Disclaimer
What follows is an excerpted, condensed rendition of the 2002 U.S. Department of Energy's "Final Environmental Impact Statement For a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada." The purpose of this document is to retain the structure and language of the original but in an abbreviated form to achieve greater accessibility for a wider audience. Whilst minor edits have been made in the interest of clarity, this should be considered an abridged reproduction of the original.

Final Environmental Impact Statement
For a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada

Volume I Chapter 3 (abridged)
Affected Environment
Pgs. 3-1 – 3-194 (176 – 360)

3. AFFECTED ENVIRONMENT

Chapter 3 describes (1) environmental conditions that will exist at and in the region of the proposed repository site at Yucca Mountain after the conclusion of site characterization activities (Section 3.1); (2) environmental conditions along the proposed transportation corridors in Nevada that DOE could use to ship spent nuclear fuel and highlevel radioactive waste to the Yucca Mountain site (Section 3.2); and (3) environmental conditions at the 72 commercial and 5 DOE sites in the United States that manage spent nuclear fuel and high-level radioactive waste (Section 3.3).

3.1 Affected Environment at the Yucca Mountain Repository Site at the Conclusion of Site Characterization Activities

DOE has compiled environmental baseline information for 13 subject areas. Human health risks from exposure to airborne contaminant emissions were assessed for an area within approximately 80 kilometers (50 miles), and economic effects, such as job and income growth, were evaluated in a three-county socioeconomic region. In the past, the vicinity around Yucca Mountain has been the subject of a number of studies in support of mineral and energy resource exploration, nuclear weapons testing, and other DOE activities at the Nevada Test Site. From 1977 to 1988, the Yucca Mountain Project performed studies to assist in the site selection process for a repository. These studies, which involved the development of roads, drill holes, trenches, and seismic stations, along with non-Yucca Mountain activities, disturbed about 2.5 square kilometers (620 acres) of land in the vicinity of Yucca Mountain.

3.1.1 LAND USE AND OWNERSHIP

The region of influence for land use and ownership includes land at the site of the proposed repository that DOE would not disturb and the lands that surround the site of the proposed repository over which DOE would have to obtain permanent control to operate the repository.

3.1.1.1 Regional Land Use and Ownership

The Federal Government manages more than 85 percent of the land in Nevada (about 240,000 square kilometers or 93,000 square miles). Most of this land is under the control of the Bureau of Land Management (which is part of the U.S. Department of the Interior), the U.S. Department of Defense, and DOE. The remainder of the Federally managed land is primarily under the jurisdiction of the Forest Service, which is part of the U.S. Department of Agriculture, with smaller areas under the control of the National Park Service and the Bureau of Reclamation, both of which are parts of the Department of the Interior.

The region has special-use areas, which generally are excluded from development that would require terrain alterations unless such alterations would benefit wildlife or public recreation. There is virtually no State-owned land immediately adjacent to the repository site. There are scattered tracts of private land in and near communities such as Beatty and Indian Springs in Nevada. There are also larger private

tracts in the Las Vegas Valley, around Pahrump, and in the south-central portion of the large area that makes up Amargosa Valley. The closest year-round housing is at what was once referred to as Lathrop Wells, about 22 kilometers (14 miles) south of the site.

3.1.1.2 Current Land Use and Ownership at Yucca Mountain
The Yucca Mountain Site Characterization Office and the DOE Nevada Operations Office have a management agreement that allows the use of about 230 square kilometers (58,000 acres) of Nevada Test Site land for site characterization activities. The Land Facility Use Management Policy under the Memorandum of Agreement with the Nevada Test Site gives the Yucca Mountain Project technical responsibility independent of, but in coordination with, environmental activities at the Nevada Test Site.

3.1.1.3 Potential Repository Land Withdrawal
As noted, portions of the lands being used for site characterization that would be required for the repository are controlled by the Bureau of Land Management, the Air Force, and the DOE Nevada Operations Office. Because all of these lands are not under permanent DOE control, a land withdrawal would be required. The procedure for land withdrawal is the method by which the Federal Government places exclusive control over land it owns with a particular agency for a particular purpose. Only Congress has the power to withdraw Federal lands permanently for the exclusive purposes of specific agencies.

3.1.1.4 Native American Treaty Issue
One Native American ethnic group with cultural and historic ties to the Yucca Mountain region is the Western Shoshone. A special concern of the Western Shoshone people is the Ruby Valley Treaty of 1863. The Western Shoshone people maintain that the treaty gives them rights to 97,000 square kilometers (24 million acres) in Nevada, including the Yucca Mountain region. A 1985 U.S. Supreme Court decision (DIRS 148197-United States v. Dann 1985, all) ruled that even though the money has not been distributed, the United States has met its obligations with the Commission's final award and, as a consequence, the aboriginal title to the land had been extinguished.

3.1.2 AIR QUALITY AND CLIMATE
3.1.2.1 Air Quality
Air quality is determined by measuring concentrations of certain pollutants in the atmosphere. the Clean Air Act requires Federal agencies to ensure that their actions conform to applicable implementation plans for achieving and maintaining National Ambient Air Quality Standards for criteria pollutants. The quality of the air at the site of the proposed repository and the surrounding parts of the Nevada Test Site, Nellis Air Force Range (including southwestern Lincoln County), southwestern Esmeralda County, and southern Nye County is unclassified because there are limited air quality data (40 CFR 81.329).

In 1989, DOE began monitoring particulate matter at the site of the proposed repository as part of site characterization activities and later as part of the Nevada Air Quality operating permit requirements. Concentration levels of inhalable particles smaller than 10 micrometers in diameter have been well below applicable National Ambient Air Quality Standards, with annual average concentrations 20 to 25 percent of the standard. From October 1991 through September 1995, DOE monitored the site of the proposed repository for gaseous criteria pollutants (carbon monoxide, nitrogen dioxide, ozone, and sulfur dioxide) as part of site characterization. The concentration levels of each pollutant were well below the applicable National Ambient Air Quality Standards.

3.1.2.2 Climate
The Yucca Mountain region has a relatively arid climate, with annual precipitation totals ranging between approximately 10 and 25 centimeters (4 and 10 inches) per year. Climate studies and analyses pursued as part of the Yucca Mountain project have also included paleoclimatology, which is the study of ancient climates. These studies looked at time scales as large as hundreds of millennia. The primary assumption associated with paleoclimatology efforts is that climate is cyclical so that past climates provide insight into potential future climate.

3.1.3 GEOLOGY

3.1.3.1 Physiography (Characteristic Landforms)

Yucca Mountain is in the southern part of the Great Basin subprovince of the Basin and Range Physiographic Province, a region characterized by generally north-trending, linear mountain ranges separated by intervening valleys. Many valleys are called closed basins because they, like the Great Basin on a regional scale, lack a drainage outlet. Water and sediment from adjacent ranges become trapped and move to the lowest part of such valleys to form a playa, a flat area that is largely vegetation-free owing to high salinity, which results from evaporation of the water.

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Site Stratigraphy and Lithology. The youngest stratigraphic units at Yucca Mountain are the predominantly unconsolidated surficial deposits of late Tertiary and Quaternary age.

Selection of Repository Host Rock. Selection of the potential repository emplacement area was based on several considerations, which include (1) depth below the ground surface sufficient to protect nuclear waste from exposure to the environment, (2) extent and characteristics of the host rock, (3) location away from major faults that could adversely affect the stability of underground openings or act as pathways for water flow that could eventually lead to radionuclide release, and (4) location of the water table in relation to the proposed repository. DOE selected the middle to lower portion of the Topopah Spring Tuff as the potential repository horizon. Finally, the selected repository horizon is well above the present groundwater table. Based on geologic evidence the water table under Yucca Mountain has not been more than about 120 meters (390 feet) higher than its present level in the past several hundred thousand years; at such levels the water table would still be about 40 to 280 meters (130 to 920 feet) below the selected repository horizon.

Potential for Volcanism at the Yucca Mountain Site. The volcanism that produced the ash flows is complete (has not occurred in the region for more than 7.5 million years) and, based on the geology of similar volcanic systems in the Great Basin, no additional large-volume silicic activity is likely. Basaltic volcanism in the Yucca Mountain region began about 11 million years ago as silicic eruptions waned and continued as recently as about 80,000 years ago. The potential for future volcanic activity in the Yucca Mountain region would be associated with basaltic volcanism rather than silicic activity. It is estimated the probability of a dike disrupting the repository during the first 10,000 years after closure to be 1 chance in 7,000. The estimate was recalculated to account for the current footprint of the proposed repository. The revised estimate increases to about 1 chance in 6,300 (with 5th and 95th percentiles of 1 chance in 130,000 and 1 chance in 2000, respectively, of a volcanic dike disrupting the repository) during the first 10,000 years with the current repository layout, considering both primary and contingency blocks.

3.1.3.2 Geologic Structure

Geologic structures (folds, faults, etc.) are features that result from deformation of rocks after their original formation. The present-day geologic structure of the Great Basin, including the Yucca Mountain region, is the cumulative product of multiple episodes of deformation caused by both compression and extension (stretching) of the Earth's crust. The proposed repository has been configured so that there would be no block-bounding faults in the emplacement zone. One short northwest-trending subsidiary fault, called the Sundance fault, transects the potential repository area.

3.1.3.3 Modern Seismic Activity

DOE has monitored seismic activity at the Nevada Test Site since 1978. The epicenters of many earthquakes that the Southern Great Basin Seismic Network has located within 20 kilometers (12 miles) of Yucca Mountain do not correlate with mapped surface traces of Quaternary faults. The largest recorded historic earthquake within 50 kilometers (30 miles) of Yucca Mountain was the Little Skull Mountain earthquake in 1992, which had a Richter magnitude of 5.6. This seismic event occurred about 20 kilometers (12 miles) southeast of Yucca Mountain, about a day after the magnitude 7.3 earthquake at Landers, California, 300 kilometers (190 miles) south south east of Yucca Mountain.

Seismic Hazard. The expert assessments indicate that geologic fault displacement hazard is generally low. For locations not on a major block-bounding fault, displacements greater than 0.1 centimeter (0.04 inch) will be exceeded an average of less than once in 100,000 years, whereas the mean displacements that are likely to be exceeded on the block-bounding Bow Ridge and Solitario Canyon faults are 7.8 and 32 centimeters (3.1 and 13 inches), respectively. Mitigating potential fault displacement effects would involve avoiding faults in laying out repository facilities. As part of the Yucca Mountain site characterization activities, DOE established a 14-station, 50-kilometer (30-mile), geodetic array, centered on Yucca Mountain, and conducted surveys in 1983, 1984, and 1993. As interpreted by U.S. Geological Survey researchers, the surveys indicated no large strain accumulation.

3.1.3.4 Mineral and Energy Resources

DOE site investigations included evaluation of the potential for mineral and energy resources in the analyzed withdrawal area because the presence of such resources could lead to exploration and inadvertent human intrusion. Site characterization investigators identified no economic deposits of base or precious metals, industrial rocks or minerals, and energy resources, based on present use, extraction technology, and economic value of the resources. DOE believes the potential for economically useful mineral or energy resources in the analyzed Yucca Mountain withdrawal area is low.

3.1.4 HYDROLOGY

The hydrologic system in the Yucca Mountain region is characterized and influenced by a very dry climate, limited surface water [annual average precipitation of about 10 to 25 centimeters (4 to 10 inches), potential evaporation of almost 170 centimeters (66 inches) per year, and deep aquifers. Yucca Mountain is in the Alkali Flat-Furnace Creek groundwater basin of the larger Death Valley Regional Groundwater Flow System. Death Valley is a terminal hydrologic basin; surface water and groundwater cannot leave except by evapotranspiration.

3.1.4.1 Surface Water

3.1.4.1.1 Regional Surface Drainage

Yucca Mountain is in the southern Great Basin, which generally lacks perennial streams and other surface-water bodies. The Amargosa River system drains Yucca Mountain and the surrounding areas. Although referred to as a river, the Amargosa and its tributaries (the washes that drain to it) are dry along most of their lengths most of the time.

3.1.4.1.2 Yucca Mountain Surface Drainage

No perennial streams, natural bodies of water or naturally occurring wetlands occur at Yucca Mountain or in the analyzed land withdrawal area. Although flow in most washes is rare, the area is subject to flash flooding from intense summer thunderstorms or sustained winter precipitation

3.1.4.2 Groundwater

3.1.4.2.1 Regional Groundwater

The mountainous area that makes up the north-central portion of the Death Valley region that includes the Yucca Mountain area is often underlain by volcanic rocks and associated volcanic aquifers. the volcanic aquifers beneath Yucca Mountain are believed to provide inflow to the alluvial aquifers beneath the Amargosa Desert.

DOE has collected groundwater-level data from wells at Yucca Mountain and in neighboring areas on a routine basis since 1983, and has used the levels to which water rises in these wells—called the potentiometric surface—to map the slope of the groundwater surface and to determine the direction of flow. Based on these and other data, groundwater in aquifers below Yucca Mountain and in the surrounding region flows generally south toward discharge areas in the Amargosa Desert and Death Valley.

In the immediate vicinity of Yucca Mountain, sources of recharge to the groundwater include Fortymile

Wash and precipitation that infiltrates the surface. However, these local sources are not among the primary sources of recharge in the area that makes up the Alkali Flat-Furnace Creek groundwater basin. Water infiltrating at Yucca Mountain and becoming recharge to the groundwater would join with water in the Fortymile Canyon Section. DOE studies indicate that the quantity of water that might move through a repository area of 10 square kilometers (2,500 acres) (the largest repository footprint under any of the operating modes), assuming 4.7 millimeters (0.2 inch) of infiltration per year, would be about 0.2 percent of the estimated 23.4 million cubic meters (19,000 acre-feet) that moves from the Amargosa Desert to Death Valley on an annual basis.

3.1.4.2.2 Groundwater at Yucca Mountain

Groundwater at Yucca Mountain occurs in an unsaturated zone and a saturated zone. Unsaturated Zone Water Occurrence. The unsaturated zone at Yucca Mountain extends down from the crest of the mountain about 750 meters (2,500 feet) to the water table (the upper surface of the saturated zone. The primary emplacement area (the upper block) of the proposed repository would be in the unsaturated zone, at least 160 and up to 400 meters (530 up to 1,300 feet) above the present water table.

Water Source and Movement. When precipitation falls on Yucca Mountain, part leaves as runoff, part evaporates, and part infiltrates the ground. Some of the water that infiltrates the ground eventually evaporates in the arid climate or passes to plants; the remainder percolates into the ground as infiltration. Some of the infiltration remains at shallow levels, some eventually rises to the surface as vapor, and some (called net infiltration) moves deeper into the unsaturated zone. The estimated net infiltration for the current climate is 3.6 millimeters (0.1 inch) per year in a study area of about 120 square kilometers (48 square miles) that includes Yucca Mountain and 4.7 millimeters (0.2 inch) per year in the potential repository area.

DOE has used the ratio of chlorine-36 (a naturally occurring isotope) to total chlorine to determine where and when moisture has moved in the unsaturated zone at Yucca Mountain. High enough chlorine-36 ratios indicate waters exposed to very small amounts of fallout associated with above-ground nuclear weapons testing (called bomb-pulse water). The methodology used in these studies is complicated and is still under investigation; however, findings thus far have been valuable in reaching certain conclusions. Chlorine-36 analyses at Yucca Mountain have identified locations where water has moved fairly rapidly (in several decades) from the surface to the depth of the proposed repository and also where it has moved very slowly (thousands to tens of thousands of years). Results of these samples indicate that the groundwater travel times from the surface to the repository depth in most areas probably are thousands to tens of thousands of years. This is because there is little evidence for measurable radioactive decay of the chlorine-36 signal in the subsurface. About 13 percent of the samples (31 samples) had high enough chlorine-36-to-total-chlorine ratios to indicate the water originated from precipitation occurring in the past 50 years (that is, nuclear age precipitation).

Unsaturated Zone Groundwater Quality. DOE has analyzed water from the unsaturated zone, both pore water from the rock matrix and perched water, to obtain information on the mechanisms of recharge and the amount of connection between the two. The smaller concentrations of dissolved minerals, particularly chloride, in perched water in comparison to those in pore water is a primary indicator of differences between the two. This difference in dissolved mineral concentrations indicates that the two types of water do not interact to a large extent and that the perched water reached its current depth with little interaction with rock.

Saturated Zone Water Occurrence. The saturated zone at Yucca Mountain has three aquifers and two confining units.

Water Source and Movement. When undisturbed by pumping, groundwater levels at Yucca Mountain have been very stable. A Geological Survey study of water levels over 10 years (1985 to 1995) indicated water levels did not change by season and most water-level fluctuations are probably due to changes in barometric pressure and Earth tides.

Davies and Archambeau (1997, pp. 33 and 34) suggests that a moderate magnitude earthquake at the site could cause a southward displacement of the large hydraulic gradient to the north of the proposed repository, resulting in a water table rise of about 150 meters (490 feet) at the site. As part of its study of groundwater flow in the saturated zone, DOE elicited expert opinions on various issues from a panel of five experts in the fields of groundwater occurrence and flow. Among the issues put to the panel were those raised by Davies and Archambeau (1997, all). The panel reviewed the Davies and Archambeau paper and received briefings by project personnel and outside specialists. The consensus of the panel was that a rise of the groundwater to the level of the proposed repository was essentially improbable and that changes to the water table associated with earthquakes would be neither large nor long-lived.

Use. Two wells, J-12 and J-13, are part of the water system for site characterization activities at Yucca Mountain. These are the nearest production wells to Yucca Mountain and they support water needs for Area 25 of the Nevada Test Site and for Exploratory Studies Facility activities. The U.S. Geological Survey, in support of Yucca Mountain characterization efforts and in compliance with the State permits, has kept records of the amount of water pumped from the J-12 and J-13 wells and of measured water elevation levels in those and other wells in their immediate area since 1992.

3.1.5 BIOLOGICAL RESOURCES AND SOILS

The region of influence for biological resources and soils is the area that contains all potential surface disturbances that would result from the Proposed Action plus some additional area to evaluate local animal populations. This region is roughly equivalent to the analyzed land withdrawal area of about 600 square kilometers (230 square miles). The plants and animals in the Yucca Mountain region are typical of species in the Mojave and Great Basin Deserts.

The State of Nevada expressed the view that there was no systematic integrated environmental program to characterize the unique and fragile desert environment at Yucca Mountain before 1982, when DOE began site investigation that may have caused irreversible alteration.

DOE contends that studies initiated after the start of site investigations are suitable for establishing the baseline needed for this EIS. The purpose of studies of the impacts of site characterization activities on plants and animals was not to evaluate potential impacts from a repository, but rather to focus on the appropriate level of ecological organization for the types of impacts that occurred during characterization activities. DOE used the results of those studies in the EIS analysis to understand and predict possible impacts from similar activities that would occur during repository construction and operation (for example, habitat destruction).

3.1.5.1 Biological Resources

3.1.5.1.1 Vegetation

DOE adapted broad categories of land cover types for the analyzed land withdrawal area from two sources: a statewide classification and a detailed, field-validated classification of the area surrounding the location of the proposed repository. None of the more than 210 plant species known to occur in the analyzed land withdrawal area is endemic to the area; that is, they all occur in other places. There are approximately 30 exotic plant species present in the Yucca Mountain area. None of these exotic species is on the State of Nevada's Noxious Weed List.

3.1.5.1.2 Wildlife

Wildlife at Yucca Mountain is dominated by species associated with the Mojave Desert, with some species from the Great Basin Desert at higher elevations.

3.1.5.1.3 Special Status Species

No plant species listed as threatened or endangered or that are proposed or candidates for listing under the Endangered Species Act occur in the analyzed land withdrawal area. No plant species classified as sensitive by the Bureau of Land Management are known to occur in the analyzed land withdrawal area. One animal species that occurs at Yucca Mountain, the desert tortoise, is listed as threatened under the

Endangered Species Act. No other Federally listed threatened or endangered species or candidates for listing under the Endangered Species Act occur at Yucca Mountain.

Although Ash Meadows and Devils Hole are outside the region of influence for biological resources, they contain a number of special status species that an evaluation of regional biological resources should consider. Of the eight endemic plant species at Ash Meadows, one is listed as endangered and six are listed as threatened.

3.1.5.1.4 Wetlands
There are no naturally occurring jurisdictional wetlands (wetlands that are regulated under Section 404 of the Clean Water Act) at Yucca Mountain.

3.1.5.2 Soils
None of the soil series is surveyed is classified as prime farmland.

The Yucca Mountain site characterization project has sampled and analyzed surface soils for radiological constituents. In addition, records of spills or releases of nonradioactive materials have been maintained to meet regulatory requirements and to provide a baseline for the Proposed Action. The results of that analysis, when compared to other parts of the world, indicate average levels of the naturally occurring radionuclide uranium-238 series decay products and above-average levels of the naturally occurring radionuclides potassium-40 and thorium-232 series decay products. The higher-than-average radionuclide values might be due to the origin of the soil at the site from tuffaceous igneous rocks. The studies also detected concentrations of the manmade radionuclides strontium-90, cesium-137, and plutonium-239 from worldwide nuclear weapons testing.

3.1.6 CULTURAL RESOURCES
Cultural resources include any prehistoric or historic district, site, building, structure, or object resulting from or modified by human activity. Cultural resources could also include potential traditional cultural properties.

3.1.6.1 Archaeological and Historic Resources
Site characterization efforts have led to a number of archaeological investigations at Yucca Mountain over the past two decades, including, as an early action, an archaeological field survey of a 44-square kilometer (about 11,000-acre) parcel that proposed repository activities probably would affect.

Decades of cultural resource investigations at Yucca Mountain and at the Nevada Test Site have revealed archaeological features and artifacts. Based on archaeological site file searches at the Desert Research Institute in Las Vegas and Reno and at the Harry Reid Center at the University of Nevada, Las Vegas, approximately 830 archaeological sites have been discovered in the analyzed land withdrawal area. Most of the known archaeological sites are small scatters of lithic (stone) artifacts, usually comprised of fewer than 50 artifacts with few formal tools and no temporally or culturally diagnostic artifacts in the inventory. None of the sites has been listed on the National Register of Historic Places, but 150 are considered by DOE to be eligible for nomination as historic properties based on National Register eligibility criteria.

This EIS separates archaeological sites into two broad groups, prehistoric and historic, separated by the first contact between American Indians and Euroamerican.

3.1.6.2 Native American Interests
3.1.6.2.1 Yucca Mountain Project Native American Interaction Program
In 1987, DOE initiated the Native American Interaction Program to consult and interact with tribes and organizations on the characterization of the Yucca Mountain site and the possible construction and operation of a repository. These tribes and organizations—Southern Paiute, Western Shoshone, and Owens Valley Paiute and Shoshone people from Arizona, California, Nevada, and Utah—have cultural and historic ties to the Yucca Mountain area.

The 17 tribes and organizations have formed the Consolidated Group of Tribes and Organizations, which consists of officially appointed tribal representatives who are responsible for presenting their respective tribal concerns and perspectives to DOE. The primary focus of this group has been the protection of cultural resources and environmental restoration at Yucca Mountain.

3.1.6.2.2 Native American Views of Affected Environment
During the EIS scoping process, DOE visited many tribes to encourage their participation. Members of the Consolidated Group of Tribes and Organizations designated individuals who represented the three tribal entities (Southern Paiute, Western Shoshone, and Owens Valley Paiute and Shoshone) to document their viewpoints on the Yucca Mountain area.

The traditional stories of the Southern Paiute, Western Shoshone, and Owens Valley Paiute and Shoshone peoples identify such places, including the Yucca Mountain area. Despite the current physical separation of tribes from Yucca Mountain and neighboring lands, Native Americans continue to value and recognize the meaningful role of these lands in their culture and continued survival. Many areas in the Yucca Mountain region are important to them. According to Native Americans, the Yucca Mountain area is part of the holy lands of the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone peoples. Native Americans generally do not concur with the conclusions of archaeological investigators that their ancestors were highly mobile groups of aboriginal hunter-gatherers who occupied the Yucca Mountain area before Euroamericans.

3.1.7 SOCIOECONOMICS
To define the existing conditions for the socioeconomic environment in the Yucca Mountain region, DOE determined the current economic and demographic status in a well-defined region (called the region of influence) near the site of the proposed repository.

3.1.7.1 Population
Southern Nevada has been and continues to be among the fastest-growing areas in the country. During the 1980s, the population of the region of influence had an average annual growth rate of 4.8 percent, with a total growth of 66.5-percent for the decade, adding more than 29,000 people annually and reaching 780,000 residents in 1990. In comparison to the State of Nevada, which had a growth of 50.1 percent between 1980 and 1990, the United States had a growth of less than 10 percent during the same period. Led by Clark County, Nevada is the fastest growing state in the country.

3.1.7.2 Employment
Of the three counties that comprise the region of influence, Clark County has by far the largest economy; in 2000, the estimated employment was about 840,000. In 2000, an average of about 2,320 workers (220 work on the site and 2,100 off the site) worked on the Yucca Mountain Project. Most offsite workers are employed in the Las Vegas area.

3.1.7.3 Payments-Equal-to-Taxes
Another issue of interest is the DOE Payments-Equal-To-Taxes Program. Section 116(c)(3)(A) of the Nuclear Waste Policy Act, as amended, requires the Secretary of Energy to "…grant to the State of Nevada and any affected unit of local government an amount each fiscal year equal to the amount such State or affected unit of local government, respectively, would receive if authorized to tax site characterization activities…." The Yucca Mountain Site Characterization Office is responsible for implementing and administering this program for the Yucca Mountain Project.

The Payments-Equal-To-Taxes for sales or use taxes from May 1986 through June 2000 was about $4.4 million for purchases consumed in Clark County and $450,000 in Nye County. For property taxes it was about $940,000 in Clark County, $46 million in Nye County, $8,000 in Lincoln County, and $3,700 in Esmeralda County. For Nevada business taxes (Clark, Nye, Esmeralda, and Lincoln Counties), about $160,000 was paid.

3.1.7.4 Housing

Spurred by the rapid population growth and soaring employment opportunities, the residential housing market is strong and steady in the Las Vegas area. Because most population and employment growth in the region of influence will occur in Clark County, most housing growth also will occur there. The only other area in the region likely to see large growth is Pahrump in southern Nye County. Housing changes in Lincoln County probably will be minimal in the foreseeable future.

3.1.7.5 Public Services

Education. In the 2000-2001 school year, the region of influence contained about 223 public elementary and middle schools, 37 public high schools, 13 alternative schools, 4 special education schools, an Advanced Technology Academy, an adult education center, and 3 charter schools.

Health Care. Health care services in the region of influence are concentrated in Clark County, particularly in the Las Vegas area. Medical services are available at the Nevada Test Site for Exploratory Studies Facility personnel; these services include two paramedics and an ambulance in Area 25. Backup services are on call from other Test Site locations. In addition, the Nevada Test Site provides medical services for Yucca Mountain Project workers at a clinic in Mercury, which has no overnight capability. When patients need urgent care, the Yucca Mountain Project relies on the helicopter "Flight for Life" and "Air Life" operations from Las Vegas. In emergencies, Area 25 can call on Nellis Air Force Base or Nye County for help.

Law Enforcement. The Las Vegas Metropolitan Police Department is responsible for law enforcement in Clark County with the exceptions of the Cities of North Las Vegas, Henderson, Boulder City, and Mesquite, which have their own police departments.

Protection. A combination of fire departments provides protection in the region of influence; these include the Clark County, Las Vegas, and North Las Vegas fire departments and several other city, county, and military departments.

3.1.8 OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY

The public health and safety region of influence consists of the number of persons residing within an 80-kilometer (50-mile) radius of the repository site at the end of site characterization. The estimated population in 2000 is about 34,000, which could grow to an estimated 76,000 by 2035.

3.1.8.1 Radiation Sources in the Environment

All people are inevitably exposed to the three sources of ionizing radiation: those of natural origin unaffected by human activities, those of natural origin but affected by human activities (called enhanced natural sources), and manmade sources. Natural sources (natural background radiation) include cosmic radiation from space, cosmogenic radionuclides produced when cosmic radiation interacts with matter in the atmosphere or ground, and naturally occurring, long lived primordial radionuclides in the Earth's mantle. Enhanced natural sources include those that can increase exposure as a result of human actions, deliberate or otherwise.

At low doses, the most important adverse health effect for depicting the consequences of environmental and occupational radiation exposures (which are typically low doses) is the potential inducement of cancers that can lead to death in later years. This effect is referred to as latent cancer fatalities because the cancer can take years to develop and for death to occur, and might never actually be the cause of death. The factor used in this EIS to relate a dose to its potential effect is 0.0004 latent cancer fatality per person-rem for workers and 0.0005 latent cancer fatality per person-rem for individuals among the general population.

3.1.8.2 Radiation Environment in the Yucca Mountain Region

Ambient radiation levels from cosmic and terrestrial sources at Yucca Mountain are higher than the U.S. average. The higher elevation at Yucca Mountain results in higher levels of cosmic radiation due to less shielding by the atmosphere. The U.S. average for cosmic, cosmogenic, and terrestrial radiation

exposures is 56 millirem per year. The exposures at the Yucca Mountain ridge and Yucca Mountain surface facilities are about 160 and 150 millirem per year, respectively. Moreover, there are higher amounts of naturally occurring radionuclides in the soil and parent rock of this region than in some other regions of the United States, which also results in higher radiation doses.

The Yucca Mountain Project and the DOE Nevada Operations Office (in conjunction with the Environmental Protection Agency) conduct environmental surveillances around the Nevada Test Site. This monitoring has identified no radioactivity attributable to current operations at the Test Site. It did detect trace amounts of manmade radionuclides from worldwide nuclear testing in milk, game, and foods and in soil.

Effects from Past Nevada Test Site Weapons Testing. The history of the testing of nuclear weapons can be broadly divided into two eras, the era in which testing was predominantly performed above ground (1951 to 1961) and the era in which testing was performed predominantly underground (1961 to 1992). Since 1992, there has been a moratorium on nuclear testing.

As discussed by the National Council on Radiation Protection and Measurements, because of the time that has elapsed since the occurrence of atmospheric nuclear weapons testing, much of the radioactivity in the environment with the potential to cause appreciable radiation dose has undergone decay. Therefore, individuals with the greatest potential for appreciable radiation doses from weapons testing would be those who were born before the 1960s, with less potential for those born later.

3.1.8.3 Health-Related Mineral Issues Identified During Site Characterization
Certain minerals known to present a potential risk to worker health are present in the volcanic rocks at Yucca Mountain. The risks are generally related to potential exposures caused by inhalation of airborne particulates (dust). Some of the minerals represent a hazard commonly associated with underground construction, whereas others are rare and less well known.

3.1.8.4 Industrial Health and Safety Impacts During Construction of the Exploratory Studies Facility
Site characterization activities at Yucca Mountain have had no involved worker fatalities.

3.1.9 NOISE AND VIBRATION
3.1.9.1 Noise Sources and Levels
Yucca Mountain is in a quiet desert environment where natural phenomena such as wind, rain, and wildlife account for most background noise. Manmade noise occurs periodically in the area as vehicles travel to and from Yucca Mountain, from site characterization activities at the operations areas, and from occasional low-flying military jets.

3.1.9.2 Regulatory Standards
With the exception of prohibiting nuisance noise, neither the State of Nevada nor local governments have established numerical noise standards. High risk for hearing loss occurs at 120 decibels and can result from short-term exposure of seconds to minutes. Ground transportation activities such as those associated with the Proposed Action (either rail or heavy-haul trucks) would not propagate noise levels of this magnitude to the environment.

3.1.9.3 Vibration
Ground vibration is an element of environmental assessment. There are two measurements for evaluating ground vibration: peak particle velocity and root-mean square velocity. Background levels of ground vibration at the Yucca Mountain site are low. Other than site characterization-related activities, there is basically a lack of the classical, manmade sources of ground vibration impacts.

3.1.10 AESTHETICS
The region surrounding Yucca Mountain consists of unpopulated to sparsely populated desert and rural

lands. Because much of Yucca Mountain is on the Nevada Test Site and Nellis Air Force Range with restricted public access, public visibility is limited to portions of U.S. Highway 95 near Amargosa Valley.

The Bureau of Land Management has not assigned a Visual Resource Management class to Yucca Mountain because the Nevada Test Site is not under the Bureau's jurisdiction. However, using the Bureau's method of determining scenic quality, DOE has evaluated the visual resources of the Yucca Mountain region from two observation points—one at Amargosa Valley on U.S. 95 and the other on the Nevada Test Site at a location that provides a clear view of the proposed repository site. The visual assessment at both these locations concluded that the scenic quality classification of Yucca Mountain is C. Class C includes areas in which the characteristics are fairly common to the region.

3.1.11 UTILITIES, ENERGY, AND SITE SERVICES

3.1.11.1 Utilities

Water and sewer utilities in the region could be affected by the Proposed Action as a result of project related increases in population and the associated increases in water demand and sewage production. DOE anticipates that the predominant project-related increase in population would occur in Clark County, with a smaller increase in Nye County.

Water. In southern Nye County, where the repository would be, groundwater is the only source of water. The evaluation indicated the Beatty water utility would have difficulty meeting future water demands due not to a high growth rate but to falling well yields and poor water quality in some wells. Since the 1996 evaluation, Beatty has gained the use of another well, which has provided a capacity sufficient to meet water demand now and for the immediate future, even while ending the use of two wells with high fluoride.

3.1.11.2 Energy

Electric Power. Three different power distributors—Nevada Power Company, Valley Electric Association, Inc., and Lincoln County Power District No. 1—supply electric power in the region of influence. At present, two commercial utility companies own transmission lines that supply electricity to the Nevada Test Site. The electric power for the Yucca Mountain Project in Area 25 comes through the Nevada Test Site power grid. The capacity of the Nevada Test Site grid is 72 megawatts. Since 1990, the peak load was about 37megawatts and occurred in January 1992.

Fossil Fuel. The fossil fuels that DOE has used at the Exploratory Studies Facility are heating oil, propane, diesel, gasoline, and kerosene. Fossil-fuel supplies are delivered to the Nevada Test Site and the Exploratory Studies Facility by truck from readily available supplies in southern Nevada.

3.1.11.3 Site Services

DOE has established an existing support infrastructure to provide emergency services to the Exploratory Studies Facility. The project cooperates with the Nevada Test Site in such areas as training and emergency drills and exercises to provide full emergency preparedness capability to the site. In addition, the project trains and maintains an underground rescue team.

3.1.12 WASTE AND HAZARDOUS MATERIALS

The region of influence for waste and hazardous materials consists of on- and offsite areas, including landfills and radioactive waste processing and disposal sites, in which DOE would dispose of waste generated under the Proposed Action. The Yucca Mountain Site Characterization Project developed its waste management systems to handle the waste and recyclable material generated by its activities. DOE uses landfills to dispose of solid waste and construction debris; accumulates and consolidates hazardous waste, then transports it off the site for treatment and disposal; treats and reuses wastewater; and treats and disposes of sanitary waste. In most categories of waste, especially solid waste, some types of material can be recycled or reused. DOE has processes in place to ensure that it collects the material and recycles it as appropriate.

3.1.12.1 Solid Waste
DOE disposes of Yucca Mountain Site Characterization Project solid waste and construction debris in landfills in Areas 23 and 9, respectively, on the Nevada Test Site.

3.1.12.2 Hazardous Waste
The Yucca Mountain Site Characterization Project is a small-quantity [less than 1,000 kilograms (2,200 pounds) a month] generator of hazardous waste. DOE accumulates hazardous wastes near their generation sources, consolidates them at a central location at the Yucca Mountain site, and ships them off the site for treatment and disposal. The hazardous waste accumulation areas are managed in accordance with Federal and State regulations. The waste is treated and disposed of off the site at a permitted treatment, storage, and disposal facility.

3.1.12.3 Wastewater
DOE uses a septic system to treat and dispose of sanitary sewage at the Yucca Mountain site. The system design can handle a daily flow of about 76,000 liters (20,000 gallons). At present, wastewater from tunneling operations and water from secondary containment (following rains) is processed through an oil-water separator, and the treated water is used for dust suppression in accordance with a State of Nevada permit. The oil is recycled with the other used oil generated by the project.

3.1.12.4 Existing Low-Level Radioactive Waste Disposal Capacity
The Nevada Test Site accepts low-level radioactive waste for disposal from approved generator sites. DOE estimates that a total of approximately 1.1 million cubic meters (39 million cubic feet) of low-level radioactive waste will be disposed of at the Test Site through 2070, not including repository-generated waste. Commercial spent nuclear fuel generators and contractor-operated transportation facilities such as an intermodal transfer station would dispose of low-level radioactive waste in commercial facilities. Commercial disposal capacity for low-level radioactive wastes is available at three licensed facilities.

3.1.12.5 Materials Management
n/a

3.1.13 ENVIRONMENTAL JUSTICE
This EIS considers whether activities at Yucca Mountain could cause disproportionately high and adverse human health or environmental effects to minority and low-income communities in the region of influence.

3.1.13.1 State of Nevada
Minority persons comprised 21 percent of the population in Nevada in the 1990 census. In the 2000 Census, minority persons comprised 35 percent of the population of Nevada. The environmental justice analysis considered the potential for disproportionately high and adverse impacts on two portions of the overall population—minority communities and low-income communities.

3.2 Affected Environment Related to Transportation
3.2.1 NATIONAL TRANSPORTATION
The loading and shipping of spent nuclear fuel and high-level radioactive waste would occur at 72 commercial and 5 DOE sites in 37 states. Transport of these materials to the Yucca Mountain site could involve trains, legal-weight trucks, heavy-haul trucks, and barges; the trains and trucks would travel on the Nation's railroads and highways. This includes existing railroads and highways in Nevada up to a point of departure to specific Nevada routes. Because no new land acquisition and construction would be required to accommodate these shipments, this EIS focuses on potential impacts to human health and safety and the potential for accidents along the shipment routes.

3.2.1.1 Highway Transportation
Highway (legal-weight truck) transportation of spent nuclear fuel and high-level radioactive waste to the Yucca Mountain site would use local highways near the commercial and DOE sites and near Yucca

Mountain, Interstate Highways, Interstate bypasses around metropolitan areas, and preferred routes designated by state routing agencies where applicable.

3.2.1.2 Rail Transportation
In most cases, rail transportation of spent nuclear fuel and high-level radioactive waste would originate on track operated by shortline rail carriers that provide service to the commercial and DOE sites. At railyards near the sites, shipments in general freight service would switch from trains and tracks operated by the shortline rail carriers to trains and tracks operated by national mainline railroads.

3.2.1.3 Barge and Heavy-Haul Truck Transportation
Commercial sites that do not have direct rail service could ship spent nuclear fuel on heavy-haul trucks or barges to nearby railheads. Heavy-haul trucks would use local highways to carry the spent nuclear fuel to a nearby railhead for transfer to railcars for transport to Nevada. Barge shipments would use navigable waterways accessible from the nuclear plant site.

3.2.2 NEVADA TRANSPORTATION
Shipments of spent nuclear fuel and high-level radioactive waste arriving in Nevada would be transported to the Yucca Mountain site by legal-weight truck, rail, or heavy-haul truck. Legal-weight truck shipments in Nevada would use existing highways and would be a very small fraction of the total traffic [less than 0.5 percent of commercial vehicle traffic on U.S. Highway 95 in southern Nevada.

3.2.2.1 Environmental Baseline for Potential Nevada Rail Corridors
3.2.2.1.1 Land Use and Ownership
Less than 1 percent of the land associated with the Caliente Corridor is private. The Caliente Corridor begins in Lincoln County, at an existing section of the Union Pacific Railroad at Eccles, and moves north across mostly Bureau of Land Management lands toward U.S. 93 near Comet Siding, which is south of Panaca. There are numerous houses, farms, and ranches north of Caliente and extending toward Panaca. Areas of ponded water and streams associated with the Meadow Valley Wash occur through this area along the eastern side of U.S. 93 (which in this area is part of the State Scenic Byway). Death Valley National Park, west of Beatty at the point closest to the rail corridor, is approximately 11 kilometers (7 miles) to the west. The area surrounding Beatty and extending southeast toward Amargosa Valley has several small towns and numerous current and historic mining operations.

Most of the lands associated with the Carlin Corridor (about 86 percent) are public lands managed by the Battle Mountain and Las Vegas offices of the Bureau of Land Management. About 7 percent of the land associated with the Carlin Corridor is private. Most of the lands associated with the Caliente-Chalk Mountain Corridor (about 57 percent) are public lands managed by the Ely Office of the Bureau of Land Management. Less than 1 percent of the lands associated with the Caliente-Chalk Mountain Corridor is private. Most of the lands associated with the Jean Corridor (about 83 percent) are public lands managed by the Las Vegas office of the Bureau of Land Management. About 5 percent of the land associated with the Jean Corridor is private. About 53 percent of the lands associated with the Valley Modified Corridor are public lands managed by the Las Vegas office of the Bureau of Land Management.

3.2.2.1.2 Air Quality and Climate
Air Quality. The Caliente, Carlin, Caliente-Chalk Mountain, and Jean Corridors pass through rural parts of Nevada that are either unclassifiable or in attainment for criteria pollutants. The Las Vegas Valley air basin is in nonattainment for the 3-hour carbon monoxide standard, largely the result of vehicular emissions.

Climate. There are two general climate descriptions for the five rail corridors: one for the three corridors that approach the Yucca Mountain site from the north and one for the two corridors that approach the site from the south or southeast. The Caliente, Carlin, and Caliente-Chalk Mountain Corridors approach from the north and cross a number of mountain ranges and valleys with elevations well above 1,500 meters (4,900 feet). In central Nye County the annual precipitation exceeds 20 centimeters (8 inches),

and the annual snowfall exceeds 25 centimeters (10 inches); annual precipitation exceeds 40 centimeters (16 inches) in some mountainous areas, and snowfall exceeds 100 centimeters (40 inches). Each of the three corridors approaching Yucca Mountain from the north pass through central Nye County, and DOE believes that the climate described is amreasonable average for conditions along these corridors.

The Jean and Valley Modified Corridors approach the Yucca Mountain site from the south where precipitation is generally between 10 and 20 centimeters (4 and 8 inches) per year and snowfall is rare. Occasional brief periods of intense rainfall at rates exceeding 5 centimeters (2 inches) an hour can occur in the summer.

3.2.2.1.3 Hydrology
3.2.2.1.3.1 Surface Water. The goal in planning the corridors was to avoid springs and riparian lands by 400 meters (1,300 feet) if possible.

3.2.2.1.3.2 Groundwater. None of the corridors would completely avoid Designated Groundwater Basins. However, the Caliente-Chalk Mountain Corridor would cross only two Designated Basins, one at Panaca Valley near the start of the corridor and one at Penoyer Valley where the Caliente and Caliente-Chalk Mountain Corridors split.

3.2.2.1.4 Biological Resources and Soils
3.2.2.1.4.1 Biological Resources.
Caliente. The only resident threatened or endangered species in the Caliente Corridor is the desert tortoise, which occurs only along the southern end of the corridor from about Beatty Wash to Yucca Mountain. This area is not critical habitat for desert tortoises and their abundance in this area is low in relation to other areas in the range of the species in Nevada. Unnamed subspecies of the Meadow Valley Wash speckled dace and Meadow Valley Wash desert sucker have been found in Meadow Valley Wash north of Caliente. In the Beatty area, the Nevada sand dune beardtongue has been found on sandy soils 10 kilometers (6 miles) north of Springdale. Though not listed in the table, a number of bats classified as sensitive by the BLM also may occur along the corridor and the southern end of the corridor is in the range of the chuckwalla.

Carlin. The only resident threatened or endangered species in the Carlin Corridor is the desert tortoise, which occurs only along the southern end of the corridor from about Beatty Wash to Yucca Mountain. This area is not critical habitat for desert tortoises and their abundance in the region is low. A ferruginous hawk (also classified as protected by Nevada) nesting area is east of Mount Callaghan. The San Antonio pocket gopher has been found in Big Smoky Valley northwest of the San Antonio Mountains. The Nevada sand dune beardtongue has been found in sandy soils 10 kilometers (6 miles) north of Springdale. A number of bats classified as sensitive by the Bureau of Land Management might occur along the corridor, and the southern end of the corridor is in the range of the chuckwalla.

Caliente-Chalk Mountain. The only resident threatened or endangered species in the Caliente-Chalk Mountain Corridor is the desert tortoise, which occurs on the Nevada Test Site south of Yucca Flat. This area is not critical habitat for desert tortoises and their abundance is low. Four species classified as sensitive by the Bureau of Land Management have been found in the corridor. Unnamed subspecies of the Meadow Valley Wash speckled dace and Meadow Valley Wash desert sucker have been found in Meadow Valley Wash. Ripley's spring parsley has been reported between Sand Spring Valley and Yucca Mountain in Yucca Flat. The large flower sun cup has been found in the corridor at three locations in Yucca Flat. Bats classified as sensitive by the Bureau of Land Management also may occur near the corridor. Chuckwalla may occur in suitable habitat on the Nevada Test Site.

Jean. The only resident threatened or endangered species in the Jean Corridor is the desert tortoise. The entire corridor is in the range of this species. Along most of the corridor, especially the western portions from Pahrump to Yucca Mountain, the abundance of desert tortoises is low. However, some areas crossed by the corridor in Ivanpah, Goodsprings, Mesquite, and Pahrump Valleys have a higher abundance of tortoises. The corridor does not cross areas classified as critical habitat for desert tortoises.

One location of each of two subspecies of the pinto beardtongue, which is classified as sensitive by the Bureau of Land Management, is in the first 5 kilometers (3 miles) of the corridor near Jean.

Valley Modified. The only resident threatened or endangered species in the Valley Modified Corridor is the desert tortoise. The entire corridor is in the range of this species. In general, the abundance of tortoises along this corridor through Las Vegas Valley, Indian Springs Valley, and the Nevada Test Site is low. This corridor does not cross areas classified as critical habitat for desert Tortoises. Two other species classified as sensitive by the Bureau of Land Management occur in the corridor. Three populations of Parish's scorpion weed and a population of Ripley's spring parsley have been reported on the Nevada Test Site in Rock Valley. No other Bureau of Land Management sensitive species have been documented in the corridor, although chuckwalla, gila monsters, and a number of bat species probably occur there in suitable habitat.

3.2.2.1.4.2 Soils. Based on the query of the State Soil Geographic database, there are no soils classified as prime farmlands in the rail corridors, including the option and alternate segments. In general terms, the corridors that approach Yucca Mountain from the north (that is, the Caliente, Carlin, and Caliente-Chalk Mountain Corridors) encounter relatively high percentages of soils with shrink swell, erodes easily, and blowing soil characteristics. The corridors that approach Yucca Mountain from the south (that is, the Jean and Valley Modified Corridors) encounter relatively high percentages of soils with only two of those characteristics (that is, shrink swell and blowing soil). None of the corridors would have high percentages of unstable fill, though such soil is present in about 10 percent of the Jean Corridor. Should a decision be made to select one of the rail corridors for transportation of materials to Yucca Mountain, DOE would perform soil surveys of the selected corridor to collect detailed information on the environmental and engineering characteristics of the soils that would be encountered.

3.2.2.1.5 Cultural Resources

Archaeological and Historic Resources. Archaeological surveys have been conducted in less than 1 percent of the total areas for the Caliente, Jean, and Valley Modified Corridors, less than 3 percent of the total area for the Carlin Corridor, and less than 5 percent of the total area for the Caliente-Chalk Mountain Corridor. Initially, archaeological site file searches were completed for larger rail corridors, ranging between 1.6 and 8 kilometers (1 and 5 miles) in total width. More than 2,300 archaeological and historic sites were documented for these wider corridors.

Native American Interests. Through the American Indian Writers Subgroup of the Consolidated Group of Tribes and Organizations, Native Americans have noted that, while transportation issues are of extreme interest to them, at present they cannot provide specific comments on any of the Nevada transportation project alternatives due to the absence of systematic ethnographic studies for any of the proposed project areas.

General concerns for potential transportation-related impacts raised by Native Americans include the following:

• Radioactive and hazardous waste transportation could have an adverse impact along rail or highway routes near existing or planned Native American communities, people, businesses, and resources.
• All of the proposed routes being considered pass through the traditional holy lands of the Southern Paiute, Western Shoshone, and Owens Valley Paiute and Shoshone peoples.
• Many of these routes correspond or are adjacent to ancient pathways and complex trail systems known to and used by Native American peoples.
• The Consolidated Group of Tribes and Organizations is aware of important culturally sensitive areas, traditional use areas, sacred sites, and other important resources that fall in the proposed transportation project areas, and will present this information when appropriate in the development of the Nevada transportation system.

These general concerns apply to the proposed rail corridors discussed in this section, and the proposed heavy-haul truck route alternatives and intermodal transfer station locations.

3.2.2.1.6 Socioeconomics
Socioeconomic effects from the construction of a rail line would be small and, for the most part, short term.

Population. The population of Esmeralda County is 100 percent rural. The 1990 Census population for the county was about 1,300 persons. The population of Eureka County is 100 percent rural. The 1990 Census population of the county was about 1,500. The population of Lander County is rural, with a small urbanized population concentrated entirely in Battle Mountain. The 1990 Census population of the county was about 6,300 persons.

Employment. In 2000, Esmeralda, Eureka, and Lander Counties had average labor forces of about 470, 850, and 2,320, respectively, and average unemployment rates of 10.0, 2.6, and 7.7 percent.

Housing. N/A

Economy. Esmeralda, Eureka, and Lander are very small counties in economic terms. Eureka and Esmeralda Counties derive most of their economic activity from the accommodations and food service industry. Lander County's largest industries are in the retail and wholesale sectors. Like Lincoln County, Esmeralda and Lander have lower per capita incomes than other Nevada counties and chronically high unemployment.

Public Services. N/A

3.2.2.1.7 Noise and Vibration
Most of the proposed rail corridors pass through unpopulated desert with average day-night background sound levels of 22 to 38 A-weighted decibels (dBA).

Caliente. Most of the Caliente Corridor passes through undeveloped Bureau of Land Management land where background noise levels range from 22 to 38 dBA.

Carlin. The Carlin Corridor, from its origin at Beowawe to its terminus at Yucca Mountain, including the Monitor Valley option and other options south of Tonopah, traverses mostly unpopulated desert. The only town within 1.6 kilometers (1 mile) of the corridor is Hadley at the southern end of Big Smoky Valley (Monitor Valley option). Noise levels of 40 to 55 dBA are present in rural communities near the corridor, including Beatty, Goldfield, Tonopah, Austin, and smaller communities between Tonopah and Battle Mountain.

Caliente-Chalk Mountain. Almost half of the 345-kilometer (214-mile) Caliente-Chalk Mountain Corridor is on Nellis Air Force Range or Nevada Test Site land; the remainder is on Bureau on Land Management land. Noise levels of 40 to 55 dBA are present.

Jean. The Jean Corridor, with the Stateline option, passes through Bureau of Land Management land and a small section of private land. A large portion of this proposed corridor passes through unpopulated desert. Noise levels of 40 to 55 dBA are present in small communities along the corridor including Amargosa Valley, Goodsprings, Pahrump, and Jean.

Valley Modified. The Valley Modified Corridor, and its various options, begins in the northeast end of the Las Vegas Valley, travels west across Nellis Air Force Base and the southern end of the Desert National Wildlife Range, and then closely parallels U.S. 95 to the vicinity of Mercury (a government installation). Noise levels along stretches of unpopulated desert should range from 22 to 38 dBA, which are typical for a desert environment during calm and windy days.

Ground Vibration. Railroad construction and the operation of trains transporting materials and nuclear

waste in casks have been proposed for several candidate rail corridors. These corridors have been planned to avoid human residences and communities to the extent possible. As a consequence, background levels of ground vibration lack human influence and are small; that is, most likely less than 50 VdB (velocity decibels, a measure of vibration amplitude).

3.2.2.1.8 Aesthetics
Visual resources include the natural and manmade physical features that give a particular landscape its character and value as an environmental factor. Based on these descriptions, all of the candidate rail corridors have been affected to some extent by man. Based on a field survey by DOE, these impacts can be seen from the potential corridors and in detail from the adjacent mountains.

3.2.2.1.9 Utilities, Energy, and Materials
All five primary rail corridors pass through typically remote Nevada countryside but are within the southern Nevada supply chain for the commodities required during construction and operation. Electric power, which would be available to a limited extent at nearby communities or other locations near power lines, probably would not be needed.

3.2.2.1.10 Environmental Justice
The five candidate rail corridors would not appreciably affect counties other than those through which they pass. In 2000, the minority population (White Hispanic, Black, Asian/Pacific Islander, American Indian/ Eskimo/Aleut, and Other) of Esmeralda County was about 190, or 20 percent of the population. In 2000, the minority population of Eureka County was about 250 persons, or 15 percent. In 2000, the minority population of Lander County was about 1,400 persons, or 24 percent.

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3.3 Affected Environment at Commercial and DOE Sites
3.3.1 SITE ENVIRONMENTAL FACTORS
3.3.1.1 COMMERCIAL SITES
At present, there are 103 operating commercial nuclear powerplants at 69 sites in 31 of the contiguous United States. In addition, three sites (Trojan in Oregon, and Humboldt Bay and Rancho Seco in California) have reactors in various stages of decommissioning.

3.3.1.1.1 Land Use and Ownership
Typically, nuclear powerplant sites and the surrounding areas are flat-to-rolling countryside in wooded or agricultural areas. More than half of the sites have 80-kilometer (50-mile) population densities of fewer than 200 persons per square mile, and more than 80 percent have 80-kilometer densities of fewer than 500 persons per square mile. The most notable exception is the Indian Point Station, which is within 80 kilometers of New York City, which has a population density of more than 2,000 persons per square mile. In general, these sites are owned and maintained by the investor owned utilities (sites operated by the Tennessee Valley Authority are Federally owned) that operate the associated power plants and control egress to the sites to protect the health and safety of the public.

3.3.1.1.2 Socioeconomic Environment
Although the size of the workforce varies considerably among sites, the average permanent staff size at a nuclear powerplant ranges from 800 to 2,400 people, depending on the number of operating units at the site. In addition to the permanent workforce, many temporary workers are required for tasks that occur during refueling and maintenance outages. Between 200 and 900 additional workers can be employed during these outages to perform the normal maintenance work. In addition to direct employment, plant subcontractors and service industries in the area provide hundreds of indirect jobs. In rural communities, industries that provide this number of jobs at relatively high wages are major contributors to the local economy.

A nuclear powerplant represents an investment of several billion dollars. Such an asset on the tax rolls is extraordinary for rural communities and can constitute the major source of local revenues for small

or remote taxing jurisdictions. This revenue often enables higher quality and more extensive public services with lower tax rates to the citizens.

3.3.1.1.3 Radioactive Effluents

During normal operations, nuclear powerplants release small amounts of radioactive materials to the environment through atmospheric and aquatic pathways. These radioactive materials, released under controlled conditions, include fission and activation products.

In 1993, boiling-water and pressurized-water reactors released about 31,000 and 28,000 curies, respectively, of fission and activation gases to the atmosphere. In addition, boiling-water reactors and pressurized-water reactors released 0.75 and 0.30 curies, respectively, of iodine-131 and particulates to the atmosphere.

3.3.1.1.4 Occupational and Public Health and Safety

Occupational Radiation Exposures

Nuclear plant workers who conduct activities involving radioactively contaminated systems or who work in radiation areas can be exposed to radiation. Most of the occupational radiation dose to such workers results from external radiation rather than internal exposure to inhaled or ingested radioactive materials.

In 1999, the total collective occupational dose for all operating commercial reactors was almost 14,000 person-rem or an average per licensee of 131 person-rem. This total collective dose was received by about 114,000 monitored workers for an average annual individual dose of 120 millirem, which is about 40 percent of the average background radiation dose for the United States.

Public Radiation Exposures

Releases of radioactive materials from nuclear power reactors result in radiation doses to humans that are small in relation to doses from natural background radiation. Persons can be exposed to radiation from nuclear power reactors through atmospheric and aquatic pathways.

The major exposure pathways include the following:

- Inhalation of contaminated air
- Drinking milk or eating meat from animals that graze on open pasture on which radioactive contamination might fall
- Eating vegetables grown near the site
- Drinking water or eating fish caught near the point of discharge of liquid effluents

In 1992, the estimated total population doses for populations living within 80 kilometers (50 miles) of operating nuclear power reactors were 32 person-rem by waterborne pathways and 15 person-rem by airborne pathways, for a total of 47 person-rem. However, estimated population dose commitments for the waterborne and airborne pathways varied widely among the sites. The estimated average annual dose to the offsite individual living within 80 kilometers was 0.0003 millirem, which is a very small fraction of the average annual dose from natural background radiation of 300 millirem in the United States.

3.3.1.2 DOE SITES

3.3.1.2.1 Land Use and Ownership

Of the five DOE sites that manage spent nuclear fuel and high-level radioactive waste, three (Hanford Site, Idaho National Engineering and Environmental Laboratory, Savannah River Site) are on large tracts of Federally owned land ranging from 2,300 square kilometers (890 square miles) for Idaho National Engineering and Environmental Laboratory to 800 square kilometers (310 square miles) for the Savannah River Site.

3.3.1.2.2 Socioeconomic Environment

Because of their large employment base, the Hanford Site, Idaho National Engineering and Environmental Laboratory, West Valley Demonstration Project, and Savannah River Site represent a substantial portion of their respective local workforces. For example, in December 1997 the Hanford Site employed almost 11,000 DOE and contractor personnel, which represented 13 percent of the total employment in the area. River Site employed 8,100 and 14,000 workers, respectively, which represented about 7 percent of their local area workforces. In 1993, the West Valley Demonstration Project employed more than 1,000 DOE and contract workers and was the largest local employer; these workers represented almost 4 percent of the local workforce. In addition to base employment, DOE sites contribute to the local economic conditions through the creation of indirect employment and through the purchase of goods and services from local firms.

3.3.1.2.3 Radioactive Effluents

As a result of ongoing process and remediation activities, most DOE sites routinely release quantities of radioactive materials to the atmosphere and surface waters that eventually enter the surrounding environment. These effluents are carefully monitored at their points of discharge to ensure that releases remain within limits specified by DOE Orders and applicable state and Federal statutes and regulations. Radioactive materials released from DOE sites consist of fission and activation products (such as tritium, cesium, strontium, iodine, and krypton), transuranics (such as plutonium and americium), and source material (such as uranium).

3.3.1.2.4 Occupational and Public Health and Safety

Occupational Radiation Exposures

In 1999, DOE reported a total workforce (including contractors) of approximately 130,000 individuals. Of these individuals, about 113,000 were monitored for potential radiation exposure. Only about 17,000 received measurable doses. DOE reported a total collective dose of about 380 person-rem for 1999. This dose was received by almost 6,000 individuals with measurable doses, for an average annual dose of about 60 millirem per person. This dose represents 20 percent of the national average background dose of 300 millirem. The Fort St. Vrain site reported no measurable doses for 1999.

Public Radiation Exposures

In 1999, for the five DOE sites discussed in this section, the total estimated offsite population dose was about 7.1 person-rem. This dose was received by a total 80-kilometer population of about 2.5 million people for an average dose of about 0.003 millirem per person, which is a very small fraction of the average annual dose from natural background radiation of 300 millirem in the United States.

In addition to average population doses, DOE estimated doses for the hypothetical maximally exposed offsite individual. For the four sites with reported offsite doses, the maximally exposed offsite individual received a maximum dose of 0.28 millirem.

3.3.2 REGIONAL ENVIRONMENTAL FACTORS

To develop the hypothetical sites, DOE divided the generator sites among the five regions. Climate varies considerably across the United States. Radionuclide release rates would depend primarily on the interaction of climate and materials. Similarly, the process constructed downstream populations of water users and river flow for the hypothetical sites from population and river flow data for actual sites, so they reflect the populations downstream of actual storage facilities and the actual amount of water those populations use.

3.3.2.1 REGIONAL INVENTORIES OF SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE

3.3.2.2 CLIMATIC FACTORS AND MATERIAL

DOE assumed that a single hypothetical site in each region would store all the spent nuclear fuel and high-level radioactive waste in each region. Such a site does not exist, but DOE used it for this analysis. To ensure that the calculated results of the regional analyses reflected the appropriate inventory, facility

and material degradation, and radionuclide transport, DOE developed the spent nuclear fuel and high level radioactive waste inventories, engineered barriers, and environmental parameters for the hypothetical site from data from the actual sites in that region.

The following climate parameters are important to material degradation times and rates of release:
• Precipitation rate (amount of precipitation per year)
• Rain days (percent of days with measurable precipitation)
• Wet days (percent of year that included rain days and days when the relative humidity was greater than 85 percent)
• Temperature
• Precipitation chemistry (pH, chloride anions, and sulfate anions)

3.3.2.3 GROUNDWATER PARAMETERS
Most of the radioactivity and metals from degraded material would seep into the groundwater and flow with it to surface outcrops to rivers or streams. Therefore, the analysis had to account for the groundwater characteristics at each site, including the time it takes the water to move through the unsaturated zone and the aquifer.

3.3.2.4 AFFECTED WATERWAYS
Most of the estimated population dose for the No-Action Alternative would be a result of drinking contaminated surface water. The first step in determining the population dose was to identify the waterways that receive groundwater from beneath existing storage facilities and the number of public drinking water systems that draw water from the potentially contaminated waterways along each river, and used this number in the calculation to determine dose to the population.

3.3.2.5 AFFECTED POPULATIONS
After identifying the affected waterways, DOE identified the populations that get their drinking water from those waterways. The total population using the river was expressed as number of people per cubic foot per second. If a river system traverses more than one region (for example, the Mississippi drains three regions), weighting criteria accounted for materials received from storage facilities upstream of the region that would flow past several downstream population centers, as necessary.