APPENDIX B
ENVIRONMENTAL IMPACTS METHODOLOGIES

APPENDIX B
ENVIRONMENTAL IMPACTS METHODOLOGIES

This appendix briefly describes the methods used to assess the potential direct, indirect, and cumulative effects of the alternatives in this *Draft Supplemental Environmental Impact Statement for the Nuclear Facility Portion of the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico (CMRR-NF SEIS)*. Included are impact assessment methods for land use and visual resources, site infrastructure, air quality, noise, geology and soils, surface and groundwater quality, ecological resources, cultural and paleontological resources, socioeconomics, environmental justice, human health, waste management and pollution prevention, transportation and traffic, and cumulative impacts. Each section includes descriptions of the affected resources, region of influence (ROI), and impact assessment methods.

The methods described in this appendix are also used to assess the effects of operating the Radiological Laboratory/Utility/Office Building (RLUOB). RLUOB is complete and was built to provide administrative and support functions to the Chemistry and Metallurgy Research Replacement (CMRR) Nuclear Facility (CMRR-NF).

Impact analyses vary for each resource area. For air quality, for example, estimated pollutant emissions from the candidate facilities were compared with appropriate regulatory standards or guidelines. Comparison with regulatory standards is a commonly used method for benchmarking environmental impacts, and is done here to provide perspective on the magnitude of identified impacts. For waste management, waste generation rates were compared with the capacities of waste management facilities. Impacts within each resource area were analyzed consistently; that is, the impact values were estimated using a consistent set of input variables and computations. Moreover, calculations in all resource areas used accepted protocols and up-to-date models.

The baseline conditions assessed in this *CMRR-NF SEIS* are consistent with conditions under the No Action Alternative described in the 2008 *Final Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico* (*LANL SWEIS*) (DOE 2008), and updated in the SWEIS Yearbooks and site environmental reports. These decisions include the programmatic level of operations at Los Alamos National Laboratory (LANL) facilities (including the CMRR Facility) for at least the next 5 years, as well as project-specific decisions for individual projects at LANL, including those at Technical Area 55 and within surrounding and nearby technical areas along the Pajarito Road corridor. The No Action Alternative was used as the basis for the comparison of impacts that would occur under implementation of the other alternatives.

B.1 Land Use and Visual Resources

B.1.1 Land Use

B.1.1.1 Description of Affected Resources and Region of Influence

Land use is defined in terms of the kinds of anthropogenic activities (for example, agriculture, residential, industrial) for which land is developed (EPA 2006). Natural resources and other environmentally characteristic attributes make a site more suitable for some land uses than for others. Changes in land use may have beneficial or adverse ecological, cultural, geologic, and atmospheric effects on other resources. The ROI for land use varies due to the extent of land ownership, adjacent land use patterns and trends, and other geographic or safety considerations, but generally includes the site and areas immediately adjacent to the site.

B.1.1.2 Description of Impact Assessment

The amount of land disturbed and conformity with existing land use were considered for the purpose of evaluating the impacts of construction and operation at each candidate site (see **Table B–1**). Both factors were considered for each of the action alternatives. However, because new construction would not take place under the Continued Use of CMR Building Alternative, only conformity with existing land use was evaluated under this alternative. Land use impacts could vary considerably from site to site, depending on the extent of construction activities and the location(s) (that is, undeveloped or developed land) where they would take place.

Table B–1 Impact Assessment Protocol for Land Resources

	Required Data		
Resource	***Affected Environment***	***Alternative***	***Measure of Impact***
Land area used	Site acreage	CMRR Project activity location and acreage requirement	Acreage converted to CMRR Project use
Compatibility with existing or future land use	Existing land use configurations	Location of CMRR Project activity on the site and expected modifications of current activities and missions to accommodate the alternatives	Incompatibility with existing or future land use
Visual resources	Current Visual Resource Management classification	Location of CMRR Project activity on the site and activity dimensions and appearance	Change in Visual Resource Management classification

CMRR = Chemistry and Metallurgy Research Building Replacement.

B.1.2 Visual Resources

B.1.2.1 Description of Affected Resources and Region of Influence

Visual resources are the natural and manmade features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The ROI for visual resources includes the geographic area from which the candidate facilities may be seen.

B.1.2.2 Description of Impact Assessment

Impacts on visual resources from construction of the CMRR-NF and operation of the CMRR-NF and RLUOB at LANL may be determined by evaluating whether the U.S. Bureau of Land Management Visual Resource Management classifications of the candidate sites would change as a result of the proposed alternatives (DOI 1986) (see Table B–1). Existing classifications were derived from an inventory of scenic qualities, sensitivity levels, and distance zones for particular areas. For those alternatives involving existing facilities at LANL, alterations to visual features may be readily evaluated and the impact on the current Visual Resource Management classification may be determined. To determine the range of potential visual effects from new CMRR Project activities, the analysis considered the potential impacts of construction and operation on the aesthetic quality of surrounding areas, as well as the visibility of such activities from public vantage points.

B.2 Site Infrastructure

B.2.1 Description of Affected Resources and Region of Influence

Site infrastructure includes the utility systems required to support construction and/or modification and operation of the candidate facility. It includes the capacities of the electric power transmission and distribution system, natural gas and liquid fuel (fuel oil, diesel fuel, and gasoline) supply systems, and the water supply system. The ROI for utility infrastructure resources includes the LANL site, including the affected technical areas and the individual facilities, and the surrounding area to include non-LANL users who rely on the same utility systems (electric power, natural gas, and water) that serve LANL.

B.2.2 Description of Impact Assessment

In general, infrastructure impacts were assessed by evaluating the requirements under each alternative against the site capacity and/or the system capacity. An impact assessment was made for each resource (electricity, fuel, and water) under the various alternatives (see **Table B–2**). Tables reflecting site availability and infrastructure requirements were developed for each alternative. Data for these tables were obtained from reports describing the existing site and regional infrastructure and from the data reports for each alternative. If necessary, design mitigation considerations conducive to reduction of the infrastructure demand were also identified.

Table B–2 Impact Assessment Protocol for Infrastructure

	Required Data		
Resource	***Affected Environment***	***Alternative***	***Measure of Impact***
Electricity			
Energy consumption (megawatt-hours per year) Peak load (megawatts)	Site and system capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site/system capacity
Fuel			
Natural gas (cubic meters per year)	System capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding system capacity
Water (liters per year)	Site and system capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site/system capacity

Any projected demand for infrastructure resources exceeding site or system availability can be regarded as an indicator of environmental impact. Whenever projected demand approaches or exceeds capacity, further analysis of that resource is warranted. Often, design changes can mitigate the impact of additional demand for a given resource. For example, substituting fuel oil for natural gas (or vice versa) for heating or industrial processes can be accomplished at little cost during the design of a facility if the potential for impact is identified early. Similarly, a dramatic spike or surge in peak demand for electricity can sometimes be mitigated by upgrading the existing infrastructure.

B.2.3 Sustainable Building

Executive Orders 13423 and 13514 require Federal agencies to meet specific sustainability goals in terms of conserving non-renewable resources and reducing emissions of pollutants. Several U.S. Department of Energy (DOE) orders define requirements to meet these goals. DOE Order 413.3B addresses the internal management processes for acquisition of high-performing facilities. This order also lays out a series of critical decision points that develop project goals and objectives and refine project parameters, including goals for sustainability. Through this process, design development progresses in tandem with decisions about cost, and budget during the project life cycle. DOE Order 430.2B defines the specific benchmarks for measuring progress toward achieving the sustainability goals, including reductions in greenhouse gas emissions and energy and water use, established in Executive Order 13423. DOE Order 450.1A has the broader purpose of improving sound stewardship practices to protect air, water, land, and other natural and cultural resources. It also makes it necessary for sites (such as LANL) to include site-wide objectives and targets in the environmental management system that align with DOE Order 430.2B. These orders pave the way toward making sustainability an active principle for DOE sites and facilities. For additional information on applicable laws, regulations, and other requirements, see Chapter 5.

Sustainability requires implementation of a comprehensive plan of action. One strategy is to design, construct, and operate more-efficient and environmentally responsible buildings. To this end, the U.S. Green Building Council developed the Leadership in Energy and Environmental Design® (LEED) building certification system to provide independent, third-party verification that a building or community is designed and built using strategies aimed at improving performance across metrics such as energy savings, water efficiency, carbon dioxide emissions reduction, improved indoor environmental quality, resource stewardship, and sensitivity to the impacts of construction and operation. The LEED system certifies building performance via a voluntary rating system based on a consensus-based national standard derived from technical criteria and professional knowledge.

The LEED system uses various rating criteria for new construction (including homes, schools, commercial and industrial facilities), renovations to existing buildings (residential, commercial, and industrial), and neighborhood design. The LEED system uses the following six areas to rate a project's sustainable design proficiency:

- Sustainable sites
- Water efficiency and quality
- Energy and atmosphere
- Materials and resources
- Indoor environmental quality
- Innovative design

Within these areas, a project is scored on specific measures to earn "credits." The sum of the earned credits determines the total score and certification level achieved by the project (Certified, Silver, Gold, or Platinum levels). The advantage of project certification is not only demonstrable energy and environmental consideration, but also recognition and status in a value-driven market (for commercial endeavors) and long-term cost savings for operating and maintaining a sustainable facility.

The LEED certification process starts in the design phase and drives decisions regarding the six key areas above. LEED rating criteria, for example, address material and product selection, construction methods, and waste management, as well as post-construction commissioning of the building to ensure lifetime optimal performance. DOE Order 430.2B[1] now requires all DOE projects to incorporate LEED certification measures into the design/build process. DOE Order 430.2B specifies that LEED Gold

[1] *LEED requirement from DOE Order 430.2B: "The installation of sustainable building materials and practices throughout the Department's existing building assets and the attainment of the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Gold certification for all new construction and major building renovations in excess of $5 million. All buildings falling below this threshold are required to comply with the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings (Guiding Principles)."*

certification applies to all new buildings and major renovations that were in the Critical Decision-1 (CD-1) stage or lower (CD-0) of project development on October 1, 2008. Because the CD-1 decision for the CMRR-NF was made on May 18, 2005, this level of certification was not yet a formulating criterion for this project. Notwithstanding, other DOE orders and directives made sustainability and high building performance a key factor.

The LEED system assessment for this *CMRR-NF SEIS* considers whether proposed construction projects incorporate LEED strategies to minimize potential use of energy and water. Because LEED offers six areas of achievement, certification may result from a combination of factors, not just reduced energy and water use. LEED construction is one method for DOE to achieve the sustainable goals required under Executive Orders 13423 and 13514. Implementation of the proposed project, in combination with other actions and sustainability initiatives at LANL, is considered in the cumulative impacts analysis in this *CMRR-NF SEIS*. The assessment describes qualitatively how LEED certification of the CMRR-NF would factor into site-wide progress toward meeting sustainability goals (see Chapter 4, Section 4.6).

RLUOB, which has already been built and will provide administrative and support functions to the CMRR-NF, is anticipated to be awarded LEED Silver Certification for new construction.

B.3 Air Quality

B.3.1 Description of Affected Resources and Region of Influence

Air pollution refers to the direct or indirect introduction of any substance into the air that could endanger human health, harm living resources and ecosystems, damage material property, or impair or interfere with the comfortable enjoyment of life and other legitimate uses of the environment.

For the purpose of this *CMRR-NF SEIS*, only outdoor air pollutants were addressed. These outdoor air pollutants may be in the form of solid particles, liquid droplets, gases, or a combination of these forms. Generally, they can be categorized as primary pollutants (those emitted directly from identifiable sources) and secondary pollutants (those produced in the air by interaction between two or more primary pollutants or by reaction with normal atmospheric constituents that may be influenced by sunlight). Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Thus, air quality is affected by air pollutant emission characteristics, meteorology, and topography.

Ambient air quality in a given location can be described by comparing the concentrations of various pollutants in the atmosphere to the appropriate standards established by Federal and state agencies. These ambient air quality standards allow an adequate margin of safety for the protection of public health and welfare from the adverse effects of pollutants in ambient air. Pollutant concentrations higher than the corresponding standards are considered unhealthy; concentrations below such standards are considered acceptable.

The pollutants of concern are primarily those for which Federal and state ambient air quality standards have been established, including criteria air pollutants, hazardous air pollutants, and other toxic air compounds. Criteria air pollutants are those listed in Title 40 of the *Code of Federal Regulations* (CFR), Part 50 (40 CFR Part 50), "National Primary and Secondary Ambient Air Quality Standards." Hazardous air pollutants and other toxic compounds are those listed in Title I of the Clean Air Act, as amended (40 *United States Code* [U.S.C.] 7401 et seq.), those regulated by the National Emissions Standards for Hazardous Air Pollutants (40 CFR Part 61), and those that have been proposed or adopted for regulation by the applicable states or listed in state guidelines. States may set ambient standards that are more stringent than the National Ambient Air Quality Standards (NAAQS). The more stringent of the Federal or state standards for each site are discussed in this document.

Areas with air quality better than the NAAQS for criteria air pollutants are designated as "attainment," while areas with air quality worse than the NAAQS for such pollutants are designated as "nonattainment." Areas may be designated as "unclassified" when there are insufficient data for attainment status designation. Attainment status designations are assigned by county; metropolitan statistical area; consolidated metropolitan statistical area, or portions thereof; or air quality control regions. Air quality control regions designated by the U.S. Environmental Protection Agency (EPA) are listed in 40 CFR Part 81, "Designation of Areas for Air Quality Planning Purposes." LANL is located in an attainment area (40 CFR 81.332).

For locations that are in an attainment area for criteria air pollutants, Prevention of Significant Deterioration regulations limit pollutant emissions from new or modified sources and establish allowable increments of pollutant concentrations. Three Prevention of Significant Deterioration classifications are specified according to the criteria established in the Clean Air Act. Class I areas include national wilderness areas and memorial parks larger than 5,000 acres (2,020 hectares), national parks larger than 6,000 acres (2,430 hectares), and areas that have been redesignated as Class I. Class II areas are all areas that are not designated as Class I (42 U.S.C. 7472, Title I, Section 162). LANL is in a Class II area; it is adjacent to the Bandelier National Monument and Wilderness Area Class I area (DOE 2008).

The ROI for air quality encompasses the area surrounding a candidate site that is potentially affected by air pollutant emissions caused by the alternatives. The air quality impact area normally evaluated is the area in a Class II area in which concentrations of criteria pollutants would increase more than a significant amount. This determination is based on averaging periods and acceptable concentrations established for specific pollutants: 1 microgram per cubic meter for the annual average for sulfur dioxide, nitrogen dioxide, and particulate matter less than or equal to 10 microns in aerodynamic diameter (PM_{10}); 5 micrograms per cubic meter for the 24-hour average for sulfur dioxide and PM_{10}; 500 micrograms per cubic meter for the 8-hour average for carbon monoxide; 25 micrograms per cubic meter for the 3-hour average for sulfur dioxide; and 2,000 micrograms for the 1-hour average for carbon monoxide (40 CFR 51.165). Averaging periods are the average rate or rates at which a source emits a pollutant during the stated period of 1 hour, 3 hours, 8 hours, 24 hours, or a year. Generally, this area covers a few kilometers downwind from the source. For sources within 60 miles (100 kilometers) of a Class I area, the air quality impact area evaluated would include the Class I area if the increase in concentration were greater than 1 microgram per cubic meter (24-hour average). The area of the ROI depends on the emission source characteristics, pollutant types, emission rates, and meteorological and topographical conditions. For analysis purposes, the impacts were evaluated at the site boundary and along roads within the site to which the public has access, plus any additional area in which contributions to pollutant concentrations are expected to exceed significance levels.

Baseline air quality is typically described in terms of the pollutant concentrations modeled for existing sources at each candidate site and the background air pollutant concentrations measured near the sites. For this analysis, concentration estimates for existing sources were obtained from the 2008 *LANL SWEIS* and from concentrations models using recent emissions inventories and the AERMOD Version 09292 screening model AERSCREEN. The AERSCREEN model produces concentration estimates that are equal to or greater than the estimates produced by AERMOD, which provides a "worst-case" scenario (EPA 2010a). As of December 9, 2006, EPA's promulgated AERMOD package replaced the ISC3 (Industrial Source Complex) dispersion model (EPA 2010b). Thus, the most recent model was used to determine air emissions.

B.3.2 Description of Impact Assessment

Potential air quality impacts of pollutant emissions from construction and normal operations under each alternative were evaluated. This assessment included a comparison of pollutant concentrations under each alternative with applicable Federal and state ambient air quality standards (see **Table B–3**). If both Federal and state standards exist for a given pollutant and averaging period, compliance was evaluated using the more stringent standard. Operational air pollutant emissions data for each alternative were based on conservative engineering analyses.

Table B–3 Impact Assessment Protocol for Air Quality

	Required Data		
Resource	***Affected Environment***	***Alternative***	***Measure of Impact***
Criteria air pollutants and other regulated pollutants [a]	Measured and modeled ambient concentrations (micrograms per cubic meter) from existing sources at the site	Emission rates (kilograms per year) of air pollutants from facility; source characteristics (stack height and diameter, exit temperature and velocity)	Concentration under the alternatives and total site concentration of each pollutant at or beyond the site boundary or within the boundary on public roads, as compared to applicable standards
Toxic and hazardous air pollutants [b]	Measured and modeled ambient concentrations (micrograms per cubic meter) from existing sources at the site	Emission rates (kilograms per year) of pollutants from facility; source characteristics (stack height and diameter, exit temperature and velocity)	Concentration under the alternatives and total site concentration of each pollutant at or beyond the site boundary or within the boundary on public roads, which were used to calculate the hazard quotient or cancer risk

[a] Carbon monoxide; hydrogen fluoride; lead; nitrogen oxides; ozone; particulate matter less than or equal to 10 microns in aerodynamic diameter; sulfur dioxide; total suspended particulates.
[b] Clean Air Act (40 U.S.C. 7401 et seq.), Section 112(d), hazardous air pollutant: pollutants regulated under the National Emissions Standard for Hazardous Air Pollutants and other state-regulated pollutants.

Contributions to offsite air pollutant concentrations under each alternative were modeled based on guidance provided in EPA's "Guidelines on Air Quality Models" (40 CFR Part 51, Appendix W). EPA's recommended model AERSCREEN (EPA 2010a) was selected as an appropriate model for air dispersion modeling because it is designed to support the EPA regulatory modeling program and it predicts conservative, worst-case impacts.

The modeling analysis incorporated conservative assumptions, which tended to overestimate pollutant concentrations. The maximum modeled concentration for each pollutant and averaging period was selected for comparison with the applicable standard. The concentrations evaluated were the maximum concentrations occurring at or beyond the site boundary and at a public access road or other publicly accessible area within the site. Available monitoring data, which reflect both onsite and offsite sources, were also taken into consideration. Concentrations of the criteria air pollutants were presented for each alternative. Concentrations of hazardous and toxic air pollutants were evaluated in the public and occupational health effects analysis. At least 1 year of representative hourly meteorological data was used.

Ozone is typically formed as a secondary pollutant in the ambient air (troposphere). It is formed in the presence of sunlight from the mixing of primary pollutants, such as nitrogen oxides, and volatile organic compounds that emanate from vehicular (mobile) sources and natural and other stationary sources. Ozone is not emitted directly as a pollutant from the candidate sites. Although ozone may be regarded as a regional issue, specific ozone precursors, notably nitrogen dioxide and volatile organic compounds, were analyzed because they are applicable to the alternatives under consideration.

The Clean Air Act, as amended, requires that Federal actions conform to the host state's "state implementation plan." A state implementation plan provides for implementation, maintenance, and enforcement of the NAAQS for the six criteria pollutants: sulfur dioxide, PM_{10}, carbon monoxide, ozone, nitrogen dioxide, and lead. Its purpose is to eliminate or reduce the severity and number of violations of the NAAQS and to expedite attainment of these standards. "No department, agency, or instrumentality of the Federal Government shall engage in, support in any way or provide financial assistance for, license or permit, or approve any activity that does not conform to an applicable implementation plan" (42 U.S.C. 7506). The final rule for "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" (58 *Federal Register* [FR] 63214) took effect on January 31, 1994. LANL is within an area currently designated as in attainment for criteria air pollutants. Therefore, the alternatives being considered in this *CMRR-NF SEIS* are not affected by the provisions of the conformity rule.

Emissions of potential stratospheric ozone-depleting compounds, such as chlorofluorocarbons, were not evaluated because no emissions of these pollutants were identified in the conceptual engineering design reports.

B.3.3 Greenhouse Gases

On February 18, 2010, the Council on Environmental Quality released its *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions* (CEQ 2010), which suggests that proposed alternatives that are reasonably anticipated to emit 25,000 metric tons or more of direct carbon dioxide equivalent air emissions should be evaluated by quantitative and qualitative assessments. This is not a threshold of significance, but a minimum level that should be considered in documentation required by the National Environmental Policy Act (NEPA), as amended (42 USC 4321 et seq.). Quantitative analysis of greenhouse gas emissions (carbon dioxide equivalent air emissions) in this *CMRR-NF SEIS* may be useful in making reasoned choices among the alternatives. Neither the Council on Environmental Quality nor EPA has issued final guidance regarding how to address greenhouse gas/climate change impacts under NEPA.

The greenhouse gas analysis assessed the impacts, where applicable, of the six primary greenhouse gases; carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, as defined in accordance with Section 19(i) of Executive Order 13514.

The predominant source of anthropogenic carbon dioxide emissions is combustion of fossil fuels. Forest clearing, other biomass burning, and some non-energy-production processes (for example, cement production) also emit notable quantities of carbon dioxide. Another greenhouse gas, methane, comes from landfills, coal mines, oil and gas operations, and agriculture. Anthropogenic sources of nitrous oxide emissions include burning fossil fuels and the use of certain fertilizers and industrial processes. Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are powerful, synthetic greenhouse gases that are released as byproducts of industrial processes and through leakage.

The following section describes the methodology used for the quantitative greenhouse gas analysis in this *CMRR-NF SEIS*.

B.3.3.1 Description of Impact Assessment

The potential impacts of greenhouse gas emissions of carbon dioxide, methane, and nitrous oxide from construction and operation under each alternative were evaluated. The annual and total greenhouse gas emissions that would result from construction and operation of the proposed CMRR-NF, including emissions from onsite construction equipment, construction material transport, worker commutes, and refrigerant usage during operation of the facility were calculated. Cement for construction purposes would be produced at an electric cement batch plant. Emissions from electricity consumption during cement production and the CMRR facility operation are not under the direct control of LANL, and do not occur directly on site, but have been included under environmental consequences. Under the analysis of operations, the impacts from the normal operation of RLUOB were also analyzed.

B.3.3.1.1 Summary of Calculations

All calculations follow the guidance provided by EPA for greenhouse gas inventory calculations (EPA 2008, 2009). Emission factors (**Table B–4**) and global warming potentials (**Table B–5**) were chosen based on this guidance.

Table B–4 Emission Factors Used in the Construction and Operations Analysis of the Alternatives

Emission Factors (diesel) [a]		
Pounds Carbon Dioxide per Gallon	**Pounds Methane per Gallon**	**Pounds Nitrous Oxide per Gallon**
22.4	0.000097354	0.00010344
Emission Factors (gasoline) [a]		
Pounds Carbon Dioxide per Gallon	**Pounds Methane per Gallon**	**Pounds Nitrous Oxide per Gallon**
19.5	0. 0016152	0. 001466
Electricity Generation Emission Factors [b]		
Pounds Carbon Dioxide per Megawatt-Hour	**Pounds Methane per Megawatt-Hour**	**Pounds Nitrous Oxide per Megawatt-Hour**
1,311.05	0.01745	0.01794

[a] EPA 2003.
[b] EPA 2010c.

Table B–5 Global Warming Potential for Major Greenhouse Gases

Chemical Name	*Global Warming Potential* [a]
Carbon dioxide	1
Methane [b]	21
Nitrous oxide	310
Hydrofluorocarbons	1,300

[a] 100-year time horizon.
[b] The global warming potential of methane includes the direct effects and those indirect effects due to the production of tropospheric ozone and stratospheric water vapor. The indirect effect due to the production of carbon dioxide is not included.
Source: IPCC 2007.

Construction Equipment

Construction of the CMRR-NF requires various types of construction equipment or nonroad vehicles. The following data were required to calculate the emissions for contractor-owned (nonroad) highway vehicles:

- Vehicle class
- Vehicle hours of operation
- Fuel type
- Average fuel consumption rate
- Emission factor
- Global warming potentials

Specific data were given on the types of equipment, fuel type, and hours of operation (LANL 2011). Emissions factors and global warming potentials are shown in Table B–4 and Table B–5. A fuel consumption rate of 4 gallons (15 liters) per hour was assumed.

Materials Transport

The following data were required to calculate the emissions for delivery trucks:

- Vehicle class
- Vehicle miles traveled
- Fuel type
- Average fuel efficiency
- Emission factor
- Global warming potentials

Specific information on the type of vehicle class for the delivery trucks was not available; therefore, it was assumed that they are hybrid diesel vehicles with an average fuel efficiency of 7.8 miles per gallon (3.3 kilometers per liter) (EPA 2003). Section B.14 describes the methodology used to estimate the number of trips made and distance traveled by each truck evaluated in this analysis.

Privately Owned Vehicles

Greenhouse gas emissions from privately owned vehicles (POVs) were calculated assuming one vehicle per construction worker. Data similar to those used for delivery trucks emissions were used to calculate emissions from construction worker commutes. Specific information on the type of vehicle classes was not available; therefore, it was assumed that light-duty gasoline vehicles with an average fuel efficiency of 22.1 miles per gallon (9.4 kilometers per liter) are the only POVs used. This is an average of the fuel efficiency of light-duty gasoline cars (24.1 miles per gallon [10.2 kilometers per liter]) and light-duty trucks (16.4 miles per gallon [7.0 kilometers per liter]) (EPA 2003). It was also assumed that workers had a 30-mile (48-kilometer) round-trip commute to the central parking area, where they board transport buses. This section also includes the bus transport to the construction site from the parking area and back.

Electricity Consumption

Greenhouse gas emissions from cement batch plant electricity use were calculated using the electricity consumption data given in Section B.2, "Site Infrastructure." The electricity generation emission factors are shown in Table B–4. Emissions of greenhouse gases were calculated by taking the amount of electricity consumed and multiply it by the emissions factor and the appropriate global warming potential.

Operations

Emissions of greenhouse gases (carbon dioxide, methane, nitrous oxide, and fluorinated gases) that would be associated with normal operation of the proposed CMRR-NF and RLUOB were quantified. This included offsite emissions associated with production of the electricity used on site.

The only direct greenhouse gas emissions from operation of the CMRR-NF and RLUOB are from refrigerants used on site to cool the buildings.

Refrigerants

Emissions from the refrigerants were calculated by taking the amount of material used multiplied by the appropriate global warming potential (Table B–5). Data on the refrigerants used in the CMR Building (which would also be used in the proposed CMRR-NF and RLUOB) show that HFC-134a [1,1,1,2-tetrafluoroethane] is the only refrigerant currently in use (LANL 2011).

Electricity Consumption

Greenhouse gas emissions from electricity generation were calculated using the electricity consumption data given in Section B.2, "Site Infrastructure." The electricity generation emission factors are shown in Table B–4. Emissions of greenhouse gases were calculated by taking the amount of electricity consumed and multiplying it by the emissions factor and the appropriate global warming potential.

The various greenhouse gas emissions were added together and are presented as carbon dioxide equivalent emissions—a sum that describes the quantity of each greenhouse gas weighted by a factor of its effectiveness as a greenhouse gas, using carbon dioxide as a reference. This is achieved by multiplying the quantity of each greenhouse gas emitted by a factor called the global warming potential. The global warming potential accounts for the lifetime and the radiative forcing of each gas over a period of 100 years (for example, carbon dioxide has a much shorter atmospheric lifetime than sulfur hexafluoride; therefore, it has a much lower global warming potential). The global warming potentials for the main greenhouse gases discussed are presented in Table B–5.

B.4 Noise

B.4.1 Description of Affected Resources and Region of Influence

Sound results from the compression and expansion of air or some other medium when an impulse is transmitted through it. Sound requires a source of energy and a medium for transmitting the sound wave. Propagation of sound is affected by various factors, including meteorology, topography, and barriers. Noise is undesirable sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities (hearing and sleep), damage hearing, or diminish the quality of the environment.

Sound-level measurements used to evaluate the effects of nonimpulsive sound on humans are compensated by an A-weighting scale that accounts for the hearing response characteristics (frequency) of the human ear. Sound levels are expressed in decibels, or in the case of A-weighted measurements, decibels A-weighted. EPA has developed noise level guidelines for different land use classifications. Some states and localities have established noise control regulations or zoning ordinances that specify acceptable noise levels by land use category.

Noise from facility operations and associated traffic could affect human and animal populations. The ROI for each candidate site includes the site, nearby offsite areas, and transportation corridors where proposed activities might increase noise levels. Transportation corridors most likely to experience increased noise levels are those roads within a few miles of the site boundary that carry most of the site's employee and shipping traffic.

Sound-level data representative of site environs were obtained from existing reports. The acoustic environment was further described in terms of existing noise sources for each candidate site.

B.4.2 Description of Impact Assessment

Construction noise was evaluated using the Roadway Construction Noise Model, version 1.00, the U.S. Federal Highway Administration's standard model for prediction of construction noise (DOT 2006). The Roadway Construction Noise Model has the capability to model the types of construction equipment that are expected to be the dominant construction-related noise sources associated with this action. All construction noise analyses were assumed to make use of a standard set of construction equipment.

Noise impacts associated with the alternatives may result from construction and operation of facilities and increased traffic (see **Table B–6**). The impacts of facility construction and operation were assessed according to the types of noise sources and the locations of the candidate facilities relative to the site boundary. Potential traffic noise impacts were based on the likely increase in traffic volume. Possible impacts on wildlife were evaluated based on the possibility of sudden loud noises occurring during facility construction or modification and operation.

Table B–6 Impact Assessment Protocol for Noise

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	***Alternative***	
Noise	Identification of sensitive offsite receptors (nearby residences); description of sound levels in the vicinity of the technical area/site	Description of major construction, modification, and operational noise sources; shipment and workforce traffic estimates	Increase in day–night average sound level at sensitive receptors

B.5 Geology and Soils

B.5.1 Description of Affected Resources and Region of Influence

Geologic resources include consolidated and unconsolidated earth materials, including mineral assets such as ore and aggregate materials and fossil fuels such as coal, oil, and natural gas. Geologic conditions include hazards such as earthquakes, faults, volcanoes, landslides, sinkholes, and other conditions leading to land subsidence and unstable soils. Soil resources include the loose surface materials of the earth in which plants grow, usually consisting of mineral particles from disintegrating rock, organic matter, and soluble salts. Certain soils are considered important to farmlands, as designated by the U.S. Department of Agriculture Natural Resources Conservation Service. Important farmlands include prime farmland, unique farmland, and other farmland of statewide or local importance, as defined in 7 CFR 657.5, and may be subject to the Farmland Protection Policy Act (7 U.S.C. 4201 et seq.).

Geology and soils were considered with respect to those attributes that could be affected under the alternatives, as well as those geologic and soil conditions that could affect each alternative. Thus, the ROI for geology and soils includes the CMRR Project site and nearby offsite areas that would be subject to disturbance by facility construction, modification, and operations under the alternatives, as well as those areas beneath existing or new facilities that would remain inaccessible for the life of the facilities. Geologic conditions that could affect the integrity and safety of facilities under the alternatives include large-scale geologic hazards (for example, earthquakes, volcanic activity, landslides, and land subsidence) and local hazards associated with the site-specific attributes of the soil and bedrock beneath site facilities.

B.5.2 Description of Impact Assessment

Facility construction and operations under the alternatives in this *CMRR-NF SEIS* were considered from the perspective of impacts on specific geologic resources and soil attributes. Construction and facility modification activities were the focus of the impacts assessment for geologic and soil resources; hence, one of the key factors considered in the analysis was the land area that would be disturbed during construction and occupied during operations (see **Table B–7**). The assessment included an analysis of the constraints on siting the proposed CMRR-NF over unstable soils that are prone to subsidence, liquefaction, shrink-swell, or erosion.

Table B–7 Impact Assessment Protocol for Geology and Soils

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Geologic hazards	Presence of geologic hazards within the ROI	Location of facility on the site	Potential for damage to facilities
Valuable mineral and energy resources	Presence of any valuable mineral or energy resources within the ROI	Location of facility on the site	Potential to destroy or render resources inaccessible
Important farmland soils	Presence of prime or other important farmland soils within the ROI	Location of facility on the site	Conversion of important farmland soils to nonagricultural use

ROI = region of influence.

The geology and soils impact analysis (see Table B–7) also considered the risks to existing and new facilities from large-scale geologic hazards, such as faulting and earthquakes, lava extrusions and other volcanic activity, landslides, and sinkholes (conditions that tend to affect broad expanses of land). This element of the assessment included collection of site-specific information concerning the potential for impacts on site facilities from local and large-scale geologic conditions. Historical seismicity within a given radius of each facility site was reviewed as a means of assessing the potential for future earthquake activity. In this *CMRR-NF SEIS*, earthquakes are described in terms of the parameters presented in **Table B–8**.

Probabilistic earthquake ground motions, expressed in terms of peak ground acceleration and spectral (response) acceleration, were determined to provide a comparative assessment of seismic hazards. The U.S. Geological Survey National Seismic Mapping Project uses both parameters. The U.S. Geological Survey's latest National Earthquake Hazards Reduction Program maps are based on spectral acceleration and have been adapted for use in the International Building Code (ICC 2000). These maps depict anticipated peak ground accelerations at 0.2- and 1.0-second spectral acceleration, based on a 2 percent probability of exceedance in 50 years (corresponding to an annual probability of occurrence of about 1 in 2,500 in 50 years). Available site-specific seismic hazard analyses were also reviewed and compared.

An evaluation also determined whether construction or operation of proposed facilities at a specific site could destroy or preclude the use of valuable mineral or energy resources.

Pursuant to the Farmland Protection Policy Act of 1981 (7 U.S.C. 4201 et seq.) and its implementing regulations (7 CFR Part 658), the presence of important farmland, including prime farmland, was also evaluated. This act requires agencies to make Farmland Protection Policy Act evaluations part of their NEPA process, primarily to reduce the conversion of farmland to nonagricultural uses by Federal projects and programs. However, otherwise qualifying farmlands in or already committed to urban development, land acquired for a project on or prior to August 4, 1984, and lands acquired or used by a Federal agency for national defense purposes are exempt from the act's provisions (7 CFR 658.2 and 658.3).

Table B–8 The Modified Mercalli Intensity Scale of 1931, with Generalized Correlations to Magnitude and Peak Ground Acceleration

Modified Mercalli Intensity [a]	*Observed Effects of Earthquake*	*Approximate Magnitude* [b]	*Peak Ground Acceleration* [c] *(g)*
I	Usually not felt, except by a very few under very favorable conditions.	Less than 3	Less than 0.0017
II	Felt only by a few persons at rest, especially on the upper floors of buildings.	3 to 3.9	0.0017 to 0.014
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.		
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy object striking building. Standing motor cars rock noticeably.	4 to 4.9	0.014 to 0.039
V	Felt by nearly everyone; at night, many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.		0.039 to 0.092
VI	Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.	5 to 5.9	0.092 to 0.18
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.	6 to 6.9	0.18 to 0.34
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings, with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.	7 to 7.9	0.34 to 0.65
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.		0.65 to 1.24
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.		1.24 and higher
XI	Few, if any, (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.	8 and higher	
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.		

[a] Intensity is a unitless expression of observed effects from earthquake-produced ground-shaking. Effects may vary greatly between locations based on earthquake magnitude, distance from the earthquake, and local subsurface geology. The descriptions given are abbreviated from the Modified Mercalli Intensity scale of 1931.

[b] Magnitude is an exponential function of seismic wave amplitude that is related to the energy released. There are several "magnitude" scales in common use, including local "Richter" magnitude, body-wave magnitude, surface-wave magnitude, and moment magnitude. Each has applicability for measuring particular aspects of seismic signals and may be considered equivalent within each scale's respective range of validity.

[c] Acceleration is expressed as a percent relative to Earth's gravitational acceleration (g) (g = 980 centimeters per second squared). Given values are correlated to Modified Mercalli Intensity based on measurements of California earthquakes only (Wald et al. 1999).

Source: Wald et al. 1999; USGS 2002.

B.6 Surface and Groundwater Quality

B.6.1 Description of Affected Resources and Region of Influence

Water resources are surface water and groundwater suitable for human consumption, traditional and ceremonial uses by Native Americans, aquatic or wildlife propagation, agricultural purposes, irrigation, or industrial/commercial purposes. The ROI used for water resources encompasses those onsite and adjacent surface-water and groundwater systems that could be affected by effluent discharges, and releases (that is, spills) or stormwater runoff associated with facility construction and operational activities under the proposed CMRR Project alternatives and the operation of the CMRR-NF and RLUOB. Water use is addressed in Section B.2.

B.6.2 Description of Impact Assessment

Assessment of the impacts of the proposed CMRR Project alternatives on surface-water and groundwater quality consisted of a comparison of site-generated data and professional estimates regarding effluent discharge with applicable regulatory standards, design parameters, and standards commonly used in the water and wastewater engineering fields, as well as recognized measures of environmental impacts. Certain assumptions were made to facilitate the impacts assessment: (1) all effluent treatment facilities would be approved by the appropriate permitting authority; (2) the effluent treatment facilities would meet effluent limitations imposed by the relevant National Pollutant Discharge Elimination System permits; (3) any stormwater runoff from construction and operation activities would be handled in accordance with the regulations of the appropriate permitting authority; (4) during construction, sediment fencing or other erosion control devices would be used to mitigate the short-term adverse impacts of sedimentation; and (5) as appropriate, stormwater holding ponds would be constructed to reduce the impacts of runoff on surface-water quality.

B.6.2.1 Water Quality

The water quality impacts assessment analyzed how effluent discharges to surface water, as well as discharges reaching groundwater, from facilities under each alternative would directly affect current water quality. The determination of the impacts of the alternatives (summarized in **Table B–9)** consisted of a comparison of the projected effluent quality with relevant regulatory standards and implementing regulations under the Clean Water Act (33 U.S.C. 1251 et seq.), Safe Drinking Water Act (42 U.S.C. 300 (f) et seq.), state laws, and existing site permit conditions. The impacts analysis evaluated the potential for contaminants to affect receiving waters as a result of spills, stormwater discharges, and other releases under the alternatives. Separate analyses were conducted for surface-water and groundwater impacts.

Table B–9 Impact Assessment Protocol for Water Quality

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Facility Design*	
Surface-water quality	Surface water near the facilities in terms of stream classifications and changes in water quality	Expected contaminants and contaminant concentrations in discharges to surface water	Exceedance of relevant surface-water quality criteria or standards established in accordance with the Clean Water Act or state regulations and existing permits
Groundwater quality	Groundwater near the facilities in terms of classification, presence of designated sole-source aquifers, and changes in groundwater quality	Expected contaminants and contaminant concentrations in discharges that could reach groundwater	Contaminant concentrations in groundwater exceeding relevant standards or criteria established in accordance with the Safe Drinking Water Act or state regulations and existing permits

Surface-Water Quality—The evaluation of impacts on surface-water quality focused on the quality and quantity of any effluents (including stormwater) that would be discharged and the quality of the receiving stream resulting from the discharges. The evaluation of effluent quality featured a review of the expected parameters, such as the design average and maximum flows, as well as the effluent parameters reflected in the existing (or expected) National Pollutant Discharge Elimination System permits or applicable state discharge permits. Parameters of concern include total suspended solids, metals, organic and inorganic chemicals, and any other constituents that could affect the local environment. Proposed water quality management practices were reviewed to ensure that any applicable permit limitations and conditions would be met. Factors that currently degrade water quality were also identified.

During facility construction, ground-disturbing activities could affect surface water through increased runoff and sedimentation. Such impacts relate to the amount of land disturbed, type of soil at the site, topography, and weather conditions. These impacts would be minimized by applying standard best management practices for stormwater and erosion control (for example, construction of sediment fences and mulching of disturbed areas).

During operations, surface water could be affected by increased sheet flow runoff from parking lots, buildings, or other cleared areas. Stormwater from these areas could be contaminated with materials deposited by airborne pollutants, automobile exhaust and residues, materials handling releases such as spills, and process effluents. Impacts of stormwater discharges could be highly variable and site-specific, and mitigation would depend on best management practices, holding facility designs, topography, and adjacent land use. Data from existing water quality monitoring sampling results were compared with expected discharges from the facilities to determine the potential impacts on surface water.

Groundwater Quality—Potential groundwater quality impacts associated with any effluent discharges and other contaminant releases during facility construction and operation activities were examined. Available engineering estimates of contaminant concentrations were weighed against applicable Federal and state groundwater quality standards, effluent limitations, and drinking water standards to determine the impacts under each alternative. The consequences of groundwater use and effluent discharge on groundwater conditions were also evaluated.

B.6.2.2 Waterways and Floodplains

The locations of waterways (that is, ponds, lakes, and streams) and the delineated floodplains were identified from maps and other existing documents to assess the potential impacts of facility construction and operations activities, including direct effects on hydrologic characteristics or secondary effects such as sedimentation (see the discussion above on surface water quality). All activities would be conducted to avoid delineated floodplains and to ensure compliance with Executive Order 11988, *Floodplain Management*.

B.7 Ecological Resources

B.7.1 Description of Affected Resources and Region of Influence

Ecological resources include terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. The ROI for the ecological resource analysis encompassed the site and adjacent areas potentially affected by construction and operation activities associated with the proposed alternatives.

Terrestrial resources are defined as those plant and animal species and communities that are most closely associated with the land, or for aquatic resources, a water environment. Wetlands are defined by the U.S. Army Corps of Engineers and EPA as "… those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3).

Federally endangered species are defined under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) as those in danger of extinction throughout all or a large portion of their range. Threatened species are defined as those species likely to become endangered within the foreseeable future. The U.S. Fish and Wildlife Service and the National Marine Fisheries Service propose species to be added to the lists of federally threatened and federally endangered species. These agencies also maintain a list of "candidate" species for which they have evidence that listing may be warranted, but are currently precluded by the need to list species that are more in need of Endangered Species Act protection. Such candidate species do not receive legal protection under the Endangered Species Act, but should be considered in project planning in case they are listed in the future. The LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2000) identifies areas of environmental interest for various federally listed threatened or endangered species for the purpose of managing and protecting these areas because of their significance to biological or other resources. In general, an area of environmental interest consists of a core area that contains important breeding or wintering habitat for a specific species, as well as a buffer area around the core area to protect it from disturbances that would degrade its value. The *Threatened and Endangered Species Habitat Management Plan* defines the types and levels of activities that may be conducted within these areas. The State of New Mexico also designates species as endangered, threatened, or sensitive. The state law is not applicable on Federal lands and potential impacts on the state-protected species are not assessed; however, when staff perform surveys at LANL, they look for and record the occurrence of these species.

B.7.2 Description of Impact Assessment

Impacts on ecological resources may occur as a result of land disturbance, water use, air and water emissions, human activity, and noise associated with CMRR Project implementation (see **Table B–10**). Each of these factors was considered when evaluating the potential impacts of the proposed alternatives. For those activities involving the construction of a new facility or placement of laydown or spoils disposal areas, assessment of direct impacts on ecological resources was based on the acreage of land disturbed by construction. The indirect impacts of factors such as human disturbance and noise were evaluated qualitatively. Indirect impacts on ecological resources due to erosion and sedimentation also were evaluated qualitatively, recognizing that standard erosion and sediment control practices would be followed. Impacts on terrestrial and aquatic ecosystems and wetlands from water use and air and water emissions were evaluated based on the results of the analyses conducted for air quality and water resources. Determination of the impacts on threatened and endangered species was based on factors similar to those noted above for terrestrial resources, wetlands, and aquatic resources, in addition to biological assessments and annual species surveys conducted for this project.

Table B–10 Impact Assessment Protocol for Ecological Resources

Resource	Required Data: Affected Environment	Required Data: Alternative	Measure of Impact
Terrestrial resources	Vegetation and wildlife within the vicinity of CMRR Project activity	CMRR Project activity location and acreage requirements, air and water emissions, and noise	Loss or disturbance of terrestrial habitat, emissions and noise values above levels shown to cause impacts on terrestrial resources
Wetlands	Wetlands within the vicinity of CMRR Project activity	CMRR Project activity location and acreage requirements, air and water emissions, and wastewater discharge quantity and location	Loss or disturbance of wetlands, discharge to wetlands
Aquatic resources	Aquatic resources within the vicinity of CMRR Project activity	CMRR Project activity air and water emissions, water source and quantity, and wastewater discharge location and quantity	Discharges above levels shown to cause impacts on aquatic resources, changes in water withdrawals and discharges
Threatened and endangered species	Threatened and endangered species and areas of environmental interest within the vicinity of CMRR Project activity	CMRR Project activity location and acreage requirements, air and water emissions, noise, water source and quantity, and wastewater discharge location and quantity	Measures similar to those noted above for terrestrial and aquatic resources

CMRR = Chemistry and Metallurgy Research Building Replacement.

B.8 Cultural and Paleontological Resources

B.8.1 Description of Affected Resources and Region of Influence

Cultural resources are indications of human occupation and use of the landscape as defined and protected by a series of Federal laws, regulations, and guidelines. For this *CMRR-NF SEIS*, potential impacts were assessed separately for each of the three general categories of cultural resources: archaeological resources, historic buildings and structures, and traditional cultural properties. Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age, and may be sources of information on ancient environments and the evolutionary development of plants and animals. Although not governed by the same historic preservation laws as cultural resources, they could be affected by the proposed alternatives in much the same manner.

Archaeological resources include any material remains of past human life or activities that are of archaeological interest, including items such as pottery, basketry, bottles, weapons, rock art and carvings, graves, and human skeletal materials. The term also applies to sites that can provide information about past human lifeways. Historic buildings and structures include buildings or other structures constructed after 1942 that have been evaluated for eligibility for the National Register of Historic Places. Traditional cultural properties are defined as a place of special heritage value to contemporary communities (often, but not necessarily, Native American groups) because of their association with the cultural practices or beliefs that are rooted in the histories of those communities and their importance in maintaining the cultural identity of those communities (LANL 2006).

B.8.2 Description of Impact Assessment

The analysis of impacts on cultural and paleontological resources addressed potential direct and indirect impacts at each candidate site from construction and operation (see **Table B–11**). Direct impacts include those resulting from groundbreaking activities associated with new construction and spoils disposal. Indirect impacts include those associated with reduced access to a resource site, as well as impacts associated with increased stormwater runoff, increased traffic, and visitation to sensitive areas.

Table B–11 Impact Assessment Protocol for Cultural and Paleontological Resources

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Archaeological resources	Archaeological resources within the vicinity of CMRR Project activities	CMRR Project activity location and acreage requirement	Potential for loss, isolation, or alteration of the character of archaeological resources; introduction of visual, audible, or atmospheric elements out of character
Historic buildings and structures	Buildings and structures within the vicinity of CMRR Project activities	CMRR Project activity location and acreage requirement	Potential for loss, isolation, or alteration of the character of historic buildings and structures; introduction of visual, audible, or atmospheric elements out of character
Traditional cultural properties	Traditional cultural properties within the vicinity of CMRR Project activities	CMRR Project activity location and acreage requirement	Potential for loss, isolation, or alteration of the character of traditional cultural properties; introduction of visual, audible, or atmospheric elements out of character
Paleontological resources	Paleontological resources within the vicinity of CMRR Project activities	CMRR Project activity location and acreage requirement	Potential for loss, isolation, or alteration of paleontological resources

CMRR = Chemistry and Metallurgy Research Building Replacement.

B.9 Socioeconomics

B.9.1 Description of Affected Resources and Region of Influence

Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics of a region. The number of jobs created by the proposed alternatives could affect regional employment, income, and expenditures. Job creation is characterized by two types: (1) construction-related jobs, which are transient in nature and short in duration, and, thus, less likely to affect public services; and (2) operation-related jobs, which would last for the duration of the proposed CMRR Project and, thus, could create additional service requirements within the ROI.

The ROI for the socioeconomic environment represents a geographic area where site employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. Site-specific ROIs were identified as those counties in which approximately 90 percent or more of the site's workforce resides. This distribution reflects an existing residential preference for people currently employed at LANL and was used to estimate the distribution of workers associated with facility construction and operation under the proposed alternatives.

B.9.2 Description of Impact Assessment

Data were compiled on the current socioeconomic conditions near LANL, including unemployment rates, economic area industrial and service sector activities, and the civilian labor force. The workforce requirements of each alternative were determined to measure their possible effect on these socioeconomic conditions. Although workforce requirements might be met by employees already working at LANL, it was assumed that new employees would be hired to ensure assessment of the maximum impact. Census statistics were also compiled on the local population and housing demand. U.S. Census Bureau population forecasts for the ROI were combined with overall projected workforce requirements for each of the alternatives being considered to determine the extent of the potential impacts on the local economy, population, and housing demand (see **Table B–12**).

Table B–12 Impact Assessment Protocol for Socioeconomics

Resource	***Required Data***		***Measure of Impact***
	Affected Environment	***Alternative***	
Regional Economic Characteristics			
Workforce requirements	Site workforce projections	Estimated construction and operating staff requirements and timeframes	Workforce requirements added to site workforce projections
Region of influence civilian labor force	Labor force estimates	Estimated construction and operating staff requirements and timeframes	Workforce requirements as a percentage of the civilian labor force
Employment	Latest available employment estimates in counties surrounding the site	Estimated construction and operating staff requirements	Potential change in employment
Demographic Characteristics			
Population and demographics of race, ethnicity, and income	Latest available estimates by county from the U.S. Census Bureau	Estimated effect on population	Potential effects on population
Housing Characteristics			
Housing – home owner and renter vacancy rates	Latest available data from the U.S. Census Bureau	Estimated housing unit requirements	Potential change in housing unit availability

B.10 Environmental Justice

B.10.1 Description of Affected Resources and Region of Influence

Environmental justice requires assessment of the potential for disproportionately high and adverse human health or environmental impacts on minority and low-income populations as a result of implementing any of the alternatives analyzed in this *CMRR-NF SEIS*. In assessing these impacts, the following definitions of minority individuals and populations and low-income population were used:

- *Minority individuals:* These individuals are members of one or more of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races.

- *Minority populations:* Minority populations are identified where either (1) the minority population of the affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. "Meaningfully greater" is defined here as 20 percentage points.

- *Low-income population:* Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect (CEQ 1997). The most recent poverty estimates were supplied from the 2005–2009 *American Community Survey 5-Year Estimates*.

Consistent with the impact analysis for the public and occupational health and safety, the affected populations are defined as those minority and low-income populations that reside within 50 miles (80 kilometers) of Technical Area 55.

B.10.2 Description of Impact Assessment

Adverse impacts on offsite populations were measured using the methods presented for the various resource areas described in this appendix and analyzed throughout Chapter 4 of this *CMRR-NF SEIS*. Disproportionately high and adverse impacts occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or another appropriate comparison group. Therefore, estimates of environmental justice impacts were determined using the impacts analysis presented throughout Chapter 4 for the various resource areas to assess the potential for a minority or low-income population to disproportionately bear any adverse impacts.

B.11 Human Health

B.11.1 Description of Affected Resources

Public and occupational health and safety analysis examines the potential adverse human health effects of exposure to ionizing radiation and hazardous chemicals from facility operation. In addition, occupational health and safety analysis examines work-related industrial safety issues that determine potential death, illness, or injury resulting from construction and operation activities. Human health effects for transportation of radioactive materials are discussed in Section B.13.

B.11.1.1 Facility Operation

For facility operation, health effects were determined by identifying the types and quantities of additional radioactive materials and toxic chemicals to which individuals may be exposed and estimating the doses or exposures and resulting indicators of health effects (latent cancer fatalities [LCFs]). The impacts of various releases during both normal activities (facility operations and disposition) and postulated accidents on the health of workers and the public residing within an ROI of 50 miles (80 kilometers) were assessed using site-specific factors such as meteorology, population distribution, and distance to nearby receptors.

B.11.1.2 Industrial Safety

Work-related accidents were evaluated in terms of total recordable cases (TRCs), injuries, and deaths resulting from facility construction, operation, and disposition using LANL, other DOE facility, and Bureau of Labor Statistics historical accidents databases. Two categories of industrial safety impacts, TRCs and fatalities, were analyzed. In addition to fatalities, TRCs include work-related illnesses or injuries that result in loss of consciousness, restriction of work or motion, or transfer to another job, as well as injuries that require medical treatment beyond first aid.

B.11.2 Description of Impact Assessment

B.11.2.1 Facility Operation

Health effects, in terms of incremental doses or exposures and related risks (LCFs), were assessed based on the types and quantities of materials released. Impacts on involved workers were estimated based on operational experience, engineering estimates, and administrative control levels. Models were used to estimate impacts on the health of noninvolved workers and the public resulting from releases during both normal (incident-free) operations and accident conditions. The models used were GENII [Hanford Environmental Radiation Dosimetry Software System (Generation II)] for radioactive air emissions during normal operation (PNNL 2007), MACCS2 [MELCOR Accident Consequences Code System] for accidental releases of radioactive materials (NRC 1998).

B.11.2.2 Industrial Safety

DOE and contractor TRC and fatality incident rates were obtained from DOE's Computerized Accident/Incident Reporting System database. The database was used to collect and analyze DOE and DOE contractor reports of injuries, illnesses, and other accidents that have occurred during DOE operations. General industry data were obtained from information maintained by the Bureau of Labor Statistics. In addition, LANL site-specific TRCs were obtained from the 2008 *LANL SWEIS* and the SWEIS Yearbooks.

A number of occupational incidence rates are available for use in estimating the industrial safety impacts. The rates vary between 1.6 and 4.0 incidents per 200,000 labor hours (see **Table B–13**). This table provides the three most relevant sources of data for this *CMRR-NF SEIS*: LANL site-specific data, DOE and contractor data, and private industry data maintained by the Bureau of Labor Statistics.

The LANL site-specific injury and illness data are summarized in the 2008 *LANL SWEIS* (DOE 2008) as follows: 2.40 and 1.18 for TRCs and days away, restricted, or transferred (DART) rates, respectively. In addition, the similar information for the activities at DOE facilities is projected to result in 1.6 TRCs and 0.7 DARTs, based on the accident cases from 2004 through 2008 (DOE 2011). These rates are well below industry averages, which in 2006 through 2009 were 4.0 TRCs and 2.0 DARTs cases as a result of an occupational injury or illness (BLS 2010).

Table B–13 Total Recordable Cases and Fatality Incident Rates

	Total Recordable Cases (rate [a])	*Fatalities (rate [b])*	*DART (rate [a])*
DOE and contractor	1.6	0.0008	0.7
LANL site-specific	2.4	0.0	1.18
Private industry (BLS)	4.0	0.0038	2.0

BLS = Bureau of Labor Statistics; DART = days away, restricted, or transferred; LANL = Los Alamos National Laboratory.

[a] Average illness and injury cases per 200,000 labor hours from 2004 through 2008 for DOE and 2006 through 2009 for BLS. Days away, restricted, or transferred –DART rate per 200,000 labor hours.

[b] Average fatality rate per 200,000 labor hours from 2004 through 2008 for DOE and 2006 through 2009 for BLS.

Source: BLS 2010a, 2010b; DOE 2011.

B.12 Waste Management and Pollution Prevention

B.12.1 Description of Affected Resources and Region of Influence

Construction of the CMRR-NF is expected to principally generate nonhazardous waste, such as construction and disposition debris. However, because some of the activities associated with construction could occur in the vicinity of potential release sites that require or could potentially require remediation, it is possible that small quantities of other wastes could be generated, including low-level radioactive waste and mixed low-level radioactive waste and/or chemical waste. Operation of the CMRR-NF and RLUOB is expected to generate transuranic and mixed transuranic wastes, low-level radioactive waste, mixed low-level radioactive waste, chemical waste, and nonhazardous waste. Decommissioning, decontamination, and demolition of the CMRR-NF are expected to generate transuranic and mixed transuranic waste, low-level radioactive waste, mixed low-level radioactive waste, chemical waste, and nonhazardous waste.

All of these wastes are defined as follows:

- *Transuranic waste:* Radioactive waste not classified as high-level radioactive waste and containing more than 100 nanocuries per gram of alpha-emitting transuranic isotopes with half-lives greater than 20 years.

- *Mixed transuranic waste:* transuranic waste that also contains hazardous components regulated under the Resource Conservation and Recovery Act (42 U.S.C. 6901 et seq.).

- *Low-level radioactive waste:* Waste that contains radioactive material and is not classified as high-level radioactive waste, transuranic waste, or spent nuclear fuel, or the tailings or wastes produced by extraction or concentration of uranium or thorium from ore processed primarily for its source material. Test specimens of fissionable material irradiated for research and development purposes only (not for the production of power or plutonium) may be classified as low-level radioactive waste, provided the transuranic concentration is less than 100 nanocuries per gram of waste.

- *Mixed low-level radioactive waste:* low-level radioactive waste that also contains hazardous components regulated under the Resource Conservation and Recovery Act.

- *Chemical waste:* Defined as hazardous waste under Resource Conservation and Recovery Act regulations; toxic waste (asbestos and polychlorinated biphenyls) under the Toxic Substances Control Act; and special waste (including industrial waste, infectious waste, and petroleum contaminated soils) under New Mexico's Solid Waste Regulations.

- *Nonhazardous waste:* Discarded material including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations or from community activities. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act (42 U.S.C. 2011 et. seq.).

Waste management activities in support of the proposed alternatives would be contingent on Records of Decision (RODs) issued for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a). In its ROD for transuranic waste (63 FR 3629) and subsequent revisions to this ROD (65 FR 82985, 66 FR 38646, and 67 FR 56989), DOE decided (with one exception) that each DOE site that currently has or will generate transuranic waste would prepare its transuranic waste for disposal and store the waste on site until it could be shipped to the Waste Isolation Pilot Plant in Carlsbad, New Mexico, for disposal. In the ROD for hazardous waste released on August 5, 1998 (63 FR 41810), DOE decided that DOE sites will continue to use offsite facilities for treatment and disposal of major portions of their nonwastewater hazardous waste. Based on the ROD for low-level radioactive waste and mixed low-level radioactive waste issued on February 18, 2000 (65 FR 10061), minimal treatment of low-level radioactive waste will be performed and, to the extent practicable, onsite disposal of low-level radioactive waste will continue. DOE's Hanford Site and Nevada National Security Site (formerly called the Nevada Test Site) will be made available to all DOE sites for disposal of low-level radioactive waste. Mixed low-level radioactive waste analyzed in the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* will be treated at the Hanford Site, Idaho National Laboratory, the Oak Ridge Reservation, and the Savannah River Site and will be disposed of at the Hanford Site and the Nevada National Security Site. This decision does not preclude use of a commercial capability for treatment and/or disposal of low-level radioactive waste and mixed low-level radioactive waste.

B.12.2 Description of Waste Management Impacts Assessment

Waste management impacts were assessed by comparing projected waste stream volumes generated from the proposed activities with LANL's waste management capacities and generation rates (see **Table B–14**). Only impacts relative to the capacities of waste management facilities are considered here; other environmental impacts of waste management facility operations (for example, human health effects) are evaluated in other sections of this *CMRR-NF SEIS* or in other facility-specific or site-wide NEPA documents. Projected waste generation rates for the proposed activities were compared with the site processing rates and capacities of those storage, treatment, and disposal facilities likely to be involved in managing the additional waste.

Table B–14 Impact Assessment Protocol for Waste Management

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Waste management capacity - Transuranic waste - Mixed transuranic waste - Low-level radioactive waste - Mixed low-level radioactive waste - Chemical waste - Nonhazardous waste	Site generation rates for each waste type Management capabilities of potentially affected storage, treatment, and disposal facilities for each waste type	Generation rates from facility construction, operations, and DD&D for each waste type	Waste generation rates in comparison to the capabilities of applicable waste management facilities

DD&D = decommissioning, decontamination, and demolition.

B.13 Transportation

B.13.1 Description of Affected Resources and Region of Influence

Transportation of any commodity involves a risk to both transportation crewmembers and members of the public. This risk results directly from transportation-related accidents and indirectly from increased levels of pollution from vehicle emissions, regardless of the cargo. Transportation of certain materials, such as hazardous or radioactive waste, can pose an additional risk due to the unique nature of the materials themselves. Two types of transportation impacts were analyzed: the impacts of incident-free (routine) transportation and the impacts of transportation accidents. The impacts of incident-free transportation and transportation accidents may be either nonradiological or radiological, or both. Incident-free transportation impacts include radiological impacts on the public and the workers due to the radiation field surrounding the transportation package. Nonradiological impacts of potential transportation accidents include traffic accident fatalities.

For incident-free transportation, the ROI for the affected population includes individuals living within 0.5 miles (800 meters) of each side of the road or rail. For transportation accidents, the ROI for the affected population includes individuals residing within 50 miles (80 kilometers) of the accident; the maximally exposed individual would be an individual located 330 feet (100 meters) directly downwind from the accident.

B.13.2 Impact Assessment

The impact of a specific radiological accident is expressed in terms of probabilistic risk, which is defined as the accident probability (that is, accident frequency) multiplied by the accident consequences. The overall risk is obtained by summing the individual risks from all reasonably conceivable accidents. In addition to calculating the radiological risks that would result from all reasonably conceivable accidents during transportation of radioactive waste, the consequences of maximum reasonably foreseeable accidents (events with a probability greater than 1×10^{-7} [1 chance in 10 million] per year) were assessed. The models used to estimate impacts on the health of the general public resulting from releases during transportation accidents were the Transportation Routing Analysis Geographic Information System (TRAGIS) computer program for route selection and population estimates along the routes, the RADTRAN 6 [Radioactive Material Transportation] risk assessment computer code for incident-free and accident conditions, and the RISKIND [Risks and Consequences of Radioactive Material Transport] computer code for maximum reasonably foreseeable accidents.

The risk from transportation of radioactive materials can be affected by a number of factors. These factors are predominantly categorized as either radiological or nonradiological impacts. Radiological impacts are those associated with the accidental release of radioactive materials and the effects of low levels of radiation emitted during normal, or incident-free, transportation. Nonradiological impacts are those associated with transportation, regardless of the nature of the cargo, such as accidents resulting in death or injury when there is no release of radioactive material.

Shipping packages containing radioactive materials emit low levels of radiation during incident-free transportation. The amount of radiation emitted depends on the kind and amount of material being transported. U.S. Department of Transportation regulations require that shipping packages containing radioactive materials have sufficient radiation shielding to limit the radiation to an acceptable level of 10 millirem per hour at 6.6 feet (2 meters) from the transporter. For incident-free transportation, the potential human health impacts from the radiation field surrounding the transportation packages were estimated for transportation workers and the general population along the route (off traffic, or off-link), people sharing the route (in traffic or on-link), people at rest areas, and at stops along the route. RADTRAN 6 (SNL 2009) was used to estimate the impacts for transportation workers and populations, as well as the impact on a maximally exposed individual (a person stuck in traffic, a gas station attendee, an inspector, etc.) who could be a worker or a member of the public.

Transportation accidents involving radioactive materials present both nonradiological and radiological risks to workers and the public. Nonradiological impacts of potential transportation accidents include traffic accident fatalities. A release of radioactive material during transportation accidents would occur only when the package carrying the material is subjected to accident forces that exceed the package design standard. The impact of a specific radiological accident is expressed in terms of probabilistic risk, which is defined as the accident probability (that is, accident frequency) multiplied by the accident consequences. The overall risk is obtained by summing the individual risks from all reasonably conceivable accidents. The analysis of accident risks takes into account a spectrum of accident severities ranging from high-probability accidents of low severity (for example, a fender bender) to hypothetical high-severity accidents that have a correspondingly low probability of occurrence. Only as a result of a severe fire and/or a powerful collision, which are of extremely low probability, could a transportation package of the type used to transport radioactive material under the alternatives of this *CMRR-NF SEIS* be damaged to the extent that there could be a release of radioactivity to the environment with significant consequences.

In addition to calculating the radiological risks that would result from all reasonably conceivable accidents during transportation of radioactive wastes, DOE assessed the highest consequences of a maximum reasonably foreseeable accident with a radioactive release frequency greater than 1×10^{-7} (1 chance in 10 million) per year along the route. The latter consequences were determined for atmospheric conditions that would prevail during accidents. The analysis used RISKIND to estimate doses to individuals and populations (Yuan et al. 1995).

Incident-free health impacts are expressed in terms of additional LCFs. Radiological accident health impacts are also expressed as additional LCFs, and nonradiological accident risk as additional immediate (traffic) fatalities. LCFs associated with radiological exposure were estimated by multiplying the occupational (worker) and public dose by 6.0×10^{-4} LCFs per person-rem of exposure (DOE 2003a).

To determine transportation risks, per-shipment risk factors were calculated for the incident-free and accident conditions using RADTRAN 6 (SNL 2009) in conjunction with TRAGIS (Johnson and Michelhaugh 2003) to choose transportation routes in accordance with U.S. Department of Transportation regulations. TRAGIS calculates transportation routes in terms of distances traveled in rural, urban, and suburban areas. It provides population density estimates based on the 2000 Census for each area along the routes to determine population radiological risk factors. For incident-free operations, the affected population includes individuals living within 0.5 miles (800 meters) of each side of the road or rail line. For accident conditions, the affected population includes individuals living within 50 miles (80 kilometers) of the accident, and the maximally exposed individual is assumed to be an individual located 330 feet (100 meters) directly downwind from the accident.

For determining traffic accident fatalities from offsite commercial truck transportation, separate accident rates and accident fatality risks were used for rural, suburban, and urban population zones. These accident and fatality rates were taken from data provided in *State-Level Accident Rates for Surface Freight Transportation: A Reexamination (Accident Rates Report)*, (Saricks and Tompkins 1999). The values selected were the mean accident and fatality rates given in the *Accident Rates Report* for "interstate," "total," and "primary." These values were assigned to rural, suburban, and urban population zones, respectively. Accident rates are generically defined as the number of accident involvements (or fatalities) in a given year per unit of travel in that same year. Therefore, the rate is a fractional value, with accident involvement count as the numerator of the fraction and vehicular activity (total travel distance in truck-kilometers) as its denominator. The accident rates for rural, suburban, and urban zones were 3.15, 3.52, and 3.66 per 10 million truck-kilometers, respectively; and the fatality rates were 0.88, 1.49, and 2.32 per 100 million truck-kilometers, respectively.

A review of the truck accidents and fatalities reports by the Federal Carrier Safety Administration indicated that state-level accidents and fatalities were underreported. For the years 1994 through 1996, which were the basis for the analysis in the *Accident Rates Report*, the review found that accidents were underreported by about 39 percent and fatalities were underreported by about 36 percent (UMTRI 2003). Therefore, truck accident and fatality rates in the *Accident Rates Report* were increased by factors of 1.64 and 1.57, respectively, to account for the underreporting.

For determining traffic accident fatalities from local and regional transportation of industrial and hazardous waste, New Mexico state accident and fatality rates, which are also given in the *Accident Rates Report*, were used. The rates used were 1.13 accidents per 10 million truck-kilometers and 1.18 fatalities per 100 million truck-kilometers. For assessment purposes, the total number of expected accidents or fatalities was calculated by multiplying the total shipment distance for a specific waste by the accident or fatality rate.

Radiological consequences were calculated by assigning radionuclide release fractions on the basis of the type of waste, the type of shipping container, and the accident severity category. The release fraction is defined as the fraction of the radioactivity in the container that could be released to the atmosphere in an accident with a given level of severity. Release fractions vary according to waste type and the physical or chemical properties of the radioisotopes. Most solid radionuclides are nonvolatile and are, therefore, relatively nondispersible.

Representative release fractions were developed for each waste and container type on the basis of DOE and U.S. Nuclear Regulatory Commission reports (DOE 1994, 1997b, 2002, 2003b; NRC 1977, 2000). The severity categories and corresponding release fractions provided in these documents cover a range of accidents from no impact (zero speed) to impacts with speeds in excess of 120 miles (193 kilometers) per hour onto an unyielding surface. Traffic accidents that could occur at the site would be of minor impact due to lower local speed, with no release potential.

As stated earlier, offsite route characteristics were determined using TRAGIS, which determines routes for shipment of radioactive materials that conform to U.S. Department of Transportation regulations as specified in 49 CFR Part 397. The TRAGIS-generated population densities along the routes were extrapolated to the year 2030, based on state population growths from the 2000 Census and 2010 Census. The specific route selected determines both the total potentially exposed population and the expected frequency of transportation-related accidents. Route characteristics are expressed in terms of travel distances and population densities in rural, suburban, and urban areas according to the following breakdown:

- Rural population densities range from 0 to 139 persons per square mile (0 to 54 persons per square kilometer).
- Suburban population densities range from 140 to 3,326 persons per square mile (55 to 1,284 persons per square kilometer).
- Urban population densities include all population densities greater than 3,326 persons per square mile (1,284 persons per square kilometer).

Route characteristics were determined for offsite shipments from the LANL site to the following sites:

- Nevada National Security Site in Mercury, Nevada
- Energy Solution Site in Clive, Utah, as a representative of a commercial disposal site
- Waste Isolation Pilot Plant in Carlsbad, New Mexico

In addition, route characteristics for local routes, that is, LANL to Pojoaque (along Route 502), and Pojoaque to Interstate 25 (south of Santa Fe), were also determined. **Table B–15** summarizes the route characteristics for these sites.

Table B–15 Offsite Transport Truck Route Characteristics

Origin	*Destination*	*Nominal Distance (miles)*	*Distance Traveled in Zones (miles)*			*Population Density in Zone (persons per square mile)*			*Number of Affected Persons* [a]
			Rural	*Suburban*	*Urban*	*Rural*	*Suburban*	*Urban*	
Truck Routes									
LANL	NNSS	777	664	88	25	37.0	1,541.6	10,951.0	427,304
	Commercial [b]	669	583	70	16	30.8	1,790.4	11,743.8	333,612
	WIPP	376	353	22	1.2	22.3	943.5	7,106.7	37,050
Truck Routes (local from Interstate 25 to LANL)									
LANL to Pojoaque		19	17	2.4	0.1	21.8	1,362.3	9,048.9	4,681.0
Pojoaque to Santa Fe [c]		32	27	5	0	71.0	670.3	0	5,169.0

LANL = Los Alamos National Laboratory, NNSS = Nevada National Security Site, WIPP = Waste Isolation Pilot Plant.
[a] The estimated number of persons residing within 0.5 miles along the transportation route.
[b] Energy Solution is a representative commercial disposal facility.
[c] Pass through Santa Fe bypass (New Mexico 599) to Interstate 25.
Note: To convert miles to kilometers multiply by 1.6093; persons per square mile to persons per square kilometer, multiply by 0.3861.

Figure B–1 shows the analyzed truck routes for shipments of radioactive waste materials in this *CMRR-NF SEIS*.

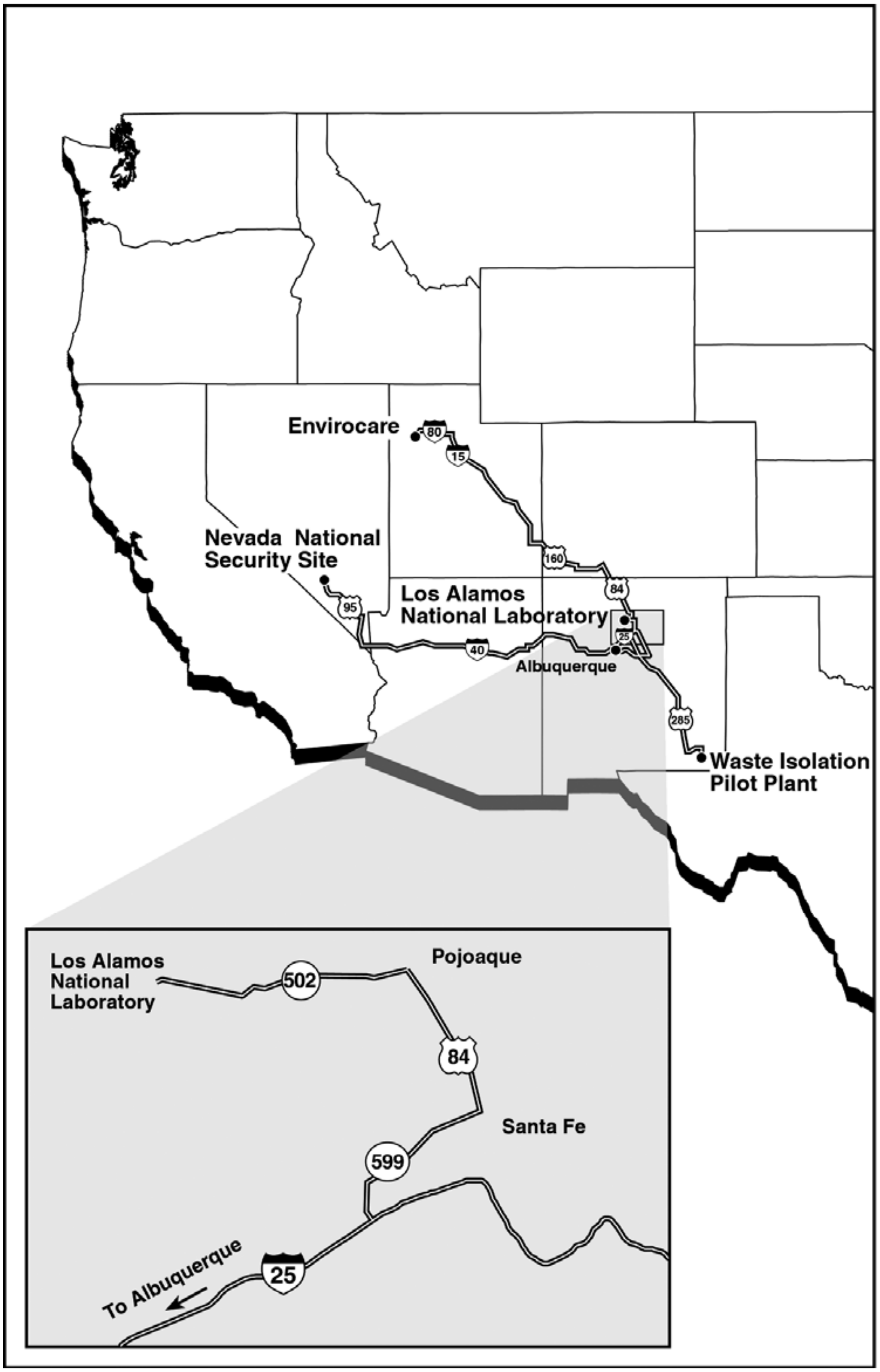

Figure B–1 Analyzed Truck Routes

B.14 Traffic

B.14.1 Description of Affected Resources

This analysis involved a review of engineering estimates or the calculation of engineering estimates of transportation and traffic associated with construction of the CMRR-NF and operation of the CMRR-NF and RLUOB. The impacts of the proposed alternatives were evaluated with respect to internal LANL roadways, access control points, and public roadway network near LANL under both existing and future conditions. Potential shifts in traffic created by the proposed alternatives and corresponding trip generation were estimated. The expected trips were then assigned to road segments. Based on these assumptions, net changes in vehicle volumes were developed and analyzed for each alternative.

The traffic generated by the proposed CMRR-NF construction and operation of the CMRR-NF and RLUOB was estimated, and the impact of that traffic was evaluated for the affected roadway segments. That traffic was added to the expected traffic volume on the respective roadways and the level of service (LOS) was determined for each segment. The LOSs determined for the proposed alternatives were then compared to determine the impacts on the roadways in question.

Increases in peak hour traffic of fewer than 100 vehicles per hour are generally considered not to be significant by transportation engineers in determining LOSs. The operation of the CMRR-NF and RLUOB is not anticipated to generate more trips than the existing facilities. The impacts of the construction of the proposed CMRR-NF are addressed separately. In addition to the impacts on traffic volume, the possible impacts on the existing roadways of the construction traffic are evaluated.

B.14.2 Methodology Used to Analyze Traffic Volume Impacts

Analysis of traffic volume impacts focused on assessing the ability of the existing roadway system to accommodate increased utilization of particular road segments. The number of trips that would be generated by the proposed alternatives was estimated. The level of traffic on each roadway analyzed was estimated using publicly available information from the New Mexico Department of Transportation (Valencia 2010) and from prior traffic studies on LANL. The level of traffic was escalated by an assumed rate of growth on public roadways. Traffic impacts were evaluated for the year construction is expected to begin and for the year construction is expected to be completed. The LOSs for selected roadways were then determined using the methods and tables contained in the 2000 *Highway Capacity Manual* (National Research Council 2000). Construction was considered to occur between 2010 through 2014 under the No Action Alternative, between 2010 and 2022 under the Modified CMRR-NF Alternative Deep Excavation Option, and between 2010 and 2020 under the Shallow Excavation Option.

Traffic volumes are typically based on the number of expected vehicles in a 1-hour period, also called the peak hourly volume, which is defined by traffic engineers as the 30^{th} highest traffic volume expected in any 60-minute period of a calendar year. To understand the function of the roadway under its peak traffic loading, the LOS is determined based on the peak hourly volume.

The number of peak-hour trips expected to be gained or lost due to CMRR-NF construction was estimated using methods contained in *Trip Generation, 7^{th} Edition* (ITE 2003). For each alternative, the expected traffic was added to the traffic volumes forecast for the affected roadway for the year when construction begins and the year when construction is anticipated to end. The expected change in LOS under each alternative was then determined using the 2000 *Highway Capacity Manual* (National Research Council 2000).

According to the traffic-count information provided by the New Mexico Department of Transportation, the roadways surrounding LANL have experienced an annual average growth in total vehicles/trips of between 0 percent and 0.8 percent (Valencia 2010). This analysis assumed the transportation growth rates for the road segments analyzed would continue at the same rates as those of past years.

Traffic on roadways is measured by their LOS, as generally defined below.

- **LOS A** describes the highest quality of traffic service, with drivers able to travel at their desired speed. Drivers find driving on LOS A roadways to be stress-free.
- **LOS B** describes a condition where drivers have some restrictions on their speed of travel. Most drivers find LOS B roadways slightly stressful.
- **LOS C** describes a condition of stable traffic flow, but with significant restrictions on drivers' ability to travel at desired speeds. Most drivers find LOS C roadways somewhat stressful.
- **LOS D** describes unstable traffic flow. Drivers are restricted into slow-moving platoons, and disruptions in the traffic flow can cause significant congestion. There is little or no opportunity to pass slower-moving traffic. Most drivers find LOS D roadways stressful.
- **LOS E** represents the highest volume of traffic that can move on the roadway without a complete shutdown. Most drivers find LOS E roadways very stressful.
- **LOS F** represents heavily congested flow with traffic demand exceeding capacity. Traffic flows are slow and discontinuous. Most drivers find LOS F roadways extremely stressful.

Traffic volumes on existing roadways are expected to increase over time and the LOSs of those roadways are expected to decrease unless roadway improvements are made. As LOSs deteriorate, roadway improvements become more likely. Significant impacts on traffic LOSs are generally considered to occur when the LOSs on the studied roadway segments fall below the acceptable LOS for those roadways. Each roadway segment has an acceptable LOS determined by local authorities responsible for that segment. Generally, in urban areas, an acceptable LOS is LOS D, or sometimes LOS E. In rural areas, an acceptable LOS is LOS C or better. It is significant if the LOS falls below the expected LOS at an earlier time. For example, it would be significant if a roadway segment were projected to reach LOS E in 2020 and impacts under the proposed alternatives were to cause the LOS to fall to LOS E in 2015.

LOS changes that are not considered significant typically include any LOS changes caused by changes in peak-hour trips of less than 100 vehicles per hour. The LOS designations are a continuum based on motorists perceptions, and it is unlikely that changes of less than 100 vehicles per hour would greatly inconvenience motorists even if that change results in a change in the LOS letter assignment. It is also not considered a significant change if the LOS changes from one acceptable LOS to another acceptable LOS. For example, if LOS changes from LOS A to LOS B this would not be considered a significant change. Any changes that are not significant would be considered acceptable changes.

B.14.3 Vehicle Control Points

A Vehicle Control Point (VCP) is a facility entrance/exit where the identities of vehicle occupants are verified prior to their being allowed to proceed inside or outside the bounds of the secured facility. Typical security checks include inspections of vehicle decals, driver and passenger identifications, and the contents of vehicles. The capacity of a VCP is limited and depends on the type of security check being used. If the volume of traffic attempting to utilize a VCP exceeds the capacity of the VCP to process that traffic, roadway backups will occur. Traffic impacts on VCPs were determined by estimating the number of trips generated, using the methodology found in the Institute of Transportation Engineers *Trip Generation* 2003 report (similar to the methodology used to analyze impacts on roadways). The abilities of VCPs to function adequately at the levels of traffic estimated were evaluated using the methods contained in *Traffic and Safety Engineering for Better Entry Control Facilities* (SDDCTEA 2006).

B.14.4 Structural Impacts on Internal Roadways at Los Alamos National Laboratory

Some of the material deliveries would need to pass over internal LANL roadways. The existing roadways at LANL are constructed using asphaltic concrete. These roadways were originally constructed as part of an industrial facility, so it is expected that they were constructed for some level of truck traffic. However, the trucks in common usage today are much heavier than those anticipated for use in the 1950s and 1960s, the timeframe of the LANL roadways' construction.

Analysis using methods contained in the *American Association of State Highway and Transportation Officials Guide for Design of Pavement Structures* (AASHTO 1993), and assuming "fair" soil conditions, indicates that an asphaltic concrete pavement structure would need to have a minimum pavement structure of a 2-inch (5-centimeter) asphaltic concrete surface course, a 4-inch (10-centimeter) asphaltic concrete base course, and a 6-inch (15-centimeter) aggregate base over a prepared subgrade to support the expected truck traffic without significant damage to the roadways. If the LANL roadways are of a lesser thickness, or are already significantly deteriorated, then the expected construction traffic is expected to affect the roadways. Any public roadways utilized by construction traffic are expected to be substantially thicker than the minimum described above and structural impacts are not anticipated.

B.15 Cumulative Impacts

Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time (40 CFR 1508.7). The cumulative impact analysis for this *CMRR-NF SEIS* involved combining the impacts of the alternatives with the impacts of other past, present, and reasonably foreseeable activities in the ROI. The key resources are identified in **Table B–16**.

Table B–16 Key Resources and Associated Regions of Influence

Resources	***Region of Influence***
Infrastructure use	The site and Los Alamos County
Air quality	The site, nearby offsite areas within local air quality control regions where significant air quality impacts may occur, and Class I areas within 62 miles
Transportation	Transportation corridors to offsite disposal locations and population centers along the transportation routes
Radiological	Persons residing within 50 miles of Los Alamos National Laboratory
Waste management	The site

Note: To convert miles to kilometers, multiply by 1.6093.

In general, the cumulative impacts were determined by collectively considering the baseline affected environment (conditions attributable to present actions by DOE and other public and private entities), the proposed alternatives, and other future actions. Quantifiable information was incorporated to the degree it was available. Factors were weighed against the appropriate impact indicators (site capacity or number of fatalities) to determine the potential for impacts (see **Table B–17**).

Table B–17 Selected Indicators of Cumulative Impact

Category	*Indicator*
Infrastructure use	- Electricity use compared with site and county capacity - Water use compared with site and county capacity - Natural gas use compared with site and county capacity
Air quality	Criteria pollutant concentrations and comparisons with standards or guidelines
Transportation	Accidents
Radiological	Radiological emissions and exposure compared with standards or guidelines
Waste management	Waste generated compared to previous site estimates

The analysis focused on the potential for cumulative impacts at LANL from DOE actions under detailed consideration at the time of this *CMRR-NF SEIS*, as well as cumulative impacts associated with transportation. The 2008 *LANL SWEIS* was used to establish the baseline conditions against which the incremental cumulative impacts were assessed and later information was collected on future actions where available.

B.16 References

AASHTO (American Association of State Highway and Transportation Officials), 1993, *Guide for Design of Pavement Structures*, ISBN 1-56051-055-2, Washington, DC.

BLS (Bureau of Labor Statistics), 2010a, *Workplace Injuries and Illnesses-2009*, Chart 1 Total recordable nonfatal occupational injury and illness incident rates by case type, private industry, 2003-2009 (available at http://www.bls.gov/iif/oshsum.htm), November 18.

BLS (Bureau of Labor Statistics), 2010b, Census of Fatal Occupational Injuries (CFO1) Charts; 1992-2009," (available at http://www.bls.gov/iif/oshcfoil.htm#charts), November 18.

CEQ (Council on Environmental Quality), 1997, E*nvironmental Justice Guidance Under the National Environmental Policy Act*, Executive Office of the President, Washington, DC, December 10.

CEQ (Council on Environmental Quality), 2010, *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions*, February 18.

DOE (U.S. Department of Energy), 1994, *DOE Handbook – Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facility*, DOE-HDBK-3010-94 (Change Notice No. 1, March 2000), Washington, DC, December.

DOE (U.S. Department of Energy), 1997a, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste,* DOE/EIS-0200-F, Office of Environmental Management, Washington, DC, May.

DOE (U.S. Department of Energy), 1997b, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, New Mexico, September.

DOE (U.S. Department of Energy), 2002, *A Resource Handbook on DOE Transportation Risk Assessment*, DOE/EM/NTP/HB-01, Office of Environmental Management, National Transportation Program, Albuquerque, New Mexico (available at http://www.ntp.doe.gov/readnews21.shtml), July.

DOE (U.S. Department of Energy), 2003a, *Recommended Radiation Risk Factors Updated*, National Environmental Policy Act Lessons Learned, Office of NEPA Policy and Compliance, Quarterly Report, Issue No. 34, Washington, DC, March 3.

DOE (U.S. Department of Energy), 2003b, *West Valley Demonstration Project Waste Management Environmental Impact Statement*, Final, DOE/EIS-0337F, West Valley Area Office, West Valley, New York, December.

DOE (U.S. Department of Energy), 2008, *Final Site-wide Environmental Impact Statement for Continued Operation of los Alamos National Laboratory, Los Alamos, New Mexico*, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, May.

DOE (U.S. Department of Energy), 2011, *Computerized Accident Incident Reporting and Recordkeeping system (CAIRS)*, "DOE and Contractor Injury and Illness Experience by Year by Quarter, 2002 through 2009, 4th Quarter," Office of Health, Safety and Security (available at http://www.hss.energy.gov/CSA/Analysis/ cairs/cairs/summary/oipds094/tl.html), February 4.

DOI (U.S. Department of the Interior), 1986, *Visual Resource Contrast Rating*, BLM Manual Handbook H-8431-1, Bureau of Land Management, Washington, DC, January 17.

DOT (U.S. Department of Transportation), 2006, *FHWA Roadway Construction Noise Model User's Guide.* Prepared for the U.S. Department of Transportation Federal Highway Administration Office of Environment Planning, Washington, DC, January.

EPA (U.S. Environmental Protection Agency), 2003, *Mobile Source Emission Factor Model (MOBILE6.2)*. Office of Mobile Sources, Ann Arbor, Michigan.

EPA (U.S. Environmental Protection Agency), 2006, *Mid-Atlantic Integrated Assessment: Mid-Atlantic Highlands Streams Assessment*, Appendix C, "Glossary" (available at http://www.epa.gov/maia/thml/mah-apc.html), March 3.

EPA (U.S. Environmental Protection Agency), 2008, Greenhouse Gas Inventory Protocol Core Module Guidance, Direct Emissions from stationary combustion sources, May 2008.

EPA (U.S. Environmental Protection Agency), 2009, *Federal Register*, 40 Code of Federal Regulation (CFR) Parts 86, 87, 89, 98, Mandatory Reporting of Greenhouse Gases, Final Rule, EPA-HQ-OAR-2008-0508-2278, October 30.

EPA (U.S. Environmental Protection Agency), 2010a, *Screening* Models, Technology Transfer Network Support Center for Regulatory Atmospheric Modeling (available at http://www.epa.gov/ttn/scram/dispersion_screening.htm#aerscreen), November 15.

EPA (U.S. Environmental Protection Agency), 2010b, *Alternative Models*, Technology Transfer Network Support Center for Regulatory Atmospheric Modeling (available at http://www.epa.gov/scram001/dispersion_alt.htm), November 15.

EPA (U.S. Environmental Protection Agency), 2010c, USEPA eGRIDweb Version 1.1, eGRID2007 Subregion AZNM—WECC Southwest (available at http://cfpub.epa.gov/egridweb/), December 15.

Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, October 5, 2009.

ICC (International Code Council, Inc.), 2000, *International Building Code*, Falls Church, Virginia, March.

IPCC (Intergovernmental Panel on Climate Change), 2007, *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, United Kingdom and New York, New York, pp. 996.

ITE (Institute of Transportation Engineers), 2003, *Trip Generation, 7th Edition*, ISBN No:0.935403-79-5, Washington, DC.

Johnson, P. E., and R. D. Michelhaugh, 2003, *Transportation Routing Analysis Geographic Information System (TRAGIS)–User's Manual*, ORNL/NTRC-006, Rev. 0 (available at http://apps.ntp.doe.gov/tragis/tragis.htm), U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, Tennessee, June.

LANL (Los Alamos National Laboratory), 2000, *Threatened and Endangered Species Habitat Management Plan*, LA-UR-00-4747, Los Alamos, New Mexico, April.

LANL (Los Alamos National Laboratory), 2006, *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico*, LA-UR-04-8964, March.

LANL (Los Alamos National Laboratory), 2011, "Supplemental Environmental Impact Statement for the Nuclear Facility Portion of the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico," Data Call Response.

National Research Council, 2000, *National Research Council Highway Capacity Manual*, HCM2000, ISBN 0-309-06746-4, Transportation Research Board, Washington, DC.

NRC (U.S. Nuclear Regulatory Commission), 1977, Final Environmental Impact Statement on the Transportation of Radioactive Materials by Air and Other Modes, NUREG-0170, Washington, DC, December.

NRC (U.S. Nuclear Regulatory Commission), 1998, *Code Manual for MACCS2, Volume 1, User's Guide*, NUREG/CR-6613, Washington DC, May.

NRC (U.S. Nuclear Regulatory Commission), 2000, *Reexamination of Spent Fuel Shipping Risk Estimates*, NUREG/CR-6672, SAND2000-0234 (available at http://ttd.sandia.gov/nrc/docs.htm), Washington, DC, March.

PNNL (Pacific Northwest National Laboratory), 2007, *GENII Version 2 Users' Guide*, PNLL-14583, REV. 2, Richland, Washington, March.

Saricks, C., and M. M. Tompkins, 1999, *State-Level Accident Rates for Surface Freight Transportation: A Reexamination*, ANL/ESD/TM-150, Center for Transportation Research, Argonne National Laboratory, U.S. Department of Energy, Argonne, Illinois, April.

SDDCTEA (Military Surface Deployment and Distribution Command Transportation Engineering Agency), 2006, *Traffic and Safety Engineering for Better Entry Control Facilities*, Pamphlet 55-16, Newport News, Virginia.

SNL (Sandia National Laboratories), 2009, RadCat 3.0 User Guide, SAND2009-5129P, Albuquerque, New Mexico, and Livermore, California, May.

UMTRI (University of Michigan Transportation Research Institute), 2003, "Evaluation of the Motor Carrier Management Information System Crash File, Phase One," UMTRI-2003-06, Center for National Truck Statistics, Ann Arbor, Michigan, March.

USGS (U.S. Geological Survey), 2002, *General Earthquake Information*, Magnitude and Intensity, Modified Mercalli Intensity Scale, Magnitude/Intensity Comparison, Frequently Asked Questions (available at http://neic.usgs.gov/neis/general/handouts/), December 27.

Valencia, B., 2010, Management Analyst, New Mexico Department of Transportation, Santa Fe, New Mexico, Personal communication (email) to M. Smith, Science Applications International Corporation, St. Louis, Missouri, "Looking for Traffic Count Information in Los Alamos County" November 4.

Wald, D. J., V. Quitoriano, T. H. Heaton, and H. Kanamori, 1999, "Relationships Between Peak Ground Acceleration, Peak Ground Velocity and Modified Mercalli Intensity in California," *Earthquake Spectra*, Vol. 15 (3), pp. 557-564 (available at http://www-socal.wr.usgs.gov/ shake/pubs/regress/regress.html).

Yuan, Y. C., S. Y. Chen, B. M. Biwer, and D. J. LePoire, 1995, *RISKIND - A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel*, ANL/EAD-1, Argonne National Laboratory, Argonne, Illinois, November.