Texas.

The following population data are derived from the 1990 Census of Population and Housing (U.S. Bureau of the Census 1994); these data are the best available environmental justice data at the block group level. (Block grouping is a division of territory, the size of which varies according to population density, which has approximately four hundred households.)

Within the environmental justice ROI, the total population of 101,129 persons includes 4.1 percent non-White, 32.6 percent Hispanic, and 36.8 percent minority (all except White non-Hispanic persons) (DOE 2001a). In addition, 21.5 percent of the total population had 1989 incomes below the poverty level, as defined by the U.S. Bureau of the Census. There are no Native American reservations in the ROI (U.S Bureau of Census 1994). Figures 3-1 and 3-2 display maps of the distribution of minority and low-income populations according to the percentage of the block group population in the environmental justice ROI for the WIPP Alternative.

The proportions of Hispanic, minority, and low-income persons in the ROI are all greater than in the United States as a whole (DOE 2001a). Also, the proportion of low-income persons in the ROI is greater than in both New Mexico and Texas. Finally, the proportion of Hispanic persons in the ROI is smaller than in New Mexico but greater than in Texas.

3.8.3 LANL Site

The area considered for the environmental justice analysis for the LANL SWEIS (DOE 1999) was the area within an 80-kilometer (50-mile) radius. The center of the area is the emissions stack at the Los Alamos Neutron Science Center in TA–53. The stack was chosen because it is the primary source of LANL airborne radionuclide emissions. The use of an 80-kilometer (50-mile) radius circle was patterned after the methodology used by the Nuclear Regulatory Commission for assessing potential risks to populations from nuclear power plants and is intended to encompass the potential impacts from LANL operations across all areas of analyses (such as water, air, cultural resources).

The racial and ethnic diversity and geographic distribution of the populations within this region require the region be separated into smaller spatial portions (sectors) to assist DOE in identifying minority and low-income populations. To divide the region, four additional circles, centered on the Los Alamos Neutron Science Center stack with radii at 16-kilometer (10-mile) intervals, were overlaid on the 1990 U.S. Census map for this region. The concentric circles were divided by sixteen arcs, each 22.5 degrees in width (the resulting sectors are not of equal area). The minority and low-income population data for each sector were derived from U.S. Census Bureau data using Geographic Information System software.

This map was used to overlay impacts to enable DOE to determine if any LANL operations result in disproportionately high and adverse human health or environmental impacts on minority and low-income populations. Figure 3-3 presents the area analyzed, the 1990 U.S. Bureau of Census-defined places within this area, and the resulting eighty sectors (discussed above). Eight counties, including all of Los Alamos County and parts of Rio Arriba, Taos, Mora, San Miguel, Santa Fe, Bernalillo, and Sandoval Counties, are within the region. Many villages and other rural settlements (not depicted in this figure) are scattered throughout the area but were too small to have been defined as distinct places for the 1990 U.S. Census. Figure 3-4 presents the eighty sectors, highlighted with the low-income or minority populations greater than 25 percent of the total sector population. All minority population and income data used in Figures 3-3 and 3-4 were derived from the 1990 U.S. Census (DOC 1993) because they were the best data available when the LANL SWEIS (DOE 1999) was conducted.

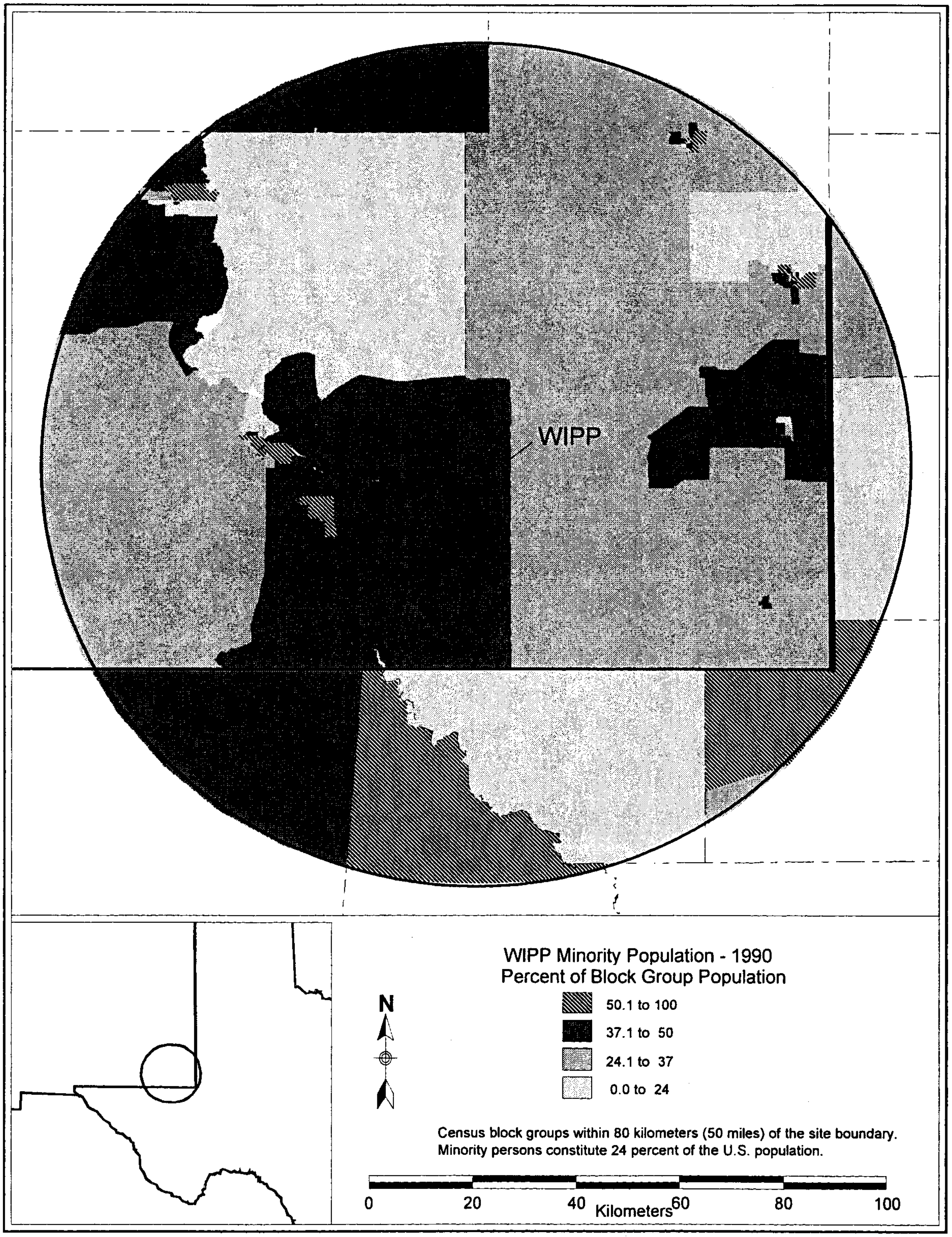

Figure 3-1. Minority Population, WIPP ROI

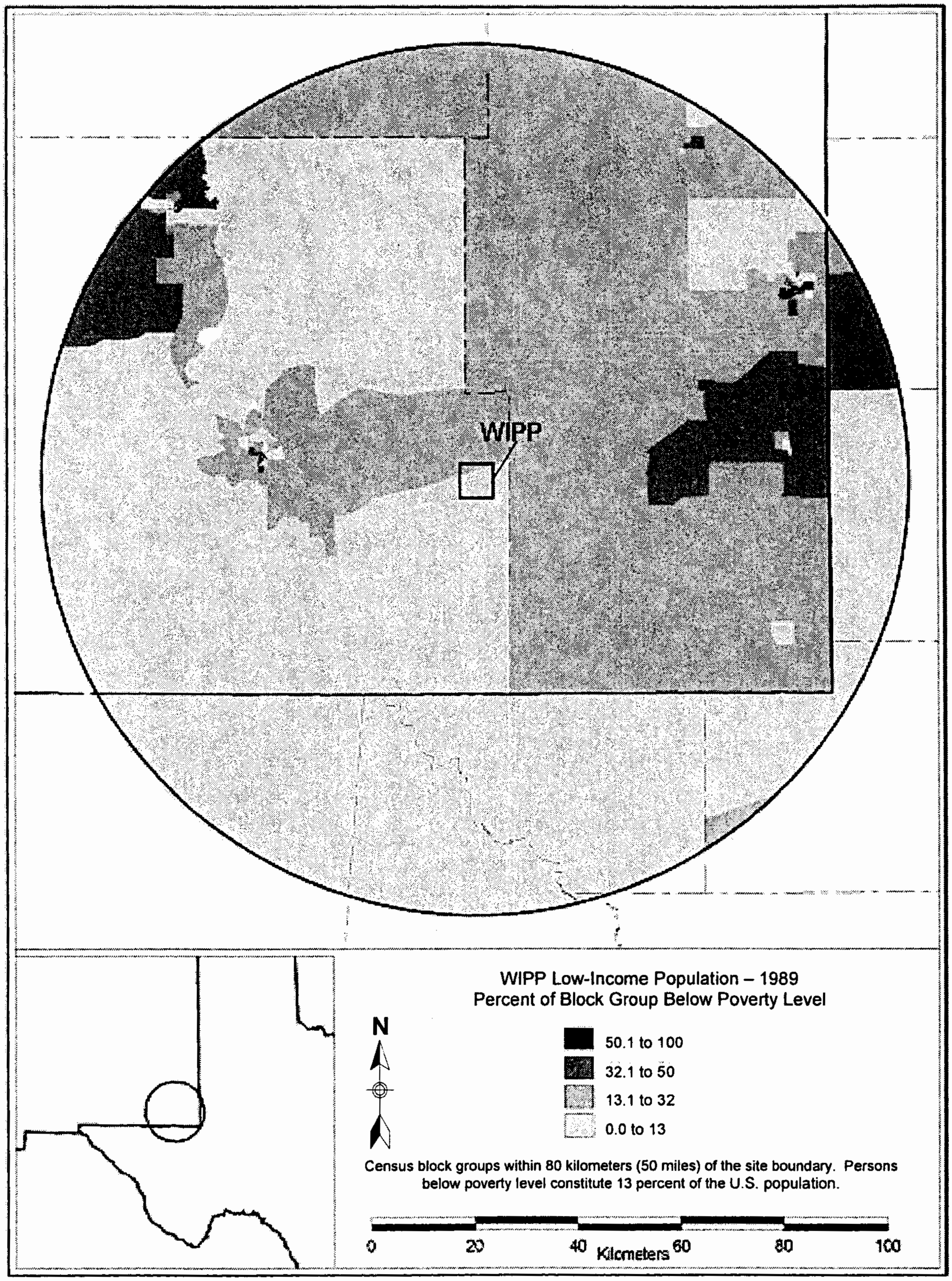

Figure 3-2. Low-Income Population, WIPP ROI

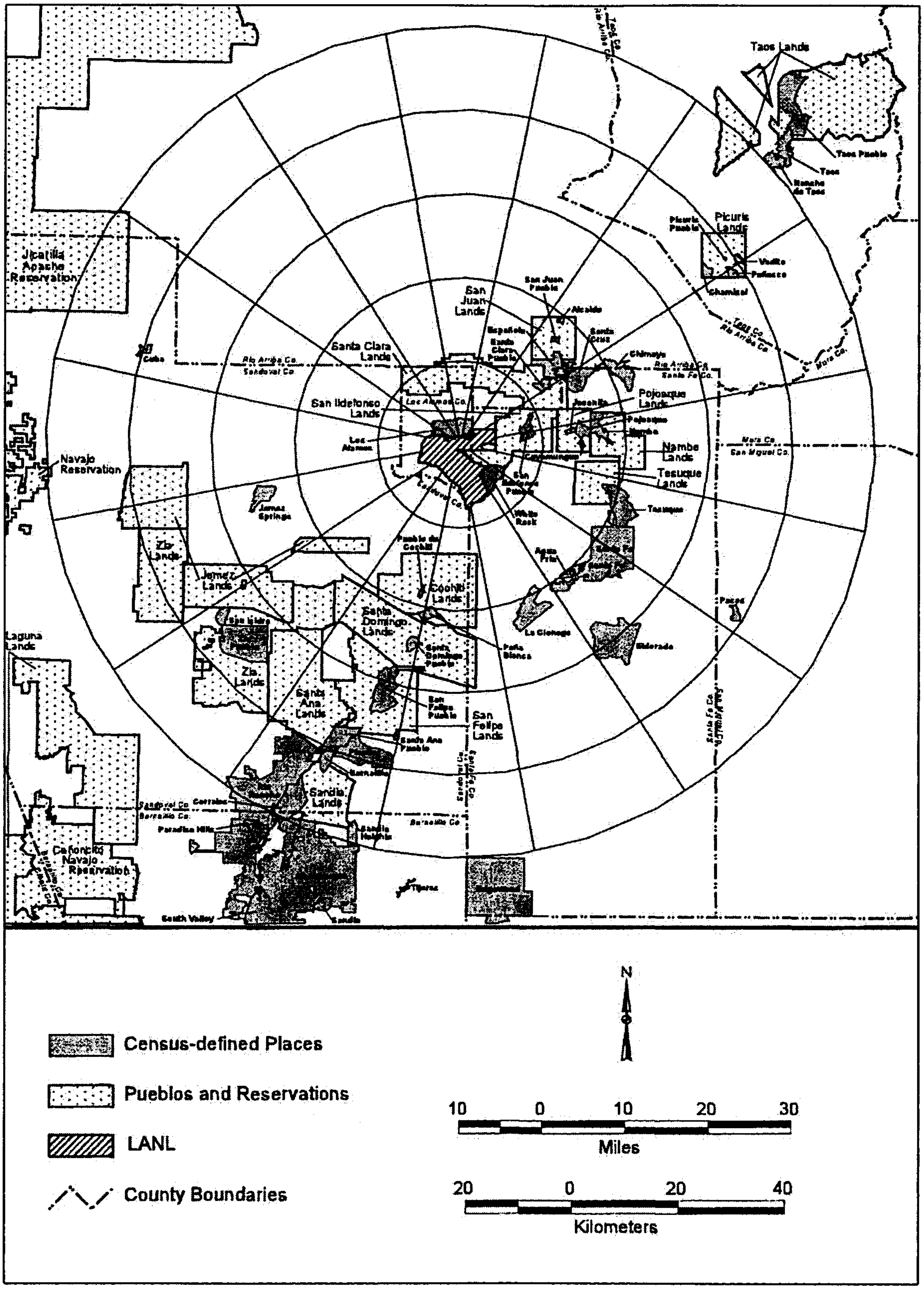

Figure 3-3. Sectors Used for Environmental Justice Analysis Within 50 Miles (80 Kilometers) of LANL

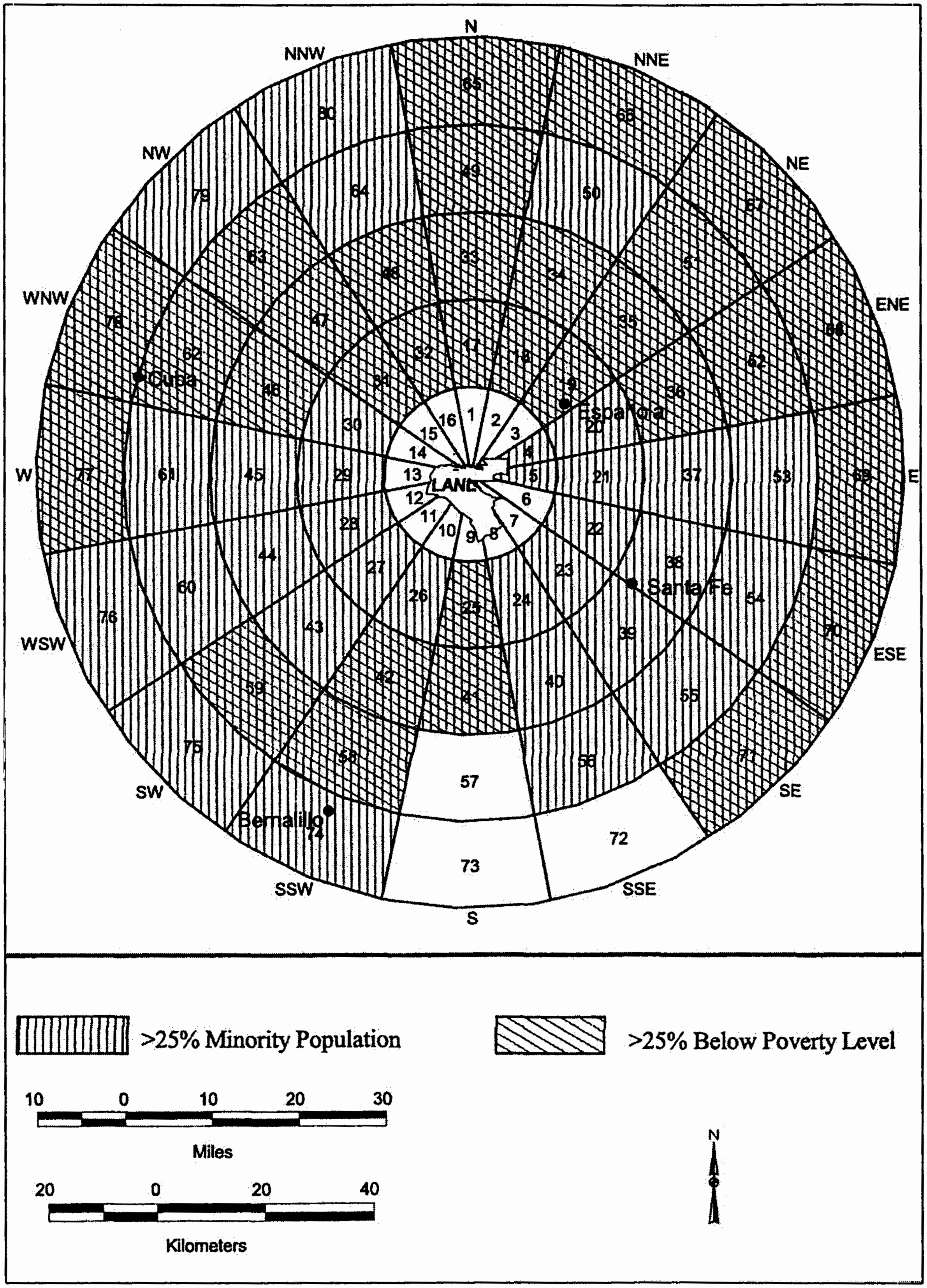

Figure 3-4. Sectors with Minority and Low-Income Populations Greater than 25 Percent of the Sector Population

The 80-kilometer (50-mile) region includes at least portions of fifteen American Indian Pueblos and one American Indian Reservation. These Pueblo and Tribal communities are presented in Figure 3-3. Only uninhabited or sparsely inhabited sectors of the Pueblo of Taos and Jicarilla Apache Indian Reservation fall within the 80-kilometer circle.

The Pueblo communities in closest proximity to LANL are the Pueblo of San Ildefonso, Pueblo of Santa Clara, Pueblo de Cochiti, and Pueblo of Jemez. DOE has signed intergovernmental agreements (accords) with these sovereign nations to improve cooperation and dialogue regarding LANL operations.

The total 1990 population within the 80-kilometer (50-mile) region is 212,771. This population was calculated by summing the populations of all the census tracts within the 80-kilometer radius. Census block data were used when the 80-kilometer radius split a census tract. Twenty-five of the sectors have populations of less than 200, while three sectors contain 57 percent of the regional population. The sectors containing 57 percent of the population are: (1) the Santa Fe metropolitan area (62,015); (2) the Rio Rancho, Pueblo of Sandia, and Sandia Heights areas (44,293); and (3) the Pueblo of Santa Clara, Española, and the Pueblo of San Juan (15,182).

Nearly 54 percent of the population within the 80-kilometer (50-mile) radius area is minority. The area's largest minority group is the Hispanic population (97,378 or about 46 percent), followed by American Indians (14,308 or about 7 percent), African Americans (1,264 or less than 1 percent), and Asians or Pacific Islanders (1,142 or less than 1 percent). Within New Mexico, minorities make up 49.6 percent of the total state population. Minorities are about 15 percent of Los Alamos County's population, with Hispanics being the largest minority group (11 percent).

Hispanics reside throughout the 80-kilometer (50-mile) radius area, but most are located in the Española Valley and in the Santa Fe metropolitan area. Sixty-two percent of the Hispanics living within this area reside within a transportation corridor that extends north from Santa Fe, along U.S. Highway 84/285 through its junction with State Road 502, and north toward Española and its neighboring communities.

In 1989, the median household income for New Mexico was $24,087, while 21 percent of the population lived below the poverty threshold ($12,674 for a family of four). Los Alamos County had the highest median income ($54,801) within the state. Fifteen percent of the total population living within the 80-kilometer (50-mile) area had 1989 incomes below the poverty level. Los Alamos County had the lowest percentage (2.4 percent) of individuals living below the poverty level when compared to other census county divisions in the area.

CHAPTER 4

ENVIRONMENTAL IMPACTS

This chapter presents the results of the potential environmental impacts under the Proposed Action at the CEMRC, the WIPP Alternative, and the No Action Alternative at LANL.

4.1 HUMAN HEALTH

This section describes the potential human health impacts as a result of the three alternatives evaluated. Construction and operation of an actinide chemistry laboratory could potentially affect the health and safety of workers at the facility and members of the public in the surrounding area as the result of industrial activities (workers only) and exposure to radioactive and hazardous materials.

4.1.1 Proposed Action at CEMRC

The Proposed Action involves the addition of the proposed ACRSL facility to the existing CEMRC facility. Human health impacts may occur from construction and operation of this facility.

4.1.1.1 Construction

Construction of the proposed ACRSL facility could result in occupational injuries and illnesses to construction workers. Approximately six to fifteen construction workers would be employed for 10 months to add the 725-square-meter (7,800-square-foot) ACRSL facility at the CEMRC. Using the latest available occupational injury and illness statistics from the Bureau of Labor Statistics (year 2000 data from BLS 2002), the number of total recordable cases of expected injuries and illnesses would be one, while less than one (0.51) lost workday case would be expected. No other non-radiological or radiological impacts would occur to workers or members of the public during construction because no hazardous or radioactive materials would be present.

4.1.1.2 Operations

As described in Chapter 2 and Appendix A, operations at the proposed ACRSL facility would involve various chemical and radiochemical laboratory experiments and procedures. Workers could incur occupational injuries such as falls and cuts and potentially be exposed to radioactive materials or chemicals used in the experiments. Members of the public could be exposed to radioactive materials and chemicals that potentially would be released from the facility during experiments.

Workers

The total estimated number of full-time equivalent workers in the proposed ACRSL facility, including scientists, technicians, support staff, and visiting scientists, would be 25. Using Bureau of Labor Statistics for private industry (BLS 2002), the estimated annual number of total recordable cases of injury and illness would be about two (1.5), and the annual number of lost workday cases would be less than one (0.75).

The highest occupational radiation dose to a staff member at the proposed ACRSL facility would be less than 100 mrem per year, mainly from external radiation from small gamma sources. All potentially dispersible radionuclides would be handled in fume hoods or glove boxes. The probability of a latent cancer fatality from a 100-mrem dose to an individual would be about 0.00004 per year. The average

dose to staff members at the proposed ACRSL facility would be less than this, estimated at about 10 mrem per year or less. Total radiation dose to the work force would be about 0.25 person-rem per year; the estimated number of occupational latent cancer fatalities in the worker population would be about 0.0001 per year. Over a 30-year facility lifetime, no latent cancer fatality (less than 0.004) would be expected. The proposed ASRCL facility would implement a radiation dosimetry program to monitor potential internal and external worker exposures to radioactive material to help keep such exposures as low as reasonably achievable and below applicable regulatory and administrative limits in all cases.

Small quantities of non-radioactive but potentially toxic or hazardous material also would be used in the proposed ACRSL facility. Appendix B contains a list of the chemicals used in the CEMRC and their quantities. All are chemicals typically found in chemical or radiochemical laboratories. The quantities shown in Appendix B for laboratory chemicals would increase by no more than a factor of two to accommodate proposed ACRSL operations. The largest single container of any chemical in stock would be about 3.8 liters (1 gallon). Like radionuclides, chemicals would typically be handled in fume hoods or glove boxes. The potential for health and safety impacts to staff members at the proposed ACRSL facility would be very low.

Public

The proposed ACRSL facility would be designed with the best available radionuclide control technology, including HEPA filters on all fume hoods and glove boxes to minimize the potential release of radionuclides to the atmosphere from the facility ventilation exhaust. No radionuclides would be released in sanitary sewage streams, as small quantities of liquid waste would be collected in carboys beneath lab sinks, dried, and disposed of as low-level waste.

The potential radiation dose to the maximally exposed member of the public (also known as the maximally exposed individual or MEI) was estimated based upon the CEMRC facility permit for up to 2 curies, which would apply to the combined ACRSL and CEMRC facilities. It was assumed that 2 curies of plutonium-239 were used in experiments and sample analyses over the course of 1 year. Experimental media and samples were assumed to be in particulate solid or solution form. Estimates of radionuclide emissions were made using guidance found in 40 CFR 61 Appendix D. Ventilation exhaust would pass through a minimum of two HEPA filters, each with 99 percent or higher efficiency for particle removal. Atmospheric dispersion was estimated using Carlsbad-specific meteorological data from SEIS-II (DOE 1997). Radiation doses were estimated using dose-screening factors from NCRP Report No. 123 (NCRP 1996). The MEI was assumed to reside 100 meters (328 feet) south of the proposed ACRSL facility and raise a large amount of their own food at this location. This individual would receive an estimated dose of less than 0.003 millirem per year, with the probability of a latent cancer fatality being less than 2×10^{-9} per year. If the entire population of Eddy County, numbering 51,658 (U.S. Bureau of the Census 2002), was assumed to be located within 1.6 kilometers (1 mile) of the ACRSL, the dose to the population would be less than 0.006 person-rem, with no (less than 0.000003) latent cancer fatality expected in the exposed population. Over a hypothetical 30-year facility lifetime, no latent cancer fatality (about 0.00009) would be expected in the exposed population. In reality, the potential doses and health impacts to individuals and the surrounding population would be lower than these conservative estimates because actual operating conditions would result in lower releases (for example, more HEPA filters would likely be present, with higher removal efficiency). Radionuclide exposures would also likely be lower, because the population is more dispersed and relatively few individuals would be expected to raise a large amount of their own food.

Potential impacts to members of the public from non-radiological but potentially toxic or hazardous chemicals would also be very small because only small quantities of chemicals would be used in the preparation and analysis of chemicals. As noted above, Appendix B contains a list of the chemicals used

in the CEMRC that are also likely to be used in the ACRSL in similar or somewhat larger quantities. The largest single container of any laboratory chemical in stock would be about 3.8 liters (1 gallon). Laboratory chemicals would be present in quantities below the Reportable Quantities provided in 40 CFR 302. Like radionuclides, no releases of chemicals would occur in building liquid effluent streams. Potential releases in ventilation exhaust would be very small, and no potential health impacts would be expected for members of the public.

4.1.2 Alternative at WIPP

This section describes the potential human health impacts under the WIPP Alternative.

4.1.2.1 Construction

Under this alternative, a new laboratory facility would be constructed at WIPP. Although the WIPP site infrastructure would be available to support the construction, more construction workers would be needed. Construction activities could result in occupational injuries and illnesses to construction workers. Approximately twenty construction workers would be employed for fifteen months to build the new actinide facility at WIPP. Using the latest available occupational injury and illness statistics from the Bureau of Labor Statistics (year 2000 data from BLS 2002), the expected total recordable cases would be 2.1, while approximately one lost workday case would be expected. DOE and DOE contractor occupational injury statistics were not used because a private contractor was assumed to construct the facility. No other non-radiological or radiological impacts would occur to workers or members of the public during construction because no hazardous or radioactive materials would be present.

4.1.2.2 Operations

Operations at an actinide chemistry laboratory under this alternative at WIPP would involve the same chemical and radiochemical laboratory experiments and procedures discussed for the Proposed Action. Workers could incur occupational injuries such as falls and cuts and potentially be exposed to radioactive materials or chemicals used in the experiments. Members of the public could be exposed to radioactive materials and chemicals that potentially would be released from the facility during experiments.

Workers

Operations in a new actinide facility at WIPP would be identical to those described under the Proposed Action. The total estimated number of full-time equivalent workers in the ACRSL, including scientists, technicians, support staff, and visiting scientists, would be about thirty (slightly more than the proposed ACRSL facility) because this laboratory would be a separate, stand-alone building. Using DOE occupational injury and illness statistics for operations of the DOE Carlsbad Area Office (2000 data from CAIRS 2002), the estimated annual number of total recordable cases would be less than one (0.3), as would the annual number of lost workday cases (0.15).

As for the Proposed Action, the highest occupational radiation dose to a staff member at the alternative laboratory at WIPP would be expected to be less than 100 mrem per year, mainly from external radiation from small gamma sources. All potentially dispersible radionuclides would be handled in fume hoods or glove boxes. The probability of a latent cancer fatality from a 100-mrem dose would be about 0.00004 per year. The average dose to staff members at the alternative laboratory at WIPP would be less than this, estimated at about 10 mrem per year. Total radiation dose to the work force would be about 0.3 person-rem per year, with the estimated number of occupational latent cancer fatalities about 0.00015 per year. Over a hypothetical 30-year facility lifetime, no latent cancer fatality (less than 0.004) would be expected. The alternative laboratory at WIPP would be included under WIPP's existing

radiation dosimetry program to monitor potential internal and external worker exposures to radioactive material to help keep such exposures as low as reasonably achievable and below applicable regulatory and administrative limits in all cases.

Small quantities of non-radioactive but potentially toxic or hazardous material would be used in the alternative WIPP actinide laboratory. Chemicals likely to be used would be similar to those shown in Appendix B for the CEMRC. Quantities used would also likely be similar. Like radionuclides, chemicals would typically be handled in fume hoods or glove boxes. The potential for health and safety impacts to staff members at the alternative laboratory at WIPP would be very low.

Public

The alternative WIPP actinide laboratory would be designed with the best available radionuclide control technology, including HEPA filters on all fume hoods and glove boxes to minimize the potential release of radionuclides to the atmosphere from the facility ventilation exhaust. Liquid wastes containing radionuclides would be controlled so there would be no radionuclide releases in liquid effluent streams such as sanitary sewage. The potential radiation dose to the maximally exposed member of the public was estimated based upon a building inventory of 2 curies, the same as the Proposed Action. It was assumed that 2 curies of plutonium-239 were used in experiments and sample analyses over the course of one year. Experimental media and samples were assumed to be in particulate solid or solution form. Estimates of radionuclide emissions were made using guidance found in 40 CFR 61, Appendix D. Ventilation exhaust would pass through a minimum of two HEPA filters, each with 99 percent or higher efficiency for particle removal. Atmospheric dispersion was estimated using meteorological data from SEIS-II (DOE 1997). Radiation doses were estimated using dose-screening factors from NCRP Report No. 123 (NCRP 1996). The MEI was assumed to reside continuously 3,000 meters (1.9 miles) north of the laboratory, the same location as described in SEIS-II (DOE 1997), and raise a large amount of their own food at this location. This individual would receive an estimated dose of about 0.00001 millirem per year, with the probability of a latent cancer fatality being less than 1×10^{-11} per year. The dose to the population within 80 kilometers (50 miles) of WIPP would be less than 0.00001 person-rem, with no (4×10^{-9}) latent cancer fatality expected. Over a hypothetical 30-year facility lifetime, no latent cancer fatality (about 0.0000001) would be expected. These are also conservative estimates, and actual doses and health impacts to individuals and the surrounding population would likely be lower because actual operating conditions would result in lower releases (for example, more HEPA filters would likely be present, with higher removal efficiency). Radionuclide exposures would also likely be lower, because of the assumptions made about potentially exposed individuals raising a large amount of their own food. Most individuals in the potentially exposed population would purchase a large portion of the food.

Potential impacts to members of the public from non-radiological but potentially toxic or hazardous chemicals would also be very small because only small quantities of chemicals would be used in the preparation and analysis of chemicals. Laboratory chemicals in a WIPP laboratory would be present and used in amounts similar to those described for the ACRSL (Section 4.1.2.2). Laboratory chemical quantities would be below the Reportable Quantities provided in 40 CFR 302. No releases of chemicals would occur in building liquid-effluent streams. Potential releases in ventilation exhaust would be very small, and no potential health impacts would be expected for members of the public.

4.1.3 No Action Alternative at LANL

Under the No Action Alternative, actinide laboratory experiments would continue to take place in the existing TA-48-1 Radiochemistry Laboratory at LANL. There would be no new construction and therefore no potential for impacts to workers from construction-related industrial accidents or injuries.

Workers

Operations involving actinide radiochemistry experiments to support WIPP are a small part of the total operations in the LANL Radiochemistry Laboratory. WIPP-related activities would be essentially identical to those proposed for the new ACRSL facility and at the alternative laboratory at WIPP, so potential impacts to workers would be very similar to those described for the other alternatives. Potential impacts to members of the public would also be very low. The MEI would be located about 890 meters (2,900 feet) north-northeast of TA-48. Using the same assumptions affecting the potential release of radionuclides as were used for the Proposed Action, the estimated annual dose to the MEI would be about 0.00009 millirem per year, with the probability of a latent cancer fatality being about 5×10^{-11} per year.

Public

There is a larger population within 80 kilometers (50 miles) of LANL than around either Carlsbad or WIPP, although most of it is more than 32 kilometers (20 miles) distant. The dose to the population within 80 kilometers (50 miles) of LANL would be about 0.0001 person-rem, with no (7×10^{-8}) latent cancer fatality expected. Over a hypothetical 30-year facility lifetime, no latent cancer fatality (about 0.000002) would be expected. Similar to operations at the proposed ACRSL facility or at the alternative laboratory at WIPP, potential exposure of the public from toxic or hazardous chemicals would be very low, and no health impacts would be expected.

4.2 ACCIDENTS

This section describes potential accidents as a result of the three alternatives evaluated. DOE analyzed the same accident scenarios at the three alternative locations for the proposed ACRSL, taking into account different atmospheric conditions at the sites. However, because the CEMRC site and the WIPP site are in close proximity, the same atmospheric conditions were assumed for these two sites.

4.2.1 Proposed Action at CEMRC

This section investigates the potential hazards that could result from operations at the proposed ACRSL expansion of the CEMRC facility and conducts a bounding analysis to illustrate the quantitative effects of potential accidents. A preliminary hazards analysis was conducted to identify potential hazards at the facility. A standard accident analysis was used to identify potential hazards and accidents that could result if the hazards were uncontrolled. Next, the physical and administrative barriers that would be designed to control the frequencies of the identified hazards or minimize releases of radioactive or hazardous materials are identified for each potential accident. The information is intended to assess the impacts from a potential accident.

General information about the proposed ACRSL facility and the existing CEMRC facility (CEMRC 2000, Webb 2002a) that was used to identify hazards, accidents, and associated controls is summarized below.

- The State of New Mexico is a Nuclear Regulatory Commission-designated Agreement State. New Mexico regulations do not require an accident analysis to support emergency preparedness planning for facilities possessing less than 2 curies of radioactive material (20 NMAC 3.1, Section 309, New Mexico Environment Department, Radiation Licensing and Registration). The State has approved, and the CEMRC is now permitted to possess, up to 2 curies of radioactive material.

- Currently, the CEMRC possesses less than 100 microcuries, and the inventory is dominated by gamma emitters such as cesium.

- With the addition of the proposed ACRSL facility, the maximum limit allowed on the site would be 2 curies of plutonium-239. However, a more realistic isotopic breakdown of the 2-curie limit would be 1 curie of plutonium, 0.5 curie of uranium, and 0.5 curie of all other radioactive materials (for example, plutonium-241).

- If experimental operations were initiated at the proposed ACRSL facility, the radiological hazard would be dominated by the plutonium inventory in a glove box where samples would be prepared. There would also be a fume hood where experiments would occur over a long timeframe (several years) that may contain many millicurie-size samples. The general plan would be to bring in, for example, 1 curie of plutonium into the glove box, separate it into millicurie-size samples, and transfer the millicurie-size samples to other locations for the experiments when needed. The plutonium would be a nitrate solution, but there also may be a need for certain solid-state experiments. Some plutonium metal may be brought in. Other solid-state plutonium may be in the form of precipitates that form in solutions in certain experiments.

- The proposed ACRSL facility would be constructed to be consistent with, or greater than, Uniform Building Code seismic criteria. It would be a single-story, all-steel structure with a concrete floor.

- There would be no radioactive releases to the sanitary sewer. All potentially radioactive liquids would be collected in carboys beneath lab sinks, dried, and disposed of as low-level waste. The proposed ACRSL facility would be provided with evaporation, precipitation, and filtration capabilities for the purpose of drying the potentially contaminated solutions collected from sink drains.

- No airborne emissions above regulatory limits would be expected from the proposed ACRSL facility due to physical and administrative barriers. All exhaust airflows would have double-HEPA filters at a minimum. The glove box would also be provided with a local HEPA filter in its exhaust so this would receive a triple-HEPA-filter treatment before discharge to the environment. The high-activity fume hood would also be provided with a local HEPA filter.

- The CEMRC is currently a conditionally exempt hazardous material facility. For this to continue with the addition of the proposed ACRSL facility, the CEMRC could possess quantities of hazardous materials up to EPA threshold quantities as listed in 40 CFR 355. The current hazardous chemical inventory at the CEMRC is shown in Table B-1 of Appendix B. The future combined inventory for both the proposed ACRSL facility and the existing CEMRC facility would be no more than twice the current CEMRC inventory. The largest single container of any chemical in stock would be 3.8 liters (1 gallon).

- Standard industrial hygiene practices would be implemented in the proposed ACRSL facility, including flammable chemical storage in special cabinets and separation of acids and bases. The CEMRC would be audited by the State to ensure these practices were adequate to protect workers and control chemical hazards.

- The proposed ACRSL facility would be provided with fire protection systems that comply with National Fire Protection Association requirements. These systems would include fire suppression systems (for example, local fire extinguishers and a wet pipe sprinkler system) and detection systems (for example, smoke and flame detectors in lab rooms, hallways, and ventilation ductwork). There would also be fire barriers between rooms. The proposed ACRSL building would be constructed with noncombustible materials (that is, all metal walls and a concrete floor).

- Criticality would not be credible because of the 2-curie limit.

- Occupational doses for the CEMRC staff are estimated to be less than 100 mrem per year to the maximally exposed worker. To date, none of the CEMRC personnel has recorded a dose. Each quarter, the CEMRC performs a survey of dose rates and lab smears to identify potential problems. Currently, CEMRC personnel do not wear personnel dosimeters because the dose rates are so low and the quarterly checks confirm the low dose rates. However, they would restart the dosimetry program if the additional radioactive material were received for the proposed ACRSL facility. This would include personnel dosimeters, urine bioassay, and lung whole-body counting. There also would be continuous air monitors in rooms with high activity in the proposed ACRSL facility such as the glove box room and the high-activity fume hood.

Based on the above information and the proposed ACRSL facility description provided in Chapter 2, the hazard analysis in Table 4-1 was developed. As shown, for all of the key hazards associated with the radiological and chemical materials in the facility, at least one mitigation measure is available to either control the frequency of occurrence or the consequences of potential accidents that could result from the presence of the hazard.

Table 4-1. Preliminary Hazard and Accident Identification

Hazard	Potential Accident	Mitigation
Kinetic/potential energy	Lab container dropped, struck by other object, container breaks and spill occurs	-Only small quantities (millicuries) of radioactive material would be handled outside containment (glove box, fume hood) -All lab areas would have minimum double-HEPA filtration
	Shipping container dropped, breaks open, releases contents (inside or outside the facility)	-Container integrity – radionuclides would be received in certified transportation containers -All lab areas would have minimum double-HEPA filtration -Operating procedures
Leakage	Loss of air balance in glove box or fume hood expels radioactive material into room	-Consequences would be small because experiments involve small quantities (millicuries) of radioactive material -Continuous air monitors would be used in rooms with high activities -Air balance (negative air pressure maintained) -Use of personnel dosimetry, bioassay, whole body counting -Use of personnel protective equipment (e.g., eye protection)
Thermal energy	Fire in glove box	-Fire detectors in glove box, ductwork -Non-combustible construction -Local fire extinguishers, trained operators
	Fire in Lab Room	-Fire detectors -Fire barriers between rooms -Non-combustible construction -Wet-pipe sprinkler system -Flammable chemical storage
	Hot exposed surface burns personnel	-Operator procedures and training -Thermal sources insulated or access restricted
	Site-wide fire	-Non-combustible construction -Fire Department response
Chemical reactions	Explosion	-Separate storage cabinets for acids and bases would be used -Use of a chemical information system to identify chemical incompatibilities when ordering -Operator training/accreditation -Use of personnel protective equipment (e.g., eye protection)

Table 4-1. Preliminary Hazard and Accident Identification (continued)

Hazard	Potential Accident	Mitigation
Chemical reactions (continued)	Mixing error leads to inadvertent chemical reaction	-Use of a chemical information system to identify chemical incompatibilities when ordering -Operator procedures and training -Use of small quantities at any one time would limit energy release
Toxic chemical	Toxic chemical spill into sanitary sewer	All potentially contaminated lab sinks would drain into carboys; no direct connection to sanitary sewer
	Chemical spill contaminates personnel	-Use of a chemical information system to identify incompatibilities, toxicity, container requirements, etc. -Use of personnel protective equipment -Availability of lab showers -Operator procedures and training
	Chemical spill leads to offsite release	-Use of hazardous chemical quantities less than EPA threshold quantities, limits offsite exposures -Use of a chemical information system to identify incompatibilities, toxicity, container requirements, etc.
Nuclear reaction	Inadvertent criticality	Not possible - less than minimum critical mass allowed in facility
External penetrating radiation	Personnel overexposure	-Low radiation dose rates limit the potential for overexposure -Personnel dosimeters, bioassay program, whole-body counters -Quarterly dose rate measurements
Radioactive contamination	Personnel receives external contamination	-Quarterly lab smears -Personnel dosimeters, bioassay program, whole body counters
Electrical energy	Personnel receives electrical shock	-Installation of standard electrical protection, such as insulated high-voltage sources, grounded outlets, etc. -Operator training
Seismic event	Seismic event causes spill	-Building structures and heating, ventilation, and air conditioning systems designed to Uniform Building Code seismic event -Glove box supported in accordance with Uniform Building Code criteria -Minimum double-HEPA filtration; local HEPA filter at glove box and high-activity fume hoods
	Seismic event causes building collapse	-Building structures and heating, ventilation, and air conditioning systems designed to Uniform Building Code seismic event -Glove box supported in accordance with Uniform Building Code criteria -Inventory limits control offsite radiation doses and chemical exposures -Chemicals stored in cabinets that limit upsets, releases

4.2.1.1 Radiological Impacts

A bounding analysis was conducted to illustrate the potential consequences that could result from a release of radioactive material from the proposed ACRSL facility. This bounding analysis was based on atmospheric dispersion data from both SEIS-II (DOE 1997) and the LANL SWEIS (DOE 1999). The following equation was used to calculate the radiological consequences:

Dose (TEDE) = Release * E/Q * Breathing Rate * DCF

where:

TEDE	=	Total effective dose equivalent (rem)
Release	=	Release quantity (curies)
E/Q	=	Time-integrated atmospheric dispersion where the receptor is located (seconds per cubic meter)
Breathing rate	=	0.00033 cubic meter per second
DCF	=	Dose conversion factor (rem per curie)

The input values for each of these parameters are discussed below.

Release. For this bounding assessment, it was conservatively assumed that the entire 2-curie inventory of radioactive material would be released from the proposed ACRSL facility. It was further assumed that the entire release would be plutonium-239, although release of this quantity of material from the building would not be possible given the administrative controls and physical barriers in place designed to prevent such an occurrence. Furthermore, it was assumed the entire release quantity is dispersible and consists of respirable-size particles. This is also conservative, given that much of the plutonium in the facility would be in a liquid form and not respirable.

E/Q. Atmospheric dispersion factors for the CEMRC and WIPP sites were taken from SEIS-II (DOE 1997) and amount to 0.00065 second per cubic meter for both the offsite public and noninvolved workers. These values were used for both the Proposed Action and the WIPP Alternative because no E/Q values for the existing CEMRC site were available. For LANL, the E/Q values are 0.00065 second per cubic meter for the public MEI and 0.0014 second per cubic meter for the noninvolved worker (DOE 1997).

Breathing Rate. The breathing rate used in the analysis was 0.00033 cubic meter per second. This rate is representative of a typical acute breathing rate (light activity) and was taken from the International Commission on Radiological Protection Publication 23 (1975).

Dose Conversion Factor. The dose conversion factor for plutonium-239 (0.000116 Sievert per becquerel) was taken from *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion* (EPA 1988).

Table 4-2 presents the results of this bounding analysis for all three alternatives as bounding approximations of the potential exposure for the proposed ACRSL facility. As shown, the total dose to the maximally exposed member of the public and noninvolved worker at the CEMRC or WIPP sites from a release of the entire inventory of plutonium at the facility would be about 18 mrem. Using a standard dose-to-health-effects conversion factor of 0.0005 latent cancer facility per rem, the probability of this MEI contracting a fatal cancer is about 0.00001 or one chance in 100,000. Based on the air dispersion factors used for CEMRC and WIPP, there would be no public health impact from this conservative release scenario at the proposed ACRSL facility.

As shown in Table 4-2, the impacts to the public MEI under the No Action Alternative would be the same as those under the Proposed Action and WIPP Alternative because the E/Q values are the same. The noninvolved worker impacts would be slightly higher under the No Action Alternative than under the WIPP Alternative because the noninvolved worker at LANL would be located closer to the facility than would the noninvolved worker at WIPP. The noninvolved worker at the proposed ACRSL facility at the CEMRC would be located at the same distance from the facility as the noninvolved worker at WIPP;

therefore, there would be no difference in impacts. However, no incremental latent cancer fatalities are anticipated for the LANL noninvolved workers and thus are not anticipated for noninvolved workers at the proposed ACRSL facility at the CEMRC.

Table 4-2. Results of Radiological Accident Impact Analysis

	Release (Ci Pu-239)	E/Q (sec/m^3)	Breathing Rate (m^3/sec)	Dose Conversion Factor (Sv/Bq)	Unit Conversion		Total Effective Dose Equivalent	
					(Bq/Ci)	(rem/Sv)	(rem)	(mrem)
Proposed Action (CEMRC) and WIPP Alternative								
MEI and noninvolved worker	2	0.000650	0.000330	0.000116	37 billion	0.0100	0.0184	18
No Action Alternative (LANL)								
MEI	2	0.000650	0.000330	0.000116	37 billion	0.0100	0.0184	18
Noninvolved worker	2	0.00140	0.000330	0.000116	37 billion	0.0100	0.0397	40

4.2.1.2 Hazardous Chemical Impacts

Estimates of the noncarcinogenic consequences of exposure to potentially hazardous chemicals are made by comparing air concentrations found in the Emergency Response Planning Guidelines. For many chemicals, such guidelines have not yet been developed. Instead, DOE has supported the development of Temporary Emergency Exposure Levels (TEELs) that provide interim, temporary, or equivalent exposure limits until Emergency Response Planning Guidelines' limits are developed (Craig 2000). Descriptions of the various TEEL levels are provided below.

- *TEEL-0:* The threshold concentration below which most people will experience no appreciable risk of health effects.
- *TEEL-1:* The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.
- *TEEL-2:* The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.
- *TEEL-3:* The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing life-threatening health effects.

For hazardous chemical impacts, the concentrations of the chemicals at the MEI receptor locations were calculated and compared to the appropriate TEEL level (that is, 0, 1, 2 or 3) using the following equation:

$$\mathbf{TEEL_f} = \frac{\mathbf{E/Q \times Rate}}{\mathbf{TEEL\text{-}X}}$$

where:

$TEEL_f$	=	Fraction of the TEEL-X level, an indicator of the potential noncarcinogenic impact from exposure to polychlorinated biphenyls
E/Q	=	Time-integrated atmospheric dispersion factor where the receptor is located (seconds per cubic meter)
Rate	=	Source term release rate (milligrams per second [assumed to be released over 2-hour period or 7,200 seconds])
TEEL – X	=	Appropriate TEEL level (milligrams per cubic meter)

The hazardous chemicals of interest to this assessment were taken from a recent inventory of chemicals at the CEMRC facility (see Table B-1 in Appendix B). As stated previously, the estimated hazardous chemical inventory for the ACRSL facility would be no more than double the current inventory at the CEMRC facility. Thus, the existing CEMRC facility inventory represents the incremental chemical inventory required to support the ACRSL facility at the CEMRC. This would also represent the incremental inventory required to support the WIPP and LANL alternatives. The chemicals evaluated here were those that have threshold-planning quantities as defined in 40 CFR 355, *Emergency Planning and Notification*. The other chemicals listed in Table B-1 were not evaluated further. However, researchers at the proposed ACRSL facility would be trained in the proper storage, handling, and use of all of these chemicals.

The results of the hazardous chemical impact calculations for the proposed ACRSL facility are shown in Table 4-3 for a hypothetical, conservative release scenario that affects the entire inventory of each chemical. As shown, none of the chemical concentrations exceeded TEEL-3, which indicates that no life-threatening health effects are anticipated. The concentration of one chemical, nitric acid, approaches the TEEL-2 concentration (that is, it is near the concentration at which the exposure could impair a person's ability to take protective action). The other chemicals are all less than one-half of the TEEL-2 value and would not be expected to affect a person's ability to take protective action.

Table 4-3. Results of Hazardous Chemical Impact Analysis for All Three Alternatives

Chemical Name	Concentration (mg/m^3)	Fraction of TEEL Levels			
		TEEL-0	TEEL-1	TEEL-2	TEEL-3
Acetic acid, glacial	0.51	0.021	0.014	0.0060	0.0042
Acetone	3.7	0.0021	0.0016	0.00018	0.00018
Hydrochloric acid (concentrated)	10	14	2.3	0.34	0.046
Hydrofluoric acid	0.57	0.35	0.35	0.035	0.014
Hydroquinone	0.045	0.023	0.0075	0.0045	0.00090
Lactic acid	0.056	0.0038	0.0014	0.00019	0.00011
Mercurous chloride	0.0090	0.36	0.12	0.090	0.00090
Nitric acid (concentrated, reagent)	13	4.9	4.9	0.98	0.24
Nitric acid (fuming)	0.34	0.13	0.13	0.026	0.0066
Sulfuric acid	3.3	3.3	1.7	0.33	0.11

The concentrations calculated in Table 4-3 were based on a hypothetical, bounding scenario that affects the entire inventory of each chemical. Such a scenario would require a large event such as a fire or severe earthquake, which would involve multiple rooms. Although the total quantities of some of the chemical inventories may be relatively large (for example, 93 liters [25 gallons] of nitric acid), they would be received and moved around the facility in much smaller quantities. The largest container of any chemical would be 3.8 liters (1 gallon). Consequently, an accidental release of such a chemical would most likely

not involve the entire inventory but rather a small fraction of the inventory that represents, at most, a few containers. Therefore, the results presented in Table 4-3 are extremely conservative.

In addition, an accident scenario that involves the entire inventory of a chemical in the facility would not be credible. This judgment was made based on the provided fire protection systems (including fire detection and suppression systems and fire barriers between rooms), chemical storage requirements, non-combustible facility construction, and seismic design requirements. These and other accident mitigation measures would prevent a facility-wide accident from releasing hazardous chemicals from multiple locations. Therefore, it was determined that a facility-wide accident scenario was not credible. Nonetheless, the impacts of such an event were calculated to illustrate the effects of such an event.

A conservative bounding analysis was conducted to illustrate the potential consequences that could result from an offsite release of hazardous chemicals from the proposed ACRSL facility. This bounding analysis was based on atmospheric dispersion data from both SEIS-II (DOE 1997) and the LANL SWEIS (DOE 1999). If the existing laboratory at LANL were used, the public MEI consequences would be identical to those for a new laboratory located at WIPP because the chemical inventories would be the same, and the E/Q for the public MEI at LANL is the same as the E/Q at WIPP. For the noninvolved worker, the E/Q is slightly higher than at WIPP, as discussed earlier. The noninvolved worker consequences at LANL would be equivalent to the consequences shown in Table 4-3 multiplied by the ratio of E/Q values, or about 2.1 (0.0014/0.00065). Even under these conditions, no life-threatening health effects would be anticipated (all concentrations would be less than TEEL-3), and only nitric acid concentrations would exceed the TEEL-2 concentration. Thus, no health effects would be anticipated from a release of hazardous chemicals at the proposed ACRSL facility using the extremely conservative bounding analysis results for the LANL and WIPP sites.

4.2.2 Alternative at WIPP

Based on the conservative bounding analysis results using atmospheric dispersion data from SEIS-II (DOE 1997) for both radiological materials and hazardous chemicals described in Section 4.2.1 for the Proposed Action, no health effects would be anticipated from operation of a new actinide chemistry laboratory at WIPP. The results of the bounding analysis for WIPP are presented for radiological materials in Table 4-2 and for hazardous chemicals in Table 4-3. This assumes a new actinide chemistry laboratory at WIPP would have inventories of radiological materials and hazardous chemicals equivalent to those described above for the Proposed Action.

4.2.3 No Action Alternative at LANL

Based on the conservative bounding analysis results using atmospheric dispersion data from the LANL SWEIS (DOE 1999) for both radiological materials and hazardous chemicals described for the Proposed Action, no health effects would be anticipated for continuation of actinide chemistry experiments at the Radiochemistry Building (TA-48-1) at LANL. The results of the bounding analysis for LANL are presented for radiological materials in Table 4-2 and for hazardous chemicals in Table 4-3. This evaluation only includes the types of actinide chemistry experiments at the Radiochemistry Building (TA-48-1) that are described for the Proposed Action; it does not include other experimental programs that may be conducted in the same building. Thus, it assumes inventories of radiological materials and hazardous chemicals would be equivalent to those described above for the Proposed Action.

4.3 LAND USE

This section describes the potential land use impacts as a result of the three alternatives evaluated.

4.3.1 Proposed Action at CEMRC

Under the Proposed Action for a new laboratory at the CEMRC, impacts on land use would be minimal. The new laboratory would be constructed adjacent to the existing CEMRC building on land that was previously disturbed during the original construction of the CEMRC. The proposed ACRSL facility would make use of existing CEMRC support facilities (for example, meeting rooms, administrative offices, reception area, and parking), so no additional land would be required for these support facilities.

4.3.2 Alternative at WIPP

Under the alternative for a new actinide chemistry laboratory at WIPP, the impacts on land use would be minimal. The most likely location for this new laboratory would be in the northeast corner of the WIPP site inside the fence (see Figure 2-1), which is not currently in use and has been dedicated for use by facilities supporting WIPP. The surface area that would be required for laboratory construction under this alternative would be larger than that required under the Proposed Action because the new laboratory would need to include facilities for meeting rooms, administrative offices, and a reception area.

4.3.3 No Action Alternative at LANL

No land use impacts would occur under the No Action Alternative, which would involve continued use of the existing Radiochemistry building (TA-48-1) at LANL for actinide chemistry experiments. Use of the Radiochemistry building for actinide chemistry experiments would be consistent with the land use for other laboratories in the LANL area.

4.4 GEOLOGY AND HYDROLOGY

This section describes the potential impacts to surface geology and hydrology as a result of the three alternatives evaluated.

4.4.1 Proposed Action at CEMRC

Under the Proposed Action for a new laboratory at the CEMRC, impacts on the surface geology or hydrology due to construction would be minimal. There would be a very minor impact to the surface geology due to construction of the proposed laboratory on an area of about 725 square meters (7,800 square feet). Because the proposed laboratory would make use of existing CEMRC support facilities (for example, meeting rooms, administrative offices, reception area, and parking), no additional impacts would occur to the surface area.

4.4.2 Alternative at WIPP

Under the alternative for a new actinide chemistry laboratory at WIPP, impacts on the surface geology or hydrology due to construction would be minimal. There would be a minor impact to the surface geology due to construction of the proposed laboratory. The surface area required for the laboratory construction under this alternative would be greater than that for the Proposed Action because the new laboratory would need to include facilities for meeting rooms, administrative offices, and a reception area.

4.4.3 No Action Alternative at LANL

No impacts on the surface geology or hydrology would occur under the No Action Alternative. No disturbance to the surface geology would be required because this alternative would involve continued use of the existing Radiochemistry building (TA-48-1) at LANL for actinide chemistry experiments.

4.5 BIOLOGICAL RESOURCES

This section describes the potential impacts to biological resources as a result of the three alternatives evaluated.

4.5.1 Proposed Action at CEMRC

Construction and maintenance of the ACRSL at the CEMRC would have little biological impact. The facility would be constructed on previously disturbed land. Previous surveys of the CEMRC site have found no threatened or endangered species at the site. The arroyos bordering the site are well vegetated, and great care would be taken during construction to ensure the plants were not disturbed.

4.5.2 Alternative at WIPP

Construction and maintenance of a new actinide chemistry laboratory within the fenced area of the WIPP site would have little impact on the biological resources. There have been no endangered or threatened species observed within the WIPP boundaries during DOE-conducted surveys over the past several years (DOE 1997).

4.5.3 No Action Alternative at LANL

Under the No Action Alternative, no construction would take place and the biological environment would remain unchanged. Therefore, no new impacts to biological resources would occur.

4.6 CULTURAL RESOURCES

This section describes the potential impacts to cultural resources as a result of the three alternatives evaluated.

4.6.1 Proposed Action at CEMRC

As discussed in Section 3.4.1, a cultural resources survey conducted at the CEMRC (DOE 1995c) did not locate any prehistoric or historic properties. Based on the documented absence of cultural resource sites at the CEMRC property, construction of the ACRSL would have no impact to cultural resources.

4.6.2 Alternative at WIPP

The northeast corner of the fenced area has been previously disturbed by construction activities and was found to not have any cultural resources present prior to that disturbance. Therefore, construction of the new ACRSL at this area of the WIPP site would have no impact to cultural resources.

4.6.3 No Action Alternative at LANL

Under the No Action Alternative, conducting experimental activities in actinide chemistry would continue at the LANL Radiochemistry Building (TA-48-1). Although this particular building has not yet been formally recorded and evaluated for eligibility in the National Register of Historic Places by the LANL Cultural Resources Management Team, continued laboratory use without structural modifications would have no adverse effect on its pending evaluation as a historic property.

4.7 SOCIOECONOMIC RESOURCES

This section describes the potential socioeconomic impacts as a result of the three alternatives evaluated.

4.7.1 Proposed Action at CEMRC

Under the Proposed Action, the ACRSL facility would be administered as an integrated program of the CEMRC. Consolidated operations at the CEMRC site would potentially increase the efficacy of the WIPP experimental program at a reduced cost to DOE. Long- and short-term research projects could be performed by research entities identified by CBFO, with the CEMRC facilitating these projects under its operations and maintenance contract with DOE.

Carlsbad, New Mexico, located in Eddy County, is considered the affected region when analyzing the socioeconomic impacts from the construction and operation of the ACRSL facility. Potential socioeconomic impacts were projected for the design, construction, and operations phases of the capital project. During the design and construction phases of the project, local economic impacts are considered relative to employment and earnings in specific industries (for example, construction, lodging, and restaurants) and in use of additional public goods and services (for example, roads and highways, hospitals, schools, and universities). Managerial economic impacts are considered relative to the potential cost-savings to DOE during the operations phase of the project, which would include consolidation of research activities and reduction in outsourcing and administrative costs. Project cost information was provided by CEMRC (2000).

4.7.1.1 Local Economic Impacts

Construction of the ACRSL facility would represent a modest capital investment towards expanding CEMRC research activities to meet current and future needs involving experiments by various DOE contractors. Project engineers have provided scheduling and budget information relating to the facility design, construction, and operations at the CEMRC site (all cost figures are measured in 2000 dollars).

ACRSL Facility Construction

The total budget for construction activities is estimated to be $3,634,937, as summarized in Table 4-4. The projected total cost includes site work, construction, construction contingency, major fixed and movable building equipment, minor movable equipment and furnishings, fees, salary, fringe benefits, domestic travel, and facility and administrative costs.

Construction could be completed within about 18 months of the completion of design activities, award of funding by DOE, and acceptance by New Mexico State University.

Based on scheduling and budget information provided by project engineers, the total estimated costs for the design and construction phases would be $4.2 million spread over a 32-month period. This level of capital spending would have negligible effects on the demand for goods and services within the local Carlsbad economy, when compared to numerous larger construction projects by DOE in the Carlsbad area such as WIPP. At the same time, construction of the ACRSL facility at the CEMRC site would require few additional workers and would have only a very minor, positive, short-term impact on employment and earnings in the local economy. Similarly, design and construction of the facility would not be expected to have any significant impacts on public goods or services in Carlsbad or the surrounding community.

Table 4-4. Budget for Construction

Category	Cost (in dollars)
CEMRC Project Support	
Professional salary	85,631
Fringe benefits @ 27%	23,120
Domestic travel	4,000
Facility & administrative costs @ 26%	29,316
Subtotal	*142,067*
Construction Costs	
Building cost at $250/gross square feet (7,800 square feet)	1,950,000
Major fixed and movable building equipment @ 35% building cost (e.g., fume hoods, glove boxes etc.)	682,500
Land cost	0
Site costs (e.g. parking lots, utilities, landscaping)	200,000
Construction contingency @ 10% building costs	195,000
State of New Mexico gross receipt tax (6.8%)	205,870
Subtotal	*3,233,370*
Other Costs	
Minor movable equipment and furnishing costs @ 10% building costs	195,000
Miscellaneous allowances @ 3% building/site costs (e.g., relocation cost, legal fees, etc.)	64,500
Subtotal	*259,500*
Total	**3,634,937**

ACRSL Facility Operation

The estimated budget for operating and maintaining the ACRSL facility at the CERMC site is $2,870,194, as summarized in Table 4-5. The CEMRC would operate the facility as a multi-user research laboratory to support the WIPP experimental program under a contract from DOE, providing basic usage coordination, physical plant operation, and environmental, safety, and health management. The analysis assumes a 5-year period of performance. Proposed funding levels for operations of the ACRSL facility at the CEMRC site are under $600,000 per year. Operating costs and staff salaries are assumed to increase by 1 percent and 2 percent, respectively, in each year. Annual budgets are based on actual operating costs for the CEMRC during FY1998 through FY2000. These costs were conservatively determined and based on historical costs of CEMRC operations, making adjustments for building size (in square feet) and accounting for the fact that the proposed ACRSL facility would be more costly to operate on a square-foot basis. The amount of laboratory space in the proposed ACRSL would be very similar to that currently in operation at the CEMRC. One assumption in estimating the operating costs for the ACRSL was that the non-laboratory space at the current CEMRC contributes minimally to historical operating costs.

Based on the budget information provided by project engineers in December 2000, the annual operating costs for the proposed ACRSL facility would have negligible impacts on the demand for goods and services in the local economy. Operations of the facility would have only a very minor, positive impact on local employment opportunities, as most administrative staff are employed at the CEMRC and some of the proposed fifteen permanent research staff are already situated in the Carlsbad area. Most of the research staff would consist of personnel on long-term assignments from LANL, Sandia National

Table 4-5. Annual Operating Cost for the ACRSL

Category	Cost (in dollars)					
	FY2004	**FY2005**	**FY2006**	**FY2007**	**FY2008**	**Total**
Minor building equipment replacement	6,000	6,060	6,121	6,182	6,244	30,606
Environmental health and safety management	20,000	20,200	20,402	20,606	20,812	102,020
Building-related maintenance and service contracts	50,000	50,500	51,005	51,515	52,030	255,050
Insurance	100,000	101,000	102,010	103,030	104,060	510,101
Building-related office and non-office supplies	25,000	25,250	25,503	25,758	26,015	127,525
Chemical reagents	25,000	25,250	25,503	25,758	26,015	127,525
Communications	15,000	15,150	15,302	15,455	15,609	76,515
Utilities	64,000	64,640	65,286	65,939	66,599	326,464
Custodial and pest control services	12,000	12,120	12,241	12,364	12,487	61,212
Professional and technical staff salary	100,000	102,000	104,040	106,121	108,243	520,404
Fringe benefits @ 27%	27,000	27,540	28,091	28,653	29,226	140,509
Subtotal	*444,000*	*449,710*	*455,503*	*461,379*	*467,340*	*2,277,932*
Facility and administrative cost @ 26%	115,440	116,925	118,431	119,958	121,508	592,262
Total	**559,440**	**566,635**	**573,933**	**581,337**	**588,849**	**2,870,194**

Laboratories, and the Westinghouse TRU Solutions, LLC, who would probably reside permanently in Carlsbad. Some staff would consist of personnel on short-term assignments from other DOE laboratories, other federal agencies, American university or companies, or foreign governments, universities, or companies. These personnel would probably not reside permanently in Carlsbad. The total long- and short-term staff would comprise between fifteen and twenty-five people. Thus, the operations phase of the project would only have very minor, positive impacts on the income levels in the local economy. Facility operations would not be expected to have any significant impacts on public goods or services.

4.7.1.2 Potential Managerial Economies to DOE

In the past, research activities involving actinide chemistry have been performed at LANL, Argonne National Laboratory, Florida State University, and Pacific Northwest National Laboratory. Now, with the exception of the LANL location, WIPP has ended experiments at other sites. DOE has determined that it will be much more efficient and cost-effective to consolidate these activities in a local Carlsbad facility that does not present the difficulties inherent with the distances currently involved or the security requirements at laboratories that primarily perform weapons-related work. Operating the ACRSL facility at the CERMC would consolidate the WIPP experimental program in Carlsbad, New Mexico, and offer DOE a potential cost-savings as compared to current mechanisms for funding the WIPP experimental programs (that is, consolidation of research activities and reduction of outsourcing and administrative costs). These and other potential benefits are examined below.

Consolidation of Research Activity

The proposed ACRSL would be built contiguous to the existing CEMRC facility and make use of existing facility infrastructure and staff support (for example, land, access road, parking, fiber optic line, utilities, meeting rooms, administrative offices, low-level laboratories, and reception area). Operating

costs for the ACRSL would also be minimized through the support of the CEMRC administrative infrastructure (for example, director, fiscal specialist, buyer, computer technicians, etc.) as a continuing direct cost under an existing grant. By leveraging these resources, project engineers estimate the size requirements of the ACRSL would decrease by approximately 50 percent and reduce project costs by approximately $2 million over construction elsewhere where these existing resources were not available (that is, the WIPP Alternative).

Reduction of Outsourcing and Administrative Costs

Ignoring construction cost, the annual operating and research costs of the ACRSL would be approximately $5.6 million, which compares favorably to annual outsourcing costs over the past 5 years ($8 million per year on actinide chemistry support for the WIPP experimental program). Based on the current and projected needs of the WIPP experimental program, these potential cost savings would continue throughout the operations phase of the project and in the "out years" beyond FY2008. Thus, during the operational phase, the CEMRC estimates a cost savings of some $12 million over the 5-year period as compared to operational costs at national laboratories. Although such comparisons are difficult because of ever-changing scope (when compared to the past), this cost comparison was conducted using the projected staffing data provided by local offices at Sandia National Laboratories and LANL. The annual operating cost was primarily based on the staffing plan (for example, number of full-time equivalents) for the proposed ACRSL using loaded rates for the Sandia National Laboratories and LANL staff.

4.7.2 Alternative at WIPP

This section describes the potential socioeconomic impacts under the WIPP Alternative, as the result of construction and operation of a new actinide chemistry laboratory at the WIPP site in Carlsbad. Construction costs under this alternative would be relatively higher than the construction cost estimates described under the Proposed Action. Operations costs under the WIPP Alternative would also differ from the Proposed Action because the new actinide chemistry laboratory would require employment of a new set of laboratory administrators. Although there would be insignificant local economic impacts under this alternative, DOE could potentially experience relatively higher managerial and programmatic costs over the various phases of the project. These impacts are described below.

4.7.2.1 Local Economic Impacts

Compared to the Proposed Action, the design and construction of a new actinide chemistry laboratory at the WIPP site represent a larger capital project. Laboratory construction under this alternative would require infrastructure that would not be required under the Proposed Action. The additional infrastructure required at the WIPP site would include fiber optic line, utilities, meeting rooms, administrative offices, and a reception area. Nonetheless, the level of capital spending represents a minor capital investment in the local economy and would not have a significant impact on the demand for goods and services in the Carlsbad community.

Design and construction of a new actinide chemistry laboratory at the WIPP site would require few additional workers and would have insignificant impacts on employment and earnings in the local economy. Similarly, the design and construction of the facility would not be expected to have any significant impacts on public goods or services in Carlsbad or the surrounding community. Operations of a new actinide chemistry laboratory at the WIPP site would also have insignificant impacts on local employment opportunities, as most administrative and research staff are already situated in the Carlsbad area. Thus, the operations phase of the project would have insignificant impacts on the employment base or income levels.

4.7.2.2 Potential Managerial Economies to DOE

As described earlier, research activities involving actinide chemistry have recently been performed at several separate laboratories around the country. Thus, operating a new actinide chemistry laboratory facility at the WIPP site would help centralize the WIPP experimental program in Carlsbad, New Mexico, and offer DOE a potential cost-savings as compared to the existing WIPP experimental program. However, the administrative costs of managing the facility would tend to increase, relative to the Proposed Action, because DOE would not be leveraging existing infrastructure and human resources to the same degree. Also, DOE would potentially lose the benefits of having a simplified licensing mechanism for the facility and the programmatic cost advantages offered by the CEMRC.

4.7.3 No Action Alternative at LANL

Currently, the actinide chemistry experiments are conducted in the Radiochemistry Laboratory (TA-48-1). The existing laboratory facility was designed as an actinide chemistry and metallurgy building, with full capabilities for performing special nuclear material analytical chemistry and materials science. Consequently, this alternative does not require additional construction or operations costs and would not pose additional socioeconomic impacts for the Los Alamos community. Nonetheless, the No Action Alternative could potentially result in higher managerial and programmatic costs as compared to the Proposed Action, as described below.

Research activities involving actinide chemistry have recently been performed at several separate laboratories around the country, including LANL. Through continuation of these experiments at the LANL site, the WIPP experimental program would remain decentralized. As compared to the Proposed Action, the WIPP experimental program would continue to experience the burden of coordinating research activities and the attendant outsourcing costs.

4.8 AIR QUALITY

This section describes the potential air quality impacts as a result of the three alternatives evaluated.

4.8.1 Proposed Action at CEMRC

If a new laboratory were constructed at the CEMRC, there would be: (1) local, temporary degradation of air quality during construction of the new ACRSL; (2) small amounts of air emissions associated with the operation of heating and cooling equipment (for example, emissions of carbon monoxide, nitrogen oxides, hydrocarbons, sulfur oxides, and particulates); and (3) emissions of low levels of hazardous air pollutants. Temporary construction-related air quality degradation would be the primary air quality impact. However, it would be of short duration, limited to daytime construction hours, and confined to the general area of construction, although on windy days dust and PM_{10} emissions could be mobilized and transported beyond the immediate construction area. Construction-related emissions would vary from day to day, depending on the level of construction activity, specific operation, and weather. Air emissions from heating and cooling equipment during operation of the facility would be minor, similar to those from a small cluster of houses. Emissions of hazardous air pollutants would be within the limits established by existing regulations.

Appendix A of the CEMRC EA (DOE 1995c) discusses the air quality investigations, including the methodology, calculations, and estimates of emission rates, that were conducted and submitted to the New Mexico Environment Department Air Quality Bureau for informal review prior to construction of the CEMRC. These investigations included the primary effects from construction and other effects from heating and cooling equipment and from hazardous air pollutant emissions. The New Mexico

Environment Department accepted the results based on "worst case assumptions" and concluded that there would be no need for the CEMRC to seek an air quality permit. In addition, because anticipated emission levels were low, the New Mexico Environment Department concluded that computer modeling, as further substantiation of emission levels, was not warranted.

If the Proposed Action were implemented, there would be an increase in the inventory and estimated total annual use of some volatile solvents and reagents whose use would result in toxic air emissions (Appendix B provides the current chemical inventory). A conservative projection would double the estimated total annual use and, therefore, potentially double the emission rates or concentrations cited in the CEMRC EA (DOE 1995c, Appendix A, Table 2). However, the projected increase in the inventory and use rates of volatile solvents and reagents would not result in aggregate emission rates or concentrations that would require permitting under air quality regulations.

Although the CEMRC is permitted to emit very low levels of radionuclides, it has never reported any release of radionuclides to the atmosphere, and the Proposed Action would not result in any planned releases of radionuclides. Redundant HEPA filters would prevent releases of airborne radionuclides during normal operations. At a minimum, all exhaust airflows in the proposed laboratory would be treated by double-HEPA filtration. Each glove box would also be provided with a local HEPA filter in its exhaust, which would afford triple-HEPA filtration before discharge to the environment.

4.8.2 Alternative at WIPP

The WIPP Alternative would construct and operate a new laboratory that would essentially be identical to the one proposed under the Proposed Action, but it would be located about 42 kilometers (26 miles) to the southeast on the WIPP site. Because of the relative proximity of the CEMRC and WIPP, weather and ambient air quality conditions would be very similar or identical. Consequently, air quality impacts from the construction and operation of a new laboratory at WIPP would be identical to those described for construction and operation of a new laboratory at the CEMRC.

The post-construction air quality impacts from the WIPP Alternative would not represent a significant degradation in current air quality at the WIPP site. SEIS-II (DOE 1997) assessed the potential impacts, including air quality impacts, of continuing the phased development of WIPP as a geologic repository for the safe disposal of TRU waste.

4.8.3 No Action Alternative at LANL

Under the No Action Alternative, actinide chemistry experiments would continue to be conducted in the Radiochemistry Building (TA-48-1). This alternative would maintain the *status quo*; consequently, there would be no radiological or non-radiological air quality impacts above those currently occurring at LANL. The LANL SWEIS (DOE 1999) provides an analysis of the environmental impacts, including air quality impacts, resulting from ongoing and reasonably foreseeable new operations and facilities at LANL.

4.9 WASTE GENERATION AND DISPOSAL

This section describes the potential impacts on waste generation and disposal as a result of the three alternatives evaluated.

4.9.1 Proposed Action at CEMRC

The City of Carlsbad municipal waste treatment and disposal systems process 54,100 metric tons (59,600 tons) annually (NMED 2000). The projected additional 2 metric tons (2.2 tons) of solid sanitary waste that would be produced by the ACRSL would have little impact on the city's waste management system.

The quantities of hazardous and radioactive wastes at the expanded CEMRC would not pose an environmental impact. Current levels of hazardous and radioactive wastes generated at the CEMRC would double with the addition of the ACRSL. However, the new quantity and types of wastes would be well within the capabilities of commercial disposal companies already used at the CEMRC.

4.9.2 Alternative at WIPP

The additional waste that would result from the construction and operation of a new actinide chemistry laboratory at WIPP would have little environmental impact. The sanitary liquid waste treatment system at WIPP would be capable of handling the output from the actinide chemistry laboratory, and the commercial companies handling and disposing of hazardous waste from WIPP would be capable of managing the additional wastes.

4.9.3 No Action Alternative at LANL

No additional wastes would be produced should the existing laboratory at LANL continue normal operations. There would therefore be no new environmental impacts due to waste generation and disposal.

4.10 ENVIRONMENTAL JUSTICE

This section considers the potential environmental justice impacts that would result from the three alternatives evaluated. Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.

In February 1994, the President issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 Fed. Reg. 7629 (1994)). This Order directs federal agencies to incorporate environmental justice as part of their missions. As such, federal agencies are specifically directed to identify and address as appropriate disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations.

The Council on Environmental Quality has issued guidance to federal agencies to assist them with their NEPA procedures so that environmental justice concerns are effectively identified and addressed (CEQ 1997). In this guidance, the Council encouraged federal agencies to supplement the guidance with their own specific procedures tailored to particular programs or activities of an agency. DOE (2000) has prepared a draft guidance document based on Executive Order 12898 and the Council on Environmental Quality environmental justice guidance.

Among other things, the DOE draft guidance states that even for actions that are at the low end of the sliding scale with respect to the significance of environmental impacts, some consideration (which could be qualitative) is needed to show that DOE considered environmental justice concerns. DOE needs to demonstrate that it considered apparent pathways or uses of resources that are unique to a minority or low-income community before determining that, even in light of these special pathways or practices, there are no disproportionately high and adverse impacts on the minority or low-income populations. The DOE draft guidance also defines "minority population" as a demographic composition of the populace where either the minority population of the affected area exceeds 50 percent or the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population.

For this EA, DOE applied the draft environmental justice guidance to determine whether there could be any disproportionately high and adverse human health or environmental impacts on minority or low-income populations in the ROIs (see Section 3.8) as a result of the implementation of any of the alternatives analyzed. Analysis of environmental justice concerns was based on an assessment of the impacts reported in Sections 4.1 through 4.9. Although no high and adverse impacts were identified, DOE considered whether minority or low-income populations would be disproportionately affected by the alternatives.

The proportions of minority or low-income persons in the ROIs for the Proposed Action, WIPP Alternative, and No Action Alternative are greater than in the United States and the region as a whole. Thus, to the extent that some offsite impacts could occur (particularly in the unlikely event of an accident involving offsite radiological or hazardous chemical releases), the minority or low-income communities living near the proposed or existing laboratory for each alternative would be adversely affected. However, based on the analysis in Section 4.2, releases of radioactive or hazardous chemical materials from the proposed laboratory during an accident would not be expected to be sufficient to result in any public health impacts because of the very low volume of materials present.

4.10.1 Proposed Action at CEMRC

As discussed above and in Sections 4.1 through 4.9, the Proposed Action to construct and operate the ACRSL facility at the CEMRC site would not pose significant environmental justice impacts on either minority or low-income populations in the ROI.

4.10.2 Alternative at WIPP

As discussed above and in Sections 4.1 through 4.9, the alternative to locate a new actinide chemistry laboratory at WIPP would not pose significant environmental justice impacts on either minority or low-income populations in the ROI.

4.10.3 No Action Alternative at LANL

As discussed above and in Sections 4.1 through 4.9, the alternative to continue to use LANL laboratory facilities as part of the WIPP experimental program would not pose significant environmental justice impacts on either minority or low-income populations in the ROI. Also, no impacts to the general public from the existing actinide chemistry research in the Radiochemistry Building (TA-48-1) at LANL were identified in the LANL SWEIS (DOE 1999).

4.11 CUMULATIVE IMPACTS

NEPA implementing regulations require an analysis of the cumulative impacts of the proposed action. Cumulative impacts are defined as the impact on the environment that could result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. In accordance with guidance issued by the Council on Environmental Quality, a cumulative impact analysis requires the identification, through research and consultations, of federal, non-federal, and private actions that, when combined with the proposed action, could have an adverse effect on resources, ecosystems, and human communities. This section addresses the cumulative impacts under the Proposed Action for this EA (construction and operation of an ACRSL facility in Carlsbad to support actinide chemistry experiments for WIPP).

The proposed ACRSL facility would be located adjacent to the existing CEMRC laboratory and managed by the CEMRC administration for DOE. As indicated in Chapter 1, the CEMRC is equipped for the low-level measurement of actinides, fission products, activated corrosion products, and naturally occurring radionuclides, although the primary focus of the CERMC environmental chemistry program is the measurement of non-radioactive inorganic substances in various environmental media. Thus, some of the radiological research currently conducted at the CEMRC is very similar to the actinide chemistry research described in Chapter 2 for the Proposed Action, but it uses materials with much lower levels of radioactivity. As indicated in this chapter, the inventory of hazardous chemicals and radiological materials used at the CEMRC would essentially be the same as that for the Proposed Action, but the combined quantities would be increased to accommodate the research for the Proposed Action. The radiological materials inventory for both laboratories combined would be less than 2 curies. The combined hazardous chemical inventory for both laboratories would be no more than double the current inventory for the CEMRC alone.

The human health analysis in Section 4.1.1 considered the impact of the hazardous chemical and radiological material inventories for the proposed new ACRSL laboratory and concluded that there would be no impacts on worker health or the general public. Under normal operations, there would be no cumulative impacts on worker health or the general public due to the combined CEMRC and proposed ACRSL because chemical emissions from fume hoods would be extremely small and both facilities would be designed with the best available radionuclide-control technology, including HEPA filters on all fume hoods and glove boxes. No radionuclides would be released in sanitary sewage streams.

A radiation dosimetry program to monitor potential internal and external worker exposures to radioactive materials would be in place for the combined CEMRC and proposed ACRSL to help keep such exposures as low as reasonably achievable and below applicable regulatory and administrative limits in all cases. The analysis in Section 4.1.1 indicated that the highest occupational radiation dose to a staff member at the proposed ACRSL facility would be less than 100 mrem per year. This applies to both the CEMRC and proposed ACRSL combined, because it was based on the maximum permitted inventory of 2 curies. The probability of a latent cancer fatality from a 100-mrem dose to staff member would be about 0.00004 per year. The potential radiation dose to the public was also estimated based upon a maximum permitted inventory of 2 curies for both laboratories combined. Given the combined inventory of 2 curies, the dose to the population within 1.6 kilometers (1 mile) of the CEMRC/ACRSL under normal operating conditions would be less than 0.006 person-rem. There would be no latent cancer fatality expected in the exposed population on either an annual basis (less than 0.000003) or hypothetical 30-year facility lifetime (about 0.00009). In reality, the potential doses and health impacts to individuals and the surrounding population would be lower than these conservative estimates because actual operating conditions would result in lower releases.

The accident analysis in Section 4.2.1 considered the impacts of the hazardous chemical and radiological material inventories for the proposed new ACRSL laboratory, and it concluded that there would be no impacts on worker health or the general public. The concentrations calculated in Table 4-3 were based on a hypothetical, bounding scenario that would affect the entire inventory of each chemical. Such a scenario would require a large event such as a fire or severe earthquake, which would involve multiple rooms. However, doubling the inventory (to consider both laboratories combined) doubles each of the TEEL fractions in Table 4-3. Even with the increase from doubling the inventories, only one chemical (nitric acid) would exceed TEEL-2 and no chemicals would exceed TEEL-3. However, it is not considered credible that the combined inventory of nitric acid at both laboratories would be released in the same accident. As indicated in Section 4.2.1, the chemical inventories would be received and moved around the facility in small quantities, and the largest container of any chemical would be 3.8 liters (1 gallon). Given the administrative and physical barriers that would be in place to prevent accidents and uncontrolled releases of hazardous chemicals, an accidental release of such a chemical would most likely not involve the entire inventory but rather a small fraction of the inventory that represents, at most, a few containers. Therefore, the results presented in Table 4-3 are conservative and represent more than the maximum credible amount that would be released from an accident.

The accident analysis in Section 4.2.1 also considered the impacts of the combined radiological material inventories for both the CEMRC and the proposed new ACRSL laboratory, and it concluded that there would be no impacts to worker health or the general public. For this hypothetical, bounding assessment, it was conservatively assumed that the entire 2-curie inventory of radioactive material would be released, which is the maximum quantity permitted at the combined CEMRC and proposed ACRSL. It was further assumed the entire release would be plutonium-239, although release of this quantity of material from the building would not be possible given the administrative controls and physical barriers in place designed to prevent such an occurrence. As shown in Table 4-2, the total dose to the MEI and noninvolved worker from a release of the entire inventory of plutonium at the combined facilities would be about 18 mrem. Thus, the probability of this MEI contracting a fatal cancer is about 0.00001 or one chance in 100,000. Based on the air dispersion factors used for CEMRC, there would be no public health impacts from this conservative release scenario at the combined CEMRC and proposed ACRSL facilities.

The impacts of the Proposed Action on land use (Section 4.3.1), geology and hydrology (Section 4.4.1), biological resources (Section 4.5.1), and cultural resources (Section 4.6.1) would be expected to be very minor or nonexistent. The cumulative impacts of the CEMRC and proposed ACRSL would not be expected to be any greater, because no additional land use is planned for the CEMRC.

The cumulative impacts of the combined CEMRC and the proposed ACRSL would be expected to have a very minor, positive impact on socioeconomics in the Carlsbad area. The research grant for the CEMRC was increased from $27 to $33 million and extended from 1999 to 2008 (CEMRC 2000). When this is combined with the operating budget for the proposed ACRSL, there would be a very minor, positive impact to the Carlsbad community. As indicted in Section 4.7.1, the estimated budget for operating and maintaining the proposed ACRSL facility at the CERMC site is $2,870,194 over 5 years.

As indicated in Section 4.8.1 on air quality, a conservative projection would double the estimated total annual use of hazardous chemicals and, therefore, potentially double the emission rates or concentrations cited in the CEMRC EA (DOE 1995c, Appendix A, Table 2). However, the projected increase in the inventory and use rates of volatile solvents and reagents would not result in aggregate emission rates or concentrations that would require permitting under air quality regulations.

As indicated in Section 4.9.1 on waste generation and disposal, the quantities of hazardous and radioactive wastes at the combined CEMRC and proposed ACRSL would not pose an environmental impact. Current levels of hazardous and radioactive wastes generated at the CEMRC would double with

the addition of the ACRSL. However, the combined quantity and types of wastes would be well within the capabilities of commercial disposal companies already used at the CEMRC.

The proposed ACRSL, combined with the existing CEMRC, would be located in the vicinity of New Mexico State University, the Guadalupe Medical Center, and the Radiation Oncology Center (DOE 1995c). None of these last three facilities releases any radioactive materials. There are some chemical emissions from the chemical laboratory at New Mexico State University, but these emissions are very small as compared to the combined emissions expected from the proposed ACRSL and the CEMRC. The cumulative impacts of chemical emissions from the proposed ACRSL/CEMRC and the chemical laboratory at New Mexico State University would be essentially the same as those for the proposed ACRSL/CEMRC alone.

4.12 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The short-term uses of the proposed ACRSL facility would not result in any significant impact on long-term productivity. Except for a very minimal impact on land use from construction of the proposed ACRSL facility adjacent to the existing CEMRC laboratory, there would be no long-term impact on geology, hydrology, or biological resources.

4.13 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

The irreversible and irretrievable commitment of resources (such as land and energy) due to the Proposed Action would be minor. Impacts on land use would be minimal. The land used for construction of the proposed ACRSL would only be approximately 725 square meters (7,800 square feet) and would be located adjacent to the existing CEMRC. Because the proposed ACRSL facility at the CEMRC would make use of existing CEMRC infrastructure (for example, meeting rooms, administrative offices, reception area, and parking), no additional land would be required for these support facilities. As with any laboratory, there would be an energy commitment (for example, gas and electricity) for building heating, ventilation (including fume hoods), air conditioning, and operation of laboratory equipment. The energy commitment would be significantly reduced by use of the existing support facilities at the CEMRC, as compared to building a new facility at WIPP.

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CHAPTER 5

INDIVIDUALS AND AGENCIES CONTACTED

NEPA regulations require that federal, state, and local agencies with jurisdiction or special expertise regarding environmental impacts be consulted and involved in the NEPA process. Agencies involved include those with authority to issue permits, licenses, and other regulatory approvals. Other agencies include those responsible for protecting significant resources such as endangered species or wetlands. The individuals and agencies listed below were contacted during the preparation of this EA.

- James L. Conca
  Project Leader, Actinide Chemistry and Repository Science
  LANL Carlsbad Operations
  115 N. Main Street
  Carlsbad, NM 88220

- Magdalena Etemadi
  U.S. Fish and Wildlife Service
  New Mexico Ecological Services Field Office
  2105 Osuna NE
  Albuquerque, NM 87113

- Doris B. Garvey, Program Manager
  Site-Wide Issues Program Office
  ESH-SWI MS-M889
  Los Alamos National Laboratory
  Los Alamos, NM 87545

- Dave Kraig, ESH-17
  Environmental Health Physics
  MS J978
  P.O. Box 1663
  Los Alamos National Laboratory
  Los Alamos, NM 87545

- W. Bruce Masse
  Cultural Resources Management Team
  ESH-20, Ecology Group
  MS M887
  Los Alamos National Laboratory
  Los Alamos, NM 87545

- Jane Susan MacCarter
  New Mexico Department of Game and Fish
  Conservation Services Division
  P.O. Box 25112
  Santa Fe, NM 87504

- Daryl Mercer
  U.S. Department of Energy
  Carlsbad Field Office
  P.O. Box 3090
  Carlsbad, NM 88221

- Robert Sivinski
  New Mexico Energy, Minerals, and Natural Resources Department Forestry Division
  1220 S. St. Francis Drive, Room 112
  Santa Fe, NM 87505

- Joel Webb
  Manager of Program Development
  Carlsbad Environmental Monitoring and Research Center
  New Mexico State University
  1400 University Drive
  Carlsbad, NM 88220

CHAPTER 6

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CHAPTER 7

GLOSSARY

actinide	The 15 chemical elements with atomic numbers 89 to 103, inclusively. The group consists of actinium, thorium, protactinium, uranium, neptunium, plutonium, americium, curium, berkelium, californium, einsteinium, fermium, mendelevium, nobelium, and lawrencium.
Actinide Source-term Waste Test Program (STTP)	Program designed to measure time-dependent concentrations of actinide elements from actual, contact-handled transuranic waste immersed in brines that are chemically similar to those found in the underground formations at WIPP. The program will determine the effects of transuranic waste matrices and brine chemistry on the concentrations and behavior of actinides under WIPP bounding conditions.
aqueous	Related to water.
background radiation	Radiation from: (1) naturally occurring radioactive materials, as they exist in nature prior to removal, transport, or enhancement or processing by man; (2) cosmic and natural terrestrial radiation; (3) global fallout as it exists in the environment; (4) consumer products containing nominal amounts of radioactive material or emitting nominal levels of radiation; and (5) radon and its progeny in concentrations or levels existing in buildings or the environment that have not been elevated as a result of current or past human activities.
block group	Divisions of territory, the size of which varies according to population density, which have approximately 400 households.
brine	Water saturated or strongly impregnated with salt.
caliche	Calcium carbonate ($CaCO_3$) deposited in the soils of arid or semiarid regions.
chelating agent	A substance with molecules that can form several bonds to a single metal ion.
colloid	Very small, finely divided solids (that do not dissolve) that remain dispersed in a liquid for a long time due to their small size and electrical charge.
complexing agent	A reaction in which a metal ion and one or more anionic ligands chemically bond. Complexes often prevent the precipitation of metals.
concentration	The amount of a substance contained in a unit quantity (mass or volume) of a sample.

conservative	When used with predictions or estimates, leaning on the side of pessimism. A conservative estimate is one in which the uncertain inputs are used in the way that provides an overestimation of an impact.
contact-handled transuranic waste	Transuranic waste that does not require shielding other than that provided by its container to protect those handling it from radiation exposure. The radiation level at the outer surface of the container is specified as no more than 200 millirem per hour.
containment	Retention of a material or substance within prescribed boundaries.
critical habitat	The specific areas within the geographical area occupied by a species at the time it is listed as threatened or endangered in which are found those physical or biological features that are essential to the conservation of the species and that may require special management considerations or protection. It also includes specific areas outside the geographical area occupied by the species at the time it is listed if these areas are determined to be essential for the conservation of the species.
cumulative impacts	Those impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
curie	A unit of radioactivity equal to 37 billion (3.7×10^{10}) disintegrations per second.
decommissioning	The removal from active service of a facility.
decontamination	The removal of unwanted material (especially radioactive material) from the surface or from within another material.
dosimetry	The measurement of radiation doses. Also known as radiation dosimetry.
Eh	The ability of an environment to give or absorb electrons. A positive Eh favors oxidation, while a negative favors reduction.
environmental impact statement	A document required by the National Environmental Policy Act for proposed major federal actions involving potentially significant environmental impacts.
endangered species	Plants and animals that are threatened with extinction, serious depletion, or destruction of critical habitat. Requirements for declaring a species endangered are contained in the Endangered Species Act.
energy	The capacity for doing work.

environment	The sum of all external conditions and influences affecting the life development and, ultimately, the survival of an organism.
fission products	An element or compound resulting from the splitting of a heavy nucleus into two approximately equal parts (infrequently three parts), which are nuclei of lighter elements accompanied by the release of energy and generally one or more neutrons.
fume hood	A fume-collection device over an enclosed shelf or table, so that experiments involving poisonous or unpleasant fumes or gases may be conducted away from the experimental area.
geologic repository	A system for disposing of radioactive waste in excavated geologic media, including surface and subsurface areas of operation, and the adjacent part of the geologic setting that provides isolation of the radioactive waste in the controlled area.
glove box	A sealed box with gloves attached and passing through openings into the box, so that workers can handle materials in the box; used to handle certain radioactive and biologically dangerous materials and to prevent contamination of materials and objects.
groundwater	All subsurface water, especially that contained in the saturated zone below the water table.
habitat	The part of the physical environment in which a plant or animal lives.
heavy metal	Metallic elements with high atomic weights; (e.g., mercury, chromium, cadmium, arsenic and lead); can damage living things at low concentrations and tend to accumulate in the food chain.
HEPA filter	A high-efficiency particulate air filter capable of removing at least 99.97 percent of particles 0.3 micrometer (about 0.00001 inch) in diameter. These filters include a pleated fibrous medium (typically fiberglass) capable of capturing very small particles.
hot cell	A heavily shielded enclosure for handling and processing (by remote means or automatically) or storing highly radioactive materials.
isotope	An atom of a chemical element with a specific atomic number and atomic weight. Isotopes of the same element have the same number of protons but different numbers of neutrons. Isotopes are identified by the name of the element and the total number of protons and neutrons in the nucleus. For example, uranium-235 is an isotope of uranium with 92 protons and 143 neutrons and uranium-238 is an isotope of uranium with 92 protons and 146 neutrons.

latent cancer fatality — Death resulting from cancer that has become active after a latent period following radiation exposure. Latent cancer fatalities can be calculated for the public by using the risk conversion factor of $5x10^{-4}$ deaths per person-rem and for the worker by using the risk conversion factor of $4x10^{-4}$ deaths per person-rem.

ligand — The molecule, ion, or group bound to the central atom in a chelate or a coordination compound.

low-income population — A population where 25 percent or more of the population is identified as living in poverty.

maximally exposed individual — A hypothetical member of the public who is exposed to a release of radioactive or chemically hazardous material in such a way (by combination of location, dietary habits, etc.) that the individual will likely receive the maximum dose from such a release.

millirem (mrem) — One-thousandth of a rem (0.001 rem); see *rem.*

minority population — A demographic composition of the populace where either the minority population of the affected area exceeds 50 percent or the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population.

National Environmental Policy Act — The act designed to promote inclusion of environmental concerns in federal decision-making.

oxidation — A chemical reaction in which a compound or radical loses electrons, that is in which the positive valence is increased.

person-rem — A measure of the radiation dose to a given population; the sum of the individual radiation doses received by that population.

pH — An expression of the intensity of the basic or acid condition of a liquid; may range from 0 to 14, where 0 is the most acid and 7 is neutral.

radiation — Ionizing radiation; e.g., alpha particles, beta particles, gamma rays, X-rays, neutrons, protons, and other particles capable of producing ion pairs in matter. As used in this document, radiation does not include nonionizing radiation.

radioisotopes — An isotope that undergoes a spontaneous transformation, emitting radiation. In this document, the radioisotopes of concern include plutonium, americium, uranium, thorium, and neptunium.

radiolysis — The dissociation of molecules by radiation; for example, a small amount of water in a reactor core dissociates into hydrogen and oxygen during operation.

radionuclide — A nuclide that emits radiation by spontaneous transformation.

Record of Decision	The document, publicly available, by which a federal department or agency decides on an alternative presented and evaluated through the environmental impact statement process.
redox	Short for oxidation-reduction. A chemical reaction consisting of an oxidation reaction in which a substance loses or donates electrons, and a reduction reaction in which a substance gains or accepts electrons.
reduction	The addition of hydrogen, removal of oxygen, or addition of electrons to an element or compound.
rem	The unit of a dose equivalent from ionizing radiation to the human body; it is used to measure the amount of radiation to which a person has been exposed. Rem means Roentgen Equivalent in Man.
remote-handled transuranic waste	Transuranic waste that requires shielding in addition to that provided by the container to protect people nearby from radiation exposure. By definition, the radiation level at the outer surface of the container is greater than 200 millirems per hour and less than 1,000 rem per hour.
repository	A facility for the disposal of radioactive waste.
resource	Mineralization that is concentrated enough, in a large enough quantity, and in a physical and chemical form such that its extraction may be economical in the future.
seismicity	All of the earthquakes that may occur in a region, regardless of magnitude.
solubility	The degree to which a compound in its pure state will dissolve.
sorption	The binding, on a microscopic scale, of one substance to another.
source material	Material from which fissionable material can be extracted.
special nuclear material	A category of material subject to regulation under the Atomic Energy Act, consisting primarily of fissile materials. It is defined to mean plutonium, uranium-233, uranium enriched in the isotopes uranium-233 or uranium-235, and any other material that the Nuclear Regulatory Commission determines to be special nuclear material; does not include source material.
speciation	As used in this EA, speciation refers to the distribution of different oxidation states.
stable isotopes	Nuclei that do not decay to other isotopes on geologic timescales, but may themselves be produced by the decay of radioactive isotopes.
surface water	A creek, stream, river, pond, lake, bay, sea, or other waterway that is directly exposed to the atmosphere.

threatened species	Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Requirements for declaring a species threatened are contained in the Endangered Species Act.
tracer	A foreign substance, usually radioactive, that is mixed with or attached to a given substance so the distribution or location of the given substance can be determined at a later time; used to trace chemical behavior of a natural element in an organism.
transuranic waste	Waste materials (excluding high-level waste and certain other waste types) contaminated with alpha-emitting radionuclides that are heavier than uranium with half-lives greater than 20 years and occur in concentrations greater than 100 nanocuries per gram. Transuranic waste results primarily from plutonium reprocessing and fabrication as well as research activities at U.S. Department of Energy defense installations.
waste characterization	The identification of waste composition and properties by reviewing process knowledge, nondestructive examination, nondestructive assay, or sampling and analysis. Characterization provides the basis for determining appropriate storage, treatment, handling, transportation, and disposal requirements.
Waste Isolation Pilot Plant	The facility near Carlsbad, New Mexico, that is a disposal site for transuranic waste generated as part of the nuclear defense research and production activities of the federal government.
X-ray diffraction analysis	Analysis of the crystal structure of materials by passing X-rays through them and registering the diffraction (scattering) image of the rays.

APPENDIX A

EXAMPLES OF POTENTIAL EXPERIMENTS FOR ACRSL

The specific experiments that would be performed in the proposed Actinide Chemistry and Repository Science Laboratory (ACRSL) would be determined and prioritized in discussions with the Carlsbad Field Office, Los Alamos National Laboratory, Sandia National Laboratories, Westinghouse TRU Solutions LLC, and New Mexico State University. The potential experiments would be expected to include a subset of those described below (Mercer 2002).

Research on Oxidizing Effects of Radiolysis

- Generation rates of radiolysis by-products (e.g., H_2O_2, ClO^-, Cl^-) in typical Waste Isolation Pilot Plant (WIPP) alpha and gamma irradiation fields
- A kinetic model for hypochlorite and peroxide production rates, including a complex reaction mechanism
- Quantification of radiolysis-related changes in radionuclide solubilities and speciation
- Define conditions to possibly affect actinide oxidation state

Research on the Reducing Effects

- Mild steel and aluminum corrosion
  - Influence of mild steel and aluminum corrosion on the Eh–pH system of WIPP brine, with respect to brine salinity, temperature, and pressure provided by the repository, and as a function of typical WIPP contact-handled waste and remote-handled waste irradiation fields
  - Reaction mechanism producing surface passivation and the associated agglomerations of solid inorganic phases onto the waste drum steel surfaces
- Complexing and chelating agents
  - Effects of organics on the solubility of actinides under WIPP conditions
  - Effects of organics on actinide speciation under WIPP conditions
- Microbial activity
  - Influence of microbial by-products (e.g., CO_2, N_2O, NO, N_2) on Eh-pH system of the brines
  - Effect of microbial activity on oxidation state, concentration, and speciation of radionuclides
  - Effect of microbial activity on radionuclide precipitation and the formation of colloidal particles and their transportation and migration within the geology

Research on Actinide Demobilization

- Waste form and waste package corrosion
  - Corrosion mechanism and corrosion rates of WIPP-typical waste packages
  - Influence of waste form degradation on the geochemical Eh-pH system within the near field
  - Influence of reactive waste sub-components on corrosion rates and secondary phase formation in aged Source-Term Waste Test Program brines
  - Determination of co-precipitation mechanism and the formation of possible host phases in waste form corrosion
    - Pu-$SrSO_4$ solid solution as co-precipitation mechanism in the Source-Term Waste Test Program
    - Barite-type solid solution, smectite-type solid solution, and powellite-type solid solution in waste glass corrosion
  - Compare corrosion mechanism and secondary phase formation of transuranic (TRU) waste forms to those of advanced waste forms

        - phosphate-based waste glass
        - silicate-based waste glass
        - borosilicate-based waste glass
        - ceramic phosphate-based and titanate-based (Synroc II, pyrochlore) waste forms
        - sintered waste-forms (glass-ceramic composite materials)
        - advanced Portland cement-based (e.g., improvements caused by fly ash admixtures)
- Evaluation of the role of colloids on radionuclide transportation and migration
    - The formation, characterization, and quantification of colloidal and nano-crystalline particles which influence the migration of radionuclides and the total radionuclide concentrations in the aqueous phase
    - The sorption mechanism of positively charged radionuclides onto a negatively charged colloid surface area in order to complete the current geochemical repository model, which assumes equilibrium conditions by introducing the thermodynamically non-equilibrium behavior that describes colloidal formation and radionuclide transportation and migration.
    - Investigation of the ability of colloids to influence the migration of radionuclides in the following pathways:
        - radionuclide sorption/desorption from solid phase
        - radionuclide sorption/desorption from colloid
        - colloid radionuclide sorption/desorption from solid phase
    - Readjust or replace current model that is based on radionuclide sorption to sediment using sorption distribution coefficients by a model based on colloidal transport of radionuclides in the geochemical system of WIPP

Characterization of the Radioactive Inventory

- Waste characterization in solid state
    - Non-destructive characterization of radionuclide inventory
        - Alpha counting
        - Gamma counting
        - X-ray fluorescence
        - Laser ablation mass spectroscopy
    - Characterization of the solid phase constitution
        - X-ray diffraction
        - Microscopy (Optical SEM)
        - EXAFS (optional)
    - Determination of radionuclide oxidation state
        - X-ray diffraction
        - EXAFS
- Destructive waste characterization for quantification and specification of radionuclides (including beta emitters) in the liquid phase
    - Design appropriate digestion procedure (e.g., microwave digestion)
    - Apply effective separation technique for individual quantification of beta emitters
        - Liquid-liquid extraction
        - Chromatographic column extraction
        - Supercritical CO_2 extraction (to be applied preferably in Japan, France, and United Kingdom)
    - Analysis of each beta emitter by liquid scintillation counting
    - Quantification of the total TRU waste inventory by ICP-MS
    - Determination of the radionuclide oxidation state within the TRU waste
        - Photoacoustic laser spectroscopy
        - Time resolved laser fluorescence spectroscopy
        - UV-VIS spectrophotometry

    - Vibrational spectroscopy (FTIR, Raman)
    - Electron spray mass spectroscopy
    - Analysis of Eh-pH and the concentration of radiolysis by-products (e.g., hypochlorite, peroxide, oxygen, hydrogen)
    - Actinide speciation in TRU waste and under repository conditions
    - Solubility behavior of radionulides in TRU waste under repository conditions
  - Characterization of the radioactive content in the free-standing liquid
    - Quantification of the total TRU waste inventory by ICP-MS
    - Electron spray mass spectrometry
    - Extraction technique, if applicable
    - Potentiometric titration and the concentration of radiolysis by-products (e.g., hypochlorite, peroxide, oxygen, hydrogen)
    - Analysis by UV-VIS (radiolysis by-products), laser spectroscopy

Improvement of Waste Forms, Model Conditioning, and Model Stabilization of Waste Streams Without Viable Disposition Path

- Set-up treatment test unit for waste forms that do not meet regulations and for waste forms with high possibility to fail certification procedure
  - Extract hazardous organic components *in situ* and without further repackaging. A possible secondary waste stream should be destroyed (oxidized) or stabilized.
  - Determine mineralogical phase constitution and the chemical composition of the waste package in order to define the appropriate treatment procedure.
  - Establish extraction capabilities for waste forms containing disallowed amounts of freestanding liquid and/or hazardous organic components
  - Adopt extraction technologies from real-scale deployments and industrial processes. Typical candidates might be:
    - Supercritical CO_2 treatment ($SCCO_2$) to extract free liquid and organic solvents with low dipolar moments and molar mass not greater than 500 grams per mole. $SCCO_2$ can furthermore improve leach resistance of Portland cement-based waste forms.
    - Apply pyrolysis and thermal desorption to extract and destroy (oxidize) any non-stabilized organic components like solvents and volatile combustible organics. Pyrolysis might successfully treat waste forms like Oasis sludge (Rocky Flats, IDC 801).
    - Convert mixed waste streams into combustible pyrolysis (carbonization) gas and dry residue at temperatures of 400°C to 500°C and in a low-oxygen atmosphere by applying the latest pyrolysis technology.

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APPENDIX B

CHEMICAL AND RADIOLOGICAL INVENTORIES FOR THE CEMRC

The current inventories of chemicals and radiological materials at the Carlsbad Environmental Monitoring and Research Center (CEMRC) are provided in Tables B-1 and B-2, respectively. These tables were provided by Joel Webb, Manager of Program Development at the CEMRC, New Mexico State University (Webb 2002a).

Table B-1. Onsite CEMRC Chemical Inventory

Chemical Name	Amount	Units	SARA Limit
Acetic Acid, Glacial	5,400	mL	NA[a]
Acetone	38	L	NA
AA Modifier Solution	100	mL	NA
AccuStandard mixed anion standard for IC	125	mL	NA
Acetic Acid, solution	1,000	mL	NA
Acetonitrile	4,000	mL	NA
Acetylene	100	cu.ft.	NA
Acid Spill Cleanup Kit (Hazorb)	1	kit	NA
Acid Spill Emergency Cleanup Kit	3	kit	NA
Aerosol - OT	1	L	NA
AG 1-X4 50-100 Chloride Resin	800	g	NA
AG 1-X8 100-200 Mesh Resin	2,000	g	NA
AG 1-X8 50-100 Mesh Resin	900	g	NA
AG 50W-X8 100-200 Hydrogen Resin	3,000	g	NA
AG MP 50	700	g	NA
Alcojet Detergent/Tabs	698	oz	NA
Alumina, activated	850	g	NA
Aluminum Nitrate	2,100	g	NA
Ammonium Acetate	2,200	g	NA
Ammonium Chloride	1,300	g	NA
Ammonium Chloride Solution	300	mL	NA
Ammonium Citrate	100	g	NA
Ammonium hydrogenoxalate, hemihydrate	400	g	NA
Ammonium Hydroxide	48	L	NA
Ammonium Iodide	1,000	g	NA
Ammonium Nitrate	500	g	NA
Ammonium Oxalate	600	g	NA
Ammonium Oxalate Solution	2,000	mL	NA
Ammonium Thiocyanate	1,700	g	NA
Ammonium Thiocyanate Solution	150	mL	NA
Argon, refrig. Liquid	7,000	cu.ft.	NA
Ascorbic Acid (L-Ascorbic)	600	g	NA

Table B-1. Onsite CEMRC Chemical Inventory (continued)

Chemical Name	Amount	Units	SARA Limit
Ascorbic Acid solution (L-Ascorbic)	100	mL	NA
Barium Carrier solution	25	mL	NA
Barium Nitrate	400	g	NA
Beckman diffusion pump oil	500	mL	NA
Beckman direct drive vacuum pump oil	3	L	NA
Beckman Spinkote	60	mL	NA
Bio-Rex MSZ 501(D) 25-35 mixed bed	400	g	NA
Bonded Lubricant Coating, IEC	1	oz	NA
Boric Acid	2,750	g	NA
Boric Acid solution	2,000	mL	NA
Boric Acid, crystalline	1,200	g	NA
Bromine Monochloride Solution	625	mL	NA
Bromocresol Green	5	g	NA
Bromocresol Purple	200	mL	NA
Calcium Chloride Anhydrous	400	g	NA
Calcium Chloride Dihydrate	4,500	g	NA
Calcium Chloride Dihydrate (Solution)	1,075	mL	NA
Calcium Fluoride	400	g	NA
Calcium Hydroxide	800	g	NA
Calcium Hypochlorite	250	g	NA
Calcium Nitrate Tetrahydrate	1,700	g	NA
Calcium Phosphate Dibasic	500	g	NA
Calcium Phosphate Tribasic	1,000	g	NA
Carbon suspension	1,000	mL	NA
Carbon tetrachloride	200	mL	NA
Carbon, activated	500	g	NA
Caustic Spill Kit (Vermiculite)	2,000	g	NA
Ceric Ammonium Nitrate	400	g	NA
Cerium carrier solution	30	mL	NA
Cerium Nitrate Hexahydrate	75	g	NA
Chloramine T Trihydrate	225	g	NA
Citra-Nox Detergent	2	L	NA
Citric Acid	500	g	NA
Cobalt Nitrate Hexahydrate	100	g	NA
Collodion, Flexible	20	mL	NA
Conductivity Calibration Solution, 1413 uS, Oakton	1	L	NA
Conductivity/TDS Calibration Solution, 7000 uS	4.2	L	NA
Conductivity/TDS standard, 1413 uS, Orion	300	mL	NA
Contact Cleaner (Hi-Line)	60	oz	NA
CRC 2-26	30	oz	NA
Creatinine	100	g	NA
Desi Pak (Dessicant)	2,800	g	NA

Table B-1. Onsite CEMRC Chemical Inventory (continued)

Chemical Name	Amount	Units	SARA Limit
Dextrose	500	g	NA
Diaminopropionic Acid (DAP)	2	g	NA
Dichloromethane (Methylene chloride)	1,000	mL	NA
Drierite	55	lbs	NA
EDTA	500	g	NA
EDTA solution	300		NA
Eichrom Diphonix Cation Exchange Resin, 50-100 mesh	400	g	NA
Eichrom Sr Resin	50	g	NA
Eichrom TEVA Resin	70	g	NA
Eichrom TRU Resin	180	g	NA
Eichrom UTEVA Resin	100	g	NA
Electroplating solution for Am, Cm	500	mL	NA
Electroplating solution for U, Pu, Th	1	L	NA
EluGen Cartridge (EGC-KOH), Potassium Hydroxide	1	L	NA
Epoxy Thinner	3	gal	NA
Ethylene glycol	2.5	gal	NA
Fe solution	50	mL	NA
Ferric Chloride Hexahydrate	250	g	NA
Ferric Nitrate	500	g	NA
Ferrous Chloride Tetrahydrate	250	g	NA
Ferrous sulfate solution	75	mL	NA
Fluorescein, Laser Grade	500	mg	NA
Formic Acid	400	mL	NA
Glycerol	500	mL	NA
Hazorb for Acids (Lab Safety Neutralizing Sorbent)	1,500	g	NA
Hazorb for Caustics (Lab Safety Neutralizing Sorbent)	1,000	g	NA
Hazorb Universal Sorbent (Lab Safety)	2	kit(s)	NA
HEDPA	500	g	NA
Helium, compressed	360	L	NA
Hg Absorb (Part of Mercury Cleanup System)	2,000	g	NA
Hippuric Acid	100	g	NA
Hydraulic Fluid, Carver	500	mL	NA
Hydrochloric Acid (concentrated)	95	L	189 L
Hydrochloric Acid (dilute)	27	L	189 L
Hydrochloric Acid Solution	1	L	189 L
Hydrofluoric Acid	9.1	L	37.8 L
Hydrogen peroxide solution	4.4	L	378 L
Hydroquinone	0.5	Kg	170 Kg
Hydroxylamine Hydrochloride	100	g	NA
Hydroxylamine Hydrochloride, 50% in H20	50	mL	NA
Hydroxylamine, 5 wt % in H2O	100	mL	NA
Hydroxylamine, 50 wt % in H2O	100	mL	NA

Table B-1. Onsite CEMRC Chemical Inventory (continued)

Chemical Name	Amount	Units	SARA Limit
Iron (II) chloride, anhydrous	50	g	NA
Iron (see Fe Solution, Carrier)	50		NA
Isoamyl Acetate	200		NA
Isopropyl Alcohol	5,050	mL	NA
Isopropyl Alcohol (Consumer grade)	250	mL	NA
L-/+Cysteine	50		NA
Lactic Acid	500	mL	378 L
Lanthanum carrier solution	50		NA
Lanthanum oxide	600	g	NA
Lead Nitrate	500	g	NA
Lead Standard, Orion	475	mL	NA
Liqui-Nox (soap)	2,030	mL	NA
Lithium Chloride	95	g	NA
Magnesium Chloride Hexahydrate	3,809	g	NA
Magnesium Nitrate	25	g	NA
Magnesium Oxide (Heavy Powder)	3	kg	NA
Magnesium perchlorate	265	g	NA
Magnesium Sulfate Anhydrous	500	g	NA
Magox 95 WG	12	Kg	NA
Manganous Chloride Tetrahydrate	500	g	NA
Manometer Fluid	1,296	mL	NA
Mercurous Chloride	0.1	Kg	170 Kg
Mercury	4	unit(s)	NA
Mercury Check Swabs	6	swab	NA
Mercury Cleanup System (Lab Safety)	2	kit	NA
Mercury Indicator Powder (Part of Mercury Cleanup System)	1,000	g	NA
Methanesulfonic Acid (g)	500	g	NA
Methanesulfonic Acid (mL)	833	mL	NA
Methanol	26	L	NA
Methyl Red	10	g	NA
Methylene Blue	10	g	NA
Molecular Sieve	2,500	g	NA
Molybdovanadate	500	mL	NA
Neodymium carrier solution	40	mL	NA
Nitric Acid (concentrated, reagent,)	93	L	302 L
Nitric Acid (dilute)	25	L	302 L
Nitric Acid (fuming)	2.5	L	302 L
Nitrogen, Gas	351	L	NA
Nitrogen, Liquid	2,120	lbs	NA
Octanol (Octyl alcohol)	4,000	mL	NA
Oil, Edwards	5,500	mL	NA
Optiphase HiSafe 3	7,000	mL	NA

Table B-1. Onsite CEMRC Chemical Inventory (continued)

Chemical Name	Amount	Units	SARA Limit
Optiphase Supermix	5	L	NA
Optiphase Trisafe	4,000	mL	NA
O-Tolidine	25	g	NA
Oxalic Acid Dihydrate	1,400	g	NA
Oxalic Acid Solution	1,000	mL	NA
P-10 Gas	600	cu.ft.	NA
PAH Mixture EPA Method 525	1	mL	NA
Pepsin	100	g	NA
Perchloric Acid	12.5	L	NA
pH Ag/AgCl Reference Electrode Filling Solution, Orion	420	mL	NA
pH buffer 10.00, Oakton	8	L	NA
pH buffer 10.01, Orion	1,475	mL	NA
pH buffer 12.45, Oakton	1,000	mL	NA
pH buffer 2.00, Fisher	800	mL	NA
pH buffer 4.00, Oakton	4,000	mL	NA
pH buffer 4.01, Orion	1,575	mL	NA
pH buffer 7.00, Oakton	10	L	NA
pH buffer 7.00, Orion	1,475	mL	NA
pH Electrode Storage Solution	550	mL	NA
pH LAZAR PHR-146 Filling Solution	60	mL	NA
pH, Orion pHuture Sure-flow solution	60	mL	NA
Phenolphthalein solution	400	mL	NA
Phenolphthalein, Certified ACS	100	g	NA
Phenolphthalein, Reagent ACS	100	g	NA
Phenylbutazone	25	g	NA
Phosphoric Acid	14.5	L	NA
Phosphoric Acid, HPLC Grade	500	mL	NA
Portland Cement	94	lb	NA
Potassium Bromate	900	g	NA
Potassium Bromide	250	g	NA
Potassium Chloride	15.5	Kg	NA
Potassium Chloride Solution	1,000	mL	NA
Potassium Hydrogen Phthalate	100	g	NA
Potassium Iodide, granular	100	g	NA
Potassium Oxalate Monohydrate	200	g	NA
Potassium Permanganate	450	g	NA
Potassium Permanganate solution	2,575	mL	NA
Potassium Persulfate	2,000	g	NA
Potassium Persulfate Solution	530	mL	NA
Potassium Sulfate	1,200	g	NA
QD Contact Cleaner (CRC)	30	oz	NA
Quinhydrone	50	g	NA

Table B-1. Onsite CEMRC Chemical Inventory (continued)

Chemical Name	Amount	Units	SARA Limit
Radiacwash	6	L	NA
Reagent Alcohol	24	L	NA
Reillex HPQ Polymer, 4-Ethenylpyridinium-1-methyl chloride, polymer	200	g	NA
Safranin 0	20	g	NA
Safranine solution	5	mL	NA
Santovac 5 diffusion pump fluid	100	mL	NA
Silicon Dioxide	2	Kg	NA
Silicon Grease, Eppendorf	50	mL	NA
Silicone Emulsion	500	mL	NA
Silver Chloride	25	g	NA
Silver Nitrate	20	g	NA
Soap Solution, Gilibrator	2	oz	NA
Soda Lime	400	g	NA
Sodium Acetate Trihydrate Reagent	100	g	NA
Sodium Acetate Trihydrate Solution	750	mL	NA
Sodium Bicarbonate (Reagent Grade)	6,750	g	NA
Sodium Bicarbonate Baking Soda	32	lb	NA
Sodium Bicarbonate Solution	1,350	mL	NA
Sodium Bisulfate	500	g	NA
Sodium Bisulfite	500	g	NA
Sodium Borohydride	100	g	NA
Sodium Bromide	500	g	NA
Sodium Carbonate	2,850	g	NA
Sodium Carbonate Solution	250	mL	NA
Sodium Chlorate, reagent grade	500	g	NA
Sodium Chloride	44.9	Kg	NA
Sodium Chlorite	30	g	NA
Sodium Chromate	500	g	NA
Sodium Citrate Dihydrate	306	g	NA
Sodium Fluoride	100	g	NA
Sodium Formaldehydesulfoxylate Dihydrate	10	g	NA
Sodium Hydrosulfite	100	g	NA
Sodium Hydroxide	17.5	Kg	NA
Sodium Hydroxide Solution	3,000	mL	NA
Sodium Hydroxide Solution (10.0N)	2,000	mL	NA
Sodium Hypochlorite Solution	1	L	NA
Sodium Iodide	100	g	NA
Sodium Metaphosphate Reagent	400	g	NA
Sodium Metaphosphate Solution	600	mL	NA
Sodium meta-silicate nonahydrate	500	g	NA
Sodium Nitrate	250	g	NA
Sodium Nitrite	1,800	g	NA

Table B-1. Onsite CEMRC Chemical Inventory (continued)

Chemical Name	Amount	Units	SARA Limit
Sodium Oxalate	100	g	NA
Sodium Phosphate dibasic	300	g	NA
Sodium Phosphate monobasic	750	g	NA
Sodium Phosphate tribasic	500	g	NA
Sodium Sulfate, anhydrous	5,600	g	NA
Sodium Sulfite	500	g	NA
Sodium Sulfite (Solution)	100	mL	NA
Sodium Tetraborate Decahydrate	4,500	g	NA
Sparkleen (soap)	4	lbs	NA
Stannous Chloride	225	g	NA
Strontium Nitrate	300	g	NA
Sulfamic Acid	200	g	NA
Sulfate Standard, Orion	475	mL	NA
Sulfuric Acid	20	L	189 L
Sulfuric Acid, 1 N standardized solution	4	L	189 L
Tellurium Oxide	10	g	NA
Thioacetamide	80	g	NA
Titanium Chloride solution	800	mL	NA
Titanium Oxide	500	g	NA
Triton-X-100 Surfactant	30	mL	NA
Tween 20	90	mL	NA
Ultrasonic, Fisher (soap)	5	oz	NA
Uranium Oxide	5	g	NA
Urea	500	g	NA
Xylenol Orange	10	g	NA
Yttrium Nitrate Hexahydrate	50	g	NA
Zinc Chloride	500	g	NA
Zinc Oxide	500	g	NA

a. NA = Not applicable.

Table B-2. Onsite CEMRC Radioactive Materials Inventory (as of January 25, 2002)

Isotope	Current Activity (nCi)
Americium-241	12,800
Americium-243	18.0
Antimony-125	0.114
Barium-133	2,880
Cadmium-109	4,960
Carbon-14	64.5
Cerium-139	32.1
Cesium-137	12,600
Cobalt-57	993
Cobalt-60	12,100
Curium-244	103
Europium-152	24,400
Gadolinium-148	49.6
Hydrogen-3	272
Iron-55	356
Lead-210	5,240
Manganese-54	4.10
Mercury-203	2.20
Nickel-63	25.6
Polonium-209	11.3
Polonium-210	3.58
Potassium-40	200
Plutonium-238	3,410
Plutonium-239	1,050
Plutonium-242	15.6
Radium-226	175
Ruthenium-106	2.47
Strontium-85	28.6
Strontium-89	0.0000177
Strontium-90	588
Technetium-99	13.1
Tellurium-123m	0.0181
Thorium-228	0.0987
Thorium-229	4.66
Thorium-230	299
Thorium-234	0.0319
Tin-113	43.2
Uranium-232	10.4
Uranium-234	0.624
Uranium-235	135
Uranium-236	10.7
Uranium-238	15,500
Yttrium-88	121
Zinc-65	16.8