6

Environmental Impacts of Transportation

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6. ENVIRONMENTAL IMPACTS OF TRANSPORTATION

This chapter describes the potential environmental consequences of transporting the spent nuclear fuel and high-level radioactive waste described in Chapter 2 and Appendix A from 72 commercial and 5 U.S. Department of Energy (DOE, or the Department) sites to the Yucca Mountain site under the Proposed Action. This chapter also separately describes the potential impacts of transportation activities in the State of Nevada.

On a national basis DOE analyzed impacts of transporting spent nuclear fuel, including potential commercial spent mixed-oxide fuel containing surplus plutonium that originated from U.S. defense programs, and high-level radioactive waste, including high-level radioactive waste that could contain immobilized surplus plutonium from U.S. defense programs. These impacts include all activities necessary to transport these materials, from loading at the commercial and DOE facilities to delivery at the Yucca Mountain site. In addition, although DOE would prefer that most shipments be carried out by rail, the analysis addressed two scenarios—*mostly legal-weight truck* and *mostly rail*. These two scenarios allowed the analysis to encompass the range of potential impacts for any mix of truck and rail shipments that would actually occur. Because naval spent nuclear fuel would not be shipped by legal-weight truck (DIRS 101941-USN 1996, all) and not all of the generator sites can handle rail casks, the national scenarios involve the use of mostly legal-weight truck shipments (with only naval spent nuclear fuel being transported by rail) or mostly rail shipments (with transportation of some commercial spent nuclear fuel by truck). In addition, as part of the mostly rail scenario, the analysis assessed impacts of short hauls of commercial spent nuclear fuel in heavy-haul trucks or barges from some commercial sites to nearby railheads.

For the discussion of potential impacts of transportation by truck or rail in Nevada, such impacts would be a subset of the impacts of potential national impacts. They are discussed separately so they can be compared to a third mode of transportation, the use of heavy-haul trucks, for spent nuclear fuel and high-level radioactive waste that would arrive in Nevada by rail. Thus, the analysis considered three alternative modes of transportation for shipments once they would arrive in Nevada: (1) for those arriving by legal-weight truck, continuing the shipments by legal-weight truck to the Yucca Mountain site; (2) for those arriving by train, continuing the shipments by rail using a branch rail line in one of five candidate rail corridors to the site; or (3) for those arriving by rail, unloading the shipments from railcars and loading them on heavy-haul trucks at an intermodal transfer station for shipment to the site on one of five candidate highway routes. Figure 6-1 shows these three options. The candidate highway routes for heavy-haul trucks and rail corridors for a potential branch rail line are called *implementing alternatives*. Figure 6-2 shows the transportation implementing alternatives and their relationships to the national and Nevada transportation scenarios and to the mix of rail and legal-weight truck transportation modes that make up each scenario.

Section 6.1 summarizes both national and Nevada transportation activities. Chapter 2, Section 2.1.3, also describes national and Nevada transportation activities. Section 6.2 assesses the potential impacts of national transportation from the 77 sites to Yucca Mountain. Section 6.3 assesses potential impacts from transportation activities in Nevada. Chapter 2 describes the receipt and unloading of shipping casks at the repository (Section 2.1.2.1.1.1), the preparation of empty casks for reshipment (Section 2.1.2.1.1.3), and the potential construction and operation of a cask maintenance facility (Section 2.1.3.4). Chapter 4, Section 4.1.15, evaluates potential environmental impacts from the offsite manufacturing of shipping casks for commercial spent nuclear fuel and DOE spent nuclear fuel and high-level radioactive waste. Chapter 8, Section 8.4, discusses cumulative impacts of transportation for the Proposed Action and anticipated future radioactive material transportation activities. Appendix J contains details on transportation analysis methods and results. Appendix M provides information that is not needed to evaluate environmental impacts but that could be useful to readers to gain an understanding of nuclear waste transportation.

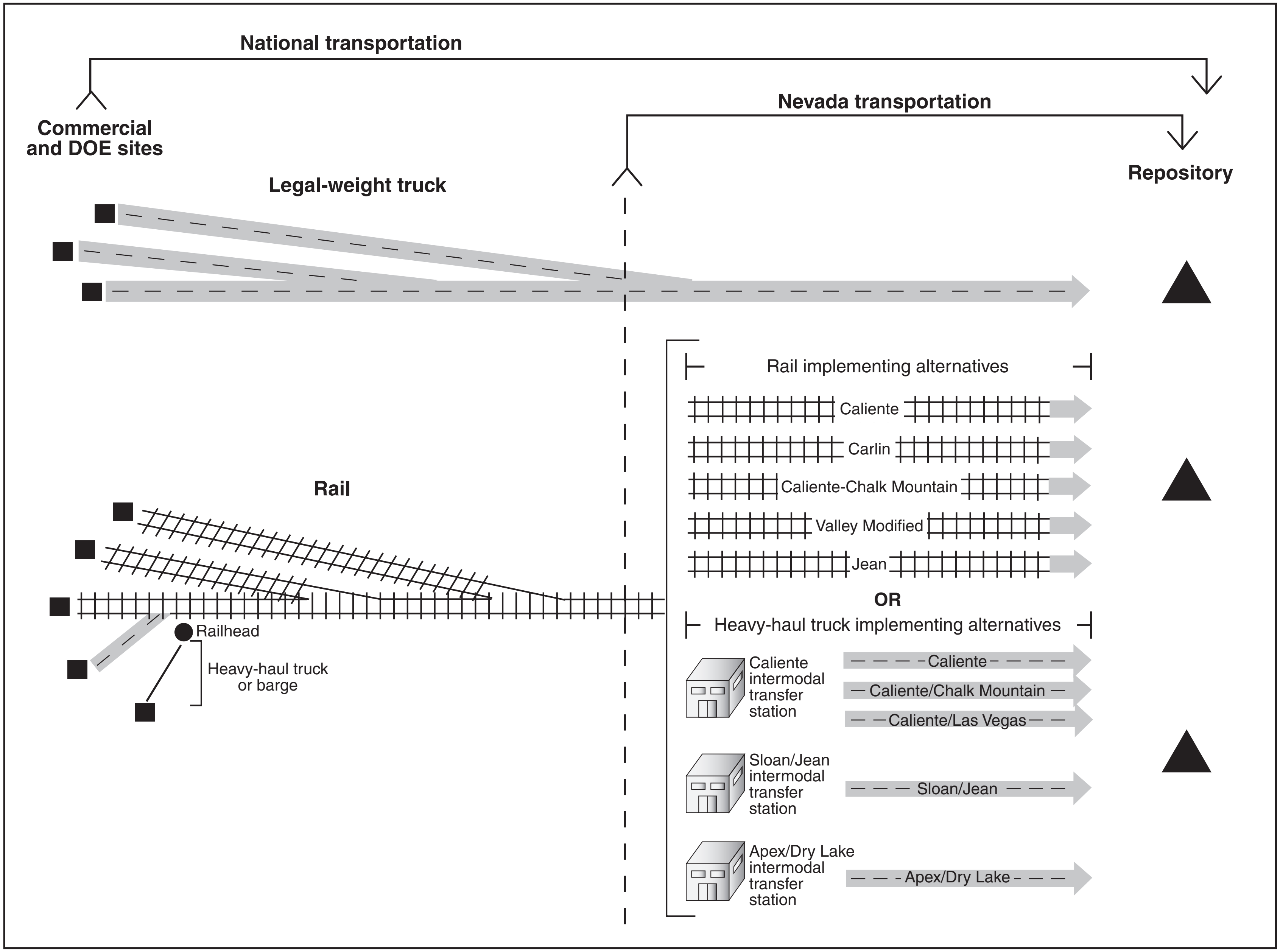
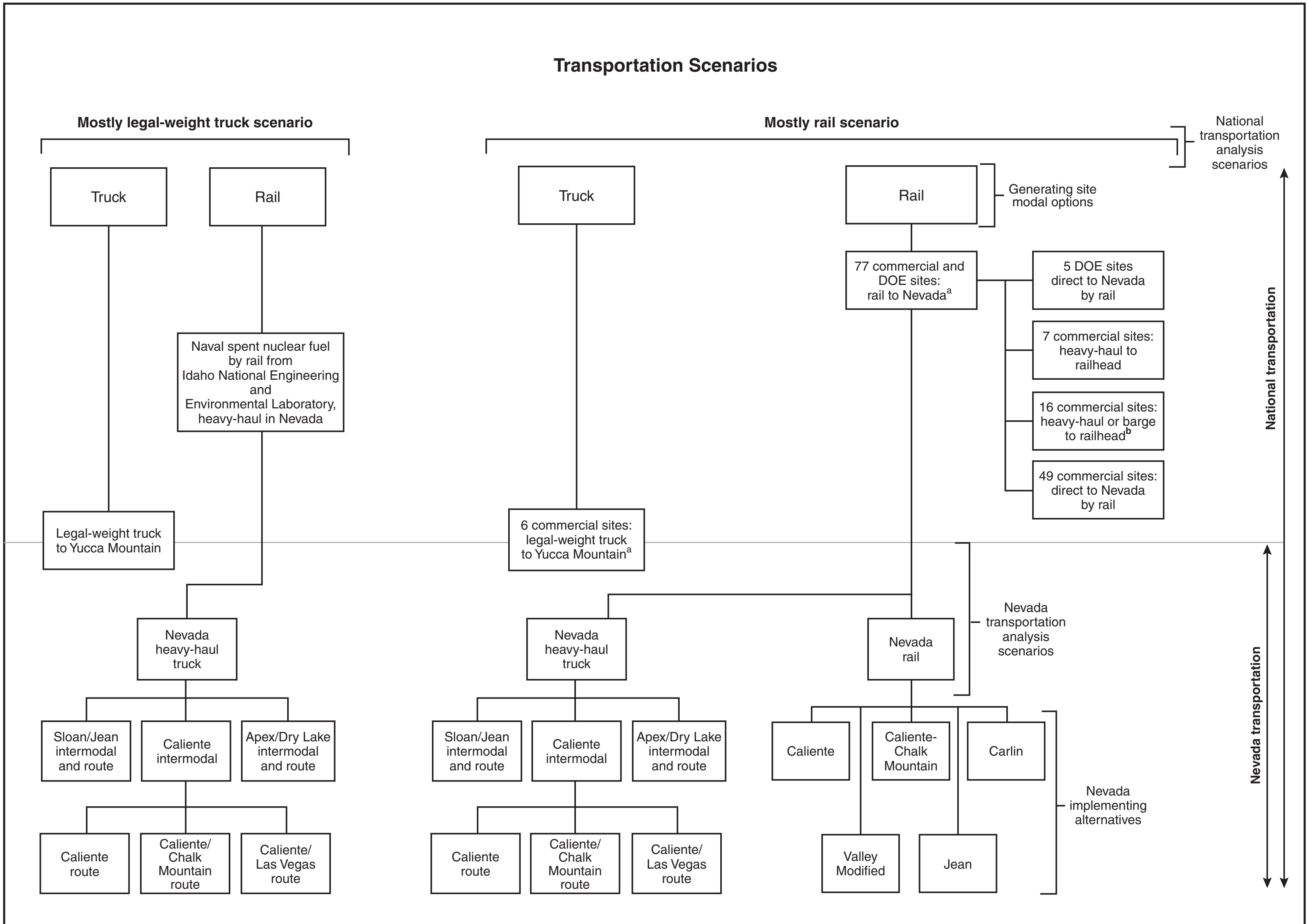


Figure 6-1. Relationship of Nevada and national transportation.



a. Six commercial sites would not have rail access until after reactor shutdown.
b. Salem and Hope Creek listed as one site.

Figure 6-2. Relationship between transportation modes, national and Nevada analytical scenarios, and Nevada transportation implementing alternatives.

CHANGES SINCE THE PUBLICATION OF THE DRAFT EIS

Changes in Information, Analytic Tools, and Assumptions

Since the publication of the Draft EIS, DOE has acquired new information and analytic tools that contribute to an improved understanding of interactions between the potentially affected environment and transportation activities necessary for the Proposed Action, including information and suggestions for improvements provided in public comments on the Draft EIS and on the Supplement to the Draft EIS. As a consequence, the impacts described in this chapter, Appendix J, and other transportation-related sections of this Final EIS differ from those described in the Draft EIS.

Notably, estimates of total impacts to public health and safety described in this chapter are smaller than those in the Draft EIS. With the exception of consequences of postulated acts of sabotage, estimates for radiological impacts of *incident-free transportation* and accidents and consequences of maximum reasonably foreseeable accidents are all smaller than the estimates in the Draft EIS. The nonradiological impacts reported in this Final EIS are approximately the same as those in the Draft EIS, including those in the Supplement to the Draft EIS. Differences in estimates of transportation-related impacts for land use; air quality; hydrology; biological resources and soils; cultural resources; socioeconomics; noise; aesthetics; waste management; utilities, energy, and materials; and environmental justice are principally the result of new information that enabled better representation of impacts that were, for the most part, identified in the Draft EIS and, for land use, changes in the affected environment that occurred after the publication of the Draft EIS. The following paragraphs describe the changes that had the most effect on the impact results, including comparisons with the results presented in the Draft EIS.

Estimated Numbers of Shipments. Estimates of the number of shipments of commercial spent nuclear fuel that would be made under the mostly legal-weight truck and mostly rail scenarios were based on a version of the CALVIN computer program (DIRS 155644-CRWMS M&O 1999, all) that has been updated from the version used for the Draft EIS. The updated version of CALVIN (Version 2.0) incorporates a number of changes, including: (1) revised estimates of future generation of commercial spent nuclear fuel; (2) revised estimates of the capabilities of commercial generator sites to handle and load large shipping casks; (3) revised estimates of the types and sizes of shipping casks that would be used; and (4) revised assumptions about how sites would select spent nuclear fuel assemblies for delivery to DOE.

The Final EIS analyses used a total of about 53,000 legal-weight truck shipments and 300 rail shipments of naval spent nuclear fuel for the mostly legal-weight truck scenario. This is an increase of about 3,000 shipments or 6 percent over the approximately 50,000 shipments reported in the Draft EIS. This increase is the result of slight changes in the assumed characteristics of spent nuclear fuel that commercial generators would deliver to DOE.

For the mostly rail scenario, the total number of shipments in the Final EIS analyses is about 10,700. About 1,100 of these shipments would be by legal-weight truck. The Draft EIS used a total of about 13,400 shipments (about 25 percent more), of which about 10,800 would be by rail and 2,600 by legal-weight truck. The reduced number of shipments is a result of changes in assumptions regarding the size of shipping casks and the capabilities of generator sites to handle and load rail casks. For this scenario, based on information available from industry sources following the publication of the Draft EIS, the updated CALVIN analysis assumed three generator sites previously considered capable of handling and loading only legal-weight truck casks could handle and load rail casks. In addition, the analysis assumed that the remaining truck-only sites would be capable of handling and loading rail casks following permanent shutdown of the sites' reactors.

Based solely on changes in the number of shipments, estimates of health and safety impacts nationally and in Nevada are 6 percent greater for the mostly legal-weight truck scenario and about 25 percent less for the mostly rail scenario than those reported in the Draft EIS. The change in the number of shipments would not cause discernible changes in impacts in other resource areas discussed in this chapter.

Characteristics of Commercial Spent Nuclear Fuel Used in Accident Analyses. The transportation analysis used the characteristics of representative spent nuclear fuel described in Appendix A, rather than the characteristics of typical (or average age) spent nuclear fuel used in the Draft EIS, to evaluate potential impacts and consequences of transportation accidents. Representative spent nuclear fuel is commercial spent nuclear fuel with a health and safety hazard that is the average of all the spent nuclear fuel that would be shipped to the proposed repository. Under this averaging, representative spent nuclear fuel would be (1) spent nuclear fuel from a pressurized-water reactor that had been discharged from a reactor for 15 years and had an average burnup of 50,000 megawatt-days per metric ton of heavy metal (MTHM), or (2) spent nuclear fuel from a boiling-water reactor that had been discharged for 14 years with a burnup of 40,000 megawatt-days per MTHM. Conversely, typical pressurized-water reactor spent nuclear fuel (also described in Appendix A) has been discharged from a reactor for 25.9 years with a burnup of almost 40,000 megawatt-days per MTHM. Typical boiling-water reactor spent nuclear fuel has been discharged from a reactor for 27.2 years with a burnup of about 32,000 megawatt-days per MTHM. DOE made the change to a representative fuel for accident analysis because it determined that estimates of accident risk using the characteristics of the typical spent nuclear fuel discussed in the Draft EIS underestimated the accident risk of shipments. This change in the analysis resulted in about a twofold increase in the estimated inventory of primary radionuclides in each shipping cask in comparison to the estimates in the Draft EIS. Primary radionuclides are those that contribute the most to impacts (see Appendix J, Section J.1.3.1).

Highway and Rail Routes. The analyses of transportation impacts in the Draft and Final EIS used the HIGHWAY (DIRS 104780-Johnson et al. 1993, all) and INTERLINE (DIRS 104781-Johnson et al. 1993, all) computer programs to identify routes that DOE could use for shipments from 77 generator sites to a Yucca Mountain Repository. DOE believes that the identified routes are representative of those that would be used if the Yucca Mountain site was approved and a repository was constructed and operated.

IDENTIFICATION OF TRANSPORTATION ROUTES

DOE has published proposed policy and procedures (63 *FR* 23756; April 30, 1998) "setting forth its revised plans for implementing a program of technical and financial assistance to states for training public safety officials of appropriate units of local government and to Indian tribes through whose jurisdictions the Department plans to transport spent nuclear fuel or high-level radioactive waste." The proposed policy and procedures state that DOE "plans to identify preliminary routes [that the Department] anticipates using within state and tribal jurisdictions when it notifies governors and tribal leaders of their eligibility." Notification would begin "approximately five years prior to transportation through" affected jurisdictions.

Most of the routes used for analyses in the Final EIS did not change from those used for the Draft EIS. However, railroad consolidations and alternative preferred routes designated by states for highway shipments resulted in changes in some of the routes identified by the computer programs and used in the analyses. For example, railroad consolidation led to a change in a potential *rail route* from the Monticello generator site in Minnesota. This caused the State of South Dakota, which was not included among the states crossed by routes analyzed in the Draft EIS, to become one of the states through which the analysis assumed shipments would travel.

In the case of highway shipments, new information published by the U.S. Department of Transportation (65 *FR* 75771; December 4, 2000) lists 14 states that have designated preferred routes for truck shipments of Highway Route-Controlled Quantities of Radioactive Materials. The Draft EIS listed 10 states based on information available at the time. The four added states are Delaware, Ohio, Texas, and Utah. Also listed for the first time in an integrated source are route restrictions and preferred route designations made by the State of Colorado that would preclude the use of Interstate Highway 70 west of Denver to the Utah border. The new information resulted in changes in the routing that the Draft EIS analysis assumed for some shipments.

Overall, the effects of changes in the routes used in the analysis on estimated impacts would be small for national transportation. However, DOE has added maps and tables that show the routes that were analyzed and the estimated health and safety impacts for each state through which shipments would pass if these routes were used (Appendix J, Section J.4).

Bureau of the Census Data. The analyses in the Draft and Final EIS used the HIGHWAY and INTERLINE computer programs to develop estimates of potentially affected populations along transportation routes. These programs use block group data from the 1990 Census. The Draft EIS used estimates of population along routes provided by these programs to estimate radiological impacts of transportation nationally and in Nevada. In a change from the Draft EIS, the Final EIS analysis used projections for each state made by the Bureau of the Census for population growth to 2025, results of the 2000 Census, and extrapolation to estimate populations along routes in 2035. These estimated population increases were used in estimating radiological health and safety impacts for national transportation.

In another change, estimates of populations along potential routes in the State of Nevada incorporate information developed using a geographic information system, 1990 Census data, and projections to 2035 obtained using the REMI computer program. Projections using REMI were based on forecasts provided to DOE by Clark County, Nye County, and the Nevada State Demographer, anchored to the results of the 2000 Census for Nevada counties. In addition, population estimates for routes that include the planned Las Vegas Beltway used a forecast for 2020 provided by a report prepared for the City of North Las Vegas (DIRS 155112-Berger 2000, all).

The overall effect of these changes is that estimated affected populations along national routes would be about 40 percent greater than the populations estimated with the use of 1990 Census data, as used in the Draft EIS. The Nevada population used in the analysis of transportation-related health and safety impacts in this Final EIS is about 100 percent greater than that used in the Draft EIS.

DOE conducted a limited sensitivity analysis of national transportation impacts using route population information based on projections provided by the TRAGIS computer program (DIRS 157136-Johnson and Michelhaugh 2000, all). The TRAGIS program, which DOE released in the Fall of 2001 to replace the HIGHWAY and INTERLINE computer codes used for the transportation analyses in this EIS, uses 2000 Census data to develop population estimates for routes. Based on the sensitivity analysis performed using TRAGIS in place of HIGHWAY, DOE determined that doses to the general public from incident-free transportation would be similar to (about 10 percent greater than) those reported in this chapter.

Performance of Shipping Casks in Transportation Accidents. DOE has revised the transportation accident analyses in the EIS to reflect new information. For example, since the publication of the Draft EIS, the Nuclear Regulatory Commission published *Reexamination of Spent Fuel Shipment Risk Estimates* (DIRS 152476-Sprung et al. 2000, all). Based on the analyses in that report, DOE concluded that the models used for analysis in the Draft EIS relied on assumptions about spent nuclear fuel and cask response to accident conditions that caused an overestimation of the resulting impacts. For example, the analyses in the Draft EIS were based on *Shipping Container Response to Severe Highway and Railway*

Assessment of the Hazards of Transporting Spent Nuclear Fuel and High-Level Radioactive Waste to the Proposed Yucca Mountain Repository Using the Proposed Northern Las Vegas Beltway **(DIRS 155112-Berger 2000, all)**

The transportation analyses in the Final EIS used some information from this document. DOE considers this report to be the only available source of some information, but is in broad disagreement with the analyses and conclusions regarding the report's estimates of impacts.

Useful information not available elsewhere includes:

- An estimate of population along the Las Vegas Beltway—an area that is currently mostly uninhabited—although, as discussed below, DOE believes the estimate is high.
- New information regarding the expected cost to construct the beltway.
- A scenario for estimating dose to a maximally exposed individual along a highway route used by heavy-haul trucks in Nevada.

DOE disagrees with some aspects of the report for a variety of reasons, including:

- The projected population growth within 3.2 kilometers (2 miles) of the 21-kilometer (13-mile)-long Northern Beltway appears to be very high, accounting for 42 percent of population growth projected by a University of Nevada Las Vegas report (DIRS 156031-Riddel and Schwer 2000, Table 1) for all of Clark County during the same period.
- The report uses a very high accident rate as a basis for accident probabilities. This rate—4 times that reported to DOE by the State of Nevada for interstate trucks on all Nevada highways (see Appendix J, Section J.1.4.2.3.3)—is 17 times greater than the rate DOE used in the EIS, which is based on statistics compiled by the U.S. Department of Transportation. The rate could be higher in part because it was based on the State of Nevada definition of an accident rather than the Department of Transportation definition recommended by the National Governors Association (see Sections J.1.4.2.3 and J.1.4.2.3.3). In addition, the rate used in the report appears to be an intercity rate (urban interstate) that does not accurately reflect the accident rate for highways in Nevada that shipments to Yucca Mountain would use.
- The report projects economic impacts in the Northern Beltway area assuming that business location decisions would be made solely on whether shipments of spent nuclear fuel and high-level radioactive waste would use the Northern Beltway. The report did not consider many other factors commonly associated with such decisions.
- The report overestimates economic impacts to Clark County under the implied assumption that not only would some companies not locate near the Northern Beltway because of shipments of spent nuclear fuel and high-level radioactive waste, these companies would not locate anywhere in Clark County; and that existing Clark County companies that could move to the Northern Beltway area would actually leave Clark County. The report ignores statistics that show that many business relocations occur in the same county. In addition, the report fails to recognize that decisions to remain at the same location would have no economic impact on the county.

Accident Conditions, which estimated that 99.4 percent of accidents would not lead to a release of radioactive materials from a shipping cask (DIRS 101828-Fischer et al. 1987, pp. 4-8, 7-25, and 7-26). Based on the revised analyses, casks would continue to contain spent nuclear fuel fully in more than 99.99 percent of all accidents (DIRS 152476-Sprung et al. 2000, p. 7-73 to 7-76). In addition, based on that report, DOE has included impacts of an accident in which the radiation shielding of a shipping cask would be damaged—so-called *loss-of-shielding* accidents. DOE also included estimated impacts of 99.99 percent of accidents in which the cask's containment and shielding would not be damaged by the accident but where nearby populations could be exposed to low-level radiation during the time it would take for accident response and recovery. The analysis assumed the low-level radiation would be the maximum allowed by regulation for a cask transporting spent nuclear fuel or high-level radioactive waste. The Draft EIS did not include these evaluations.

The collective effect of these changes was a significant reduction in estimated consequences of maximum reasonably foreseeable accidents and estimates of accident risk from those presented in the Draft EIS. In addition, the use of information from the DIRS 152476-Sprung et al. (2000, all) report permits a better description of the maximum reasonably foreseeable accidents analyzed. For example, the characteristics of the maximum reasonably foreseeable accident analyzed in this chapter for rail transportation correspond closely to reported conditions in the Baltimore Tunnel train accident fire in July 2001 (DIRS 156753-Ettlin 2001, all; DIRS 156754-Rascovar 2001, all).

Model for Estimating Doses to the Public at Truck Stops. The Draft EIS used information reported in DIRS 101888-Neuhauser and Kanipe (1992, p. 3-29) to estimate the radiation dose that would be received by members of the public at rest stops used by trucks carrying spent nuclear fuel and high-level radioactive waste. The time allocated to stops in the report is equivalent to about 1 hour of stop per hour of travel—a significant overestimate of stop time in real truck transport operations involving team drivers. As a consequence, more than 90 percent of the dose to the general public reported for the mostly legal-weight truck scenario in the Draft EIS was based on this estimate of dose to persons at truck stops.

The analysis in this Final EIS used more recent data based on field observations of truck stop time (DIRS 152084-Griego, Smith, and Neuhauser 1996, all). In addition, the analysis estimated doses to populations in areas surrounding stops, including estimates of stop time for state inspections and periodic driver walk-around, which were not part of the analyses in the Draft EIS. The analysis concluded that the average time trucks would stop would be about 1 hour for every 10 hours of travel, which resulted in a much lower estimate for radiation dose to the general public. Appendix J, Section J.1.3.2.1 provides additional information.

RADTRAN. DOE used the RADTRAN 4 computer program in estimating the radiological incident-free and accident risk impacts in the Draft EIS. For this Final EIS, DOE used an updated version of the program, RADTRAN 5, which allowed more complex analyses of impacts, such as those involving models used to estimate doses to persons at truck stops. With the exception of the improvements in capabilities afforded by RADTRAN 5, the analytical methods used by the two programs to estimate impacts to populations are largely the same. This change had no effect on the results.

Health Effect Fatality Impacts of Vehicle Emissions. New information used to estimate fatalities from health effects of vehicle emissions (DIRS 151198-Biwer and Butler 1999, all) became available following the publication of the Draft EIS. DOE used this information in conjunction with information from the Environmental Protection Agency (DIRS 155780-EPA 1993, all; DIRS 155786-EPA 1997, all) to develop risk factors for the analysis in this Final EIS. Based on this new data, estimates of impacts from vehicle emissions are about 3 times greater than the estimates in the Draft EIS, which ranged from 0.2 to 0.6 fatalities over 24 years.

First Responder. The analyses of transportation impacts in this Final EIS included estimates of doses to maximally exposed individuals not identified in the Draft EIS. These included estimates of doses to a first responder at a transportation accident and individuals who resided close to highways or rail routes in the State of Nevada.

Socioeconomic Baseline for Nevada Counties. The analyses of socioeconomic impacts in the Draft and Final EIS used baseline data developed using the REMI computer program. However, input parameters to calculations performed using REMI were adjusted for the Final EIS so predicted results reflect similar forecasts provided by Clark and Nye Counties and the Nevada State Demographer. The resultant changes in estimated socioeconomic impacts are small.

Time to Construct a Branch Rail Line. After the publication of the Draft EIS, the estimated time to construct a branch rail line to the Yucca Mountain site changed from 2.5 years (30 months) to 40 to 46 months, depending on the corridor. However, engineering estimates of materials and labor required for construction did not change, and therefore the constant-dollar cost estimates did not change. The changes in projected construction schedules led to lower estimates for socioeconomic impacts of constructing and operating a branch rail line in Nevada than those in the Draft EIS.

Cost to Construct the Las Vegas Beltway. The EIS includes estimates of socioeconomic impacts of using heavy-haul trucks on three candidate routes that include the planned Las Vegas Beltway. The analysis in the Draft EIS assumed an expenditure of $40 million (1998 dollars) for the northern segment of the Beltway, occurring between 2007 and 2010 rather than between 2010 and 2020 as planned by Clark County. The Draft EIS analysis also assumed a corresponding total of $90 million (1998 dollars) for the southern and western segments of the Beltway. An estimate in a City of North Las Vegas-sponsored report suggests the cost of completing the Northern Beltway between 2010 and 2020 could be as much as $425 million in 1998 dollars (DIRS 155112-Berger 2000, p. 29) ($463 million in 2001 dollars). DOE adopted this estimate for use in estimating socioeconomic impacts for the Caliente/Las Vegas and Apex/Dry Lake routes for heavy-haul trucks evaluated in this chapter. Using the same information, the analysis in this chapter estimated socioeconomic impacts for a Jean route for heavy-haul trucks with the assumption that the corresponding costs to complete the southern and western segments of the Beltway could be as much as $790 million. Because it assumed these larger estimated costs, the estimated socioeconomic impacts in Clark County for the Jean, Apex/Dry Lake, and Caliente/Las Vegas routes for heavy-haul trucks are higher in this Final EIS than those in the Draft EIS, but remain low for the County.

Potential Land-Use Conflicts for Construction and Operation of a Branch Rail Line in Nevada. After the publication of the Draft EIS, changes occurred in ownership and use of lands that a branch rail line in the candidate rail corridors in Nevada could cross. Land that could be crossed by the Bonnie Claire Alternate of the Caliente and Carlin Corridors has been transferred by an Act of Congress to the Timbisha Shoshone Tribe; land at the junction of the Stateline Pass Option of the Jean Corridor and the Union Pacific Railroad has been transferred by an Act of Congress to Clark County for development of the Ivanpah Valley Airport; and land near the junction of the Valley Modified Corridor and the Union Pacific Railroad has been transferred by the Bureau of Land Management to Clark County for the Apex Industrial Park. These changes result in potential land-use impacts for the affected corridors.

Changes Due to Public Comments. In response to interest and suggestions by the public and to better describe potential impacts of transportation alternatives in Nevada, DOE has modified analyses and presentations of impacts. The following are examples of such modifications:

- *Land-use and ownership.* Added available descriptive details and assessed potential impacts to wilderness study areas; grazing allotments; rights-of-way; and Bureau of Land Management, private, Nellis Air Force Range (now called the Nevada Test and Training Range), Native American, and Nevada Test Site lands along Nevada rail corridors, including variations, and along routes for heavy-haul trucks.

- *Air quality (nonradiological).* Provided more complete quantitative estimates of carbon monoxide and PM_{10} emissions from transportation activities, particularly in the Las Vegas Valley nonattainment area.

- *Hydrologic resources.* Expanded flood zone, groundwater, and surface-water resources, and water demand analyses to incorporate information for variations of Nevada rail corridors and for routes for heavy-haul trucks.

- *Biological resources and soils.* Provided more details from existing information and analyses of disturbed areas, sensitive biological resources, management areas, and soil impacts.

- *Cultural resources.* Acquired and evaluated additional cultural, archeological, and Native American data and included evaluations of potential impacts of Nevada rail variations and heavy-haul truck routes.

- *Socioeconomics.* Updated socioeconomic baseline information to accommodate 2000 Census information as well as match population forecasts provided by Clark and Nye Counties and Nevada State Demographer.

- *Noise and vibration.* Added new data and developed additional analyses of impacts of ground vibration and noise on *sensitive structures*, populations, and communities along Nevada rail corridors and routes for heavy-haul trucks.

- *Aesthetics.* Incorporated field observations made after the publication of the Draft EIS for viewsheds along candidate rail corridors and routes for heavy-haul trucks and used additional detail available from existing information.

- *Environmental justice.* Added available detail, reanalyzed data on minority and low-income populations, and reevaluated impact assessments of other disciplines.

- *Utilities, energy, and materials.* Reanalyzed impacts based on new information for the repository flexible design and for variations in the candidate rail corridors.

- *Waste management.* Added new waste data, details of waste sources and shipments, and changes in waste management from changes in information regarding the repository flexible design.

Other Changes

In addition to the changes described above, DOE added Appendix M to provide general background information on transportation-related topics that are not addressed in detail in this chapter or Appendix J and are not directly related to potential impacts of the Proposed Action. This includes information on the Department's planning, under a draft Request for Proposal, to issue shipping contracts and discussion of in-transit procedures, emergency response plans, indemnification against damages from the potential release of spent nuclear fuel and high-level waste, and cask testing.

6.1 Summary of Impacts of Transportation

6.1.1 Overview of National Transportation Impacts

This section provides an overview of the potential impacts of using the Nation's highways and railroads to transport spent nuclear fuel and high-level radioactive waste from 72 commercial and 5 DOE sites to the repository at Yucca Mountain. Detailed discussions of national transportation impacts are in Section 6.2 and analytical methods are in Appendix J. All potential impacts are related to the health and safety of populations and hypothetical maximally exposed individual members of the general public and workers. This summary includes estimated impacts from loading operations, incident-free transportation, and accidents for the mostly legal-weight truck and mostly rail national transportation scenarios. (National transportation includes transportation in Nevada to Yucca Mountain.)

Estimated national transportation impacts are based on 24 years of transportation activities during the Proposed Action and average annual shipments of about 2,200 (2,200 truck, 13 rail) for the mostly legal-weight truck scenario and about 450 (400 rail, 45 truck) for the mostly rail scenario. From all causes, about 8 fatalities could occur in the nationwide general population from transportation activities of the mostly legal-weight truck scenario and about 5 fatalities from the mostly rail scenario during the 24-year transportation period (impacts of a maximum reasonably foreseeable accident are not included).

Impact analyses for the transport of spent nuclear fuel and high-level radioactive waste in Nevada using a branch rail line are based on the assumption that the branch rail line would be dedicated to activities related to the Proposed Action. There are other possible uses for such a branch rail line in Nevada including support of ranching, industrial, and commercial endeavors; support of Federal, state, tribal and local government activities; and transport of people, materials, and products into, out of, and across the state. However, DOE has not addressed any of these possibilities because there are no concrete proposals at this time for alternative uses, and insufficient information exists to evaluate such uses. Potential uses of a branch rail line are identified in Chapter 8, but the need or level of use and growth of use has not been defined or evaluated. If the Yucca Mountain Site was designated, DOE would consider any uses that were reasonably foreseeable at that time other than transporting radioactive materials to the site in selecting an alignment within any rail corridor selected.

Impacts of Loading Operations

All spent nuclear fuel and high-level radioactive waste would be loaded onto trucks or railcars at the 77 sites for transport to the Yucca Mountain site. Some health and safety impacts would be associated with these loading operations. There would be small (0.04 latent cancer fatality) impacts to members of the public from loading operations. Over the 24 years of the Proposed Action, an estimated 6 and 2 latent cancer fatalities could occur in involved worker populations from radiation exposure for the mostly legal-weight truck and mostly rail scenarios, respectively. The probability of a latent cancer fatality to the maximally exposed involved worker would be about 0.005 for both scenarios. No worker fatalities from industrial accidents would be expected. No or very small impacts to workers or members of the public would be expected from postulated loading accidents. About 0.4 traffic fatality could occur in the worker population from commuting under the mostly legal-weight truck scenario, while about 0.2 traffic fatality could occur under the mostly rail scenario. Loading operations and potential impacts are discussed further in Section 6.2.2.

Impacts of Incident-Free Transportation

Incident-free transportation is the expected norm for transportation of spent nuclear fuel and high-level radioactive waste to the Yucca Mountain site. Impacts of incident-free transportation would include those from external radiation emitted from transportation casks and vehicle exhaust emissions along the transportation routes.

Over the 24 years of the Proposed Action, an estimated 3 (2.5) latent cancer fatalities could occur in the general population along transportation routes from radiation exposure under the mostly legal-weight truck scenario and an estimated 1 latent cancer fatality could occur under the mostly rail scenario. Under the mostly legal-weight truck and mostly rail scenarios, the probability of a latent cancer fatality to the maximally exposed member of the public would be no more than 0.0012 and 0.0001, respectively. Under these same scenarios, about 1 (0.95 for the mostly legal-weight truck scenario and 0.77 for the mostly rail scenario) fatality from vehicle emissions could occur in the general population along transportation routes.

IMPLEMENTING ALTERNATIVES AND SCENARIOS

Implementing alternatives and scenarios are used to describe the range of reasonably foreseeable transportation actions with environmental impacts that could result from the Proposed Action.

Implementing alternatives represent feasible selections that DOE could make based in part on this EIS (for example, selecting a branch rail line corridor or an intermodal transfer station location and an associated route for heavy-haul trucks). Analytical scenarios, on the other hand, are feasible combinations of actions that DOE would have limited ability to direct (for example selecting the use of rail or truck casks for shipments from a specific nuclear powerplant). The scenarios are selected such that the analysis results bound the range of impacts that could result from the Proposed Action.

The transportation modes that make up the analytical scenarios and implementing alternatives include the following:

Legal-weight truck transportation: Legal-weight trucks have gross vehicle weights, including cargo, that do not exceed 80,000 pounds, which is the loaded weight limit for commercial vehicles operated on Interstate and U.S. highways without special state-issued permits. In addition, these vehicles have dimensions that are within the constraints of Federal and state regulation limits.

Permitted overweight, overdimension truck transportation: Semi- and tandem tractor-trailer trucks with gross vehicle weights over 80,000 pounds must obtain permits from state highway authorities to use public highways. States often permit vehicles that have gross weights above 80,000 pounds as *overweight, overdimension* vehicles with operating restrictions to protect public safety. Seven-axle tractor-trailer trucks (steering axle and three drive axles on the tractor and three axles on the trailer) with weights greater than 80,000 pounds that meet Federal bridge formulas and dimensional limits can carry payloads of 70,000 pounds.

Rail transportation: Rail transportation includes railroad transportation of spent nuclear fuel and high-level radioactive waste in large rail transportation casks (rail casks). The casks would be placed on railroad cars at commercial and DOE sites or at nearby intermodal transfer facilities for shipment on trains operated by commercial railroad companies over existing tracks. Because of the weight of the casks, only one cask would be transported on a railcar.

Heavy-haul truck transportation: Heavy-haul truck transportation includes the movement of large rail casks—both loaded and empty—on large heavy-haul trucks traveling on existing highways. For the transportation of spent fuel and high-level radioactive waste rail casks, these vehicles would weigh as much as 500,000 pounds; they would be more than 100 feet long and 10 to 12 feet wide, and would stand as high as 15 feet above the road surface. Heavy-haul trucks would require special permits issued by a state transportation agency. The permits would normally restrict the times of operation (typically daylight, non-rush-hour), operating speeds, and highways used.

Barge transportation: Barge transportation would be the transportation of loaded and empty rail casks between a commercial facility and a nearby railhead using navigable waterways. Barge terminals would have intermodal transfer capabilities sufficient to transfer casks from barges to railcars.

An estimated 12 (11.7) latent cancer fatalities could occur in the worker population from radiation exposure for the mostly legal-weight truck scenario, and an estimated 3 (3.5) latent cancer fatalities could occur for the mostly rail scenario. The probability of a latent cancer fatality to the maximally exposed involved worker would be approximately 0.02 for either the mostly legal-weight truck or mostly rail scenario. DOE expects impacts to noninvolved workers to be even lower than those to involved workers. To assess potential radiological impacts at generator facilities, the EIS analysis assumed that noninvolved workers would have no direct involvement in handling spent nuclear fuel and high-level radioactive waste.

The differences in incident-free impacts between the mostly legal-weight truck and mostly rail scenarios are due principally to (1) the difference in the number of shipments for the two scenarios, and (2) differences in analysis assumptions about the numbers of in-transit stops, the number of potentially exposed persons, and their proximity to shipping casks that could result in external radiation exposure.

DOE identified no national environmental justice concerns or air quality impacts for incident-free transportation. Incident-free national transportation and the potential impacts to workers and the public are discussed further in Section 6.2.3.

Impacts of Transportation Accidents

The analysis evaluated impacts to human health and safety, collectively including the health and safety of the public and transportation workers, from transportation accidents. Thus, impacts to populations from transportation accidents would include impacts to affected workers. Because the population of transportation workers would be small compared to the general population, radiological accident risks and consequences for the worker population would be a small fraction of those estimated for the public (that is, the total population).

TRANSPORTATION ACCIDENT RADIOLOGICAL DOSE RISK

The risk to the general public of radiological consequences from transportation accidents is called *dose risk* in this EIS. Dose risk is the sum of the products of the probabilities (dimensionless) and the consequences (in person-rem) of all potential transportation accidents.

The probability of a single accident is usually determined by historical information on accidents of a similar type and severity. The consequences are estimated by analysis of the quantity of radionuclides likely to be released, potential exposure pathways, potentially affected population, weather conditions, and other information.

As an example, the dose risk from a single accident that had a probability of 0.001 (1 chance in 1,000), and would cause a population dose of 22,000 person-rem in a population if it did occur, would be 22 person-rem. If that population was subject to 1,000 similar accident scenarios, the total dose risk would be 22,000 person-rem. Using the conversion factor of 0.0005 latent cancer fatality per person-rem, an analysis would estimate a health and safety risk of 11 latent cancer fatalities from this population dose risk.

Accident impacts include the consequences where shipping casks could be breached with subsequent release of radioactive material to nearby individuals and populations. In addition, there could be impacts to individuals from “normal” traffic accidents, in which there would be no release of radioactive material from shipping casks and only those directly involved in the accident would be affected. The analysis examined radiological consequences under the maximum reasonably foreseeable accident scenario, and also estimated overall accident risk. The maximum reasonably foreseeable accident scenario is the one with the greatest potential consequences that are reasonably foreseeable. The scenario must also have an occurrence likelihood of 1 in 10 million per year or greater to be considered “reasonably foreseeable.” Accident risk considers the potential consequences of all foreseeable accident scenarios and their occurrence likelihood, ranging from accident scenarios that are likely to occur but would have no release of radioactive material to those accident scenarios that are extremely unlikely to occur but could have large consequences (for example, the maximum reasonably foreseeable accident scenario).

The overall radiological accident risk, as described in Appendix J, Section J.1.4.2.1, from all accident scenarios over the 24 years of transportation activities during the Proposed Action would be about 0.0002 latent cancer fatality for the mostly legal-weight truck scenario and about 0.0005 latent cancer fatality for the mostly rail scenario. These estimated latent cancer fatalities would occur in the hypothetically exposed population residing within 80 kilometers (50 miles) of the accident site.

The maximum reasonably foreseeable accident scenario for the mostly legal-weight truck scenario would result in about 1 latent cancer fatality in the exposed population. It is postulated to involve a release of radioactive material from a truck cask in an urbanized area under stable weather conditions. The probability of this accident scenario would be about 0.00000023 per year (a rate of about 2.3 in 10 million years). The maximum reasonably foreseeable accident scenario for the mostly rail scenario would result in about 5 latent cancer fatalities in the exposed population. It is postulated to involve a release of radioactive material from a rail cask in an urbanized area under stable weather conditions. The probability of this accident scenario would be about 0.00000028 per year (a rate of about 2.8 in 10 million years). The probability of a latent cancer fatality occurring in the hypothetical maximally exposed individual would be about 0.0015 for the mostly legal-weight truck scenario and about 0.015 for the mostly rail scenario.

DOE evaluated accidents involving the crash of a jet airliner into a legal-weight truck cask or rail cask (DIRS 157210-BSC 2001, all). Such an accident could result in up to 0.65 latent cancer fatality.

Nationwide, during the 24 years of the Proposed Action transportation activities, about 5 nonradiological fatalities could result from traffic accidents under the mostly legal-weight truck scenario. For the same time period, about 3 nonradiological fatalities could also result from traffic accidents under the mostly rail scenario. These fatalities would all be related to physical injuries associated with traffic accidents, not radiological impacts.

No environmental justice concerns were identified for transportation accident scenarios. Transportation accident scenarios and potential impacts are discussed further in Section 6.2.4.

Table 6-1 summarizes the national impacts of transporting spent nuclear fuel and high-level radioactive waste from 77 generator sites to the proposed Yucca Mountain Repository. The table lists impacts for the two transportation scenarios—mostly legal-weight truck and mostly rail. It includes impacts that would occur in Nevada among the national impacts. For the mostly rail scenario, Table 6-1 lists a range of impacts. Ten unique national impacts comprise the range—one for each of the five rail and five heavy-haul truck implementing alternatives in Nevada.

As listed in Table 6-1, impacts to the general population would be small for both scenarios. For example, impacts to individuals in a population of between 10 million and 17 million who lived within 800 meters (0.5 mile) of routes and to individuals who used the routes could range from about 0.12 millirem to as much as 0.5 millirem over the 24-year shipping campaign. These small doses would increase the risk of cancer for an average individual who lived along a route by 0.5 to 2.5 in 10 million over the individual's lifetime. This level of health and safety risk would not be discernible. A hypothetical maximally exposed individual who would live or work along transportation routes for 24 years would receive a dose of 2.4 rem (a truck stop worker for the mostly legal-weight truck scenario) or 0.29 rem (a person who lived near a rail stop for the mostly rail scenario). The estimated dose to the hypothetical truck stop worker would increase the risk of a latent cancer fatality by about 1 in 1,000 over the person's lifetime. For the maximally exposed individual who lived near a rail stop, the risk of a latent cancer fatality would increase by about 1 in 10,000 over the person's lifetime. The health and safety risks for these hypothetical individuals would not be discernible. For perspective, in the United States, about one in four deaths is caused by cancer from all causes.

Table 6-1. National transportation impacts for the transportation of spent nuclear fuel and high-level radioactive waste for the mostly rail and mostly legal-weight truck scenarios.[a,b]

Group	Impact	Mostly legal-weight truck scenario	Mostly rail scenario
Worker	*Incident-free health impacts, radiological*		
	Maximally exposed individual (rem)	48[c]	48[c]
	Individual latent cancer fatality probability	0.02	0.02
	Collective dose (person-rem)	29,000	7,900 - 8,800
	Latent cancer fatality incidence	11.7	3.2 - 3.5[d]
	Industrial safety (fatalities)	0.9	0.29
Public	*Incident-free health impacts, radiological*		
	Average exposed individual (rem)	0.0005	0.0001
	Maximally exposed individual (rem)	2.4[e]	0.29
	Individual latent cancer fatality probability	0.0012	0.00014
	Collective dose (person-rem)	5,000	1,200 - 1,600
	Latent cancer fatality incidence	2.5	0.61 - 0.81
	Incident-free vehicle emissions impacts (fatalities)	0.95	0.55 - 0.77
	Radiological impacts from maximum reasonably foreseeable accident scenario		
	Frequency (per year)	2.3 in 10,000,000	2.8 in 10,000,000
	Maximally exposed individual (rem)	3	29
	Individual latent cancer fatality probability	0.0015	0.015
	Collective dose (person-rem)	1,100	9,900
	Latent cancer fatality incidence	0.55	5
	Accident dose risk (person-rem)	0.46	0.89
	Accident risk (latent cancer fatalities)	0.00023	0.00045
Public and transportation workers	*Fatalities from vehicular accidents*	4.9	2.3 - 3.1

a. The assumed external dose rate is 10 millirem per hour at 2 meters (6.6 feet) from the vehicle for all shipments.
b. Totals for 24 years of operation, including impacts of loading.
c. Based on 2-rem-per-year dose limit.
d. Range for the 10 rail and heavy-haul truck implementing alternatives in Nevada.
e. Based on 100-millirem-per-year dose limit.

Radiological impacts of transportation accidents, which DOE estimated by summing the products of the probability of releases of radioactive materials from casks and the consequences of the releases if they occurred, would be very small. They would be small because accidents that could cause a release from a cask would be very unlikely and consequences from the small releases that could occur would generally be small. For example, Table 6-1 lists the consequences of maximum reasonably foreseeable accidents for the mostly rail and mostly legal-weight truck scenarios. In these accidents, which would have an annual likelihood of 2.3 in 10 million for the legal-weight truck scenario and 2.8 in 10 million for the mostly rail scenario, the estimated consequences would be 1,100 person-rem for a truck accident and 9,900 person-rem for a rail accident. The health and safety consequences of these doses would be about 0.55 latent cancer fatality for the truck accident and 5 latent cancer fatalities for the rail accident. The risk impacts of these accidents would be 2.3 in 10 million multiplied by 1,100 person-rem for the truck accident—about 0.00025 person-rem—and about 2.8 in 10 million multiplied by 9,900 person-rem for the rail accident—about 0.0028 person-rem. A *dose risk* of 0.0028 person-rem to a population is equivalent to a risk of 1 in 1 million of a single latent cancer fatality in the population. Thus, the radiological risks to health and safety from transportation accidents would be exceedingly small for both scenarios.

The radiological risks of accidents for the general public are not comparable with the risks of fatalities associated with immediate nonradiological consequences of transportation accidents. For the mostly legal-weight truck scenario, the analysis estimated there could be as many as 5 (4.9) fatalities over 24 years from vehicle collisions and other traffic accidents during the 53,000 legal-weight truck and 300 rail shipments. For the mostly rail scenario, which would involve as many as 9,600 rail and 1,100 legal-weight truck shipments, the analysis estimated there could be about 3 (2.5 to 3.3) fatalities over 24 years attributable to train operations; these could include fatalities from grade-crossing accidents and trespassers struck and killed by trains.

The analysis estimated long-term health effects fatalities that could be caused by the exhaust and fugitive dust emissions of the vehicles that would transport spent nuclear fuel and high-level radioactive waste. There would be 1 (0.95) fatality under the mostly legal-weight truck scenario and less than 1 (between 0.55 and 0.77) fatality under the mostly rail scenario as a consequence of 24 years of transportation. These fatalities would be latent, or would occur well after exposure to the vehicle exhaust and dust emissions.

Radiological doses to the workers who would load casks, drive trucks, operate trains, and inspect vehicles in transit would be higher than doses to the general public. Radiological protection programs would manage and limit doses to workers whose jobs would cause them to receive the greatest exposures. Even so, the analysis assumed a maximally exposed individual worker could receive a dose as high as 2 rem per year for each of the 24 years of the Proposed Action, for a total of 48 rem over 24 years. The analysis assumed that this dose, which is the maximum currently allowed under DOE administrative controls, would occur for both the mostly legal-weight truck and mostly rail scenarios. A dose of 48 rem would increase the worker's lifetime risk of a latent fatal cancer from an average of 23 percent from all causes to 25 percent.

The radiological impacts to all workers involved in shipping spent nuclear fuel and high-level radioactive waste to a Yucca Mountain Repository would be greatest for the mostly legal-weight truck scenario. For this scenario, the analysis estimated the workers would receive a total dose of 29,000 person-rem. Thus, the estimated lifetime impact to the worker population for the mostly legal-weight truck scenario would be 11.7 latent cancer fatalities from shipments over the 24 years of the Proposed Action. For the mostly rail scenario, the estimated lifetime impacts would be between 7,900 and 8,800 person-rem, or about one-third of the impacts for the mostly legal-weight truck scenario.

6.1.2 OVERVIEW OF NEVADA TRANSPORTATION IMPACTS

This section provides an overview of the environmental impacts associated with transportation of spent nuclear fuel and high-level radioactive waste in the State of Nevada. Although this section provides a more detailed, regional subset of some of the information gathered and analyses conducted for national transportation (see Section 6.1.1), it also includes information analyzed specifically for Nevada. This includes impacts from construction and operation of branch rail lines, routes for heavy-haul trucks and intermodal transfer stations, commuter transportation for construction and operations activities, and transportation of other materials in support of Yucca Mountain operations. Detailed discussions of potential impacts in Nevada are in Section 6.3 and Appendix J. The following areas were evaluated for potential impacts in Nevada from Yucca Mountain transportation activities:

- Transporting spent nuclear fuel and high-level radioactive waste by legal-weight truck in Nevada
- Constructing a branch rail line in Nevada and using it to transport spent nuclear fuel and high-level radioactive waste by rail to the repository
- Upgrading highways in Nevada for use by heavy-haul trucks to transport spent nuclear fuel and high-level radioactive waste to the repository
- Constructing and operating an intermodal transfer station in Nevada
- Transporting materials, consumables, supplies, equipment, waste, and people to support construction, operation and monitoring, and closure of the repository

Overviews are presented for the 12 environmental resource areas analyzed in this chapter and for the transportation of other materials and supplies, which is presented in further detail in Appendix J. Section 6.3 contains summaries that provide information for assessing the relative impacts in these resource areas from the mostly legal-weight truck transportation scenario, the five implementing alternatives for rail transportation, and the five implementing alternatives for heavy-haul truck transportation.

6.1.2.1 Land Use

Land-use impacts (land areas that would be disturbed or whose ownership or use would change) would be greatest for the mostly rail scenario. Land-use and ownership impacts based on a 60-meter- (200-foot)-wide rail right-of-way (land withdrawn) would affect from approximately 9.4 square kilometers (2,323 acres) for the Valley Modified route to 33.2 square kilometers (8,204 acres) for the Caliente route. Actual land disturbance in each 400-meter- (0.25-mile)-wide corridor for individual rail routes would range from approximately 5.1 square kilometers (1,260 acres) for the Valley Modified route to approximately 19.2 square kilometers (4,744 acres) for the Carlin route (see Figure 6-3). DOE based these estimated disturbances on anticipated construction activities (borrow areas, construction camps, soil areas) in the 400-meter corridor associated with the construction of a railroad and the projected width of the average construction disturbance for each rail bed. The average disturbance widths, for example, range from approximately 28 meters (91 feet) for the Caliente-Chalk Mountain Corridor to approximately 37 meters (120 feet) for the Jean Corridor. Land disturbance calculations do not include access roads. Existing roads would be used where possible. Due to possible variations along the rail corridors, land-use, ownership, and disturbances could vary from those discussed above (see Appendix J, Section J.3.1.2). Section 6.3.2.2 reports ranges due to these variations, as well as information on the representative corridor routes. No prime farmland would be affected by any of the transportation routes. The Carlin Corridor would affect the most private land [14 square kilometers (3,459 acres)]. Table 6-2 summarizes the land-use conflicts along the corridors. Selecting variations of a corridor, as described in Appendix J, Section J.3.1.2, could reduce some conflicts and increase or change conflicts in others. Overall impacts are generally proportional to the length of the corridor.

Disturbed land area for all of the heavy-haul truck implementing alternatives would range from 0.83 to 3.6 square kilometers (205 to 890 acres). No more than 0.2 square kilometer (50 acres) of private land would be affected for any route. There would be no land-use impacts from legal-weight trucks using existing highways. Land-use impacts are discussed for Nevada transportation rail implementing alternatives and for Nevada transportation heavy-haul truck implementing alternatives in Sections 6.3.2 and 6.3.3, respectively. None of the transportation implementing alternatives currently being considered would be affected by the flexible design evaluated for the proposed repository. Chapter 2, Table 2-7, summarizes the impacts to the various resource areas as the result of the repository operating modes. Section 6.3 contains summary information about the impacts in Nevada from the mostly legal-weight truck scenario and the rail and heavy-haul alternatives of the mostly rail scenario.

There are potential land-use conflicts for the Nevada implementing alternatives. The Carlin, Caliente, and Valley Modified Corridors encroach on the western and southern boundaries of the Nellis Air Force Range (also known as the Nevada Test and Training Range), and the Caliente-Chalk Mountain rail corridor and Caliente/Chalk Mountain heavy-haul truck route travel through the Range from north to south, essentially bisecting it. The U.S. Air Force has stated to DOE that the construction and use of routes through the Nellis Air Force Range would seriously affect sensitive and classified programs, would severely reduce Air Force training capabilities, and would impair the ability to comply with international testing and training obligations on the Range. In response to these concerns, DOE has identified the Caliente-Chalk Mountain Corridor and Caliente/Chalk Mountain heavy-haul route as nonpreferred alternatives. In addition, the Air Force noted the potential for safety risks of using other routes that could cross lands that are hazard areas and encompass weapons safety footprints for live weapons deployment. Although DOE is unaware of specific safety risks, the Caliente, Carlin, and Valley Modified rail corridors

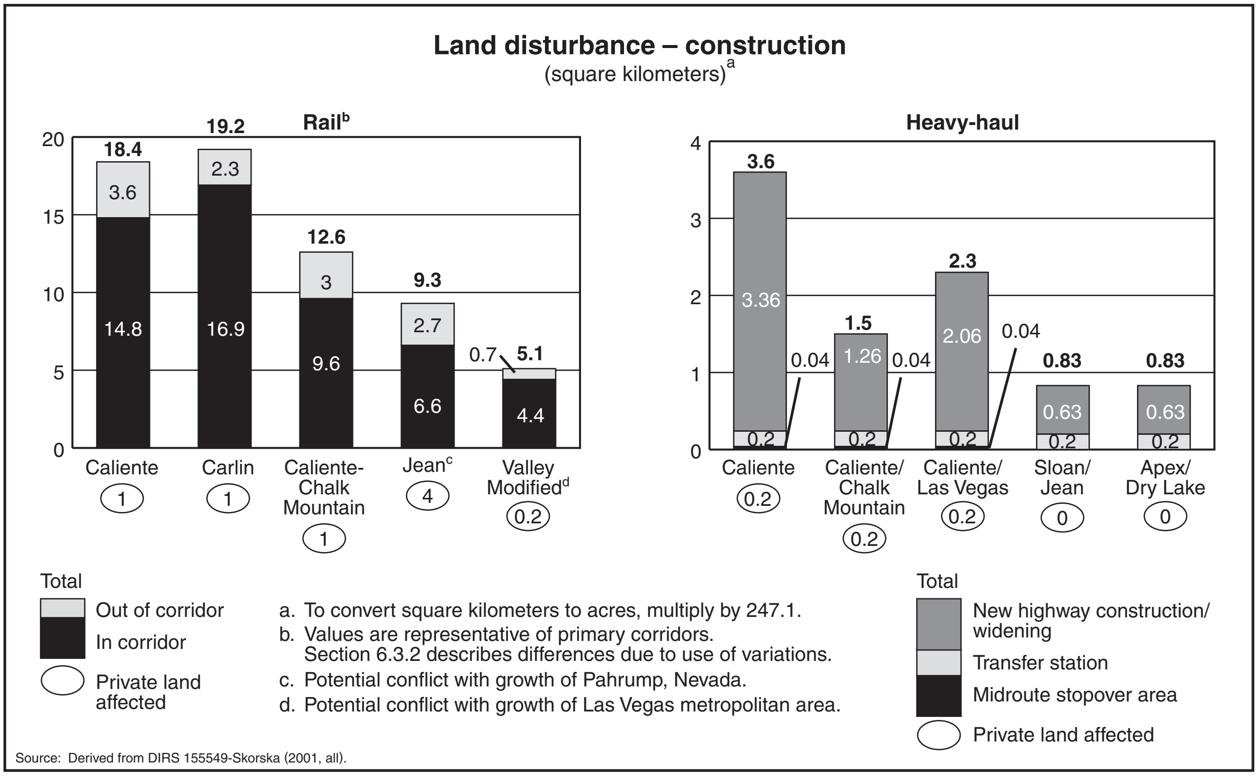


Figure 6-3. Land disturbed for construction of branch rail lines and upgrades to Nevada highways for heavy-haul use.

include sections that would encroach on the Range for short distances. For the Caliente Corridor, Carlin Corridor, and one section of the Valley Modified Corridor, DOE has identified variations that would avoid entering the Range. A short segment of the Valley Modified Corridor for which there is no currently identified variation would cross the southern Range boundary. If DOE selected this corridor, it would consult with the Air Force to determine avoidance or mitigation measures.

The Steiner Creek Alternate of the Carlin Corridor passes just west of the Simpson Park Wilderness Study Area and might encroach slightly into the Wilderness Study Area. The Caliente Corridor passes close to the Weepah Springs and Kawich Wilderness Study Areas, and passes inside and along the western boundary of the South Reveille Wilderness Study Area. The Wilson Pass Option of the Jean Corridor passes through Bureau of Land Management Visual Resource Management Class II lands in the vicinity of Wilson Pass in the Spring Mountains. The Jean and Valley Modified Corridors could have conflicts with the future community growth of Pahrump and Las Vegas, respectively. The Valley Modified Corridor passes near the Las Vegas Paiute Indian Reservation. The Valley Modified Corridor and its Sheep Mountain Alternate cross Nellis Wilderness Study Areas A, B, and C; the Quail Mountain Wilderness Study Area; and penetrates the Desert National Wildlife Refuge. The routes for heavy-haul trucks pass through the Las Vegas Paiute Indian Reservation along U.S. Highway 95 northwest of Las Vegas and approximately 4.8 kilometers (3 miles) west of the Moapa Indian Reservation. The rail origination location for the Stateline Pass Option is on lands to be used for the construction of the Ivanpah Valley Airport (Ivanpah Valley Airport Public Lands Transfer Act, Public Law 106-362, 114 Stat. 1404). The Bonnie Claire Alternate of the Carlin and Caliente Corridors passes through the newly established Timbisha Shoshone trust lands near Beatty.

Table 6-2. Land-use conflicts of rail corridor variations.[a,b]

Corridor[c]	Forest Service land	Fish and Wildlife Service land/ range	Desert Land Entry Program/ withdrawal area	Right-of-way/ road	Wilderness Study Area	Private land	Grazing allotments	Nellis Air Force Range	BLM[d]/ Nevada Test Site land	Native American Reservation
Caliente										
Caliente Corridor with Eccles Option	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Eccles Option	No	No	No	No	No	Yes	Yes	No	Yes	No
Caliente Option	No	No	No	Yes	No	Yes	No	No	Yes	No
Crestline Option	No	No	No	Yes	No	Yes	No	No	Yes	No
White River Alternate	No	No	No	No	No	Yes	No	No	Yes	No
Garden Valley Alternate	No	No	No	Yes	No	Yes	No	No	Yes	No
Mud Lake Alternate	No	No	No	No	No	No	Yes	No	Yes	No
Goldfield Alternate	No	No	No	No	No	Yes	Yes	No	Yes	No
Bonnie Claire Alternate	No	No	No	Yes	No	Yes	Yes	No	Yes	Yes
Oasis Valley Alternate	No	No	No	No	No	Yes	Yes	No	Yes	No
Beatty Wash Alternate	No	No	No	No	No	No	Yes	No	Yes	No
Carlin										
Carlin Corridor with Big Smoky Valley Option	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Big Smoky Valley Option	No	No	Yes	Yes	No	No	Yes	No	Yes	No
Crescent Valley Alternate	No	No	No	Yes	No	Yes	Yes	No	Yes	No
Wood Spring Alternate	No	No	No	No	No	No	Yes	No	Yes	No
Rye Patch Alternate	No	No	No	Yes	No	No	Yes	No	Yes	No
Steiner Creek Alternate	No	No	No	No	Yes	No	Yes	No	Yes	No
Monitor Valley Option	No	No	Yes	Yes	No	No	Yes	No	Yes	No
Mud Lake Alternate	No	No	No	No	No	No	Yes	No	Yes	No
Gold Field Alternate	No	No	No	No	No	Yes	Yes	No	Yes	No
Bonnie Claire Alternate	No	No	No	Yes	No	Yes	Yes	No	Yes	Yes
Oasis Valley Alternate	No	No	No	No	No	Yes	Yes	No	Yes	No
Beatty Wash Alternate	No	No	No	No	No	No	Yes	No	Yes	No
Caliente-Chalk Mountain										
Caliente-Chalk Mountain Corridor with Eccles Option	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Eccles Option	No	No	No	No	No	Yes	Yes	No	Yes	No
Caliente Option	No	No	No	Yes	No	Yes	No	No	Yes	No
Crestline Option	No	No	No	Yes	No	Yes	No	No	Yes	No
White River Alternate	No	No	No	No	No	Yes	No	No	Yes	No
Garden Valley Alternate	No	No	No	Yes	No	Yes	No	No	Yes	No
Orange Blossom Road Option	No	No	No	Yes	No	No	No	No	Yes	No
Mercury Highway Option	No	No	No	No	No	No	No	No	Yes	No
Topopah Option	No	No	No	No	No	No	No	No	Yes	No
Mine Mountain Alternate	No	No	No	No	No	No	No	No	Yes	No
Area 4 Alternate	No	No	No	Yes	No	No	No	No	Yes	No
Jean										
Jean Corridor with Wilson Pass Option	No	No	No	Yes	No	Yes	Yes	No	Yes	No
Wilson Pass Option	No	No	No	Yes	No	Yes	Yes	No	Yes	No
North Pahrump Alternate	No[e]	No	No	Yes	No	Yes	No	No	Yes	No
Stateline Pass Option	No	No	Yes	Yes	No	Yes	Yes	No	Yes	No
Valley Modified										
Valley Modified Corridor	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Indian Hills Alternate	No	Yes	Yes	Yes	No	No	No	No	Yes	No
Sheep Mountain Alternate	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No
Valley Connection	No	No	No	No	No	Yes	No	No	Yes	No

a. Sources: Derived from DIRS 101504-BLM (1979, all), DIRS 103077-BLM (1983, all), DIRS 101523-BLM (1994, all), DIRS 103079-BLM (1998, all), DIRS 104993-CRWMS M&O (1999, all), DIRS 155549-Skorska (2001, all).

b. For definition and illustration of Corridor, Option, Variation, and Alternative terms, see Chapter 3, Section 3.2.2. For additional explanation, see Appendix J, Section J.3.1.2.

c. The first line under each corridor indicates land-use conflicts for the entire corridor with the use of that particular variation. Further listings indicate conflicts only along the length of the particular variation.

d. BLM = Bureau of Land Management.

e. Route abuts Toiyabe National Forest.

6.1.2.2 Air Quality

The main air pollutants would be fugitive dust (PM_{10}) and equipment emissions (carbon monoxide, nitrogen dioxide, and sulfur dioxide) from construction or upgrade activities associated with the rail and heavy-haul truck implementing alternatives, and vehicle emissions associated with legal-weight truck, heavy-haul truck, and rail transportation.

Because the Las Vegas air basin is in nonattainment of air quality regulations for PM_{10} and carbon monoxide, more restrictive regulations are applied to these criteria pollutants within the Las Vegas air basin. Construction activities are a major source of PM_{10} emissions (DIRS 155557-Clark County 2001, all). Vehicle emissions are the major source of carbon monoxide emissions (DIRS 156706-Clark County 2000, all). The transportation air quality analyses focused on these pollutants and sources within the Las Vegas air basin. Annual emissions were estimated and compared to the General Conformity threshold levels established in EPA regulations implementing the Clean Air Act.

The PM_{10} emissions during construction activities would result primarily from earthmoving operations, but also from construction vehicle fuel combustion. Dust control measures are required for activities in the Las Vegas air basin (DIRS 155557-Clark County 2001, all). These measures include water application and limiting activity on windy days. Construction activities would occur under the rail and heavy-haul transportation implementing alternatives in Nevada. The General Conformity threshold level for PM_{10} (63,500 kilograms per year) would be exceeded under the mostly rail scenario for total estimated emissions of the Valley Modified Corridor (190 percent of threshold). Construction activities in other corridors would not exceed the PM_{10} threshold. The General Conformity threshold level for PM_{10} would be exceeded under the heavy-haul scenario for the Caliente-Las Vegas route (100 percent of threshold). Construction activities of other heavy-haul routes would not exceed the PM_{10} threshold.

Carbon monoxide emissions would largely be a result of vehicle emissions. The greatest vehicle emissions under all three transportation scenarios would result not from radioactive material transport to Yucca Mountain, but from commuter and materials transportation to the site. Transport of personnel and materials results indicate maximum emissions during the operations and monitoring phase (67 percent of the carbon monoxide threshold). Vehicle emissions from transportation of radioactive materials would be, at most, 14 percent of the threshold level for the Valley Modified Corridor. During the construction phase, current estimates of fuel use for construction vehicles would result in exceedances of the General Conformity threshold levels for construction of the Valley Modified Corridor (110 percent of threshold).

Section 6.1.3 discusses air quality impacts from the transportation of personnel and materials. Section 6.3.1 discusses air quality impacts for Nevada legal-weight truck transportation. Sections 6.3.2 and 6.3.3 discuss rail and heavy-haul truck implementing alternatives, respectively.

DOE has conducted a separate conformity review for the Nevada transportation implementing alternatives that could result in the release of pollutants to the Las Vegas air basin, which is in nonattainment for carbon monoxide and PM_{10} (DIRS 101826-FHWA 1996, pp. 3-53 and 3-54). Sections 6.3.1.1, 6.3.2.1, and 6.3.3.1 summarize the results of conformity reviews for legal-weight truck, rail, and heavy-haul truck transportation, respectively, in Nevada.

6.1.2.3 Hydrology

Surface-water resources are most prevalent among the Caliente and Carlin Corridors and could be affected by construction activities. The potential Caliente intermodal transfer station is about 0.19 kilometer (0.12 mile) from a perennial stream, and the Caliente, Caliente/Chalk Mountain, and Caliente/Las Vegas routes for heavy-haul trucks would pass within 1 kilometer (0.6 mile) of water resources. Surface-water impacts during construction would be avoided by implementing good management practices to prevent and mitigate spills of pollutants and would avoid, minimize, or otherwise mitigate possible changes to stream flows. Therefore, DOE does not anticipate impacts to surface waters from the construction of a rail or heavy-haul truck implementing alternative. In addition, surface-water impacts would be unlikely from legal-weight truck, rail, or heavy-haul truck operations or the operation of an intermodal transfer station.

Potential for groundwater impacts would be limited. There would be the potential for temporary withdrawals of water from groundwater sources during the construction of a branch rail line or upgrades to highways and construction of an intermodal transfer station. Estimated water use would be greater for construction of branch rail lines than for upgrades for routes for heavy-haul trucks (see Figure 6-4). Such withdrawals would require temporary permits from the State of Nevada or possibly leases of temporary water rights from individuals along the route. If groundwater could not be withdrawn for construction, water would be transported from permitted sources to the construction sites by truck.

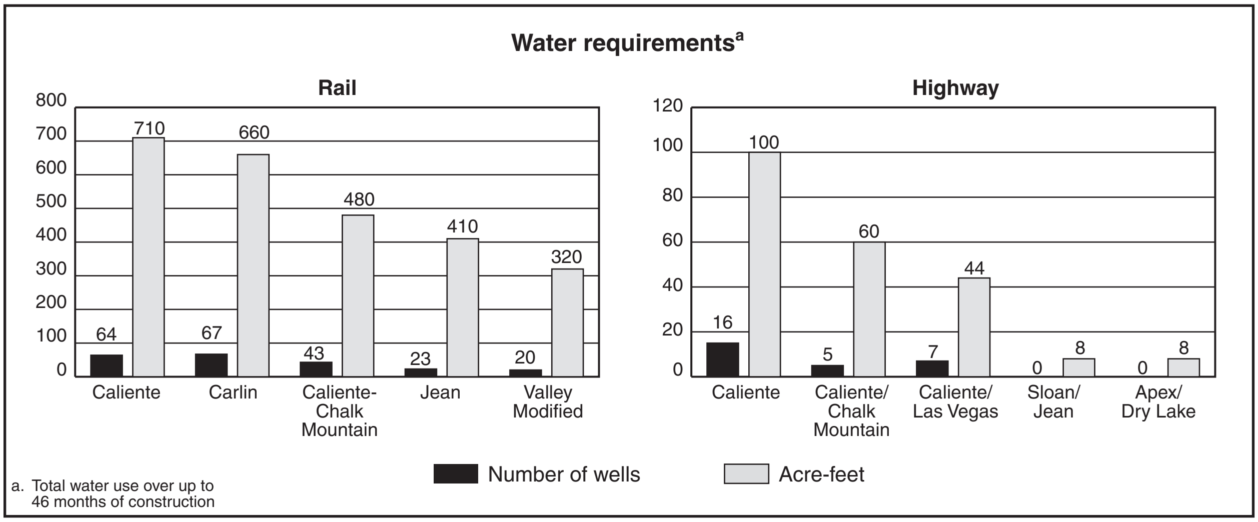


Figure 6-4. Water and number of wells required for construction of branch rail lines and upgrades to Nevada highways for heavy-haul use.

Legal-weight truck shipments, operations of a branch rail line, or operations of heavy-haul trucks, including the operation of an intermodal transfer station, would not affect groundwater resources. Water needs for these operations would be minor, and there would be little potential for contaminant releases to occur, particularly releases of a magnitude that could affect groundwater. Hydrology impacts are discussed for Nevada transportation rail implementing alternatives and for Nevada transportation heavy-haul truck implementing alternatives in Sections 6.3.2 and 6.3.3, respectively.

6.1.2.4 Biological Resources and Soils

Loss of habitat from construction of a branch rail line would be the greatest potential impact to biological resources (vegetation, habitat, threatened and endangered species, small animals, birds, game animals, wild horse and wild burro herds, and soils), potentially affecting the desert tortoise, a threatened species. Loss of desert tortoise habitat would be approximately 2.4 square kilometers (590 acres) for the Caliente/Chalk Mountain route, 3 square kilometers (740 acres) for the Caliente and Carlin routes, 5 square kilometers (1,200 acres) for the Valley Modified route (which is within the range of the desert tortoise along its entire length), and more than 11 square kilometers (2,700 acres) for the Jean route. All of these potential routes have low abundance of desert tortoises with the exception of some limited areas of the Jean route where abundance is higher.

In general, the number of herd management areas crossed by each route is related to the length of the route (as described in Section 3.2.2.1.4). Therefore, the potential for impacts to game animals or horses and burros through disruption of movement patterns or from loss of individual animals would be greater for the longer routes. The Valley Modified route does not cross any herd management areas, but passes through the Desert National Wildlife Range. The Carlin route passes through or near the greatest number of herd management areas or other areas that provide habitat for important biological resources (such as sage grouse strutting grounds). The adverse impact that loss of an individual animal could have on a particular herd would depend on the particular individual that was lost and the size of the herd. Small herds could be affected to a greater degree than large herds. Noise from passing trains could disturb game animals, horses, or burros until those animals became acclimated to the presence of the trains. DOE anticipates that two trains could pass by each day, so this disruption should be minimal.

Other features of the particular routes could affect the potential for impacts to biological resources along each route. Fencing along portions of a route could affect the number of individual animals lost because animals could be blocked from escape routes in fenced areas. Tunnels along the Jean route could be used by wildlife for shelter. Animals seeking shelter in a tunnel might not be able to escape if a train passed through while they were in the tunnel.

The potential for impacts from upgrading Nevada highways for heavy-haul truck use would be small because modifications to roads would occur in previously disturbed rights-of-way. An intermodal transfer station constructed in association with a heavy-haul truck implementing alternative would potentially disturb only about 0.2 square kilometer (50 acres) of potential desert tortoise habitat. The activities associated with constructing a branch rail line, building an intermodal transfer station, or upgrading and maintaining a heavy-haul truck route to Yucca Mountain would be likely to adversely affect a few individual desert tortoises. However, based on review of past experience and available information, DOE believes it could mitigate the impacts of these activities such that they would not negatively affect regional populations of desert tortoises, jeopardize the continued existence of the species, or result in adverse modification of designated critical habitat. Individuals of other special status species could be affected based on the route chosen. Impacts from operations, with the exception of infrequent wildlife kills by vehicles, would be unlikely. Although the proposed routes for heavy-haul trucks pass near or through herd management areas and other areas containing sensitive biological resources, adverse impacts to those resources would be small because the heavy-haul trucks would use existing roads and would represent a very small percentage of the traffic along those roads. [See DIRS 156930-NDOT (2001, all) for traffic counts along Nevada highways.] As with heavy-haul trucks, legal-weight truck shipments that used existing highways would cause only very small impacts to biological resources.

For highway upgrades, DOE or the State of Nevada would reduce concerns about soil contamination or erosion by incorporating appropriate mitigation measures during construction. These measures would include the proper control of hazardous materials and use of dust suppression and other control techniques to reduce erosion. As a result, the implementing alternatives for transportation in Nevada would be unlikely to have impacts on soil. Impacts to biological resources and soils are discussed for Nevada transportation rail implementing alternatives and for Nevada transportation heavy-haul truck implementing alternatives in Sections 6.3.2 and 6.3.3, respectively.

6.1.2.5 Cultural Resources

A comprehensive review of existing literature and many discussions with responsible Federal and State of Nevada agencies and Native American groups has identified many archaeological and cultural sites and features. Pertinent information is presented in Chapter 3, Sections 3.1.6, 3.2.2.1.5, and 3.2.2.2.5. Much of the information has been confirmed and additional information acquired during field observations.

Based on this extensive review of available information and recent field observations, the construction and operation of a branch rail line in any of the candidate corridors could present the potential for direct or indirect impacts (such as crushing or disturbing of sites; soil erosion exposing or covering sites) to archaeological and historic resources, including those related to Native American culture. None of the five rail corridors passes through presently established reservation lands, but the Bonnie Claire Alternate (for either the Carlin or Caliente Corridor) passes directly through the recently established Timbisha Shoshone Trust Lands at Scottys Junction. In some cases, proposed corridors cross historic linear sites (such as the Pony Express Trail) (see Chapter 3, Section 3.2.2.1.5). In these cases potential impacts could be identified during field studies that would evaluate the current condition of the resources at particular locales, the overall character of the impacts, and the effort required to mitigate the impacts. If a rail corridor was selected, DOE would conduct additional archaeological surveys and ethnographic studies as part of additional National Environmental Policy Act reviews to determine potential impacts of alternative alignments within a corridor.

The determination of the potential for impacts to archaeological resources and Native American cultural values from the upgrading and use of existing Nevada highways for heavy-haul truck shipments could require study. Although the widening of roadways and development of turnouts would occur within existing rights-of-way, disturbance of cultural resources near the roadway and, in some cases, within existing rights-of-way could occur. The American Indian Writers Subgroup has commented that ethnographic field studies will be needed to determine specific potential impacts to Native American cultural properties and values for candidate rail corridors (DIRS 102043-AIWS 1998, p. 4-6).

6.1.2.6 Occupational and Public Health and Safety

Impacts to occupational and public health and safety include industrial safety impacts to workers from construction and operations, radiological impacts to workers and the general public from external radiation exposure and exposure to vehicle emissions during normal operations and incident-free transportation, radiological impacts from transportation accident scenarios, radiological impacts from hypothetical severe accident scenarios that would breach shipping casks, and impacts from traffic accidents.

Potential industrial safety impacts to workers from construction and operations are listed in Table 6-3. Estimated impacts from industrial accidents would be higher for rail than for heavy-haul trucks, but in all cases there would be less than 1 industrial safety-related fatality during construction for any of the five branch rail line or five heavy-haul truck implementing alternatives. No industrial safety-related fatalities would be expected to occur during operations.

Table 6-3. Industrial safety impacts to workers from construction and operation of Nevada transportation implementing alternatives.[a]

	Branch rail line				
Impact	Caliente	Carlin	Caliente-Chalk Mountain	Jean	Valley Modified
Total recordable cases	220	210	180	150	110
Lost workday cases	110	110	95	76	58
Fatalities (industrial accidents)	0.4	0.4	0.4	0.3	0.2
	Heavy-haul truck[b]				
	Caliente	Caliente/Chalk Mountain	Caliente/Las Vegas	Sloan/Jean	Apex/Dry Lake
Total recordable cases	370	320	330	210	210
Lost workday cases	190	170	180	110	110
Fatalities (industrial accidents)	0.9	0.8	0.8	0.5	0.5

a. Impacts are totals for 24 years of operations. There are no impacts for the legal-weight truck scenario.
b. Includes impacts to workers at an intermodal transfer station.

Potential radiological impacts and vehicle emissions-related impacts from normal operations and incident-free transportation in Nevada for each of the rail and heavy-haul truck implementing alternatives and for the mostly legal-weight truck scenario are presented in Table 6-4. Radiological impacts to members of the public from external radiation exposure and risks from exposure to vehicle emissions during incident-free transportation would be lowest for rail, intermediate for heavy-haul trucks, and highest for legal-weight truck transportation, where an estimated 0.3 latent cancer fatalities could occur over 24 years. Impacts from vehicle emissions would be low in all cases (0.001 or fewer fatalities).

Table 6-4. Worker and public health and safety impacts from Nevada transportation implementing alternatives.[a]

Impact	Legal-weight truck[b]	Branch rail line: Caliente	Carlin	Caliente-Chalk Mountain	Jean	Valley Modified
Workers						
Maximally exposed individual probability of LCF[c]	0.02	0.02	0.02	0.02	0.02	0.02
Worker population LCFs	0.75	0.34	0.39	0.3	0.3	0.28
Public						
Maximally exposed individual probability of LCF	0.0016	0.00015	0.00015	0.00015	0.00015	0.00015
General population LCFs	0.17	0.009	0.019	0.009	0.08	0.013
Vehicle emissions-related health effects (fatalities)	0.09	0.25	0.25	0.2	0.23	0.13
Accident risk[d]						
Population LCFs	0.000026	0.000001	0.000001	0.000001	0.000004	0.000001
Maximum reasonably foreseeable accident scenario						
Population LCFs	0.5	5	5	5	5	5
Maximally exposed individual probability of LCF	0.0015	0.02	0.02	0.02	0.02	0.02
Traffic accident fatalities	0.49	1.93	1.85	1.57	1.27	0.94

Impact	Heavy-haul truck[b]: Caliente	Caliente-Chalk Mountain	Caliente/Las Vegas	Sloan/Jean	Apex/Dry Lake
Workers					
Maximally exposed individual probability of LCF[c]	0.02	0.02	0.02	0.02	0.02
Worker population LCFs	0.76	0.61	0.66	0.59	0.57
Public					
Maximally exposed individual probability of LCF	0.00016	0.00016	0.00016	0.00016	0.00016
General population LCFs	0.04	0.03	0.11	0.17	0.08
Vehicle emissions-related health effects (fatalities)	0.47	0.32	0.46	0.42	0.29
Accident risk[d]					
Population LCFs	0.000005	0.000001	0.000028	0.00006	0.000028
Maximum reasonably foreseeable accident scenario					
Population LCFs	5	5	5	5	5
Maximally exposed individual probability of LCF	0.02	0.02	0.02	0.02	0.02
Traffic accident fatalities	4.1	2.76	3.47	1.98	1.93

a. Impacts are totals for 24 years of operations.
b. Includes impacts to workers at an intermodal transfer station.
c. LCF = latent cancer fatality.
d. In this table, radiological accident dose risk is the sum of the products of the probabilities (dimensionless) and consequences (in person-rem) of all potential transportation accidents. This sum is converted to latent cancer fatalities using the conversion factor of 0.0005 latent cancer fatality per person-rem.

The overall radiological accident risk from all accidents over the 24 years of transportation activities in Nevada would be no higher than about 0.003 latent cancer fatality in the potentially exposed population within 80 kilometers (50 miles). Accident risk would be highest for the heavy-haul implementing alternatives and lower for the mostly legal-weight truck scenario and rail implementing alternatives. The Jean rail and Sloan/Jean heavy-haul truck implementing alternatives would have higher accident risks than other implementing alternatives. The estimated accident risks are presented in Table 6-4.

The Nuclear Regulatory Commission published a draft Addendum 1 (DIRS 148185-NRC 1999, all) to NUREG-1437, Volume 1, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (DIRS 101899-NRC 1996, all) to provide a technical basis to amend Commission regulations with the objective of improving the efficiency of renewing nuclear plant operating licenses well-understood environmental impacts to avoid repetitive reviews. The addendum addresses two aspects of spent nuclear fuel transportation that the original Commission analysis did not address—the cumulative impacts of transportation of commercial spent nuclear fuel in the vicinity of the proposed repository at Yucca Mountain, and the impacts of transporting higher-burnup fuel. The results of this DOE EIS analysis appear to be consistent with the Nuclear Regulatory Commission conclusion in the addendum, which is that "radiological and accident risks of SNF [spent nuclear fuel] transport in the vicinity of Las Vegas are within regulatory limits and small."

6.1.2.7 Socioeconomics

Socioeconomic impacts of transportation (changes in the level of employment, population, real disposable income, Gross Regional Product, and State of Nevada and local government expenditures) would occur from the construction and operation of a branch rail line, from upgrading a heavy-haul truck route, from transporting large shipping casks using heavy-haul trucks, and from constructing and operating an intermodal transfer station. Figures 6-5 through 6-8 show total regional employment changes in the peak year of construction, and average total employment in the region of influence from operations activities. Because of the large population and employment in the socioeconomic region of influence (principally in Clark County), impacts from construction activities would generally be less than 3 percent of the baseline for each socioeconomic measure in all three counties in the region of influence, for the rail or heavy-haul truck implementing alternatives. Changes in Lincoln County (the two rail corridors and three routes for heavy-haul trucks originating in Caliente) would be more visible, but still generally less than 3 percent of the applicable baseline and would not be greater than historic short-term socioeconomic changes in the county over the past two decades. The operational period for either a branch rail line or a heavy-haul truck route probably would generate relatively constant employment levels. Changes to the baseline regional populations and employment from construction or operation of a rail or heavy-haul truck implementing alternative would be unlikely to have consequences greater than 3 percent of the population baseline. DOE anticipates that the changes in the economic measures of Gross Regional Product, real disposable income, and State of Nevada and local government expenditures would be less than 3 percent of the baselines in each county. Changes in employment and subsequent changes in population would be the principal cause of the changes in these measures. Figures 6-5 through 6-8 show the changes in employment and population expected during construction and operations if DOE implemented one of the five rail or five heavy-haul truck implementing alternatives.

DOE performed detailed analyses for the corridors of the five branch rail line implementing alternatives and the five heavy-haul truck implementing alternatives. The results of these analyses, which are driven by the length of the rail corridors or the cost of construction and upgrades for the proposed routes for heavy-haul trucks, are representative of the variations (options and alternates) of each corridor listed in Appendix J, Section J.3.1.2. The lengths of the variations for each corridor are similar, as listed in Section 6.3.2.2.

In light of public comments received on the Draft EIS concerning perception-based and stigma-related impacts, DOE examined relevant studies and literature on perceived risk and stigmatization of communities to determine whether the state of the science in predicting future behavior based on perceptions had advanced sufficiently since scoping to allow DOE to quantify the impact of public risk perception on economic development or property values in potentially affected communities. Of particular interest were those scientific and social studies carried out in the past few years that directly relate to either Yucca Mountain or to DOE actions such as the transportation of foreign research reactor spent nuclear fuel. DOE also reevaluated the conclusions of previous literature reviews such as those

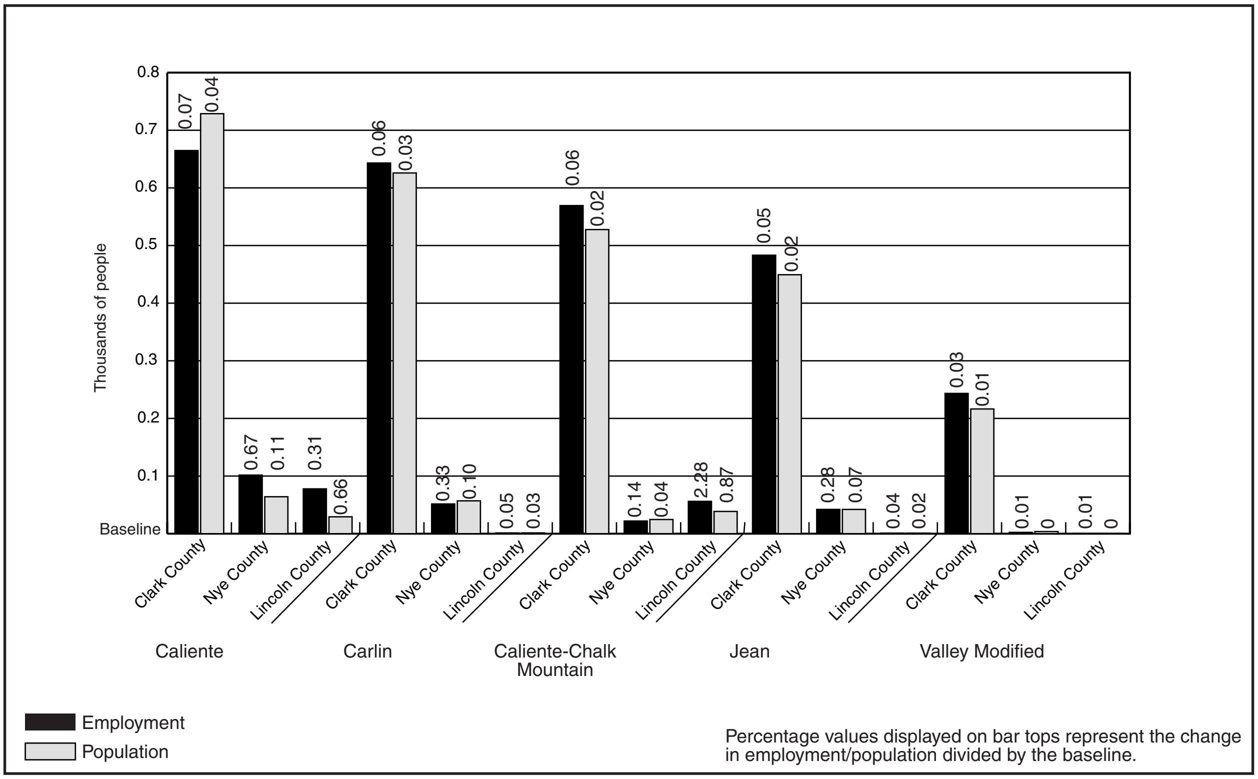


Figure 6-5. Population and employment for branch rail line implementing alternatives, construction (peak years).

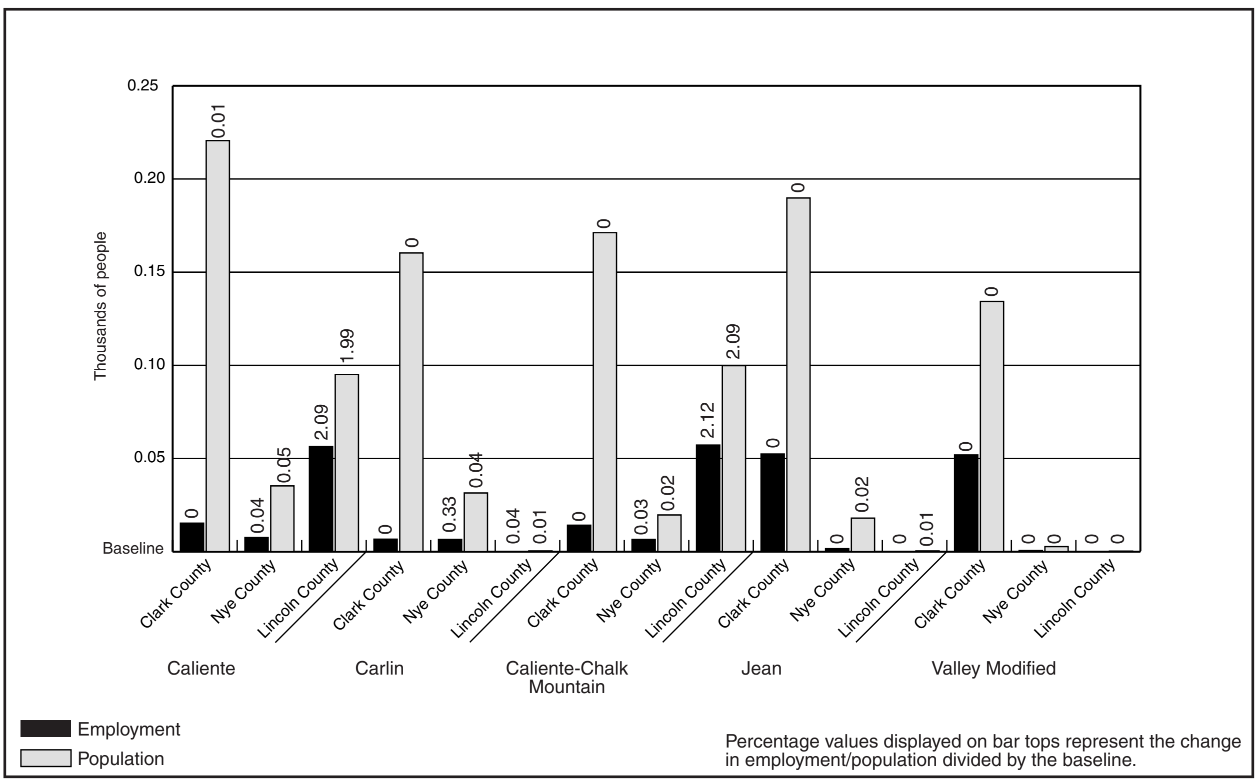


Figure 6-6. Population and employment for branch rail line implementing alternatives, operations (average years).

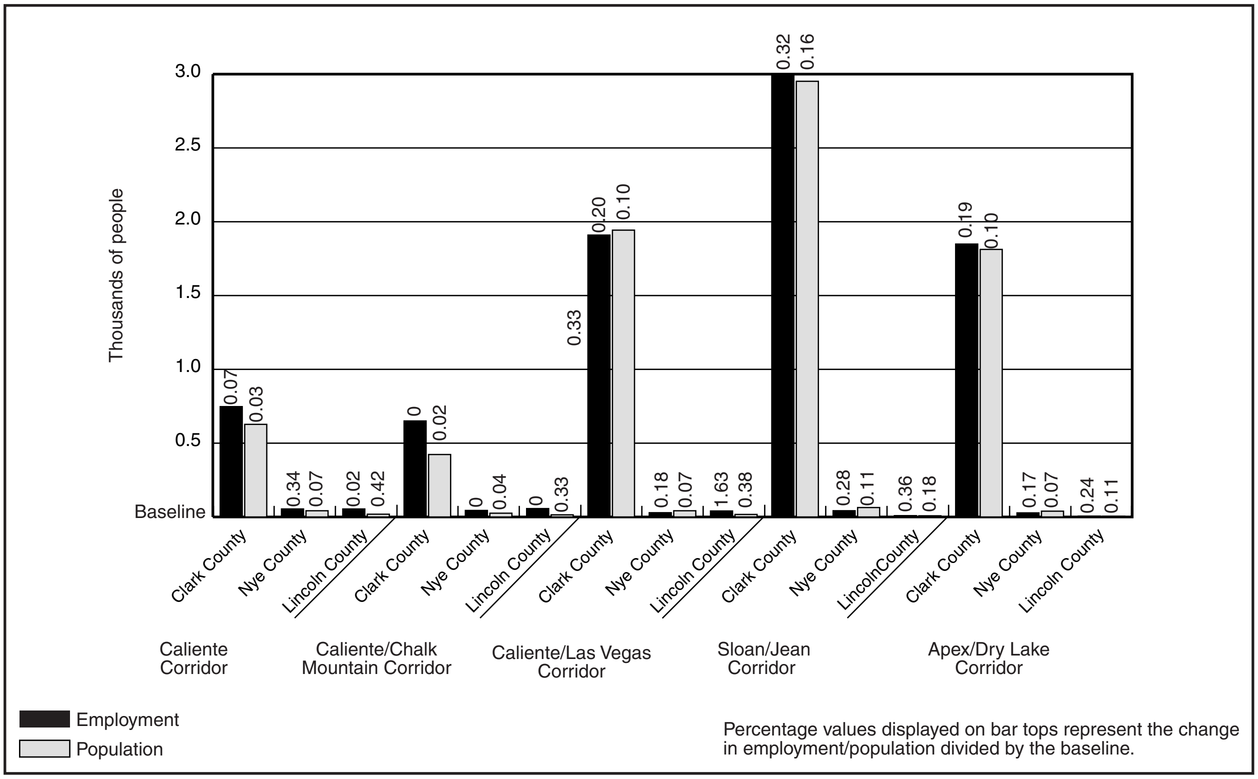


Figure 6-7. Population and employment for heavy-haul implementing alternatives, construction (peak years).

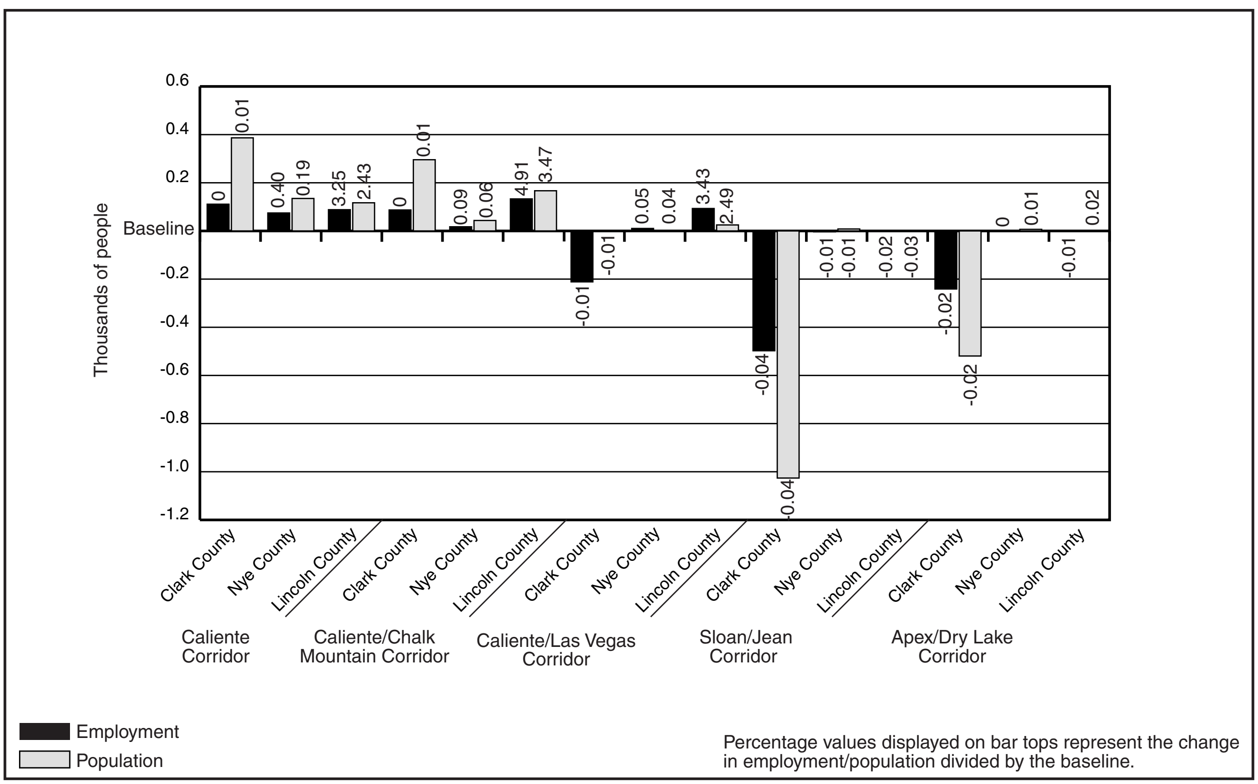


Figure 6-8. Population and employment for heavy-haul implementing alternatives, operations (average years).

conducted by the Nuclear Waste Technical Review Board and the State of Nevada, among others. DOE has concluded that:

- While in some instances risk perceptions could result in adverse impacts on portions of a local economy, there are no reliable methods whereby such impacts could be predicted with any degree of certainty
- Much of the uncertainty is irreducible, and
- Based on a qualitative analysis, adverse impacts from perceptions of risk would be unlikely or relatively small.

While stigmatization of southern Nevada can be envisioned under some scenarios, it is not inevitable or numerically predictable. Any such stigmatization would likely be an aftereffect of unpredictable future events, such as serious accidents, which may not occur. As a consequence, DOE did not attempt to quantify any potential for impacts from risk perceptions or stigma in this Final EIS. Chapter 2, Section 2.5.4 contains further detail.

6.1.2.8 Noise and Vibration

Noise from the construction of a branch rail line or upgrades to highways for heavy-haul trucks would be transient and not excessive. In addition, noise from trains, which would occur during as many as five weekly round trips, would not be excessively disruptive. Heavy-haul truck operations would use existing highways that already have traffic, including semi-trailer trucks. The American Indian Writers Subgroup identified noise from transportation as a concern because of its effects on ceremonies and the solitude necessary for healing and praying (DIRS 102043-AIWS 1998, all).

Construction upgrades of heavy-haul truck routes and construction of branch rail lines would be unlikely to cause vibration damage to historic buildings because of the distance of potentially sensitive buildings from construction sites. Upgrading of roads where they pass through or near communities would have the most potential for noise or vibration to affect buildings or be a nuisance to residents.

Train Operations. Ground vibration from trains using a branch rail line in Nevada to transport spent nuclear fuel and high-level radioactive waste to Yucca Mountain would be well below levels that would contribute to damage to historic buildings or structures.

Because DOE would place the candidate branch rail lines in areas away from communities, and because development and construction and most operations would occur during daylight hours, the potential for noise or vibration impacts from rail line construction and operation is low.

Heavy-Haul Truck Operation. Because they would use air-filled rubber tires with loads distributed to over 100 wheels and would operate on improved roadways having compacted foundation soils, ground vibration from heavy-haul trucks would be much less than that from trains. In addition, DOE assumes that speeds near communities with sensitive historic structures and buildings would be limited for safety, further ensuring that vibration criteria were not exceeded.

6.1.2.9 Aesthetics

Four of the five candidate rail corridors would not have large or lasting aesthetic impacts. The upgrades of existing highways would present short-term aesthetic impacts during construction but these would be temporary and transient, resulting largely from widening the highways. Routes originating in Caliente could cause impacts on the Class II lands of Kershaw Ryan State Park, the entrance of which is on the east side of the Meadow Valley Wash across from a potential location for an intermodal transfer station. However, the character of this area of the Meadow Valley Wash has been modified by the Union Pacific rail line, the City of Caliente water treatment facility, and agricultural uses of lands in the vicinity. Studies have identified a potential visual resource impact for the northeastern portion of the Jean Corridor that passes through the Spring Mountains. The character of Class II lands (defined in Chapter 3, Section 3.1.10) in that part of the corridor would change, possibly in conflict with visual resource management goals. All routes for heavy-haul trucks and all branch rail lines except Carlin would pass through Class III lands. Aesthetic conditions would not be affected by legal-weight trucks on existing, well-traveled highways.

6.1.2.10 Utilities, Energy, and Materials

Impacts to utility, energy, and material resources from the construction and operation of any of the rail or heavy-haul truck implementing alternatives would be small compared to usage in Nevada. For example, Nevada fossil-fuel consumption during 1996 was about 3.8 billion liters (1 billion gallons) (DIRS 148081-BTS 1999, Table MF-21). By comparison, the largest fossil-fuel use for any of the implementing alternatives would be less than 50 million liters (13 million gallons) over the construction period, or less than 0.5 percent of the Nevada annual use. Similarly, concrete use for the largest implementing alternative would be about 460,000 metric tons (200,000 cubic meters), also less than 2 percent of the Nevada annual use of 7.4 million metric tons (3.2 million cubic meters) (DIRS 104926-Bauhaus 1998, all). Figures 6-9 and 6-10 compare the use of resources for construction of the rail and heavy-haul truck implementing alternatives, respectively.

6.1.2.11 Wastes

Construction and operation of a branch rail line or use of heavy-haul trucks would produce small amounts of construction debris, sanitary solid waste, and sanitary wastewater and possibly a small amount of hazardous waste. Under the heavy-haul truck alternative, a small amount of low-level radioactive waste could be generated at an intermodal transfer station. Nonradioactive wastes would be recovered for recycling, placed in permitted landfills, reused, or in the case of sanitary sewage, treated and disposed of on the site. All waste would be managed in accordance with applicable environmental, occupational safety, and public health and safety requirements to minimize the possibility of adverse impacts to animals, vegetation, air quality, soil, and water resources.

There would be minimal impacts on the capacity of facilities to treat or dispose of wastes from Nevada transportation. For example, branch rail line construction camps with running water would generate about 37 million liters (10 million gallons) of sanitary sewage that could be treated and disposed of in permitted septic systems and about 940 metric tons (1,000 tons) of sanitary solid waste during the peak year of employment. For comparison, the waste volume from Nevada transportation would be small in relation to the volumes disposed of in the State in 2000 [3.5 million metric tons (3.9 million tons) of sanitary solid waste] (DIRS 155565-NDEP 2001, Section 2.1), so the rail construction camps would add about 0.027 percent. The estimated construction debris from an intermodal transfer station would be 23 metric tons (26 tons). Approximately 750,000 metric tons (820,000 tons) of construction debris was disposed of in Nevada in 2000 (DIRS 155565-NDEP 2001, Section 2.1), so the construction of an intermodal transfer station would add less than approximately 0.01 percent to the total. About 1,400 kilograms (3,000 pounds) of tires and drained oil filters (industrial and special wastes) would be generated during truck maintenance activities at an intermodal transfer station. About 83,000 metric tons (91,000 tons) of this type of waste was disposed of in Nevada in 2000 (DIRS 155565-NDEP 2001, Section 2.1), so the truck maintenance waste would add less than about 0.01 percent. Hazardous and low-level radioactive waste would have a small impact on the ability of facilities to treat and dispose of the waste. According to the Environmental Protection Agency, treatment and disposal capacity in the western states for hazardous waste would be above the expected demand (by 7 times for incineration and

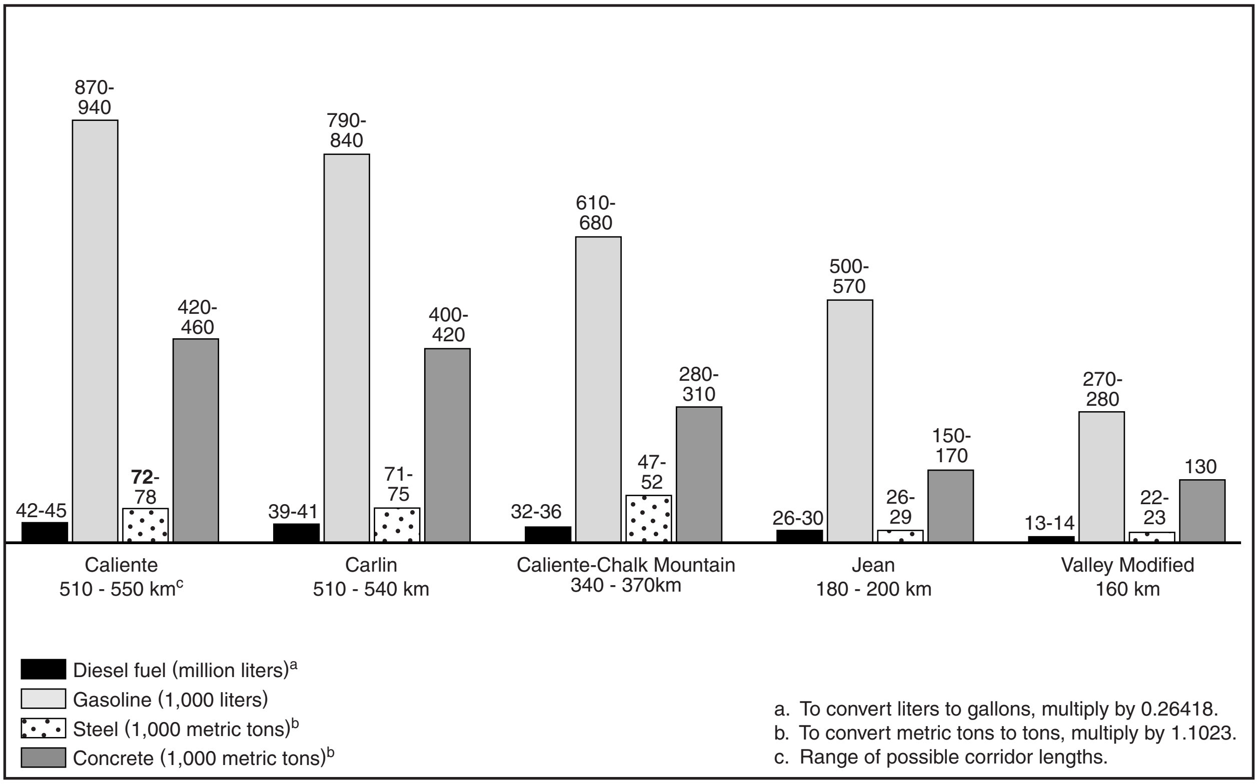


Figure 6-9. Utility, energy, and material use for construction of a branch rail line in Nevada.

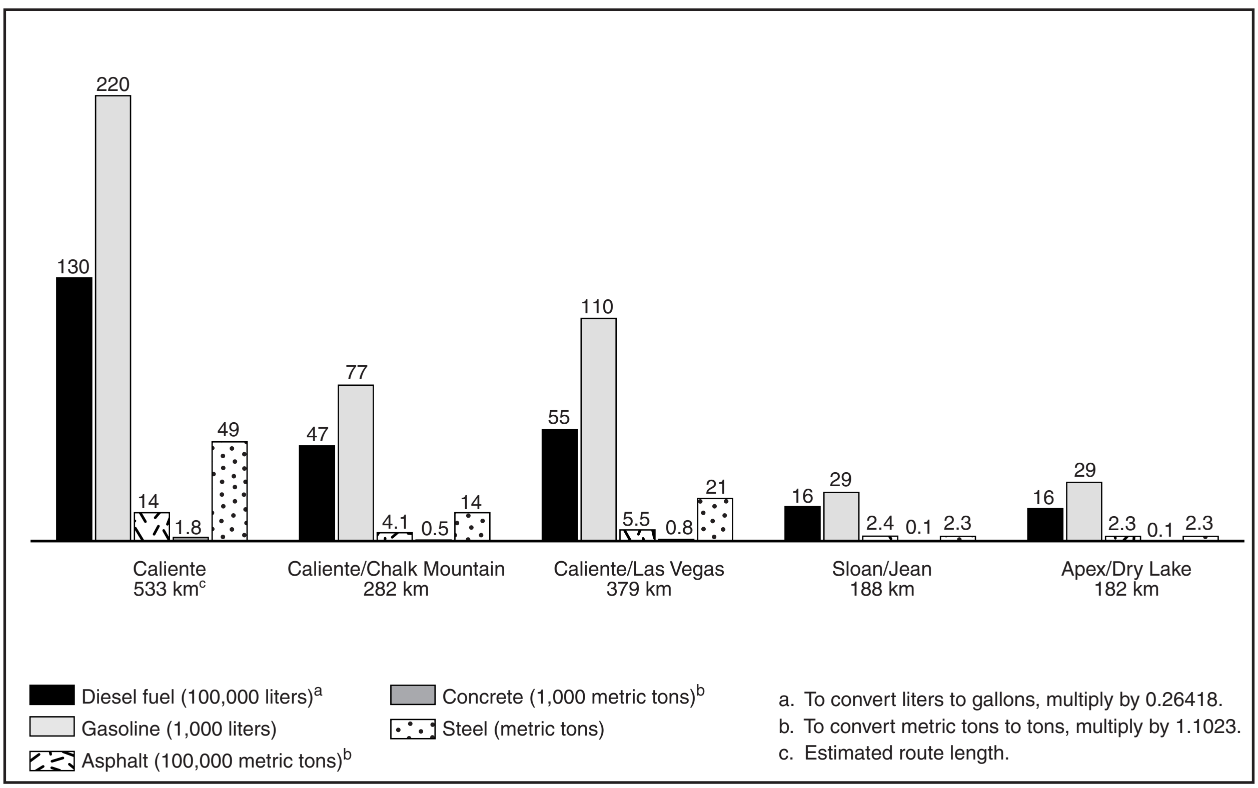


Figure 6-10. Utility, energy, and material use for upgrading of Nevada highways for heavy-haul truck use.

50 times for landfill) until 2013 (DIRS 103245-EPA 1996, pp. 32, 33, 36, 46, 47, and 50). Disposal capacity for a broad range of low-level radioactive wastes would be available at two currently licensed facilities (DIRS 152583-NRC 2000, section on U.S. Low-level Radioactive Waste Disposal).

6.1.2.12 Environmental Justice

Section 6.3 discusses the methods used in the analysis of potential environmental justice concerns. No potentially disproportionately high and adverse impacts to minority or low-income populations were identified in areas of land use; air quality; hydrology; biological resources and soils; socioeconomics; aesthetics; and occupational and public health and safety for construction or operations under the mostly legal-weight truck scenario in Nevada or any of the 10 rail and heavy-haul truck transportation implementing alternatives. Potential visual resource (aesthetic) impacts were identified for the Jean Corridor but these were not determined to be disproportionate. However, no potentially disproportionately high and adverse impacts would occur in these areas for legal-weight truck transportation that would use existing highways. If DOE identified potentially high and adverse impacts for a corridor or route, it would mitigate them (as discussed in Chapter 9).

Because impacts to humans and other impacts that could affect minority or low-income populations or populations of American Indians would not be disproportionately high and adverse, including mitigation as needed, an additional environmental justice analysis is not required. Chapter 4, Section 4.1.13.4, contains an environmental justice discussion of a Native American perspective on the Proposed Action.

6.1.3 TRANSPORTATION OF OTHER MATERIALS AND PERSONNEL

Other types of transportation activities associated with the Proposed Action would involve the transportation of personnel and of materials other than the spent nuclear fuel and high-level radioactive waste discussed above. These other materials include construction materials and consumables for repository construction and operation, including repository components (for example, disposal containers, drip shields, etc.); waste including low-level waste, construction and demolition debris, sanitary and industrial solid waste, and hazardous waste; and office and laboratory supplies, mail, and laboratory samples.

The quantities of construction materials, consumables, site-generated waste, laboratory samples, and supplies, would differ for the range of repository operating modes. The number of commuting employees would also differ. Therefore, the transportation impacts listed in Table 6-5 are ranges, from the least to the greatest impact. Appendix J, Section J.3.6, provides additional detail.

Table 6-5. Impacts related to repository transportation activities.

Factor	Impact
Total kilometers traveled (millions)	610 - 1,100
Total nonradiological latent fatalities[a]	0.9 - 1.6
Total nonradiological traffic fatalities[b]	6.3 - 11.4
Total nonradiological commuting worker traffic fatalities	2.4 - 4.2

a. From commuter and materials transportation.
b. From materials transportation and public fatalities from commuter transportation.

Additional traffic in the Las Vegas air basin would result in emissions of carbon monoxide, most significantly during the repository phases of construction and operation and monitoring. The Las Vegas air basin is in nonattainment status for carbon monoxide, which is largely a result of vehicle emissions (DIRS 156706-Clark County 2000, Appendix A, Table 1-3). As part of the conformity review DOE conducted using the guidance in DIRS 155566-DOE (2000, all), it was determined that the transportation of personnel, materials, and supplies through the Las Vegas air basin would not exceed the carbon monoxide General Conformity threshold level [91 metric tons (100 tons) per year; 40 CFR 93.153] for serious nonattainment status. The highest total emissions for personnel, materials, and supplies would be 50 tons per year during the construction phase and 67 tons per year during the operations and monitoring phase; emissions would contribute a maximum of an additional 0.07 percent to the estimated 2000 daily carbon-monoxide levels in the nonattainment area (DIRS 156706-Clark County 2000, Appendix A, Table 1-3).

Impacts in other environmental resource areas would be unlikely to occur.

6.2 National Transportation

This section describes the estimated national transportation impacts from shipping spent nuclear fuel and high-level radioactive waste from 72 commercial and 5 DOE sites throughout the United States to the proposed Yucca Mountain Repository. This section includes the following:

- Definition and an overview of the analysis scenarios (Section 6.2.1)
- Impacts to workers and the public from spent nuclear fuel and high-level radioactive waste loading operations at commercial and DOE sites (Section 6.2.2)
- Potential incident-free (routine) radiological impacts and vehicle emission impacts (Section 6.2.3)
- Potential accident scenario impacts (Section 6.2.4).

National transportation of spent nuclear fuel and high-level radioactive waste, which would use existing highways and railroads, would average 7.8 million truck kilometers (4.9 million miles) per year for the mostly truck case and 1.6 million railcar kilometers (1 million miles) per year for the mostly rail case. Barges used to ship rail casks to nearby railheads from commercial sites not served by a railroad could average as much as 6,500 kilometers (4,000 miles) per year. The national yearly average for total highway and railroad traffic is 186 billion truck kilometers (116 billion miles) and 49 billion railcar kilometers (30 billion miles) (DIRS 150989-BTS 1998, pp. 5 and 6)]. Spent nuclear fuel and high-level radioactive waste transportation would represent a very small fraction of the total national highway and railroad traffic (0.004 percent of truck kilometers and 0.003 percent of railcar kilometers). Domestic waterborne trade in 1995 accounted for about 1 billion metric tons (910 million tons) (DIRS 148158-MARAD 1998, all). This represents about 1 million barge shipments per year. Thus, shipments of spent nuclear fuel by barge would only be a very small fraction of the total annual domestic waterborne commerce.

With the exception of occupational and public health and safety impacts, which are evaluated in this section, the environmental impacts of this small fraction of all national transportation would be very small in comparison to the impacts of other nationwide transportation activities. Thus, the national transportation of spent nuclear fuel and high-level radioactive waste would have very small impacts on land use and ownership; hydrology; biological resources and soils; cultural resources; socioeconomics; noise and vibration; aesthetics; utilities, energy, and materials; or waste management.

To determine if pollutants of concern from national transportation vehicles (truck and rail) would degrade air quality in nonattainment areas, DOE reviewed traffic volumes in these areas. This review determined that the numbers of shipments of Yucca Mountain-destined vehicles through these areas would be very small in relation to normal traffic volumes. Therefore, the impact to air quality in these areas, except Nevada (see Section 6.1.3), would be very small.

Radiological impacts of accidents on biological resources would be extremely unlikely. The analysis focused the impacts from accidents on human health and safety. A severe accident scenario, such as the maximum reasonably foreseeable accident scenarios discussed in Section 6.2.4.2, that would cause a release of contaminated materials would be very unlikely. The probabilities of the severe accident scenarios discussed in Section 6.2.4.2 are less than 3 in 10 million per year for both the mostly legal-weight truck and mostly rail transportation scenarios. Because of the low probability of occurrence, an accident scenario during the transport of spent nuclear fuel and high-level radioactive waste would be unlikely to cause adverse impacts to any endangered or threatened species, and impacts to other plants and animals would be small. Therefore, the analysis did not evaluate the impacts for these environmental parameters for national transportation activities further.

This chapter does not evaluate the risks of economic loss or resultant environmental consequences from potential transportation accidents that could cause releases of radioactive materials. DOE did not perform these analyses because estimating economic risks and environmental consequences would depend on many factors associated with accidents that cannot be known in advance. Therefore, the information that would be needed for such an analysis is not available. Section J.1.4.2.5 of Appendix J presents a review and analysis of studies by the U.S. Nuclear Regulatory Commission, the National Aeronautics and Space Administration, DOE, and others that discusses cost factors and provides estimates of the range of costs and environmental consequences of cleaning up contamination following hypothetical accidental releases of radioactive materials.

6.2.1 ANALYSIS SCENARIOS AND METHODS

Under the mostly legal-weight truck scenario for national transportation, DOE would transport shipments (with the exception of naval spent nuclear fuel and possibly some DOE high-level radioactive waste) by legal-weight truck to Nevada. Naval spent nuclear fuel would be shipped by rail from the Idaho National Engineering and Environmental Laboratory. Under the mostly-legal weight truck scenario, DOE assumed that some shipments of DOE high-level radioactive waste would use *overweight trucks*. With the exception of permit requirements and operating restrictions, the vehicles for these shipments would be similar to legal-weight truck shipments but might weigh as much as 52,200 kilograms (115,000 pounds). States routinely issue special permits for trucks weighing up to 58,500 kilograms (129,000 pounds).

Figure 6-11 shows the highway routes (mostly Interstate Highways) that the analysis used to estimate transportation-related impacts, along with the locations of the commercial and DOE sites and Yucca Mountain. The routes selected for analysis are representative of routes that DOE could use for truck shipments if the Yucca Mountain site was approved. In addition, the highway routes shown would conform to the routing requirements in 40 CFR 397.101 (see Appendix J, Section J.1.2).

Although DOE cannot be certain of the actual mix of rail and truck shipments that would occur, it expects that the mostly rail scenario best represents the mix of modes it would use. This belief is based on analyses the Department has done to assess generator site capabilities to handle larger (rail) casks, distances to suitable railheads, and historic experience in actual shipments of fuel, waste, or large reactor-related components. In addition, DOE considered relevant information published by knowledgeable sources such as the Nuclear Energy Institute, which provided information on capabilities of generator sites to handle large rail casks (DIRS 155777-McCullum 2000, all). Although DOE believes the mostly rail scenario best represents what would be likely for the transportation of spent nuclear fuel and high-level radioactive waste to a Yucca Mountain Repository, Appendix J, Section J.1.2.1.4 describes an analysis that illustrates how changes in the mix of rail and truck modes would change estimated health and safety impacts for national transportation. The results of the analysis indicated how a mix between the limits represented by the mostly legal-weight truck and mostly rail scenarios would result in health and safety impacts that would be between those estimated for the two scenarios and would not be greater than the impacts from either scenario.

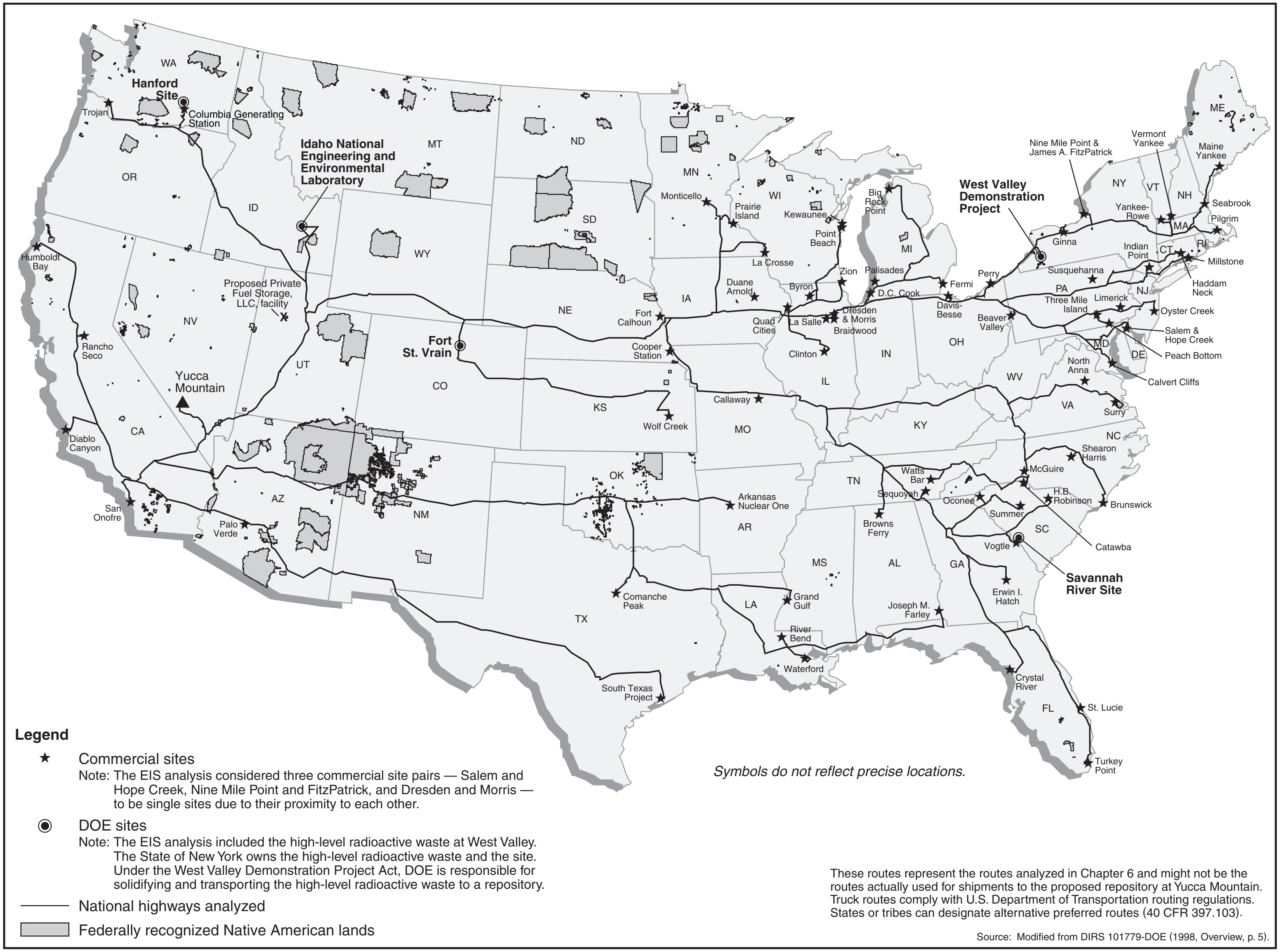


Figure 6-11. Representative truck routes from commercial and DOE sites to Yucca Mountain analyzed for the Proposed Action.

MOSTLY LEGAL-WEIGHT TRUCK AND MOSTLY RAIL SCENARIOS

The Department would prefer most shipments to a Yucca Mountain repository be made using rail transportation. It also expects that the mostly rail scenario described in this EIS best represents the mix of rail and truck transportation that would be used. However, it cannot be certain of the actual mix of rail and truck transportation that would occur over the 24 years of the Proposed Action. Consequently, DOE used the mostly legal-weight truck and mostly rail scenarios as a basis for the analysis of potential impacts to ensure the analysis addressed the range of possible transportation impacts. The estimated number of shipments for the mostly legal-weight truck and mostly rail scenarios represents the two extremes in the possible mix of transportation modes, thereby covering the range of potential impacts to human health and safety and to the environment for the transportation modes DOE could use for the Proposed Action.

Under the national transportation mostly rail scenario, DOE would transport shipments (with the exception of commercial spent nuclear fuel at six sites that do not have the capability to load a rail cask) by rail to Nevada. In addition, this scenario assumes that 24 commercial sites that have the capability to handle and load rail casks, but that do not have railroad service, would make shipments to nearby railheads by barge or heavy-haul truck. Barge shipments of rail casks containing spent nuclear fuel could be possible from 17 commercial sites that are on or near navigable waterways. Figure 6-12 shows the railroad routes that the analysis used to estimate transportation-related impacts, along with the locations of the commercial and DOE sites and Yucca Mountain. The routes selected for analysis are representative of routes that could be used for rail shipments if the Yucca Mountain site was approved. The analysis estimated that these routes would most closely follow current railroad industry practices and the system-wide capability to ship hazardous materials safely. These routes would reduce time in transit, reduce the number of interchanges between railroads, and use mainline tracks to the maximum practical extent.

The railroad routes shown in Figure 6-12 could also be used by generators to transport spent nuclear fuel to a proposed Private Fuel Storage facility near Skull Valley in northwestern Utah (DIRS 152001-NRC 2000, all). Rail routes from that facility to connections with potential branch rail lines or to an intermodal transfer station in Nevada would be essentially the same as the western sections of rail routes analyzed in this chapter. Thus, impacts presented in this chapter for five candidate routes for heavy-haul trucks and five candidate rail corridors in Nevada would be about the same whether shipments were directly from 72 commercial and 5 DOE generator sites to a Yucca Mountain Repository or from a Private Fuel Storage facility in Skull Valley, Utah. Chapter 8, Section 8.4, discusses potential cumulative impacts of transporting commercial spent nuclear fuel to a Private Fuel Storage facility and then to a Yucca Mountain Repository (see Appendix J, Section J.1.2).

This section evaluates radiological and nonradiological impacts to workers and the public from routine transportation operations and from accidents. DOE used a number of computer models and programs to estimate these impacts; Appendix J describes the analysis assumptions and models.

The CALVIN model (DIRS 155644-CRWMS M&O 1999, pp. 2 to 22) was used to estimate the number of shipments of commercial spent nuclear fuel for both the mostly legal-weight truck and mostly rail scenarios. The CALVIN program used commercial spent nuclear fuel inventories and characteristics from the *Report on the Status of the Final 1995 RW-859 Data Set* (DIRS 104848-CRWMS M&O 1996, all) and the *Calculation Method for the Projection of Future SNF Discharges* (DIRS 156305-CRWMS M&O 2001, all) (see Appendix A) to estimate the number of shipments. For DOE spent nuclear fuel and high-level radioactive waste, the analysis used inventories and characteristics for materials to be shipped under the Proposed Action that were reported by the DOE sites in 1998 (see Appendix A) to estimate the number of shipments. Chapter 2, Section 2.1.3, and Appendix J discuss the number of shipments.

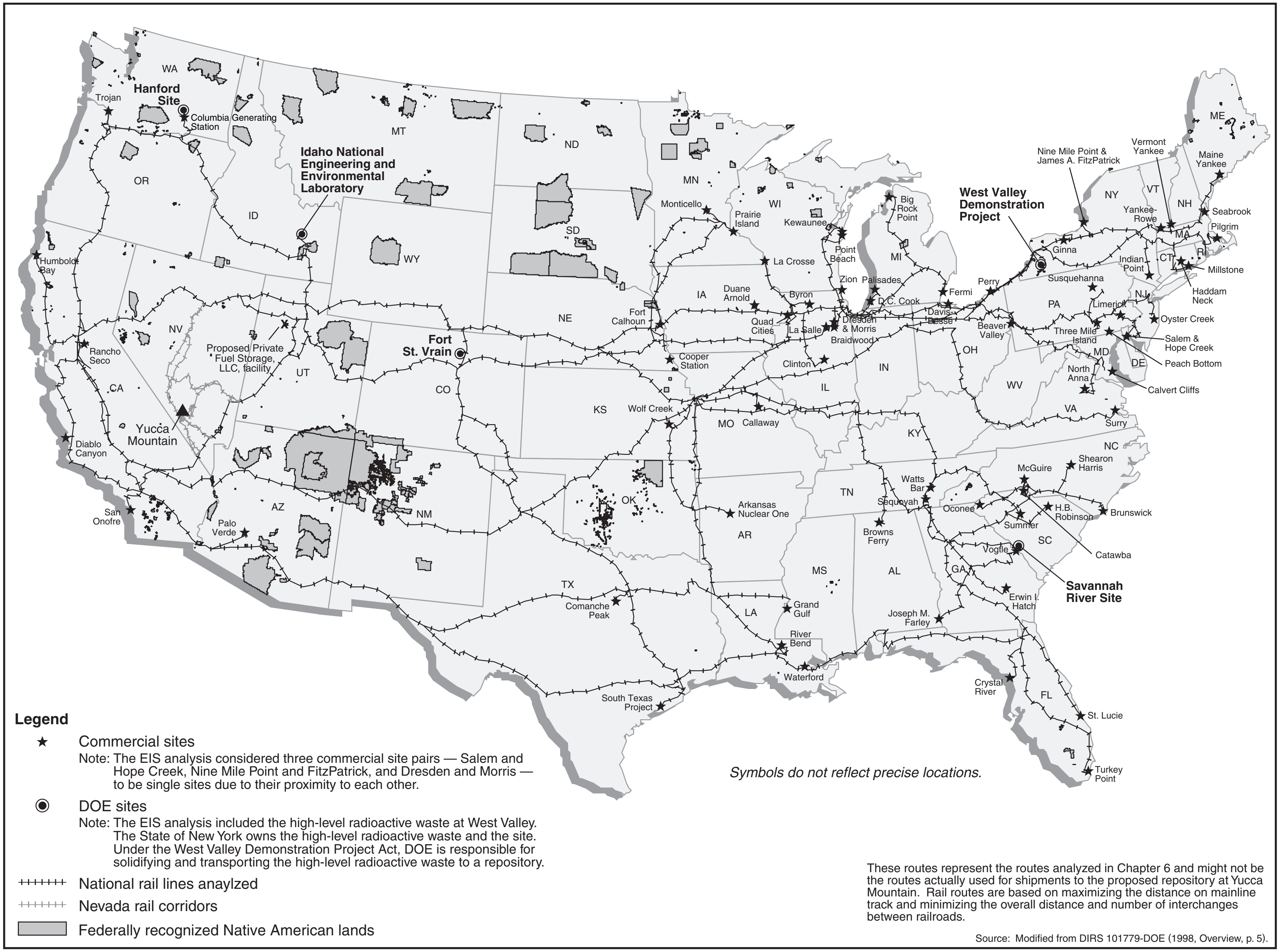


Figure 6-12. Representative rail routes from commercial and DOE sites to Yucca Mountain analyzed for the Proposed Action.

The transportation analyses used the following computer programs:

- HIGHWAY (DIRS 104780-Johnson et al. 1993, all) to identify the highway routes that it could use to transport spent nuclear fuel and high-level radioactive waste. All of the routes would satisfy U.S. Department of Transportation route selection regulations.
- INTERLINE (DIRS 104781-Johnson et al. 1993, all) to identify rail and barge routes for the analysis.
- RADTRAN 5 (DIRS 150898-Neuhauser and Kanipe 2000, all; DIRS 155430 Neuhauser, Kanipe, and Weiner 2000, all) to estimate radiological dose risk to populations and transportation workers during routine operations. The analyses also used this program to estimate radiological dose risks to populations and transportation workers from accidents.
- RISKIND (DIRS 101483-Yuan et al. 1995, all) to estimate radiological doses to the maximally exposed individuals and to the population during routine transportation. This program also estimated radiological doses to the maximally exposed individuals and to the population from transportation accidents.

6.2.2 IMPACTS FROM LOADING OPERATIONS

This section describes potential impacts from loading spent nuclear fuel and high-level radioactive waste in transportation casks and on transportation vehicles at the 72 commercial and 5 DOE sites. It also describes methods for estimating radiological and industrial hazard impacts from routine loading operations and radiological impacts of loading accidents to workers and members of the public. During loading operations, radiological impacts to workers could occur from normal operations and accidents. In addition, workers could experience impacts from industrial hazards. Members of the public could experience radiological impacts if a loading accident occurred but would not experience impacts from industrial hazards, including hazards associated with nonradioactive hazardous materials. Nonradioactive hazardous materials would be used only in small quantities, if at all, in loading operations. Chapter 4 addresses impacts from unloading operations at the repository.

6.2.2.1 Radiological Impacts of Routine Operations

Radiological impacts to members of the public from routine operations would be very small. An earlier DOE analysis estimated that public dose from loading operations (primarily due to atmospheric effluents) would be less than 0.001 person-rem per metric ton of uranium loaded (DIRS 104731-DOE 1986, Volume 2, p. E.6) (see Appendix J for more information). Therefore, to be conservative this analysis estimated the dose to the public from loading operations by multiplying the value of 0.001 person-rem per metric ton of uranium by the 70,000 metric tons (77,000 tons) of spent nuclear fuel and high-level radioactive waste DOE would transport under the Proposed Action. [DIRS 104731-DOE (1986, Volume 2, all) uses the term “metric ton uranium,” which is essentially the same as metric tons of heavy metal for commercial spent nuclear fuel.] The resulting population dose would be 70 person-rem, which, based on conversion factors recommended by the International Commission on Radiological Protection, would result in 0.04 latent cancer fatality. The Commission recommends 0.0004 and 0.0005 latent cancer fatality per person-rem for involved worker populations and the general public, respectively (DIRS 101836-ICRP 1991, p. 22).

Table 6-6 lists estimated involved worker impacts from loading spent nuclear fuel at commercial sites and loading DOE spent nuclear fuel and high-level radioactive waste at DOE facilities for shipment to the Yucca Mountain site under the Proposed Action. The impacts assume worker rotation and other administrative actions at commercial sites would follow guidance similar to that in *DOE Standard - Radiological Control Manual* (DIRS 156764-DOE 1999, Article 211). Although the guidance that the annual dose received by an individual worker could be as high as 2 rem per year, DOE policy is to limit doses to individual workers to no more than 500 millirem per year. The maximum individual dose would be 12 rem over the 24 years of loading operations for individuals who worked the entire duration of repository operations. The estimated probability of a latent cancer fatality for an involved worker from this dose would be about 0.005 (5 chances in 1,000).

Table 6-6. Estimated radiological impacts to involved workers from loading operations.[a]

Impact	Mostly rail	Mostly legal-weight truck
Maximally exposed individual		
Dose (rem)	12[b]	12[b]
Probability of LCF[c]	0.005	0.005
Involved worker population[d]		
Dose (person-rem)	4,200	15,000
Number of LCFs	1.7	6.1

a. Numbers are rounded.
b. Based on 500-millirem-per-year administrative dose limit.
c. LCF = latent cancer fatality.
d. All involved workers at all facilities, preparing about 11,000 shipments under the mostly rail scenario and about 53,000 shipments under the mostly legal-weight truck scenario over 24 years.

As many as 2 latent cancer fatalities from the mostly rail scenario and about 6 latent cancer fatalities from the legal-weight truck scenario could result in the involved worker population over 24 years. The mostly legal-weight truck scenario would result in more potential impacts than the mostly rail scenario because of the increased exposure time needed to load more transportation casks.

To assess potential radiological impacts at generator facilities, the EIS analysis assumed that noninvolved workers would have no direct involvement with handling spent nuclear fuel or high-level radioactive waste. DOE expects radiological impacts to noninvolved workers to be even smaller than those to involved workers.

6.2.2.2 Impacts from Industrial Hazards

Table 6-7 lists estimated impacts to involved workers from industrial hazards over 24 years of loading operations at the 77 sites. Fatalities from industrial hazards would be unlikely from loading activities under either national transportation scenario. The mostly legal-weight truck scenario would have about three times the estimated number of total recordable cases and lost workday cases of the mostly rail scenario because there would be more shipments and more work time (full-time equivalent worker years). Using the assumption that the noninvolved workforce would be 25 percent of the number of involved workers, the analysis determined that impacts to noninvolved workers would be about 25 percent of those listed in Table 6-7.

Table 6-7. Impacts to involved workers[a] from industrial hazards during loading operations.[b]

Impact	Mostly rail	Mostly legal-weight truck
Total recordable cases[c]	130	380
Lost workday cases[d]	67	200
Fatalities[e]	0.29	0.9

a. Includes all involved workers at all facilities during 24 years of repository operations. During the 24 years of shipments to the proposed repository, these workers would put in 1,300 worker years (2,080 hours per worker year) preparing about 11,000 shipments under the mostly rail scenario and 3,700 worker years preparing about 53,000 legal-weight truck shipments and 300 naval spent nuclear fuel rail shipments under the mostly legal-weight truck scenario. Industrial safety impacts in the noninvolved workforce would be about 25 percent of those listed.
b. Numbers are rounded to two significant digits.
c. Total recordable cases (injury and illness) based on a 1998 loss incident rate of 0.08.
d. Lost workday cases based on a 1998 loss incident rate of 0.05.
e. Fatalities based on a 1998 loss incident rate of 0.000218.

To assess potential industrial safety impacts at generator facilities, the EIS analysis assumed that noninvolved workers would be persons with office-based administrative duties associated with loading operations. In addition to industrial safety impacts, traffic fatality and vehicle emissions impacts as a result of commuting workers associated with loading operations were estimated. Traffic involving commuting workers could result in 0.4 fatality under the mostly legal-weight truck scenario and 0.2 fatality under the mostly rail scenario. Estimated vehicle emissions impacts from commuting could result in 0.06 latent fatalities for the mostly legal-weight truck scenario and 0.02 for the mostly rail scenario.

6.2.3 NATIONAL TRANSPORTATION IMPACTS

The following sections discuss the impacts of transporting spent nuclear fuel and high-level radioactive waste to the proposed Yucca Mountain Repository under the mostly legal-weight truck and mostly rail scenarios. The analysis in this section addresses the impacts of incident-free transportation. Section 6.2.4 discusses accidents, and Appendix J contains the details of the analysis and its assumptions.

6.2.3.1 Impacts from Incident-Free Transportation – National Mostly Legal-Weight Truck Transportation Scenario

This section addresses radiological and nonradiological impacts to populations and maximally exposed individuals for incident-free transportation of spent nuclear fuel and high-level radioactive waste for the mostly-legal weight truck scenario.

Incident-Free Radiological Impacts to Populations. Table 6-8 lists the incident-free population dose and latent cancer fatalities to workers and the public for the mostly legal-weight truck scenario. The impacts include those for the shipment of naval spent nuclear fuel by rail to Nevada, intermodal transfer of rail casks to heavy-haul trucks, and subsequent heavy-haul transportation to the proposed repository. Section 6.3.3 and Appendix J contain additional information on worker impacts from intermodal transfer operations. Worker impacts would include radiological exposures of security escorts for legal-weight truck, rail, and heavy-haul truck shipments and from the transfer of naval spent nuclear fuel shipments from rail to heavy-haul truck. The collective dose to the security escorts traveling in separate vehicles would be about 6 person-rem for legal-weight truck shipments. Doses to escorts of rail shipments of naval spent nuclear fuel, who would travel in railcars in sight of but separated from the cask cars, followed by escorted heavy-haul truck shipments in Nevada would be about 0.4 person-rem.

Table 6-8. Population doses and impacts from incident-free transportation for national mostly legal-weight truck scenario.[a]

Category	Legal-weight truck shipments	Rail shipments of naval spent nuclear fuel[b]	Totals[d]
Involved workers			
Collective dose (person-rem)	14,000	29	14,000
Estimated LCFs[c]	5.6	0.01	5.6
Public			
Collective dose (person-rem)	5,000	20	5,000
Estimated LCFs	2.5	0.01	2.5

a. Impacts are totals for shipments over 24 years.
b. Includes impacts from intermodal transfer operations (see Section 6.3.3.1).
c. LCF = latent cancer fatality.
d. Totals might differ from sums of values due to rounding.

If escorts accompanied legal-weight truck shipments over the full length of their shipment routes, rather than only in highly populated urban areas as required by Federal regulations (10 CFR 73.37), the estimated doses to escorts over 24 years would be 360 person-rem (a 0.14 probability of a latent cancer fatality in the population of escorts).

In addition, as is recommended by the Commercial Vehicle Safety Alliance (DIRS 155863-CVSA 2000, all), the analysis assumed state safety inspections of shipments would occur only in originating and destination states. If inspections were conducted for every shipment in each state through which the shipment would pass, inspectors would receive an additional dose of 7,000 person-rem (about 2.8 latent cancer fatalities) over 24 years.

Appendix J, Section J.1.3.2.2.2 contains additional information about the analysis of impacts to escorts and inspectors.

The estimated radiological impacts would be 6 (5.6) latent cancer fatalities for workers and 3 (2.5) latent cancer fatalities for members of the public for the 24 years of operation. The population within 800 meters (0.5 mile) of routes would be about 10 million based on projections to 2035. About 2.3 million members of this population would be likely to incur fatal cancers from all other causes not associated with the Proposed Action (DIRS 153066-Murphy 2000, p. 5).

Incident-Free Radiological Impacts to Maximally Exposed Individuals. Table 6-9 lists estimates of doses and radiological impacts for maximally exposed individuals for the legal-weight truck scenario (which considers drivers and security escorts). The risks are calculated for the 24 years of shipment activities. Appendix J discusses analysis methods and assumptions. State inspectors who conducted frequent inspections of shipments of spent nuclear fuel and high-level radioactive waste and transportation vehicle operating crews would receive the highest annual radiation doses.

Table 6-9. Estimated doses and radiological impacts to maximally exposed individuals for national mostly legal-weight truck scenario.[a,b]

Individual	Dose (rem)	Probability of latent fatal cancer
Involved workers		
Crew member (including driver)	48[c]	0.02
Inspector	48[c]	0.02
Railyard crew member	0.13	0.00005
Public		
Resident along route	0.006	0.000003
Person in traffic jam	0.016[d]	0.000008
Person at service station	2.4[e]	0.0012
Resident near rail stop	0.009	0.000005

a. The assumed external dose rate is 10 millirem per hour at 2 meters (6.6 feet) from the vehicle for all shipments.
b. Totals for 24 years of operations.
c. Based on 2-rem-per-year administrative dose limit. If a lower dose limit, for example 500 millirem per year, was imposed for transportation workers or state inspectors, maximally exposed individual doses would be lower. See DIRS 156764-DOE (1999, Article 211) for DOE guidance on occupational dose limits.
d. Person in a traffic jam is assumed to be exposed one time only.
e. Assumes the person works at the service station for all 24 years of operations. Mitigation would be required to reduce impacts to members of the public to below 100 millirem per year.

Impacts to the maximally exposed individuals in the general public would be very low. The highest impacts would be to a service station employee who worked at a station where the analysis assumed all truck shipments would stop under the mostly legal-weight truck scenario (Table 6-9). The analysis estimated that this employee would receive a dose of 2.4 rem over 24 years, which corresponds to the maximum that would be allowed (100 millirem per year) for a member of the general public under regulations in 10 CFR Part 20. The estimate assumes that measures would be taken by DOE to reduce the dose to the employee from 130 millirem per year (3.2 rem over 24 years)—the dose estimated by the analysis if dose reduction measures were not implemented. The estimate of 3.2 rem over 24 years conservatively assumed the person would be exposed to 450 truck shipments each year for 24 years. For perspective, under the mostly legal-weight truck scenario, which assumes an average of 2,200 legal-weight truck shipments per year, about 450 truck shipments would pass through the Mercury, Nevada, gate to the Nevada Test Site in 1,800 hours. A worker at a truck stop along the route to Mercury would work about 1,800 hours per year. Thus, if every shipment stopped at that truck stop, the maximum number of shipments the worker would be exposed to in a year would be 450.

Impacts from Vehicle Emissions. Using data published by DIRS 151198-Biwer and Butler (1999, p. 1165 to 1166), DIRS 155786-EPA (1997, all), and DIRS 155780-EPA (1993, Section 13.2.13) (see Appendix J, Section J.1.3.2.3), DOE estimated the number of fatalities that vehicle emissions from shipments to Yucca Mountain could cause (Table 6-10). These potential impacts would result principally from exposure to increases in levels of pollutants, where the additional pollutants would come from vehicles transporting spent nuclear fuel and high-level radioactive waste and the accompanying escort vehicles. In the context of the number of vehicle kilometers from shipments to the Yucca Mountain site, these emissions would be very small in comparison to the emissions from other vehicles.

Table 6-10. Population health impacts from vehicle emissions during incident-free transportation for national mostly legal-weight truck scenario.[a]

Category	Legal-weight truck shipments	Rail shipments of naval spent nuclear fuel	Total[b]
Estimated vehicle emission-related fatalities	0.93	0.01	0.95

a. Impacts are totals for shipments over 24 years.
b. Total differs from sums of values due to rounding.

This section addresses radiological and nonradiological impacts to populations and maximally exposed individuals from the incident-free transportation of spent nuclear fuel and high-level radioactive waste for the mostly rail national transportation scenario. In addition, it identifies impacts of legal-weight truck shipments that would occur under the mostly rail scenario for the six commercial sites that do not have the capability to load rail casks (about 1,079 legal-weight truck shipments over 24 years). Of these six sites, two have direct rail access and four have indirect access. Of the four sites with indirect access, three have barge access. The analysis assumed that the six legal-weight truck sites would upgrade their crane capacities and ship by rail after reactor shutdown.

6.2.3.2 Impacts from Incident-Free Transportation – National Mostly Rail Transportation Scenario

For this analysis, DOE assumed that it would use either a branch rail line or heavy-haul trucks in Nevada to transport rail casks to and from the repository. Accordingly, the results indicate the range of impacts for the rail and heavy-haul truck implementing alternatives that DOE could use for transportation to the repository after rail shipments arrived in Nevada. Section 6.3 and Appendix J present more information on the analysis of the environmental impacts of the Nevada rail and heavy-haul implementing alternatives. Appendix J, Section J.2, also presents a comparison of the effects of using dedicated trains or general freight services for rail shipments.

The mostly rail scenario assumes that the 24 commercial sites not served by a railroad but with the capability to handle rail casks would use heavy-haul trucks to transport the casks to railheads for transfer to railcars. In addition, 17 of the 24 sites are adjacent to navigable waterways. At some of the 17 sites on navigable waterways, barges could be used for the initial trip segments (see Appendix J, Section J.2.1). The impacts estimated by the analysis include the impacts of heavy-haul truck or barge shipments of rail casks from the 24 sites to nearby railheads.

The analysis assumed that the truck shipments of spent nuclear fuel and high-level radioactive waste would make periodic stops for state inspections, changes of drivers, rest, and fuel. Rail shipments would

VEHICLE EMISSION UNIT RISK FACTORS

DIRS 151198-Biwer and Butler (1999, all) presents unit risk factors for estimating vehicle emissions and the resulting health effects (fatalities) from truck and rail transportation. Changes to information used in the Biwer and Butler analysis resulted in revised factors used in the analyses in this EIS. DOE made four changes:

- *Fugitive dust emission factor*. Biwer and Butler used the paved road fugitive dust emission factor equation from DIRS 155786-EPA (1997, Volume 1, Supplement D, Section 13.2.1) to estimate fugitive dust emission factors for individual vehicle weight classes. The emission factor used in the Final EIS analysis is based on the fleet average weight, as recommended in the reference.

- *Diesel exhaust emission factor*. Biwer and Butler used diesel exhaust emission factors for trucks operating in 1995. The Final EIS analysis used information presented in the *Motor Vehicle-Related Air Toxics Study* (DIRS 155780-EPA 1993, all) to estimate diesel exhaust emission factors projected for the fleet of trucks operating in 2010.

- *Mortality rate used to estimate health effects*. The PM_{10} risk factor used in Biwer and Butler was calculated using a baseline mortality rate of 0.008. This is the crude rate, which is influenced by age differences in population composition. The analysis for the Final EIS used an age-adjusted mortality rate of 0.005.

- *PM_{10} risk factor*. The PM_{10} health risk factor used by Biwer and Butler was based on an upper bound reported by DIRS 152600-Ostro and Chestnut (1998, all), who also presented lower-bound and central estimates. To avoid compounding conservative assumptions, the Final EIS analysis uses the central estimate.

These changes resulted in values for vehicle emission health effect (fatality) unit risk factors that are about a factor of 30 smaller that those estimated by DIRS 151198-Biwer and Butler (1999, all).

also make periodic stops. However, the assumed frequency of the stops and the numbers of people nearby would be different from those for truck shipments and would result in a lower dose.

Incident-Free Radiological Impacts to Populations. Table 6-11 lists incident-free radiological impacts that would occur during the routine transportation of spent nuclear fuel and high-level radioactive waste under the mostly rail national transportation scenario. Because national impacts would result from transportation from the commercial and DOE sites to the repository, they include impacts from a Nevada rail or heavy-haul truck implementing alternative. For the case in which rail shipments would continue in Nevada, total impacts to members of the general public would differ depending on the implementing alternative (see Section 6.3.2 for additional details). The range of values listed in Table 6-11 includes the range of impacts from the Nevada implementing alternatives.

About 1 latent cancer fatality could result from shipments of spent nuclear fuel and high-level radioactive waste under the mostly rail scenario over 24 years. The latent cancer fatality would occur over the lifetime of an individual in the exposed population. The population within 800 meters (0.5 mile) of routes in which this fatality would occur would be approximately 16.4 million. Approximately 3.8 million members of this population would incur fatal cancers from all other causes not associated with the Proposed Action (DIRS 153066-Murphy 2000, p. 5).

Incident-Free Radiological Impacts to Maximally Exposed Individuals. Table 6-12 lists the results of risk calculations for maximally exposed individuals for the mostly rail transportation scenario over 24 years. Truck and rail crew members would receive the highest doses. The mostly rail scenario would require transport crews for legal-weight trucks (1,079 total shipments over 24 years) and for rail

Table 6-11. Population doses and radiological impacts from incident-free transportation for national mostly rail scenario.[a]

Category	Legal-weight truck shipments	Rail shipments[b,c]	Totals[d]
Involved workers			
Collective dose (person-rem)	360	3,300 - 4,300	3,700 - 4,600
Estimated LCFs[e]	0.14	1.3 - 1.7	1.5 - 1.9
Public			
Collective dose (person-rem)	130	1,100 - 1,500	1,200 - 1,600
Estimated LCFs	0.07	0.55 - 0.76	0.61 - 0.81

a. Impacts are totals for 24 years.
b. Barge transportation to a railhead on navigable waterways could be used for transportation from 17 commercial sites that do not have rail service but can load a rail cask. See Appendix J.
c. Includes impacts from intermodal transfer station operations.
d. Totals might differ from sums of values due to rounding.
e. LCF = latent cancer fatality.

Table 6-12. Estimated doses and radiological impacts to maximally exposed individuals for national mostly rail scenario.[a,b]

Receptor	Dose (rem)	Probability of latent fatal cancer
Involved workers		
Crew member (rail, heavy-haul truck, or legal-weight truck)	48[c]	0.02
Escort	48[c]	0.02
Inspector (rail)	34	0.014
Railyard crew member	4.2	0.0017
Public		
Resident along route (rail)	0.0016	0.0000008
Person in traffic jam (legal-weight truck)	0.016	0.000008
Person at service station (legal-weight truck)	0.075	0.000038
Resident near rail stop	0.29	0.00014

a. The assumed external dose rate is 10 millirem per hour at 2 meters (6.6 feet) from the vehicle for all shipments.
b. Totals for 24 years.
c. Based on 2-rem-per-year administrative dose limit. If a lower dose limit, for example 500 millirem per year, was imposed for transportation workers or state inspectors, maximally exposed individual doses would be lower. See DIRS 156764-DOE (1999, Article 211) for DOE guidance on occupational dose limits.

shipments. Individual crew members who operated legal-weight trucks and escorts for rail shipments could be exposed to as much as 48 rem over 24 years of operations (maximum exposure of 2 rem each year). State inspectors who would conduct frequent inspections of rail shipments could receive annual radiation doses as high as 1.4 rem (see Appendix J, Section J.1.3.2.2.2). Escorts traveling with rail shipments could be exposed to up to 48 rem over 24 years of operations (maximum exposure of 2 rem per year; see Appendix J, Section J.1.3.2.2.3).

Impacts from Vehicle Emissions. Less than 1 (a range from 0.55 to 0.77) fatality could result from exposure to vehicle emissions over 24 years under the mostly rail scenario. This potential would arise principally from exposure of people in urban areas to very small increases in levels of pollutants caused by vehicles transporting spent nuclear fuel and high-level radioactive waste.

6.2.4 ACCIDENT SCENARIOS

6.2.4.1 Loading Accident Scenarios

The analysis used existing information from several different sources (DIRS 104794-CRWMS M&O 1994, all; DIRS 103177-CP&L 1989, all; DIRS 103449-PGE 1996, all; DIRS 101816-DOE 1997, all) to estimate potential radiological impacts from accidents involving the loading of spent nuclear fuel or high-level radioactive waste for shipment and handling of shipping casks. As summarized below, the results in these sources indicate that, because no cask would be likely to be breached and thus no radionuclides released, there would be no or very small potential radiological consequences for the public and for workers from accidents in all cases. Appendix J, Section J.1.3.1, presents a description of typical operations for loading spent nuclear fuel in a shipping cask at a commercial facility.

Lift-handling incidents involving spent nuclear fuel in a transfer facility would have an estimated probability of 0.0001 (1 in 10,000) per handling operation (DIRS 104794-CRWMS M&O 1994, pp. 3 to 8). The estimated collective dose to workers from the incidents would be no more than 0.1 person-rem, and it would be much less to the public.

The total number of high-level radioactive waste canisters potentially handled would be approximately the same as the number of spent nuclear fuel canisters, and handling operations would be similar. DOE expects the consequences of handling incidents that involved high-level radioactive waste would be less than those involving spent nuclear fuel (DIRS 103237-CRWMS M&O 1998, p. 3). Thus, impacts from high-level waste handling would be less than the estimated 0.1 person-rem from a spent nuclear fuel handling accident.

Reports on independent spent fuel storage installations and previous DOE analyses provide further evidence of the low probable impacts associated with a loading accident. Safety analysis reports prepared for independent spent fuel storage installations at the Trojan Nuclear Station and the Brunswick Steam Electric Plant concluded that there would be no or low radiological consequences from accidents that could occur at such facilities (DIRS 103449-PGE 1996, Section 8.2; DIRS 103177-CP&L 1989, Section 8.2). This analysis examined the potential magnitude of impacts from spent nuclear fuel storage facility operations. Similarly, previous DOE analyses (DIRS 101816-DOE 1997, all; DIRS 104794-CRWMS M&O 1994, all) indicate that radiological consequences from accidents involving spent nuclear fuel and high-level radioactive waste management activities would be very small (Table 6-12). The low consequences listed in Table 6-13 are consistent with the results from an earlier DOE analysis (DIRS 104731-DOE 1986, Volume 2, p. xvii).

Table 6-13. Radiological consequences of accidents associated with handling and loading operations.

Affected group	Impact (per year)[a]	24-year impact	Source
Involved workers			
Maximally exposed involved worker			
Dose (rem)	0.0005	0.01	--[b]
Probability of LCF[c]	0.0000002	0.000005	--
Worker population			
Collective dose (person-rem)	0.1	2.4	DIRS 104794-CRWMS M&O (1994, p. 3-8)
Number of LCFs	0.00004	0.001	--
Noninvolved workers			
Maximally exposed noninvolved worker			
Dose (rem)	0.0002	0.005	--
Probability of LCF	0.00000005	0.000001	--
Public			
Maximally exposed individual			
Dose (rem)	0.0013	0.03	--
Probability of LCF	0.0000007	0.00002	--
Population			
Collective dose (person-rem)	0.000074	0.002	DIRS 104794-CRWMS M&O (1994, p. 3-8)
Number of LCFs	0.00000004	0.000001	--

a. Average annual impact for 24 years.
b. -- = determined by analysis.
c. LCF = latent cancer fatality.

6.2.4.2 Transportation Accident Scenarios

Accidents could occur during the transportation of spent nuclear fuel and high-level radioactive waste. This section describes the risks and impacts to the public and workers for a range of accident scenarios including those that are highly unlikely but that could have high consequences (called *maximum reasonably foreseeable accident scenarios*) and those that are more likely but that would have less severe consequences. The impacts would include those to the population and to hypothetical maximally exposed individuals. The following paragraphs describe the analysis approach. Appendix J, Section J.1.4, contains more details.

The analysis did not address accident impacts to workers apart from impacts to the public. For example, fatalities from train and truck accident scenarios would include fatalities for vehicle operators. The collective radiological risk from accidents to highway vehicle and train crews would be much less than for the public because of the large difference in the numbers of individuals that could be affected. In addition, based on national accident statistics, motor carrier and train operators are much less likely to be fatalities in nonradiological accidents than operators of other vehicles (DIRS 103410-DOT 1998, p. 30).

MAXIMUM REASONABLY FORESEEABLE ACCIDENT SCENARIOS

Maximum reasonably foreseeable impacts from accident scenarios for the transportation of spent nuclear fuel and high-level radioactive waste would be characterized by extremes of mechanical (impact) forces, heat (fire), and other conditions that would lead to the highest reasonably foreseeable consequences. For postulated accident scenarios such as these, the forces and heat would exceed the regulatory design limits of transportation cask structures and materials. (The performance of transportation casks was demonstrated through a combination of tests and analyses.) In addition, these forces and heat would be applied to the structures and surfaces of a cask in a way that would cause the greatest damage and bring about releases of radioactive materials to the environment. The most severe accident scenarios analyzed in this chapter would release radioactive material. These accident scenarios correspond to those in the highest accident severity category, which represent events that would be very unlikely but, if they occurred, would result in human health effect consequences.

In general, this EIS considers accidents with conditions that have a chance of occurring more often than 1 in 10 million times in a year to be reasonably foreseeable. Accidents and conditions less likely than this are not considered to be reasonably foreseeable.

The specific number, location, and severity of an accident can be predicted only in general terms of the likelihood of occurrence (the probability). Similarly, the weather conditions at the time an accident occurs cannot be precisely predicted. Therefore, the EIS analysis evaluated a variety of accident scenarios and conditions to understand the influence of various conditions on environmental impacts. The analysis of impacts to populations along routes assumed that an accident could occur at any location along a route.

The EIS analysis considered accident scenarios based on the 19 truck and 21 rail accident cases presented by DIRS 152476-Sprung et al. (2000, all). Appendix J, Section J.1.4.2.1, describes those cases and their derivations. In addition, the analysis estimated impacts of postulated releases from accident scenarios in three population zones—urban, suburban, and rural—under a set of meteorological (weather) conditions that represent the national average meteorology. The analysis used state-specific accident data, the lengths of routes in the population zones in states through which the shipments would pass, and the number of shipments that would use the routes to determine accident scenario probabilities.

The EIS analysis used the properties of a representative commercial spent nuclear fuel along with the properties for the 15 categories of DOE spent nuclear fuel and high-level radioactive waste described in Appendix A. Since the publication of the Draft EIS, DOE has reevaluated the properties of commercial spent nuclear fuel that it used in analyses of transportation accidents and determined that the representative spent nuclear fuel described in Appendix A is more appropriate for analysis of such accidents. Representative commercial spent nuclear fuel would be (1) fuel discharged after 14 years from a boiling-water reactor with a burnup of 40,000 megawatt-days per MTHM and (2) fuel discharged from a pressurized-water reactor after 15 years with a burnup of 50,000 megawatt-days per MTHM. Because representative spent nuclear fuel would be younger and have higher burnup than typical spent nuclear fuel, its relative health and safety hazard would be greater. In fact, the hazard is about 2 times greater. As a consequence, estimates of impacts of transportation accidents involving casks containing representative spent nuclear fuel would be about 2 times greater than if the casks contained typical spent nuclear fuel.

TRANSPORTATION EMERGENCIES

Under Section 180(c) of the Nuclear Waste Policy Act, as amended, the Department would provide technical assistance and funding for training of local and American Indian public safety officials of eligible states and tribes in relation to transportation under the Proposed Action. The training would cover safe routine transportation and emergency response procedures. DOE would also require its transportation contractors to comply with *Carrier and Shipper Responsibilities and Emergency Response Procedures for Highway Transportation Accidents Involving Truckload Quantities of Radioactive Materials* (DIRS 156289-ANSI 1987, Section 5.2). This standard requires the preparation of an emergency response plan and describes appropriate provisions of information and assistance to emergency responders. The standard also requires the carrier to provide appropriate resources for dealing with the consequences of the accident including isolating and cleaning up spills, and to maintain working contact with the responsible governmental authority until the latter has declared the incident to be satisfactorily resolved and closed. DOE would, as requested, assist state, tribal, and local governments in several ways to reduce the consequences of accidents related to the transportation of spent nuclear fuel and high-level radioactive waste. In addition, DOE maintains an emergency response program through eight Regional Coordinating Offices across the United States. These offices are capable of responding to transportation radiological emergencies and are on call 24 hours a day. They respond to requests for radiological assistance from state or tribal authorities. Other DOE, Federal Emergency Management Agency, and U.S. Department of Transportation programs have provided training for transportation emergencies for many areas (for example, Colorado and South Carolina to support preparation for transportation for the Foreign Research Reactor and Waste Isolation Pilot Plant programs). Appendix M contains additional detail.

In addition to the risk due to accidents involving a release of radioactive material, the analysis examined the impacts of loss-of-shielding accidents. The loss-of-shielding scenarios range from an accident with no loss of shielding to a low-probability severe accident involving both a loss of shielding (and any increased direct exposure) and a release of some of the contents of the cask.

The EIS analysis also estimated impacts from an unlikely but severe accident scenario called a *maximum reasonably foreseeable accident* to provide perspective about the consequences for a population that might live nearby. For maximum reasonably foreseeable accident scenarios, the consequences were estimated for each of the accident scenarios and for both truck and rail casks from the spectrum of accidents presented in DIRS 152476-Sprung et al. (2000, all). For each accident scenario, possible combinations of weather conditions, population zones, and transportation modes were considered. The scenarios were then ranked according to those that would have a likelihood greater than 1 in 10 million per year and would have the greatest consequences (see Appendix J).

REEXAMINATION OF SPENT FUEL SHIPMENT RISK ESTIMATES

Factors other than the environment can cause uncertainties in the prediction of accident impacts. Uncertainty can result from both limited data and the limitations of computer models used to predict accident impacts. The first comprehensive study that developed estimates of the impacts of severe accidents was the *Shipping Container Response to Severe Highway and Railway Accident Conditions* (DIRS 101828-Fischer et al. 1987, all; also called the *Modal Study*) for fractions of shipping cask contents (spent nuclear fuel or high-level radioactive waste) that such accident scenarios could release to the environment. The estimates of severe accident impacts developed in the Modal Study were reexamined by Sandia National Laboratories in *Re-Examination of Spent Fuel Shipment Risk Estimates* (DIRS 152476-Sprung et al. 2000, all) published in April 2000. The Nuclear Regulatory Commission staff, in a memorandum to the Commissioners, concluded “the best estimate spent-fuel shipment risks from the reexamination appear to be less than the ‘Modal Study’-based estimates by as much as 2 orders of magnitude” (DIRS 155562-NRC 2000, all). Although the Commission staff offered this positive finding, it also observed that several questions on the Sandia methodology require resolution before the best-estimate results can be completed. Even though it expressed caution regarding its findings, on the basis of the results presented the Commission staff concluded “the transportation risk studies provide a technical basis for determining that current regulations are sufficient to prevent releases of radioactive material during transport” (DIRS 155562-NRC 2000, all).

6.2.4.2.1 *Impacts from Accidents – National Mostly Legal-Weight Truck Scenario*

This section summarizes the potential impacts and risks associated with accidents under the legal-weight truck scenario. The impacts and risks include those associated with the legal-weight truck and rail shipments to Nevada plus the transfer of the spent nuclear fuel and high-level waste to heavy-haul trucks and its transportation in Nevada. The section summarizes radiological impacts for six accident scenario categories, under two types of weather conditions, and in three population densities (urban, suburban, and rural), in terms of a collective dose risk and consequence (latent cancer fatalities). It describes the potential impacts from the maximum reasonably foreseeable accident scenario separately. It also describes nonradiological impacts in terms of accident fatalities.

Radiological Impacts to Populations from Accidents. Based on state-specific accident rates, the total estimated number of traffic accidents under the Proposed Action for the mostly legal-weight truck scenario would be 66, or 2.8 per year. The collective radiological accident dose risk, as described in Appendix J, Section J.1.4.2.1, would be less than 1 (0.5) person-rem for the population within 80 kilometers (50 miles) along routes for the national mostly legal-weight truck scenario. This calculated risk would be the total for 24 years of shipment operations. The radiological dose risk of accidents is the sum of the products of the probabilities (dimensionless) and consequences (in person-rem) of all potential transportation accidents. A radiological dose risk of 0.5 person-rem would be likely to cause much less than 1 (0.0002) latent cancer fatality, or approximately 2 chances in 10,000 of 1 latent cancer fatality among the more than 10 million persons within 80 kilometers of the routes that the shipments would use. The 0.5 person-rem risk includes the dose risk associated with loss-of-shielding events. The accident risk for legal-weight truck shipments dominates the total risk, contributing more than 99.9 percent of the population dose and risk in comparison to the risk associated with the 300 proposed shipments of naval spent nuclear fuel.

Consequences of Maximum Reasonably Foreseeable Accident Scenario. The analysis evaluated the impacts of a maximum reasonably foreseeable accident scenario in urbanized and rural population zones for both legal-weight truck and rail shipments under the mostly legal-weight truck scenario. The maximum reasonably foreseeable transportation accident scenario that would have the greatest consequences for the mostly legal-weight truck scenario (a probability of approximately 3 in 10 million per year) would be a long-duration severe fire accident in which the transportation cask was fully engulfed by the fire. This accident is further described by DIRS 152476-Sprung et al. (2000, p. 7-25) as case 18 in accidents evaluated for legal-weight truck casks (see Appendix J, Section J.1.4.2.1). The analysis assumed that the accident would occur under stable (slowly dispersing atmospheric conditions that would not be exceeded 95 percent of the time) meteorological conditions in an urban area. Severe accidents in other population zones under stable or neutral weather conditions (atmospheric conditions that would not be exceeded 50 percent of the time) would have smaller consequences. The accident scenario assumes a breach of the shipping cask and the release of a portion of its contents to the air. This accident in combination with stable atmospheric conditions would be very unlikely (2.3 in 10 million per year). Table 6-14 summarizes the impacts of the accident scenario. This accident scenario could cause 0.55 latent cancer fatality; in comparison, a population of 5 million within 80 kilometers (50 miles) of the center of a large U.S. metropolitan area such as that assumed in the analysis would be likely to experience more than 1.1 million lifetime cancer fatalities from other causes not related to the Proposed Action (DIRS 153066-Murphy 2000, p. 5). For this accident scenario, the analysis projected that most of the dose to a population would come from inhalation, cloudshine, and groundshine sources. The maximally exposed individual, assumed to be about 150 meters (490 feet) from the accident where particles heated by the accident would fall after cooling, would receive a dose of about 0.8 rem (Table 6-14). A first responder to this accident would receive a small dose (2.6 millirem).

Table 6-14. Estimated radiological impacts of maximum reasonably foreseeable accident scenario for national mostly legal-weight truck scenario.

Impact	Urbanized area (stable atmospheric conditions)
Accident scenario probability (annual)	0.00000023 per year (about 2.3 in 10 million)
Impacts to populations	
Population dose (person-rem)	1,100
Latent cancer fatalities	0.55
Impacts to maximally exposed individuals	
Maximally exposed individual dose (rem)	3
Probability of a latent cancer fatality	0.0015
Impacts to first responder	
Maximally exposed responder dose (rem)	0.26
Probability of latent cancer fatality	0.0000013

In addition to a maximum reasonably foreseeable accident, DOE evaluated other severe accidents. Appendix J, Section J.1.4.2.1, describes these accidents and their potential impacts. The accident conditions for one truck accident (Case 11) could be similar to those from a crash of a commercial jet airliner into a legal-weight truck cask (DIRS 157210-BSC 2001, all). The consequences of this accident (1,100 person-rem or 0.55 latent cancer fatality) would be about the same as those for the maximum reasonably foreseeable truck accident described above.

Section J.1.4.2.5 in Appendix J summarizes studies of potential economic and environmental impacts of hypothetical severe transportation accidents that would release radioactive materials from transportation casks.

Impacts from Traffic Accidents. Approximately 5 (4.9) traffic fatalities could occur in the course of transporting spent nuclear fuel and high-level radioactive waste under the mostly legal-weight truck national transportation scenario during the 24 years of operations for the Proposed Action. Essentially all of these fatalities would be from truck operations; none would occur from the 300 railcar shipments of naval spent nuclear fuel. The fatalities would be principally from traffic accidents; half would involve trucks transporting loaded casks to the repository and half would involve returning shipments of empty casks. The fatalities would occur over 24 years and approximately 380 million kilometers (240 million miles) of highway travel. Based on information extrapolated from the U.S. Department of Transportation

Bureau of Transportation Statistics (DIRS 150989-BTS 1998, p. 20), during the same 24-year period about 1 million deaths would be likely to occur in traffic accidents on U.S. highways.

6.2.4.2.2 *Impacts from Accidents – National Mostly Rail Transportation Scenario*

This section discusses the results of the analysis of radiological impacts to populations and maximally exposed individuals and of traffic fatalities that would arise from accidents during the transportation of spent nuclear fuel and high-level radioactive waste for the national mostly rail transportation scenario.

DOE used the models and calculations described in Appendix J, Section J.1.4.2.1, to estimate the impacts from rail accidents, and included impacts postulated to occur during the transportation of commercial spent nuclear fuel by legal-weight trucks from six commercial sites that do not have the capability to handle or load large rail casks. The analysis also included the impacts from accidents for heavy-haul truck or barge shipments to nearby railheads from 24 commercial sites that have the capability to load a rail cask but are not served by a railroad. DOE used the models and calculations described in Appendix J to estimate the impacts. Appendix J, Section J.2.4, presents additional information on heavy-haul truck and barge transportation from the 24 commercial sites.

Accident Radiological Impacts for Populations. Based on state-specific accident rates, the total estimated number of rail and truck traffic accidents under the Proposed Action for the mostly rail scenario would be about 10, or about 0.4 per year. The collective radiological dose risk of accidents would be approximately 1 (0.89) person-rem for the population within 80 kilometers (50 miles) along routes for the national mostly rail transportation scenario. This calculated dose risk would be the total for 24 years of shipment operations. The radiological dose risk of accidents is the sum of the products of the probabilities (dimensionless) and consequences (in person-rem) of all potential transportation accidents. A radiological dose risk of 1 person-rem would be likely to cause much less than 1 (0.00045) latent cancer fatality.

Radiological risks from accidents for the mostly rail scenario would include impacts associated with about 9,646 railcar shipments (one cask to a railcar) and 1,079 legal-weight truck shipments. National rail transportation of spent nuclear fuel and high-level radioactive waste would account for most of the population dose and risk to the public.

Impacts of Maximum Reasonably Foreseeable Accident Scenario. The analysis evaluated the impacts of a maximum reasonably foreseeable accident scenario in urbanized areas or rural population zones and under stable and neutral atmospheric conditions. The maximum reasonably foreseeable accident scenario under the mostly rail scenario would involve a release of a fraction of the contents of a rail cask in an urban area under stable meteorological conditions (slowly dispersing atmospheric conditions that would not be exceeded 95 percent of the time), where *atmospheric dispersion* of contaminants would occur more slowly only 5 percent of the time. This accident scenario would have a likelihood of about 2.8 in 10 million per year, and would result in about 5 latent cancer fatalities in the population (Table 6-15). The maximally exposed individual, assumed to be about 330 meters (1,080 feet) from the accident, would receive a dose of about 29 rem. An accident that involved high impact forces or a long-duration fire could reduce the effectiveness of the radiation shielding in a shipping cask. A first responder to this accident could receive a dose of as much as 0.83 rem.

Actual transportation accidents involve collisions of many kinds, such as with other vehicles and roadside objects, involvement in fires and explosions, inundation, and burial. These accidents are caused by a variety of initiating events including human error, mechanical failure, and natural causes such as earthquakes. Accidents occur in many different kinds of places including mountain passes and urban areas, rural freeways in open landscapes, and rail switching yards. Thus, there are as many different kinds of unique initiating events and accident conditions as there are accidents. DOE could not

Table 6-15. Estimated impacts from maximum reasonably foreseeable accident scenario for national mostly rail transportation scenario.

Impact	Urbanized area (stable atmospheric conditions)
Accident probability	0.00000028 per year (about 2.8 in 10 million)
Impacts to populations	
Population dose (person-rem)	9,900
Latent cancer fatalities	5
Impacts to maximally exposed individuals	
Maximally exposed individual dose (rem)	29
Probability of a latent cancer fatality	0.01
Impacts to first responder	
Maximally exposed responder dose (rem)	0.83
Probability of latent cancer fatality	0.0004

practicably attempt to analyze every possible accident that could occur. Instead, DOE analyzed a broad range of accidents, each of which represents a grouping of initiating events and conditions having similar characteristics. For example, the EIS analyzes the impacts of a collection of collision accidents in which a cask would be exposed to impact velocities in the range of 60 to 90 miles per hour (see Appendix J, Section J.1.4.2.1).

In addition, the EIS analyzes a maximum reasonably foreseeable accident in which a collision would not occur but the temperature of a rail cask containing spent nuclear fuel would rise to between 750ºC and 1,000ºC (between 1,400ºF and 1,800ºF) (Section 6.2.4.2). The conditions of the maximum reasonably foreseeable accident analyzed in the EIS envelop conditions reported in newspapers for the Baltimore Tunnel fire (a train derailment and fire that occurred in July 2001 in a tunnel in Baltimore, Maryland). Temperatures in that fire were reported to be as high as 820ºC (1,500ºF) and the fire was reported to have burned for up to 5 days (DIRS 156753-Ettlin 2001, all; DIRS 156754-Rascovar 2001, all).

DOE evaluated other severe accidents. Appendix J, Section J.1.4.2.1, describes these accidents and their potential impacts. The accident conditions for one rail accident (Case 4) could be similar to those from a crash of a commercial jet airliner into a rail cask (DIRS 157210-BSC 2001, all). The consequences of this accident (1,300 person-rem or 0.65 latent cancer fatality) would be less than those for the maximum reasonably foreseeable rail accident described above.

Impacts From Traffic Accidents. The analysis estimated that across the United States approximately 3 (3.1) traffic and train accident fatalities could occur during transportation of spent nuclear fuel and high-level radioactive waste under the national mostly rail transportation scenario. Half of the fatalities would occur during the return of empty casks to commercial and DOE sites. Essentially all of the fatalities would involve train operations; about half would involve highway vehicles hit by trains. There would be about a 12-percent chance of 1 fatality from the 1,079 legal-weight truck shipments of commercial spent nuclear fuel. This fatality could happen during the 24 years of transportation operations involving approximately 77 million kilometers (48 million miles) of railcar travel and 10 million kilometers (6 million miles) of highway travel. On the basis of data presented by the Bureau of Transportation Statistics (DIRS 150989-BTS 1998, p. 20), during the same 24-year period about 1 million people will die in traffic accidents on U.S. highways.

6.2.4.2.3 *Impacts of Acts of Sabotage*

The Nuclear Regulatory Commission has developed a set of rules specifically aimed at protecting the public from harm that could result from sabotage of spent nuclear fuel casks. Known as physical protection and safeguards regulations (10 CFR 73.37), these security rules are distinguished from other regulations that deal with issues of safety affecting the environment and public health. The objectives of the physical protection and safeguard regulations are to:

- Minimize the possibility of sabotage
- Facilitate recovery of spent nuclear fuel shipments that could come under control of unauthorized persons

To achieve these objectives, the Nuclear Regulatory Commission physical protection and safeguard rules require:

- Advance notification of each shipment to the Nuclear Regulatory Commission, the states, and Native American governments [proposed rulemaking 10 CFR Parts 71 and 73 (64 *FR* 71331, December 21, 1999)]
- The licensee to have current procedures to cope with safeguards emergencies
- Instructions for escorts on how to determine if a threat exists and how to deal with it
- Maintenance of a communications center to monitor continually the progress of each shipment
- A written log describing the shipment and significant events during the shipment
- Advance arrangements with law enforcement agencies along the route
- Advance route approval by the Nuclear Regulatory Commission
- Avoidance of intermediate stops to the extent practicable
- At least one escort to maintain visual surveillance of the shipment during stops
- Shipment escorts to report status periodically
- Armed escorts in heavily populated areas
- Onboard communications equipment
- Protection of specific shipment information

The cask safety features that provide containment, shielding and thermal protection also provide protection against sabotage. The casks would be massive. The spent nuclear fuel in a cask would typically be only about 10 percent of the gross weight; the remaining 90 percent would be shielding and structure.

It is not possible to predict whether sabotage events would occur and, if they did, the nature of such events. Nevertheless, DOE examined various accidents, including an aircraft crash into a transportation cask. The consequences of both the maximum reasonably foreseeable accident and the aircraft crash are presented above for the mostly truck and mostly rail transportation scenarios and can provide an approximation of the types of consequences that could occur from a sabotage event. DOE also considered the consequences of a potential successful sabotage attempt on a cask. A study conducted by Sandia National Laboratories (DIRS 104918-Luna, Neuhauser, and Vigil 1999, all) estimated the amounts and characteristics of releases of radioactive materials from rail and truck casks subjected to the effects of two different devices.

Devices considered in the Sandia study (DIRS 104918-Luna, Neuhauser, and Vigil 1999, all) included possible devices that might be used in acts of sabotage against shipping casks. (Note: The shield walls of shipping casks for spent nuclear fuel and high-level radioactive waste are similar to the massive layered construction used in armored vehicles such as tanks.) These kinds of devices were demonstrated by the study to be capable of penetrating a cask's shield wall, leading to the dispersal of contaminants to the environment.

The truck cask design selected for analysis was the General Atomics GA-4 Legal-Weight Truck Cask. This cask, which uses uranium for shielding, is a state-of-the-art design recently certified by the Nuclear Regulatory Commission to ship four pressurized-water reactor nuclear fuel assemblies (DIRS 148184-NRC 1998, all). The rail cask design used was based on the conceptual design developed by DOE for the dual-purpose canister system. This design is representative of large rail casks that could be certified for shipping spent nuclear fuel and high-level radioactive waste.

DOE used the RISKIND code (DIRS 101483-Yuan et al. 1995, all) to evaluate the radiological health and safety impacts of the estimated releases of radioactive materials. The analysis used assumptions about the concentrations of radioisotopes in spent nuclear fuel, population densities, and atmospheric conditions (weather) used to evaluate the maximum reasonably foreseeable accidents.

Because it is not possible to forecast the location or the environmental conditions that might exist for acts of sabotage, the analysis determined consequences for urbanized areas (see Appendix J, Section J.1.4.2.1) under neutral (average) weather conditions.

For legal-weight truck shipments, the analysis estimated that a sabotage event occurring in an urbanized area could result in a population dose of 96,000 person-rem. This dose would cause an estimated 48 fatal cancers among the population of exposed individuals. A maximally exposed individual could receive a lifetime committed dose of 110 rem, which would increase the risk of a fatal cancer from about 23 percent from all other causes to about 29 percent.

These estimates exceed those presented in the Draft EIS for two reasons. The analysis for this section assumed that the cask would contain representative (or average hazard) spent nuclear fuel. The analysis in the Draft EIS assumed that the cask would contain typical (or average age) spent nuclear fuel. The amount of radioactivity in representative spent nuclear fuel is about twice that in typical spent nuclear fuel. In addition, the analysis in the Draft EIS used urban area populations reported in the 1990 Census, whereas the analysis for this section used populations projected to 2035. The population estimates used for 2035 are about 40 percent greater than those reported by the 1990 Census. The combined result of these changes is that the estimated consequences of an act of sabotage against a transportation cask in this section are about 3 times those estimated in the Draft EIS.

The consequences estimated for an act of sabotage involving a rail shipment would be less than those estimated for a legal-weight truck shipment. The smaller consequence for the rail shipment would be because less of the radionuclides would be released from a rail transportation cask than from a legal-weight truck transportation cask (DIRS 104918-Luna, Neuhauser, and Vigil 1999, all). For rail shipments, the analysis estimated that a sabotage event in an urbanized area could result in a population dose of 17,000 person-rem. This dose would be likely to cause an estimated 9 fatal cancers among the population of exposed individuals. A maximally exposed individual could receive a lifetime committed dose of 40 rem, which would increase the risk of a fatal cancer from about 23 percent from all other causes to about 25 percent.

Because of the attacks on September 11, 2001, the Department and other agencies are reexamining the protections built into our physical security and safeguards systems for transportation shipments. As dictated by results of this reexamination, DOE would modify its methods and systems as appropriate.

6.2.5 ENVIRONMENTAL JUSTICE

Shipments of spent nuclear fuel and high-level radioactive waste would use the Nation's existing railroads and highways. DOE expects that transportation-related impacts to land use; air quality; hydrology; biological resources and soils; cultural resources; socioeconomics; noise and vibration; aesthetics; utilities, energy, and materials; and waste management would be small. In addition, as described in the preceding sections, incident-free transportation and the risks from transportation accidents (the maximum reasonably foreseeable accident scenario would have about 3 chances in 10 million of occurring per year) would not present a large health or safety risk to the population as a whole, or to workers or individuals along national transportation routes. The low effect on the population as a whole also would be likely for any segment of the population, including minorities, low-income groups, and members of Native American tribes.

A previous DOE analysis of the potential for environmental justice concerns from the transportation of DOE spent nuclear fuel to the Idaho National Engineering and Environmental Laboratory (DIRS 101802-DOE 1995, Volume 1, pp. L-2 and L-36) also concluded that impacts to minority and low-income populations and to populations of American Indians in Idaho would not be disproportionately high and adverse. As part of that analysis, DOE consulted with the Shoshone Bannock Tribe to analyze impacts to tribe members because the shipments in question would cross the Fort Hall Reservation. The analysis (DIRS 101802-DOE 1995, Volume 3, Part A, p. 3-32) concluded that risks to the health and safety of the potentially affected tribal population in Idaho from incident-free transportation and from accidents would be very low.

The EIS analyzes potential public health effects of both routine (incident-free) transportation of radioactive materials and transportation accidents involving radioactive materials. First, regarding routine transportation, the EIS considers air emissions and doses from exposure to radioactive materials during transport. The EIS estimates the impact from air emissions to be 1 emissions-related fatality. The EIS also estimates that the 24-year national transportation campaign would cause fewer than about 3 latent cancer fatalities among the public under the mostly legal-weight truck scenario and fewer under the preferred mostly rail scenario. Although many people would be exposed nationwide over a long campaign, the radiation dose to any exposed individual would be very low. In this context, DOE does not consider such impacts to be high. Because DOE does not know of a plausible mechanism under these circumstances whereby low-income or minority populations could incur high and adverse impacts when the general public would not, the Department believes there could be no disproportionately high and adverse impacts on low-income or minority populations.

The EIS estimates the number of people in the general public who could be killed by accidents involving transportation of spent fuel and high-level radioactive waste. The two mechanisms for such impacts are bodily trauma from collisions or exposure to radioactivity that would be released if a sufficiently severe accident occurred. The analysis estimated that the 24-year national campaign would cause fewer than 5 fatalities among the general public from trauma sustained in collisions with vehicles carrying spent nuclear fuel or high-level radioactive waste. In this context, DOE does not consider such impacts to be high. Again, DOE does not know of a plausible mechanism under these circumstances whereby low-income or minority populations could incur high and adverse impacts when the general public would not.

Only a severe accident that resulted in a considerable release of radioactive material could cause high and adverse health effects to the affected population. Because the risk of these high and adverse consequences applies to the entire population along all transportation routes, it would not apply disproportionately to any minority or low-income population.

Based on the analysis of incident-free transportation and transportation accidents in this EIS and the results of a transportation analysis conducted by DOE in a previous programmatic EIS, and the fact that

DOE has identified no subsection of the population that would be disproportionately affected by transportation related to the Proposed Action, DOE has concluded that no disproportionately high and adverse impacts would be likely on minority or low-income populations from the national transportation of spent nuclear fuel and high-level radioactive waste to Yucca Mountain.

Section 6.3.4 discusses environmental justice in relation to transportation in Nevada. Chapter 4, Section 4.1.13.4, contains a discussion of a Native American perspective on the Proposed Action.

6.3 Nevada Transportation

The analysis of impacts from national transportation includes those from transportation activities in the State of Nevada. This section discusses Nevada transportation impacts separately to ensure that the impacts of alternative transportation modes in Nevada are apparent. Spent nuclear fuel and high-level radioactive waste shipped to the repository by legal-weight truck would continue in the same vehicles to the Yucca Mountain site. Material that traveled by rail would either continue to the repository on a newly constructed branch rail line or transfer to heavy-haul trucks at an intermodal transfer station that DOE would build in Nevada for shipment on existing highways that could require upgrades. Selection of a specific rail alignment within a corridor, or the specific location of an intermodal transfer station or the need to upgrade the associated heavy-haul truck routes, would require additional field surveys, environmental and engineering analysis, state, local, and Native American Tribal government consultation, and National Environmental Policy Act reviews.

The transportation analysis in the EIS treats the candidate legal-weight truck routes, rail corridors, and heavy-haul truck routes as current analysis tools and refers to them in the present tense. The EIS refers to impacts associated with these alternatives in the conditional voice *(would)* because they would not occur unless DOE proceeded with the Proposed Action. This convention is applied whenever the EIS discusses the transportation implementing alternatives.

This section describes potential impacts of three transportation scenarios and their respective implementing alternatives. The three transportation scenarios are (1) mostly legal-weight truck (corresponding to that portion of the national impacts that would occur in Nevada), (2) mostly rail, and (3) mostly heavy-haul truck.

The mostly legal-weight truck scenario does not include implementing alternatives. Under this scenario, highway shipments would be restricted to specific routes that satisfy the regulations of the U.S. Department of Transportation (49 CFR Part 397). Because the State of Nevada has not designated alternative preferred routes, only one combination of routes for legal-weight truck shipments would satisfy U.S. Department of Transportation routing regulations (I-15 to U.S. Highway 95 to Yucca Mountain). This scenario assumes that over 24 years approximately 300 shipments of naval spent nuclear fuel would arrive in Nevada by rail from the Idaho National Engineering and Environmental Laboratory and that heavy-haul trucks would transport them to the repository from a railhead.

The mostly rail scenario has five implementing alternatives, each of which includes a corridor with variations for a branch rail line in Nevada. Each implementing alternative includes the construction and operation of a rail line. These alternatives would include about 1,079 legal-weight truck shipments (about 45 per year) from 6 commercial sites that, while operational, would not have the capability to load rail casks.

The mostly heavy-haul truck scenario has implementing alternatives for five different routes on existing Nevada highways. The highways would have to be upgraded to enable heavy-haul trucks routinely to transport rail casks containing spent nuclear fuel and high-level radioactive waste from an intermodal transfer station to the repository. Each heavy-haul truck implementing alternative includes the construction and operation of an intermodal transfer station that DOE would use to transfer loaded rail casks from railcars to heavy-haul trucks and empty rail casks from the trucks to railcars. The analysis considered three potential intermodal transfer station locations. Each heavy-haul implementing alternative would also include 1,079 legal-weight truck shipments over 24 years from the 6 commercial sites that, while operational, would not have the capability to load rail casks.

Chapter 2, Section 2.1.3.3, contains detailed descriptions of the transportation scenarios and implementing alternatives in Nevada. Sections 6.3.1 through 6.3.3 discuss potential impacts for the three Nevada transportation scenarios. Section 6.3.1 discusses potential environmental impacts that could occur in Nevada for the national mostly legal-weight truck scenario. Section 6.3.2 discusses potential environmental impacts for each of the five Nevada rail transportation implementing alternatives, including those from the construction and operation of a branch rail line, and the impacts of 1,079 legal-weight truck shipments over 24 years. Section 6.3.3 discusses potential impacts of each of the five Nevada heavy-haul truck transportation implementing alternatives, including upgrading Nevada highways, the associated activities of constructing and operating an intermodal transfer station, and the impacts of 1,079 legal-weight truck shipments over the 24 years of operations. Appendix J, Section J.3.6, presents an analysis of impacts of transporting people and materials that would be necessary to implement the Proposed Action. Appendix J also discusses the methods used to analyze impacts for the 12 resource areas.

The EIS analysis evaluated potential impacts that would occur in Nevada from the construction and operation of a branch rail line or from upgrades to highways and construction and operation of an intermodal transfer station for the following environmental resource areas: land use and ownership; air quality; hydrology (surface water and groundwater); biological resources and soils; cultural resources; occupational and public health and safety; socioeconomics; noise and vibration; aesthetics; utilities, energy, and materials; waste management; and environmental justice. The following paragraphs describe the methods used to evaluate potential impacts to these resource areas for each of the three Nevada transportation scenarios—legal-weight truck, rail, and heavy-haul truck—and their applicable implementing alternatives.

Tables 6-16 and 6-17 compare the impacts of the Nevada rail and heavy-haul implementing alternatives, respectively, along with the impacts in Nevada under the mostly legal-weight truck scenario. The comparisons in the tables show that potential health and safety impacts to the public and workers in Nevada would be small for both the mostly legal-weight truck and mostly rail transportation scenarios. In addition, the tables illustrate that impacts would be similar among the 10 rail and heavy-haul truck implementing alternatives. The radiological impacts of incident-free transportation in the State for any of the 10 implementing alternatives or for the mostly legal-weight truck scenario would be small for both the public and workers. The radiological impact from 24 years of transportation would range from 0.0009 to 0.17 latent cancer fatality in the population along routes. The radiological impact to transportation workers from 24 years of operations would range from 0.28 to 0.75 latent cancer fatality for the mostly rail scenario with a Valley Modified Corridor branch rail line and the mostly legal-weight truck scenario, respectively.

As many as 5 latent cancer fatalities could occur from a maximum reasonably foreseeable accident involving a rail shipment. Less than 1 (0.5) latent cancer fatality would occur as the result of a severe truck accident with a similar probability. These accidents would have a chance of occurring nationally of less than 3 in 10 million per year. Because only a small part of each national route is in Nevada, the rate of occurrence in the State would be much less than that nationally. Accidents that would be more likely would have lesser consequences.

Traffic fatalities in Nevada and fatalities caused by the effects of vehicle emissions would be greater for the mostly rail transportation scenario than for the mostly legal-weight truck scenario. The estimate of

Table 6-16. Comparison of impacts for Nevada rail implementing alternatives and for legal-weight truck shipments (page 1 of 2).

Impact	Mostly rail with branch rail					Mostly legal-weight truck
	Caliente	Carlin	Caliente-Chalk Mountain	Jean	Valley Modified	
Corridor length (kilometers)	512 - 553	514 - 544	344 - 382	181 - 204	159 - 163	230 - 270
Land use and ownership						
Disturbed land (square kilometers)[a]	18 - 20	19 - 20	13 - 14	9.2 - 10	5 - 5.2	0
Private land (square kilometers)	0.9 - 2.5	7.3 - 15	0.8 - 1.1	0.1 - 3.5	0 - 0.18	0
Nellis Air Force Range land (square kilometers)	0 - 11	0 - 11	22	0	3.6 - 7.5	0
Tribal	0 - 1.6	0 - 1.6	0	0	0	0
Air quality						
PM_{10} and carbon monoxide (construction and operations)	Areas in attainment of air quality standards - branch rail line not a significant source of pollution	Areas in attainment of air quality standards - branch rail line not a significant source of pollution	Areas in attainment of air quality standards - branch rail line not a significant source of pollution	Except in Clark County, areas in attainment of air quality standards - branch rail line not a significant source of pollution	Clark County is in nonattainment of air quality standards for PM_{10} - branch rail line construction could be a significant source of pollution[b]	Not a significant source of pollution
Hydrology						
Surface water	Low	Low	Low	Low	Low	None
Surface water resources along route	5	6	3	0	0	NA[d]
Flood zones	9	11	At least 3	7	2	NA
Groundwater						
Water use (acre-feet)[c]	710	660	480	410	320	0
Water use (number of wells)	64	67	43	23	20	0
Biological resources and soils	Low	Low	Low	Low	Low	Very low
Cultural resources	None identified to archaeological, historical, or cultural resources	None identified to archaeological, historical, or cultural resources	None identified to archaeological, historical, or cultural resources	None identified to archaeological, historical, or cultural resources	None identified to archaeological or historical resources. Route passes close to the Las Vegas Paiute Indian Reservation	Since shipments would use existing highways, none to archaeological or historical resources. Shipments from the northeast would pass through the Moapa Indian Reservation. All shipments would pass through the Las Vegas Paiute Indian Reservation
Noise	Moderate	Low	Moderate	Moderate	Moderate	Low
Utilities and resources						
Diesel (million liters)[e]	45	41	36	30	14	Very low
Gasoline (thousand liters)	940	840	680	570	280	
Steel (thousand metric tons)[f]	78	75	52	29	23	0
Concrete (thousand metric tons)[g]	460	420	310	170	130	0

Table 6-16. Comparison of impacts for Nevada rail implementing alternatives and for legal-weight truck shipments (page 2 of 2).

Impact	Mostly rail with branch rail					Mostly legal-weight truck
	Caliente	Carlin	Caliente-Chalk Mountain	Jean	Valley Modified	
Aesthetics	Very low	Very low	Very low	Potential small area of conflict	Very low	None
Socioeconomics						
New jobs (percent of workforce in affected counties	840 (< 1% - 3.2%)	780 (< 1%)	650 (<1% - 2.3%)	530 (< 1%)	250 (< 1%)	Very low
Peak real disposable income (million dollars)	24	21	19	15	7	Very low
Peak incremental Gross Regional Product (million dollars)	40	36	31	26	13	Very low
Waste management	Limited quantity	Limited quantity	Limited quantity	Limited quantity	Limited quantity	Very low
Environmental justice (disproportionately high and adverse impacts)	None	None	None	None	None	None
Incident-free health and safety						
Industrial hazards						
Total recordable incidents	220	200	180	150	110	NA
Lost workday cases	110	100	90	80	60	NA
Fatalities	0.43	0.41	0.38	0.3	0.25	NA
Collective dose (person-rem [LCFs])						
Workers	850 [0.34]	980 [0.39]	740 [0.3]	760 [0.3]	710 [0.28]	1,900 [0.75]
Public	19 [0.009]	38 [0.019]	50 [0.025]	130 [0.06]	23 [0.012]	340 [0.17]
Fatalities from vehicle emissions	0.25	0.25	0.2	0.23	0.13	0.086
Accident impacts, nonradiological traffic						
Construction and operations workforce	1.9	1.8	1.5	1.2	0.9	NA
SNF[h] and HLW[i] shipping	0.07	0.09	0.05	0.06	0.05	0.49
Accident impacts, radiological						
Radiological accident risk						
Person-rem	0.002	0.003	0.002	0.007	0.002	0.053
Latent cancer fatalities	0.0000009	0.0000013	0.0000009	0.0000036	0.000001	0.000026
Maximum reasonably foreseeable accident						
Maximally exposed individual (rem)	29	29	29	29	29	3
Individual latent cancer fatality probability	0.014	0.014	0.014	0.014	0.014	0.0015
Collective dose (person-rem)	9,900	9,900	9,900	9,900	9,900	1,100
Latent cancer fatalities	4.9	4.9	4.9	4.9	4.9	0.55

a. Convert square kilometers to acres, multiply by 247.1.
b. Conformity determination could be required (see Chapter 6, Sections 6.3.2.1 and 6.3.2.2.5).
c. To convert acre-feet to gallons, multiply by 325,850.1.
d. NA = not applicable.
e. To convert liters to gallons, multiply by 0.26418.
f. To convert metric tons to tons, multiply by 1.1023.
g. To convert cubic feet to cubic meters, multiply by 0.028317.
h. SNF = spent nuclear fuel.
i. HLW = high-level radioactive waste.

Table 6-17. Comparison of impacts for Nevada heavy-haul truck implementing alternatives and for legal-weight truck shipments (page 1 of 3).

	Mostly rail with heavy-haul truck					
Impact	Caliente	Caliente/Chalk Mountain	Caliente/Las Vegas	Sloan/Jean	Apex/Dry Lake	Mostly legal-weight truck
Corridor length (kilometers)	530	280	380	190	180	230 - 270
Land use and ownership						
Disturbed land (square kilometers)[a]	3.4	1.3	2.1	0.63	0.63	0
Private land (square kilometers)	0	0	0	0	0	0
Nellis Air Force Range land (square kilometers)	0	0	0	0	0	0
Air quality						
PM_{10} and carbon monoxide (construction and operations)	Areas in attainment of air quality standards - not a significant source of pollution	Areas in attainment of air quality standards - not a significant source of pollution	Clark County is in nonattainment of air quality standards - heavy-haul route construction could be a significant source of pollution[b]	Except in Clark County, areas in attainment of air quality standards - not a significant source of pollution	Except in Clark County, areas in attainment of air quality standards - not a significant source of pollution	Not a significant source of pollution
Hydrology						
Surface water	Low	Low	Low	Low	Low	None
Groundwater						
Water use (acre-feet)c	100	60	44	8	8	0
Water use (number of wells)	16	5	7	Truck water	Truck water	0
Biological resources and soils	Low	Low	Low	Low	Low	Very low
Cultural resources	None identified to archaeological, historical, or cultural resources	None identified to archaeological, historical, or cultural resources	None identified to archaeological, historical, or cultural resources; route near Moapa Indian Reservation and passes across 1.6-kilometer (1-mile) corner of the Las Vegas Paiute Indian Reservation	None identified to archaeological, historical, or cultural resources; route passes across 1.6-kilometer (1-mile) corner of the Las Vegas Paiute Indian Reservation	None identified to archaeological, historical, or cultural resources; IMT[d] and route near the Moapa Indian Reservation and passes across 1.6-kilometer (1-mile) corner of the Las Vegas Paiute Indian Reservation	Since shipments would use existing highways, none to archaeological or historical resources. Shipments from the northeast would pass through the Moapa Indian Reservation. All shipments would pass through the Las Vegas Paiute Indian Reservation
Noise	Low	Low	Low	Low	Low	Low
Utilities and resources						
Diesel (million liters)[e]	13	4.7	5.5	1.7	1.6	Very low
Steel (metric tons)[f]	49	14	21	2.3	2.3	0
Concrete (thousand metric tons)[g]	1.8	0.5	0.8	0.1	0.1	0
Aesthetics	Some potential near Caliente	Some potential near Caliente	Some potential near Caliente	Very low	Very low	None

Table 6-17. Comparison of impacts for Nevada heavy-haul truck implementing alternatives and for legal-weight truck shipments (page 2 of 3).

Impact	Mostly rail with heavy-haul truck: Caliente	Caliente/Chalk Mountain	Caliente/Las Vegas	Sloan/Jean	Apex/Dry Lake	Mostly legal-weight truck
Socioeconomics						
New jobs (percent of workforce in affected counties)	860 (< 1% - 3.3%)	750 (< 1% - 4.9%)	590 - 1,980 (< 1% - 3.3%)	630 - 3,050 (< 1%)	490 - 1,880 (< 1%)	Very low
Peak real disposable personal income (million dollars)	27	22	19 - 65	21 - 97	16 - 62	Very low
Peak incremental Gross Regional Product (million dollars)	45	40	33 - 104	36 - 153	29 - 100	Very low
Waste management	Limited quantity	Limited quantity	Limited quantity	Limited quantity	Limited quantity	Very low
Environmental justice (disproportionately high and adverse impacts)	None	None	None	None	None	None
Incident-free health and safety						
Industrial hazards						
Total recordable incidents	310	270	260	150	150	NA[h]
Lost workday cases	160	140	140	80	80	NA
Fatalities	0.72	0.68	0.63	0.37	0.37	NA
Collective dose (person-rem [LCFs])						
Workers	1,600 [0.65]	1,200 [0.50]	1,400 [0.56]	1,200 [0.48]	1,100 [0.46]	1,900 [0.75]
Public	76 [0.038]	61 [0.030]	220 [0.11]	300 [0.15]	160 [0.08]	340 [0.17]
Fatalities from vehicle emissions	0.47	0.32	0.46	0.42	0.29	0.086
Accident impacts, nonradiological traffic						
Construction and operations workforce	3.5	2.4	3.0	1.7	1.7	NA
SNF[i] and HLW[j] shipping	0.6	0.33	0.43	0.25	0.23	0.49
Accident impacts, radiological						
Radiological accident risk						
Person-rem	0.01	0.002	0.056	0.12	0.056	0.053
Latent cancer fatalities	0.0000051	0.000001	0.000028	0.00006	0.000028	0.000026

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Table 6-17. Comparison of impacts for Nevada heavy-haul truck implementing alternatives and for legal-weight truck shipments (page 3 of 3).

	Mostly rail with heavy-haul truck					
Impact	Caliente	Caliente/Chalk Mountain	Caliente/Las Vegas	Sloan/Jean	Apex/Dry Lake	Mostly legal-weight truck
Maximum reasonably foreseeable accident						
Maximally exposed individual (rem)	29	29	29	29	29	3
Individual latent cancer fatality probability	0.014	0.014	0.014	0.014	0.014	0.0015
Collective dose (person-rem)	9,900	9,900	9,900	9,900	9,900	1,100
Latent cancer fatalities	4.9	4.9	4.9	4.9	4.9	0.55

a. To convert square kilometers to acres, multiply by 247.1.
b. Conformity determination could be required (see Chapter 6, Sections 6.3.3.1 and 6.3.3.2.3).
c. To convert acre-feet to gallons, multiply by 325,850.1.
d. IMT = intermodal transfer.
e. To convert liters to gallons, multiply by 0.26418.
f. To convert metric tons to tons, multiply by 1.1023.
g. To convert cubic feet to cubic meters, multiply by 0.028317.
h. NA = not applicable.
i. SNF = spent nuclear fuel.
j. HLW = high-level radioactive waste.

traffic facilities includes those that could occur when workers associated with highway or railroad construction commute to and from their work site. The estimates also include traffic fatalities that could result from highway accidents in delivering construction materials used to construct a branch rail line or upgrade highways and construct an intermodal transfer station. Construction and operations activities to transport spent nuclear fuel and high-level radioactive waste in Nevada could result in less than 1 to 5 traffic fatalities (0.5 or a 50 percent chance of 1 fatality to about 4.6). The fewest number of traffic fatalities would occur under the mostly legal-weight truck scenario, principally because the scenario would not require workers associated with construction and operations for Nevada rail implementing alternatives.

Because the trucks would use existing highways and be less than 1 percent of other commercial truck traffic on these highways, measurable impacts would not occur in environmental resource areas other than health and safety in Nevada for mostly legal-weight truck transportation. In contrast, the mostly rail scenario, or any other mix of rail and truck transportation that included a large amount of rail transportation, would require DOE to construct and operate a branch rail line in one of the five candidate rail corridors or construct and operate an intermodal transfer station and work with the State to upgrade highways to use one of the candidate routes for heavy-haul trucks. As a consequence, for the DOE-preferred mostly rail scenario, there would be impacts in Nevada to land use, air quality, hydrological resources, biological resources and soils, cultural resources, socioeconomics, aesthetics, noise and vibration, and waste management. Because it would require acquisition of a large area of land in the State, disturbance of land areas not previously disturbed, and the greatest amount of construction activity, construction of a branch rail line would have the potential to cause greater impacts in all resource areas except health and safety than would construction of an intermodal transfer station and highway upgrades. However, all five of the candidate rail corridors pass through sparsely populated or uninhabited areas of Nevada. Therefore, trains on a branch rail line after construction would have less day-to-day impact on daily life in communities than would heavy-haul trucks, which would share highways with other vehicles. Operational impacts (encompassing those impacts that would occur after construction of a branch rail line or highway upgrade for heavy-haul trucks) would be small in all resource areas for all ten of the rail and heavy-haul truck implementing alternatives.

In general, the longest rail corridor (Caliente) would have the largest potential for impacts, but there are exceptions. For example, construction of a branch rail line in the Valley Modified Corridor, which is the shortest of the five, could affect the Clean Air Act attainment objectives of Clark County for PM_{10} and carbon monoxide, for which the Las Vegas Valley air basin is currently in nonattainment. In addition, both the Jean and Valley Modified Corridors pass through desert tortoise habitat over their entire length and over a distance greater than the three longer corridors. The Wilson Pass Option of the Jean Corridor would require construction of a branch rail line in areas classified by the Bureau of Land Management as Class II for visual resource management. Construction and use of a branch rail line in these areas could be in conflict with Bureau Visual Resource Management guidelines. All five corridors and the Caliente/ Chalk Mountain heavy-haul route have potential land-use conflicts at some points along their lengths. The ability of DOE to avoid or mitigate these conflicts varies among the implementing alternatives.

Construction or upgrading of the longest heavy-haul route (Caliente) would lead to the greatest potential for impacts, with some exceptions. For example, although most impacts of using an Apex/Dry Lake heavy-haul truck implementing alternative would be less than those of using a Caliente heavy-haul truck implementing alternative, the potential for impacts to air quality in the Las Vegas Valley air basin and impacts on traffic flow in the Las Vegas metropolitan area are greater for the Apex/Dry Lake route than for the Caliente route. In addition, socioeconomic impacts in Lincoln County, although small, would be greatest for construction and use of a Caliente/Chalk Mountain heavy-haul route. Furthermore, while health and safety impacts in small communities in Nevada, while small, would be greatest for a Caliente heavy-haul route, the shortest route would use the Las Vegas Beltway, which would pass through a highly populated commercial and residential area of North Las Vegas.

Each rail corridor and heavy-haul route could pass near or through areas having high percentages of minority or low-income populations. However, DOE has determined that there would be no environmental justice concerns for any of the proposed routes for heavy-haul trucks or corridors for a potential branch rail line because no potential impact to these populations would be both high and adverse.

LAND USE AND OWNERSHIP

DOE determined that information useful for an evaluation of land-use and ownership impacts should identify the current ownership of the land that its activities could disturb, and the present and anticipated future uses of the land. The region of influence for land-use and ownership impacts was defined as land areas that would be disturbed or whose ownership or use would change as a result of the construction and use of a branch rail line, intermodal transfer station, midroute stopover for heavy-haul trucks, and an alternative truck route near Beatty, Nevada.

AIR QUALITY

The evaluation of impacts to air quality considered potential emissions of criteria pollutants [nitrogen dioxide, sulfur dioxide, carbon monoxide, particulates with aerodynamic diameters of less than 10 micrometers (PM_{10})], lead, and ozone, the percentage of applicable standards and limits, and the potential for releases of these pollutants in the Las Vegas Valley. The region of influence for the air quality analysis included (1) the Las Vegas Valley for implementing alternatives that could contribute to the levels of carbon monoxide and PM_{10}, which are already in nonattainment of Clean Air Act standards (DIRS 101826-FHWA 1996, pp. 3-53 and 3-54), during the construction and operation of a branch rail line or highway for heavy-haul trucks, and (2) the atmosphere in the vicinity of the sources of criteria pollutants that transportation-related construction and operation activities would emit. The evaluation included a conformity review for emissions to the Las Vegas Valley air basin that would result from the Proposed Action.

HYDROLOGY

The analysis evaluated surface-water and groundwater impacts separately. The attributes used to assess surface-water impacts were the potential for introduction and movement of contaminants, potential for changes to runoff and infiltration rates, alterations in natural drainage, and potential for flooding or dredging and filling actions to aggravate or worsen any of these conditions. The region of influence for surface-water impacts included areas near construction activities, areas that would be affected by permanent changes in flow, and areas downstream of construction.

The analysis addressed the potential for a change in infiltration rates that could affect groundwater, the potential for introduction of contaminants, the availability for use for construction, the potential for changing flow patterns and, if available, the potential that such use would affect other users. The region of influence for this analysis included groundwater reservoirs.

BIOLOGICAL RESOURCES AND SOILS

The evaluation of impacts to biological resources considered the potential for conflicts with areas of critical environmental concern; special status species (plants and animals), including their habitats; and jurisdictional waters of the United States, including wetlands and riparian areas. The evaluation also considered the potential for impacts to migratory patterns and populations of big game animals. The region of influence for this analysis included the following:

- Habitat, including jurisdictional waters of the United States, including wetlands and riparian areas

- Migratory ranges of big game animals that could be affected by the presence of a branch rail line

DOE identified known biological resources within 5 kilometers (3 miles) of each rail corridor or variation. Resources were categorized based on proximity to the railroad—that is, inside the 400-meter-(0.25-mile)-wide corridor or outside the corridor but within 5 kilometers of the railroad. A railroad would be unlikely to influence some resources outside the corridor, such as populations of sensitive plant species or springs. It could influence other resources, especially those involving large game animals, horses, or burros, because they could traverse the distance to the railroad easily.

DOE identified soils classified as Easily Erodible, Prime Farmland, Shrink-Swell, Unstable Fill, or Blowing Soil along each route. No Prime Farmland was identified for any route. Although these soil characteristics would principally influence construction, they could influence the amount of land disturbed inside and outside the corridor and the local environment during construction, such as temporary increases in sediment loads in nearby waterways or springs, or entrainment of blowing soil.

The analysis assessed soil impacts to determine the potential to increase erosion rates by water or wind. The region of influence for the analysis of soil impacts included areas where construction would take place and downwind or downgradient areas that would be affected by eroded soil.

CULTURAL RESOURCES

The evaluation of impacts on cultural resources considered the potential for disrupting, or modifying the character of, archaeological or historic sites, artifacts, and other cultural resources, such as traditional cultural properties and cultural landscapes.

The specific region of influence for the *direct impact* analysis included the lands in the 400-meter (0.25-mile)-wide rail corridors, lands within existing highway rights-of-way that would be upgraded for heavy-haul truck use, and sites where an intermodal transfer station could be constructed and operated. The analysis assessed the potential for impacts to areas adjacent to a proposed rail corridor, such as landscapes traditional to American Indians or other historic cultural landscapes.

OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY

The analysis of impacts to occupational and public health and safety from transportation-related activities in Nevada used the same methods, assumptions, attributes, and regions of influence used for the analysis of impacts of national transportation of spent nuclear fuel and high-level radioactive waste. However, it used the rail and highway accident rates reported for the State of Nevada (DIRS 103455-Saricks and Tompkins 1999, Table 4). The analysis also considered the daily average nonresident population in the Las Vegas metropolitan area for routes that pass through the Las Vegas metropolitan area.

In addition, the analysis included potential impacts from industrial hazards to Nevada workers from constructing and operating a branch rail line, upgrading highways for use by heavy-haul trucks, and constructing and operating an intermodal transfer station. The region of influence for the analysis included branch rail line and highway construction work sites and highways that workers and other construction-related vehicle traffic would use. The analysis considered potential radiological impacts from intermodal transfer station operations.

In addition, the analysis estimated doses to potential maximally exposed individuals in Nevada communities through which truck or rail shipments could travel. Appendix J, Section J.1.3.2.2 discusses the basis for these estimates. The health and safety portions of Sections 6.3.2.1 and 6.3.3.1 describe the potential impacts to maximally exposed individuals in Nevada.

SOCIOECONOMICS

The analysis of transportation-related socioeconomic impacts considered changes in annual levels of employment, population, housing, and schools, in addition to the economic measures of real disposable income, Gross Regional Product, and state and local government expenditures based on analyses DOE conducted using the Regional Economic Models, Inc. model (DIRS 148193-REMI 1999, all). The region of influence for the analysis included Clark, Lincoln, and Nye Counties. The other Nevada counties were included collectively in the Rest of Nevada analysis. The analysis considered impacts that would occur during construction and operation of the various transportation implementing alternatives.

The analysis expressed socioeconomic impacts as a percentage change, which it calculated by comparing the derived increase or decrease in a given socioeconomic parameter to the estimated baseline value for:

- Each county in the region of influence (Clark, Nye, and Lincoln), the Rest of Nevada, and the State of Nevada.
- The year.
- Economic measures (employment, population, real disposable income, Gross Regional Product, and State and local government spending).

Chapter 3, Section 3.1.7 lists the baseline values of each economic measure.

DOE has described the socioeconomic measures on a peak year basis for constructing a branch rail line, upgrading of highways, or constructing an intermodal transfer station and on an average basis for transportation operations. The Department used peak values and their impacts for construction because impacts would tend to be concentrated in 1 or 2 years. DOE used average values for the period of transportation operations as a more meaningful presentation of the data. Impacts, as a percentage of the baselines, would tend to be relatively stable over the 24 years of transportation operations for the Proposed Action.

In light of public comments received on the Draft EIS concerning perception-based and stigma-related impacts, DOE examined relevant studies and literature on perceived risk and stigmatization of communities to determine whether the state of the science in predicting future behavior based on perceptions had advanced sufficiently since scoping to allow DOE to quantify the impact of public risk perception on economic development or property values in potentially affected communities. Of particular interest were those scientific and social studies carried out in the past few years that directly relate to either Yucca Mountain or to DOE actions such as the transportation of foreign research reactor spent nuclear fuel. DOE also reevaluated the conclusions of previous literature reviews such as those conducted by the Nuclear Waste Technical Review Board and the State of Nevada, among others. DOE has concluded that:

- While in some instances risk perceptions could result in adverse impacts on portions of a local economy, there are no reliable methods whereby such impacts could be predicted with any degree of certainty
- Much of the uncertainty is irreducible, and
- Based on a qualitative analysis, adverse impacts from perceptions of risk would be unlikely or relatively small.

While stigmatization of southern Nevada can be envisioned under some scenarios, it is not inevitable or numerically predictable. Any such stigmatization would likely be an aftereffect of unpredictable future events, such as serious accidents, which may not occur. As a consequence, DOE did not attempt to quantify any potential for impacts from risk perceptions or stigma in this Final EIS. Chapter 2, Section 2.5.4 contains further detail.

NOISE AND VIBRATION

Nevada does not have a noise code, so the analysis used daytime and nighttime noise standards adopted by Washington State (Washington Administrative Code 173-58-040 to 173-60-040) for residential and commercial areas as benchmarks and for establishing the region of influence for potential impacts. DOE used these benchmarks [60 dBA for residential use (nighttime reduction to 50 dBA), 65 dBA for light commercial, and 70 dBA for industrial zones] to evaluate the impacts of noise from construction and operational activities for receptors in the region of influence near transportation facilities and corridors. Noise levels in areas and communities outside the region of influence were not addressed. To analyze the potential for community noise impacts, DOE established the region of influence as 1,000 meters (about 0.63 mile) based on the residential nighttime benchmark. This is the approximate distance from a railroad or highway at which the sound levels from passing trains or traffic would fall below 50 dBA. The distances for noise levels from a railroad to fall below 50 dBA (nighttime residential noise standard) and 60 dBA (daytime residential guideline) are 1,000 meters and 450 meters (about 0.25 mile), respectively.

DOE also defined a region of influence for locations where there would be a potential for impacts to solitude. These locations would include sites of special interest to Native Americans, where DOE assumes a sound level of 20 dBA would be necessary for solitude. This distance from passing trains or traffic would be about 6,000 meters (3.7 miles). To provide some perspective on the potential severity of noise impacts, the analysis estimated the population within 2 kilometers (about 1.3 miles) of each proposed rail corridor and heavy-haul truck route.

In addition to noise standards, the analysis assessed the frequency at which transportation noise from construction or operation of a transportation route could lead to complaints. It considered the proximity of transportation routes to centers of population and the frequency of shipments.

The analysis also considered potential effects of ground vibration from trains and heavy-haul trucks. In general, the operation of trains and trucks does not create vibration levels of an intensity that can damage most buildings unless they are very close to the rail line or highway (DIRS 155547-HMMH 1995, p. 8-3). Because trucks run on inflated tires, ground vibration is greatly reduced and the only situation that can produce potentially damaging ground vibration occurs when the vehicle strikes a bump or hole in the road. The intensity of the vibration depends on the size of the bump, speed and weight of the vehicle, and geology. Ground vibration can be disturbing to people, particularly at night, and it can adversely affect vibration-sensitive activities such as semiconductor manufacturing, operation of electron microscopes, and other activities. The U.S. Department of Transportation has proposed critical distances for the evaluation of ground vibration (DIRS 155547-HMMH 1995, pp. 9-4 and 8-3). These are expressed in feet and are based on the *decibel* scale for vibration (VdB) of root-mean-square (in relation to a microinch per second base). (A microinch is one-millionth of an inch or 0.0000025 centimeter; this measurement is used in applications that require extremely tight tolerances.) The endpoint for sensitive buildings is 65 VdB and the corresponding critical distance is 600 feet (about 180 meters). For human annoyance, the critical distance is based on 72 VdB and corresponds to 200 feet (about 61 meters). The estimated critical distance for structural damage due to the operation of unit coal trains is 100 meters (about 330 feet) based on a peak particle velocity measurement of 0.1 inch per second. Trains traveling to Yucca Mountain would include two locomotives and probably no more than 10 cars. The U.S. Department of Transportation (DIRS 155547-HMMH 1995, all) has proposed a structure protection criterion of

0.12-inch-per-second peak particle velocity. A corresponding region of influence is 100 meters (about 330 feet). High levels of ground vibration can be managed in sensitive areas by reducing the speed of the trains, a factor that usually occurs for safety purposes. Most of the candidate rail corridors to Yucca Mountain are in open or isolated areas with few structures; as a consequence, the chance of building damage from the operation of trains would be very small.

The analysis of impacts on biological resources considered the effects of environmental noise from trains and trucks on animals. There are no standards or regulatory measures for such impacts.

AESTHETICS

The analysis of potential impacts on aesthetic resources considered Bureau of Land Management ratings for land areas (DIRS 101505-BLM 1986, all). The regions of influence used in the analysis included the landscapes along the potential rail corridors and highway routes and near possible locations of intermodal transfer stations with aesthetic quality that construction and operations could affect.

The analysis of impacts was based on visual sensitivity ratings of viewsheds in Nevada and the Bureau of Land Management Visual Resource Management System objectives. It established ratings for scenery based on the number and types of users, public interest in the area, and adjacent land uses. The ratings are based on the scenic quality classes in the Bureau of Land Management Visual Resource Management System (DIRS 101505-BLM 1986, all).

UTILITIES, ENERGY, AND MATERIALS

The attributes used to assess impacts to utilities, energy, and materials included the requirements for electric power, fossil fuel for construction, and key consumable construction materials. The analysis compared needs to available capacity. The region of influence included the local, regional, and national supply infrastructure that would have to satisfy the needs.

WASTE MANAGEMENT

Evaluations of impacts of waste management considered the nonhazardous industrial, sanitary, hazardous, and low-level radioactive wastes that the Proposed Action would generate. The region of influence included construction areas and camps and facilities that would support transportation operations such as locomotive and railcar maintenance facilities.

ENVIRONMENTAL JUSTICE

DOE performs environmental justice analyses to identify whether any high and adverse impacts would fall disproportionately on minority and low-income populations. There would be a potential for environmental justice concerns if the following occurred:

- *Disproportionately high and adverse human health effects to minority or low-income populations:* Adverse health effects would be risks and rates of exposure that could result in latent cancer fatalities and other fatal or nonfatal adverse impacts to human health. Disproportionately high and adverse human health effects occur when the risk or rate for a minority or low-income population from exposure to a potentially large environmental hazard appreciably exceeds or is likely to appreciably exceed the risk to the general population and, where available, to another appropriate comparison group (DIRS 103162-CEQ 1997, all).

- *Disproportionately high and adverse environmental impacts to minority or low-income populations:* An adverse environmental impact is one that is unacceptable or above generally

> accepted norms. A disproportionately high impact is an impact (or the risk of an impact) to a low-income or minority community that significantly exceeds the corresponding impact to the larger community (DIRS 103162-CEQ 1997, all).

The approach to environmental justice analysis first brings together the results of analyses from different technical disciplines that focus on consequences to certain resources, such as air, land use, socioeconomics, air quality, noise, and cultural resources, that could affect human health or the environment. The environmental justice approach considers assessments from these disciplines that identify potential impacts on the general population. Second, based on available information, the approach assesses if there are unique exposure pathways, sensitivities, or cultural practices that would result in high and adverse impacts on minority and low-income populations. If potential impacts identified under either assessment would be high and adverse, the approach then compares the impacts on minority and low-income populations to those on the general population to determine if any high and adverse impacts would fall disproportionately on minority and low-income populations. In other words, if high and adverse impacts on a minority or low-income population would not appreciably exceed the same type of impacts on the general population, disproportionately high and adverse impacts would be unlikely. In making these determinations, DOE considers geographic areas that contain high percentages of minority or low-income populations as reported by the Bureau of the Census.

The EIS definition of a minority population is in accordance with the basic racial and ethnic categories reported by the Bureau of the Census. A minority population is one in which the percent of the total population comprising a racial or ethnic minority is meaningfully greater than the percent of such groups in the total population; for this EIS, a minority population is one in which the percent of the total population comprising of a racial or ethnic minority is 10 percentage points or more higher than the percent of such groups in the total population (DIRS 103162-CEQ 1997, all). Nevada had a minority population of 34.8 percent in 2000 (see Chapter 3, Section 3.1.13 for a discussion of population information). For this EIS, therefore, one focus of the environmental justice analysis is the potential for transportation-related activities of the Proposed Action to have disproportionately high and adverse impacts on the populations in census tracts in the region of influence (principally in Clark, Nye, and Lincoln Counties) with a minority population of 44.8 percent or higher.

Nevada had a low-income population of 10 percent in 1990. Using the approach described in the preceding paragraph for minority populations, a low-income population is one in which 20 percent or more of the persons in a census block group live in poverty, as reported by the Bureau of the Census in accordance with Office of Management and Budget requirements (DIRS 152051-OMB 1999, all; DIRS 103127-Bureau of the Census 1999, pp. 114 and 116). Therefore, the second focus of the environmental justice analysis for this EIS is the potential for the Proposed Action to have disproportionately high and adverse impacts on the populations in census block groups with a low-income population of 20 percent or higher.

In response to comments, DOE has updated and refined available information to determine whether the Draft EIS overlooked any unique exposure pathways or unique resource uses that could create opportunities for disproportionately high and adverse impacts to minority and low-income populations, even though the impacts to the general population would not be high and adverse. The Department identified and analyzed several unique pathways and resources (for example, cultural and aesthetic resources, land use, air quality, and noise), but none revealed a potential for disproportionately high and adverse impacts (see Section 6.3 and Appendix J, Section J.3). DOE has updated and refined information germane to environmental justice analysis, including additional and more detailed mapping of minority populations (see Appendix J, Section J.3.1.2).

Section 6.3.4 describes the results of the analysis for the Nevada transportation scenarios.

6.3.1 IMPACTS OF THE NEVADA MOSTLY LEGAL-WEIGHT TRUCK TRANSPORTATION SCENARIO

Legal-weight truck shipments in Nevada of spent nuclear fuel and high-level radioactive waste to the Yucca Mountain site would use existing highways (see Figure 6-13) and would be a very small fraction of the total traffic [less than 600,000 kilometers (370,000 miles) per year for legal-weight truck shipments in Nevada in comparison to an estimated 1.2 billion kilometers (750 million miles) per year of commercial vehicle traffic on I-15 and U.S. Highway 95 in southern Nevada]. As a consequence, impacts to land use; hydrology; biological resources; cultural resources; socioeconomics; noise and vibration; aesthetics; utilities, energy, and materials; and waste management would not be large.

Because of a U.S. Fish and Wildlife Service concern about populations of desert tortoises and Clark County concern about air quality in the Las Vegas air basin, this section addresses the potential for impacts to this threatened species and to the quality of air in the basin. This section focuses on impacts to occupational and public health and safety in Nevada. Section 6.3.4 contains a consolidated discussion of the potential for transportation activities to cause environmental justice concerns.

6.3.1.1 Impacts to Air Quality

DOE conducted a conformity review using the guidance in DIRS 155566-DOE (2000, all) for the transportation activities of the mostly legal-weight truck scenario. The Las Vegas air basin is in nonattainment status for carbon monoxide, which is largely a result of vehicle emissions (DIRS 156706-Clark County 2000, Appendix A, Table 1-3). The review determined that during repository-related operations, when maximum emissions would occur, the transportation of employees, materials, and supplies, and the transportation of spent nuclear fuel and high-level radioactive waste would not exceed the General Conformity threshold levels for carbon monoxide. Total emissions would be 63 metric tons (69 tons) per year (69 percent of the threshold) and 0.25 metric ton (0.28 ton) per day (0.07 percent of the 2000 daily carbon-monoxide levels in the Las Vegas air basin) (DIRS 156706-Clark County 2000, Appendix A, Table 1-3).

The DIRS 155112-Berger (2000, p. 55) estimate for transportation of radioactive materials only for the legal-weight truck transport for 2010 is 0.27 metric ton (0.03 ton) per day. This estimate includes traffic congestion emissions. Although DOE believes the estimate is high, a value of 0.03 ton per day, 5 days per week, 50 weeks per year, would result in about 6.8 metric tons (7.5 tons) of carbon monoxide per year, which is less than 10 percent of the threshold.

6.3.1.2 Impacts to Biological Resources

Legal-weight truck shipments in Nevada to a Yucca Mountain Repository would involve travel over highways that cross desert tortoise habitat, but none of the routes would cross habitat that the U.S. Fish and Wildlife Service has designated as critical for the recovery of this threatened species (50 CFR 17.95). Over the course of 24 years of operations under the Proposed Action and 53,000 shipments, vehicles probably would kill individual desert tortoises. However, under this scenario legal-weight trucks would contribute only about 1 percent to the daily traffic of vehicles to and from the repository site and only about 0.15 percent of all commercial truck traffic along I-15 and U.S. 95 in southern Nevada. Thus, any desert tortoises killed by trucks transporting spent nuclear fuel or high-level radioactive waste probably would be only a small fraction of all desert tortoises killed on highways. Loss of individual desert tortoises due to legal-weight truck shipments would not be a large threat to the conservation of this species. DOE is engaged in consultation with the U.S. Fish and Wildlife Service to ensure protection of desert tortoises and other biological resources.

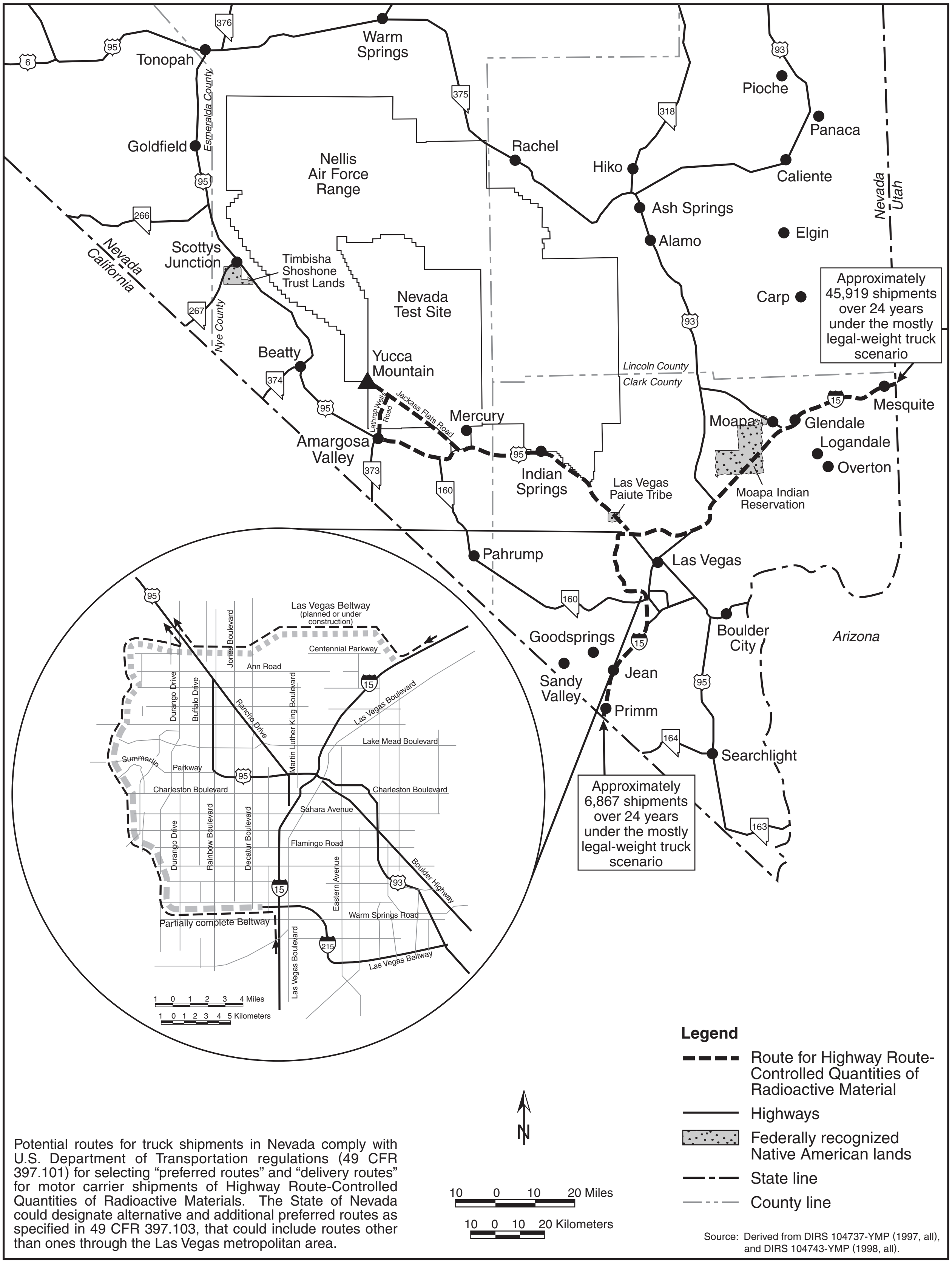


Figure 6-13. Potential Nevada routes for legal-weight trucks and estimated number of shipments.

6.3.1.3 Impacts to Occupational and Public Health and Safety

6.3.1.3.1 *Impacts from Incident-Free Transportation*

This section addresses radiological impacts to populations and maximally exposed individuals in Nevada from the incident-free transportation of spent nuclear fuel and high-level radioactive waste for the mostly legal-weight truck scenario. It includes potential impacts from exposure to vehicle emissions in Nevada.

Incident-Free Radiological Impacts to Populations. Table 6-18 lists the incident-free population dose and radiological impacts for the Nevada mostly legal-weight truck scenario. The impacts include those from the shipment of naval spent nuclear fuel by rail in Nevada to an intermodal transfer station, heavy-haul transfer activities, and subsequent heavy-haul truck transportation to the proposed repository. The analysis included the radiological impacts of intermodal transfer operations for naval spent nuclear fuel shipments. Occupational impacts would include estimated radiological exposures to security escorts for legal-weight truck, rail, and heavy-haul truck shipments. The estimated radiological impacts would be 0.75 latent cancer fatality for workers and 0.18 latent cancer fatality for members of the public over the 24 years of operation.

Table 6-18. Population doses and radiological health impacts from incident-free transportation for Nevada mostly legal-weight truck scenario.[a]

Category	Legal-weight truck shipments	Rail shipments of naval spent nuclear fuel[b]	Totals[c]
Involved workers			
Collective dose (person-rem)	1,900	18	1,900
Estimated LCFs[d]	0.75	0.01	0.75
Public			
Collective dose (person-rem)	340	10	350
Estimated LCFs	0.17	0.005	0.18

a. Impacts are totals for shipments over 24 years.
b. Includes impacts at intermodal transfer stations.
c. Totals might differ from sums of values due to rounding.
d. LCF = latent cancer fatality.

DOE based estimated impacts of legal-weight truck shipments in Nevada on routes identified for analysis in accordance with requirements in U.S. Department of Transportation regulations (49 CFR 397.101). As required by those regulations, and because the Las Vegas Beltway will be part of the Interstate Highway System, DOE assumed its use to avoid travel through the heavily traveled center of Las Vegas. In addition, DOE analyzed the potential impacts of using other routes that the State of Nevada has studied and of routing shipments through the Interstate 15-U.S. 95 interchange (the "*Spaghetti Bowl*"). Appendix J, Section J.3.1.3 discusses the results of these analyses, which range from 83 to 490 person-rem (0.04 to 0.25 latent cancer fatality in the affected population) for Nevada populations.

Incident-Free Radiological Impacts to Maximally Exposed Individuals. Table 6-19 lists estimates of dose and radiological impacts for maximally exposed individuals for the Nevada legal-weight truck scenario from 24 years of shipment activity. The analysis used the assumptions presented in Section 6.2.1 and Appendix J.

The analysis assumed the annual dose to state inspectors who conducted frequent inspections of shipments of spent nuclear fuel and high-level radioactive waste would be limited to 2 rem.

The analysis estimated that a maximally exposed individual at a service station would receive 2.4 person-rem over 24 years under the legal-weight truck scenario. This estimate conservatively assumed the person would be exposed to 450 truck shipments each year for 24 years. For perspective, under the mostly legal-weight truck scenario, which assumes an average of 2,200 legal-weight truck shipments per

Table 6-19. Estimated doses and radiological health impacts to maximally exposed individuals during incident-free transportation for Nevada mostly legal-weight truck scenario.[a,b]

Individual	Dose (rem)	Probability of latent fatal cancer
Involved workers		
Crew member	48[c]	0.02
Inspector	48[c]	0.02
Railyard crew member	0.13	0.00005
Public		
Resident along route[d]	0.02	0.00001
Person in traffic jam[e]	0.016	0.000008
Person at service station[f]	2.4	0.0012
Resident near rail stop	0.009	0.000005

a. The assumed external dose rate is 10 millirem per hour at 2 meters (6.6 feet) from the vehicle for all shipments.
b. Impacts are totals over 24 years.
c. Based on 2-rem-per-year dose limit (DIRS 156764-DOE 1999, Article 211).
d. This represents a Nevada resident approximately 11 meters (36 feet) from the highway. See Appendix J, Section J.1.3.2.2.
e. Person in a traffic is assumed to be exposed one time only.
f. Assumes the person works at the service station for all 24 years of repository operations. Mitigation would be required to reduce doses to members of the public to less than 100 millirem per year.

year, about 450 truck shipments would pass through the Mercury, Nevada, gate to the Nevada Test Site in 1,800 hours. A worker at a truck stop along the route to Mercury would work about 1,800 hours per year. Thus, if every shipment stopped at that truck stop, the maximum number of shipments the worker would be exposed to in a year would be 450. Appendix J, Section J.1.3.2.2, describes assumptions for estimating doses to maximally exposed individuals along routes in Nevada.

Impacts from Vehicle Emissions. There is potential for human health impacts to people in Nevada who would be exposed to pollutants emitted from vehicles transporting spent nuclear fuel and high-level radioactive waste, including escort vehicles. Table 6-20 lists the estimated number of vehicle emission-related fatalities from legal-weight trucks, a small number of heavy-haul trucks carrying naval spent nuclear fuel, escort vehicles, and rail locomotives under the mostly legal-weight truck scenario. Trucks would be the major contributors. Less than 1 (0.093) vehicle emission-related fatality would be likely.

Table 6-20. Population health impacts from vehicle emissions during incident-free transportation for Nevada mostly legal-weight truck scenario.[a]

Category	Legal-weight truck shipments	Rail shipments of naval spent nuclear fuel[b]	Total
Vehicle emission-related fatalities	0.086	0.0069	0.093

a. Impacts are totals for shipments over 24 years.
b. Includes heavy-haul truck shipments in Nevada.

6.3.1.3.2 *Impacts from Accidents – Nevada Legal-Weight Truck Scenario*

This section discusses radiological impacts to populations and maximally exposed individuals in Nevada and the potential number of traffic accident fatalities from accidents during the transportation of spent nuclear fuel and high-level radioactive waste for the mostly legal-weight truck scenario. The analysis of accident impacts under this scenario includes impacts from accidents that would occur during the transportation of naval spent nuclear fuel by rail in Nevada to an intermodal transfer station and by heavy-haul truck to the repository. Section 6.3.3 discusses impacts to workers from industrial hazards during the operation of an intermodal transfer station for shipments of naval spent nuclear fuel.

Radiological Impacts from Accidents. The calculated collective radiological dose risk of accidents would be approximately 0.053 person-rem for the population in Nevada within 80 kilometers (50 miles) along the routes under the mostly legal-weight truck transportation scenario. This calculated dose risk would be the total for 24 years of shipment operations. The radiological dose risk of accidents is the sum of the products of the probabilities (dimensionless) and consequences (in person-rem) of all potential transportation accidents. A radiological dose risk of 0.05 person-rem would result in much less than 1 (0.000026) latent cancer fatality in the exposed population. The radiological risk from accidents would include impacts from approximately 53,000 legal-weight truck shipments and 300 naval spent nuclear fuel rail shipments. The accident risk for legal-weight truck shipments would account for essentially all of the population dose and radiological impacts. Because DOE would not build a branch rail line to the repository under this scenario, the accident risk for rail shipments of naval spent nuclear fuel includes risks from accidents that could occur during intermodal transfers from railcars to heavy-haul trucks and during heavy-haul transportation in Nevada. Section 6.3.3 provides additional information on heavy-haul truck implementing alternatives for transporting rail casks in Nevada.

Consequences of Maximum Reasonably Foreseeable Accident Scenarios. The analysis evaluated the impacts of a maximum reasonably foreseeable accident scenario presented in Section 6.2.4.2.

Impacts from Traffic Accidents. In Nevada, less than 1 (0.49) fatality from traffic accidents would be likely during the course of transporting spent nuclear fuel and high-level radioactive waste under the mostly legal-weight truck transportation scenario. This estimate includes traffic fatalities involving escort vehicles.

MAXIMUM REASONABLY FORESEEABLE ACCIDENT SCENARIOS IN NEVADA

Maximum reasonably foreseeable accident scenarios analyzed for transportation in Nevada were the same as maximum reasonably foreseeable accident scenarios analyzed in Section 6.2.4.2 for national transportation. That is, the EIS analysis assumed that an accident determined to be reasonably foreseeable for national transportation could occur in Nevada. Because the distances traveled in Nevada would be much less than the total national travel to deliver spent nuclear fuel and high-level radioactive waste to the Yucca Mountain site, the likelihoods of these accident scenarios occurring in the State would be less than those for the rest of the Nation. The likelihoods of two of these accident scenarios occurring in national travel are reported in Section 6.2.4.2.

6.3.2 IMPACTS OF NEVADA RAIL TRANSPORTATION IMPLEMENTING ALTERNATIVES

This section describes the analysis of human health and safety and environmental impacts for five rail transportation implementing alternatives, each of which would use a newly constructed branch rail line in Nevada to transport spent nuclear fuel and high-level radioactive waste to the repository. The branch line would transport railcars carrying large shipping casks from a mainline railroad to the repository (loaded) and back (empty). DOE has identified five 400-meter (0.25-mile)-wide corridors of land—Caliente, Carlin, Caliente-Chalk Mountain, Jean, and Valley Modified—for the possible construction and operation of the branch line (Figure 6-14). Chapter 2, Section 2.1.3.3.2 describes the corridors. Chapter 3, Section 3.2.2.1, discusses their affected environments.

Appendix J, Section J.3.1.2, contains additional information on the characteristics of possible variations of each corridor. Figure 6-14 shows these variations. Section 6.3.2.1 discusses impacts that would be common among the five possible corridors, and Section 6.3.2.2 discusses impacts that would be unique for each corridor.

DOE identified the five rail corridors through a process of screening the potential rail corridors it had studied in past years.

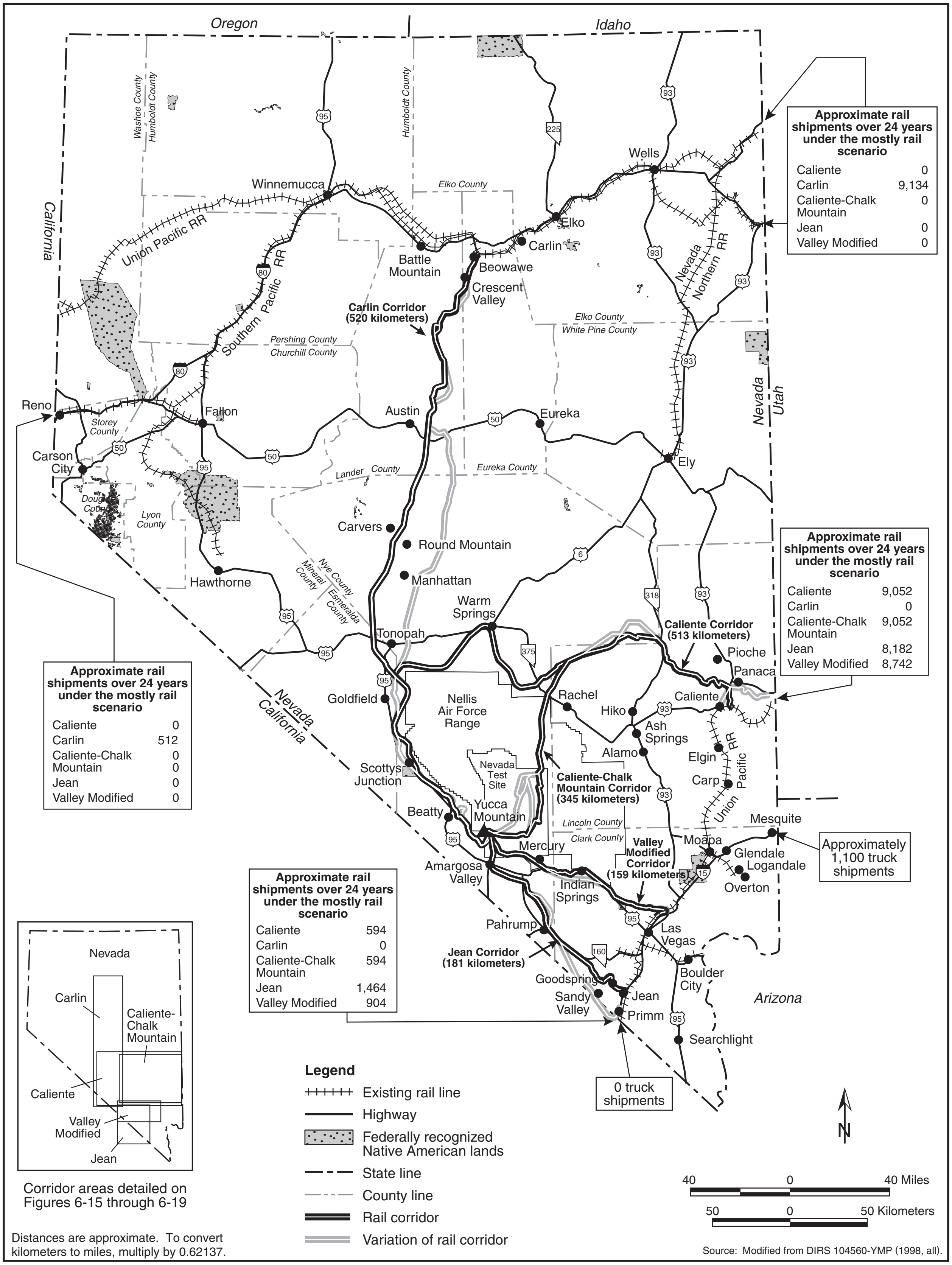


Figure 6-14. Potential Nevada rail routes to Yucca Mountain and estimated number of shipments for each route.

- The *Feasibility Study for Transportation Facilities to Nevada Test Site* study (DIRS 104777-Holmes & Narver 1962, all) determined the technical and economic feasibility of constructing and operating a railroad from Las Vegas to Mercury.
- The *Preliminary Rail Access Study* (DIRS 104792-YMP 1990, all) identified 13 and evaluated 10 rail corridor options. This study recommended the Carlin, Caliente, and Jean Corridors for detailed evaluation.
- *The Nevada Railroad System: Physical, Operational, and Accident Characteristics* (DIRS 104735-YMP 1991, all) described the operational and physical characteristics of the current Nevada railroad system.
- The *High Speed Surface Transportation Between Las Vegas and the Nevada Test Site (NTS)* report (DIRS 104786-Cook 1994, all) explored the rationale for a potential high-speed rail corridor between Las Vegas and the Nevada Test Site to accommodate personnel.
- The *Nevada Potential Repository Preliminary Transportation Strategy, Study 1* (DIRS 104795-CRWMS M&O 1995, all), reevaluated 13 previously identified rail routes and evaluated a new route called the Valley Modified route. This study recommended four rail corridors for detailed evaluation—Caliente, Carlin, Jean, and Valley Modified corridors.
- The *Nevada Potential Repository Preliminary Transportation Strategy, Study 2* (DIRS 101214-CRWMS M&O 1996, all), further refined the analyses of potential rail corridors in Study 1.

Public comments submitted to DOE during hearings on the scope of this EIS resulted in the addition of a fifth potential rail corridor—Caliente/Chalk Mountain.

The analysis of impacts for the five Nevada rail transportation implementing alternatives assumed the mostly rail transportation scenario. Therefore, the analysis included the impacts of legal-weight truck transportation from six commercial sites that would not have the capability while operational to handle or load a large rail cask. About 1,079 legal-weight truck shipments over 24 years would enter Nevada and travel to the repository. These shipments would use the same transport routes and carry about the same amounts of spent nuclear fuel per shipment as those described for the mostly legal-weight truck scenario (Section 6.3.1).

The analysis evaluated impacts to land use and ownership; air quality; hydrology; biological resources and soils; cultural resources; occupational and public health and safety; socioeconomics; noise and vibration; aesthetics; utilities, energy, and materials; and waste management. Section 6.3.4 discusses the potential for transportation activities to cause environmental justice impacts in Nevada.

6.3.2.1 Impacts Common to Nevada Branch Rail Line Implementing Alternatives

The estimated life-cycle cost of constructing and operating a branch rail line in Nevada would range from $283 million to $880 million (2001 dollars), depending on the corridor and variation. This section discusses impacts for the analysis areas listed above that would be common to all five branch rail line implementing alternatives. DOE evaluated these impacts as described in Section 6.3. The construction of the branch rail line would last between 40 and 46 months, depending on the rail corridor. Shipping operations in the rail corridor would begin at a mainline siding where railcars carrying casks of spent nuclear fuel and high-level radioactive waste would switch from the mainline to the branch line for transport to the repository, and railcars carrying empty casks from the repository would switch to the mainline for transport back to the commercial and DOE sites. These shipments would continue for 24 years. Section 6.3.2.2 discusses impacts specific to each rail implementing alternative.

6.3.2.1.1 *Common Rail Land-Use and Ownership Impacts*

In identifying the land potentially affected by a rail corridor, the analysis assumed a corridor width of 400 meters (1,300 feet, or about 0.25 mile). The purpose of the 400-meter width was to provide sufficient space for final alignment to route the rail line around sensitive land features or engineering obstacles. Actual construction and operation in the corridor would mostly require less than about 60 meters (200 feet) of the 400-meter width. Thus, at most, about 15 percent of the land in the corridor would be disturbed by construction. The analysis also assumed that as much as 3.6 square kilometers (890 acres) of land outside of the main disturbed area within the corridor would be disturbed during the construction of a branch rail line for construction roads and camps and other construction-related activities.

Each rail corridor has possible variations providing different land ownerships and projected disturbances, as described in Appendix J, Section J.3.1.2. These possible variations would make little difference in land-use impacts, which could be more or less than those described below.

The analysis indicates no conflicts with commercial use and no identified conflicts with scientific studies for any of the proposed corridors. At present, the public land in each corridor, with the exception of portions of the Caliente-Chalk Mountain Corridor, is open to mining and recreational use, as discussed in Chapter 3, Section 3.2.2.1.1.

The construction and operation of a branch rail line in any of the rail corridors would directly and indirectly affect private property. The Valley Modified Corridor would have the smallest range of private land affected, from 7.3 to 0.2 square kilometer (45 acres). The Carlin Corridor would have the largest, from 7.3 to 15 square kilometers (1,800 to 3,700 acres). Most of the private property in the Carlin Corridor is in the vicinity of Beowawe and Crescent Valley. The ownership of each parcel of affected private land would require that DOE negotiate use arrangements with owners. The division of private property parcels could affect the current and future use of the property. Each corridor contains lands associated with the Nevada Test Site and managed by DOE. The amount of land in each corridor varies from 5 square kilometers (1,200 acres) for the Carlin and Caliente Corridors to 38 square kilometers (9,400 acres) for the Caliente-Chalk Mountain Corridor. With the exception of the Caliente-Chalk Mountain Corridor, the corridors cross Nevada Test Site lands only at entry points to the repository site close to the perimeter of the property and would be unlikely to result in a change of current land use. The Caliente-Chalk Mountain Corridor would enter the northeast portion of the Test Site and pass generally through the center of the site. Although this corridor would not result in a change of ownership, it would alter the current use of the land in the vicinity of the rail corridor.

Each rail corridor, with the exception of the Jean Corridor, would cross a portion of the Nellis Air Force Range (also known as the Nevada Test and Training Range) under the management of the U.S. Air Force. Lands along the corridors managed by the Air Force range from none for the Jean Corridor to 22 square kilometers (5,400 acres) for the Caliente-Chalk Mountain Corridor. The Caliente-Chalk Mountain Corridor would enter Nellis Air Force Range lands along the northern boundary and cross approximately 52 kilometers (32 miles) of land used for Department of Defense training operations.

The U.S. Air Force has identified national security issues in relation to a Caliente-Chalk Mountain Corridor, citing interference with Nellis Air Force Range testing and training activities (DIRS 104887-Henderson 1997, all). In response to Air Force concerns, DOE regards this route as a “nonpreferred alternative.”

As of July 2001, the Nevada Public Utility Commission’s website listed 20 electric power generating facilities scheduled for construction in Nevada by 2004. Five of the 20 plants have received permits to proceed. Two of these are located in Storey County and Pershing County. Three are in Clark County—one in North Las Vegas and two for the same company in an industrial park at Apex. None is anticipated to impact land use for the repository or the transportation routes. The remaining 15 sites are anticipated to begin construction through 2002. The rights-of-way associated with the new plants are likely to cross Bureau of Land Management land. Of the 20 plants proposed, 13 are scheduled for construction in Clark County. These are on private, public, and reservation lands. None of the 20 proposed power plants would be within 50 miles (80 kilometers) of the proposed repository at Yucca Mountain. In addition, none of the proposed plant locations would conflict with any of the proposed transportation route options. The transmission lines and natural gas utility rights-of-way for the proposed locations could cross potential transportation routes. Current documentation is not sufficient to determine the locations for the proposed transmission line and natural gas rights-of-way. Conflicts due to proposed power plant rights-of-way would predominantly be associated with the proposed rail corridors and would be similar to existing rights-of-way discussed later in this section.

Each corridor has areas the public uses and areas available for sale and transfer. Each corridor crosses some roads used to access recreation areas on State of Nevada and Federal lands that are outside the corridors. As a consequence, the proposed branch rail line could result in limited access to areas currently in use by the public. Similarly, because of the corridor interface with grazing lands and wildlife areas, a rail line could create a barrier to livestock movement. Impacts to wildlife are discussed later in this section. Each corridor crosses road, highway, or utility rights-of-way. The passage of a branch rail line through these areas could result in land-use conflicts that, in turn, could result in the transfer of lands in the rights-of-way to DOE or a renegotiation of rights-of-way.

Construction. DOE expects the potential impacts of construction to be greater than those during the operation of a rail corridor. If the repository was approved and a rail corridor was selected, the following impacts from the construction of a branch rail line could occur:

- Difficulty for cattle to access water if the corridor divided Bureau of Land Management grazing allotments. Disruption of ranch operations and livestock rotations. Livestock deaths along roads used during construction. Disruptions to use of access roads to grazing allotments which typically consist of two-track roads and crisscross many of the corridors.

- Effects to private property divided by a branch rail line if alternative access was not available or provided. Although DOE would mitigate construction activities through stringent construction practices, those practices could affect property use, especially if the property was inhabited.

- Effects to mining activities such as mine operations or exploration if access roads were temporarily blocked or altered. Divided mining claims, making development of a claim less profitable if access became a problem.

- Effects on access to recreational areas. Division of some Bureau of Land Management lands currently used for recreation, which could temporarily isolate sections of land from the general public. Less ease of access in areas where Federal and State recreation areas can be accessed by roads (including two-track roads) from Bureau lands. Alteration of the recreational experience for some users; for example, construction of a rail corridor close to Bureau lands set aside for primitive and semiprimitive recreational use would alter those experiences.

- Effects on rights-of-way. Construction through these areas would require an evaluation of the impact to the road or utility or use of the right-of-way. Alteration of the construction of current roads or utility lines. Alteration of above-ground utility lines to pass beneath the branch rail line through an underpass to enable continued access to the utilities for maintenance. Movement of overhead transmission towers and poles to accommodate the branch rail line. Use of bridges or underpasses across high-volume roads to preclude at-grade crossings. Use of fencing where increased public contact could occur.

DOE would consult with the Bureau of Land Management, U.S. Air Force, other affected agencies, and other DOE program operations on the Nevada Test Site to help ensure that the final alignment of a branch rail line avoided or mitigated potential land-use conflicts.

Operations. DOE expects the operation of a rail line to cause smaller impacts than would construction. If the repository was approved and a rail corridor was selected, the following impacts of the operation of a branch rail line could occur:

- Division of some grazing lands. The Bureau of Land Management has stated that dividing grazing lands would result in a small loss of animal-unit months in large allotments, but would probably not affect ranch operations as long as there was available access across the corridor. (An *animal-unit month* represents enough dry forage for one mature cow for one month.) The loss of animal-unit months could affect the permittee's operation. In addition, the Bureau indicated that, if a branch rail line divided an allotment into separate pastures, an opportunity to rotate pasture use and thereby enable new grazing management options could be beneficial to livestock and vegetation. The Bureau acknowledges that fencing could be required along corridors where there are grazing allotments and that livestock could be isolated from water. Under these circumstances, water would have to be hauled to livestock or supplied in some other manner. In relation to branch rail line operations, train and track inspection and maintenance activities would be confined to areas disturbed by construction activities, so no additional disturbances would occur.

- No additional impacts to land use as long as there was property accessibility.

- No effects on mining activities over the long term. Effects on mining exploration if access to leases was blocked or restricted, but current mining operations probably would remain accessible.

- Effects to access to recreational areas. Division of Bureau of Land Management lands currently used for recreation and for access to Federal and State lands, which could limit access to portions of those lands. Alteration of the recreational experience for some users; for example, operation of a rail corridor close to Bureau lands set aside for primitive and semiprimitive recreational use could alter those recreational experiences.

6.3.2.1.2 *Common Rail Air Quality Impacts*

Construction. The construction of a branch rail line would comply with all applicable air quality regulations and associated requirements in the construction permits. Construction activities would increase pollutant concentrations in the areas near the rail corridor or any of the variations described in subsequent sections. Fuel use by construction equipment would emit carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulate matter with diameters of 10 micrometers or less (PM_{10}) and 2.5 micrometers or less ($PM_{2.5}$). Construction activities would also emit PM_{10} in the form of fugitive dust from excavation and truck traffic. The emissions would be temporary and would cover a very large area as construction moved along the length of the corridor.

No air quality impacts would be unique to the branch rail line implementing alternatives with the exception of the Valley Modified Corridor, as described in Section 6.3.2.2.5.

Operations. Fuel use by diesel train engines would emit carbon monoxide, nitrogen dioxide, PM_{10}, and $PM_{2.5}$. Based on the Federal standards for locomotives (40 CFR 92.005), there are no emission standards for sulfur dioxide.

DOE conducted a conformity review using the guidance in DIRS 155566-DOE (2000, all) for the transportation activities of the Nevada rail implementing alternatives. The Las Vegas air basin is in nonattainment status for carbon monoxide, which is largely a result of vehicle emissions (DIRS 156706-Clark County 2000, Appendix A, Table 1-3). The review determined that during the construction phase carbon monoxide emissions from the transportation of employees, materials, and supplies and from engine exhaust of construction vehicles working on the Valley Modified route could exceed the Clean Air Act General Conformity threshold level (about 110 to 160 percent of the threshold). These emission estimates represent about 0.1 to 0.2 percent of the 2000 daily carbon monoxide levels in the Las Vegas air basin. More detailed planning probably would result in emissions below the threshold. Emissions during the construction of all other routes and during repository operations would not exceed the carbon monoxide General Conformity threshold level in the nonattainment area.

The Las Vegas air basin is also in nonattainment status for PM_{10}, which is largely a result of dust from construction activities (DIRS 155557-Clark County 2001, Tables 3-8 and 5-3). The conformity review determined that PM_{10} emissions from the fugitive dust generated by Valley Modified route construction could exceed the General Conformity threshold level for PM_{10} (see Section 6.3.2.2.5.2). Additional dust control measures and construction planning in the nonattainment area could reduce the emissions to levels below the threshold. Emissions during the construction of all other routes and during the operation of any of those routes would not exceed the PM_{10} General Conformity threshold levels in the nonattainment area.

No air quality impacts would be unique to the branch rail line implementing alternatives with the exception of the Valley Modified Corridor, as described in Section 6.3.2.2.5.

6.3.2.1.3 *Common Rail Hydrology Impacts*

This section describes impacts to surface water and groundwater.

Surface Water

Construction. Construction-related impacts could involve the possible release and spread of contaminants by precipitation or intermittent runoff events or, for corridors near surface water, possible release to the surface water, the alteration of natural drainage patterns or runoff rates that could affect downgradient resources, and the need for dredging or filling of perennial or ephemeral streams.

Construction-related materials that could cause contamination would consist of petroleum products (fuels and lubricants) and coolants (antifreeze) necessary to support equipment operations. In addition, remote work camps would include some bulk storage of these materials, and supply trucks would routinely bring new materials and remove used materials (lubricants and coolants) from the construction sites. These activities would present some potential for spills and releases. Compliance with regulatory requirements on reporting and remediating spills and properly disposing of or recycling used materials would result in a low probability of spills. If a spill occurred, the potential for contamination to enter flowing surface water would present the greatest risk of a large migration of a contaminant before remediation took place. If there was no routinely flowing surface water (most areas along the corridors), released material would not travel far or affect critical resources before remediation occurred. During construction activities, water spraying would control dust and achieve soil compaction criteria, but water would not be used in quantities large enough to support surface-water flow and possible contaminant transport for any distance.

During construction, a contractor would move large amounts of soil and rock to develop the track platform (subgrade) and the access road. These construction activities could block storm drainage channels temporarily. However, the contractor would use standard engineering design and best management practices to place culverts, as appropriate, to move runoff water from one side of the track or road to the other. These culverts or other means of runoff control would be put in place early in the construction effort, because standing water in the work area would generally hinder progress.

Depending on site-specific conditions, construction could include regrading such that a number of minor drainage channels would collect in a single culvert, resulting in water flowing from a single location on the downstream side rather than across a broader area. This would cause some localized changes in drainage patterns but probably would occur only in areas where natural drainage channels are small.

All of the rail corridors would cross 100-year flood zones as identified on Flood Insurance Rate Maps published by the Federal Emergency Management Agency. None of the corridors has complete coverage (the percentage of the rail corridor included on the flood zone maps) on these maps due to large unstudied areas such as the Nellis Air Force Range and the Nevada Test Site, and areas with very limited coverage such as Lincoln County. For example, coverage by these flood maps ranges from about 10 percent for the Caliente-Chalk Mountain Corridor to about 90 percent for the Jean Corridor. However, the available information does provide an idea of corridor-specific flood zones, as summarized in the individual corridor discussions in Sections 6.3.2.2.1 to 6.3.2.2.5. In general, construction-related impacts associated with these flood zones would be very similar to those that could occur in any other identified drainage areas (that is, the alteration of natural drainage patterns and possible changes in erosion and sedimentation rates or locations). Construction in washes or other flood-prone areas probably would reduce the area through which floodwaters naturally flow. This could result in water building up, or ponding, on the upstream side of crossings during flood events, and then slowly draining through the culverts or bridges. Sedimentation would be likely on the upstream side of structures in such events and, accordingly, water going through the structure could be more prone to cause erosion once on the downstream side. Maintenance of a branch rail line would require periodic inspections of flood-prone areas (particularly after flood events) to verify the condition of the track and drainage structures. When necessary, sediment accumulating in these areas would be removed and disposed of appropriately. Similarly, eroded areas encroaching on the track bed would be repaired.

These alterations to natural drainage, sedimentation, and erosion would be unlikely to increase future flood damage, increase the impact of floods on human health and safety, or cause significant harm to the natural and beneficial values of the floodplains. Flood zone impacts would be minor primarily because of the relatively limited size of the disturbance that would be necessary to construct a branch rail line, and because the rail line design would accommodate a 100-year flood. In addition, the candidate rail corridors are in a region where flash flooding events are the primary concern. Though such flooding can be very violent and hazardous, it is generally focused in its extent and duration, limiting the potential for extensive impacts associated with the rail line. If DOE selected a rail corridor, it would initiate additional engineering and environmental studies and would perform additional National Environmental Policy Act reviews as a basis for final alignment selection and construction. DOE would then prepare a more detailed floodplain/wetlands assessment of the selected alternative.

Operations. The use of a completed branch rail line would have little impact on surface waters beyond the permanent drainage alterations from construction. The road and rail beds probably would have runoff rates different from those of the natural terrain but, given the relatively small size of the potentially affected areas in a single drainage system, there would be little impact on overall runoff quantities.

There would be no surface-water impacts unique to any of the branch rail line implementing alternatives with the exception of their relative proximity to surface-water resources.

Appendix L contains a floodplain/wetlands assessment that examines the effects of branch rail line construction, operation, and maintenance on the following floodplains in the vicinity of Yucca Mountain: Fortymile Wash, Busted Butte Wash, Drill Hole Wash, and Midway Valley Wash (see Section L.4.1). There are no delineated wetlands at Yucca Mountain. This section on common impacts and the following section on corridor-specific impacts address, in general terms, the flood zones along the rail corridors outside the immediate vicinity of Yucca Mountain. Appendix L, Section L.3.2, contains additional information on these portions of the corridors.

Groundwater

Construction. Potential groundwater impacts from rail line construction could include changes to infiltration rates, new sources of contamination that could migrate to groundwater, and depletion of groundwater resources resulting from increased demand. However, the potential for impacts would be spread over a large geographic area, so the probability would be low for a resource in a single area to receive adverse impacts. The above discussion of impacts to surface water identifies potential contaminants that branch rail line construction could release. These contaminants would be the same for groundwater.

Construction activities would disturb and loosen the ground, which could produce greater infiltration rates. However, this situation would be short-lived as the access road and railbed materials became compacted and less porous. In either case, localized changes in infiltration probably would cause no noticeable change in the amount of recharge in the area.

The analysis assumed that a number of wells would be required to support construction and that they would be installed along the rail corridor. It also assumed a 1-year period for construction activities in the vicinity of each well. Water withdrawal from these wells would not contribute to the depletion of a particular groundwater basin for two reasons: (1) the demand would be relatively short-term because it would stop when construction was complete, and (2) annual demands would be limited to a fraction of the perennial yields of the aquifers that would supply the water (see Chapter 3, Section 3.1.4). In addition, the Nevada State Engineer would approve water production from any well installed to support rail corridor construction. To grant approval, the State Engineer would have to determine that the short-term demand would not cause adverse impacts for other uses and users of the groundwater resource.

For the case in which water was obtained from a source other than a newly installed well and brought to the construction site by truck, water would be obtained from appropriated sources. That is, the water would be from allocations that the Nevada State Engineer had previously determined did not adversely affect groundwater resources.

Impacts on groundwater would differ among the implementing alternatives. These impacts, which Section 6.3.2.2 describes for the implementing alternatives, would include the projected water needs to support the construction of each candidate rail corridor and the estimated number of wells DOE would install along each corridor to meet that need.

Operations. The use of a completed railway corridor would have little impact on groundwater resources. There would be no continued need for water along the corridor, and possible changes to recharge, if any, would be the same as those at the completion of construction.

6.3.2.1.4 *Common Rail Biological Resources and Soils Impacts*

Construction. Construction activities would generally disturb no more than about 15 percent of the land inside a 400-meter (0.25-mile)-wide corridor. Vegetation would be cleared in an area generally less than 60 meters (200 feet) wide in the corridor to enable the construction of a branch rail line and a parallel access road. Vegetation would also be cleared from borrow areas and covered in disposal areas for excavated materials. Land for construction camps and in small areas where wells would be drilled would also be cleared of vegetation. Clearing vegetation and disturbing the soil would create habitat for colonization by exotic plant species present along a corridor. This could result in an increase in abundance of exotic species along the corridor, which could result in suppression of native species and increased fuel loads for fire. Reclamation of disturbed areas would enhance the recovery of native vegetation and reduce colonization by exotic species.

Impacts to biological resources from the construction of a branch rail line would occur due to a loss of habitat for some terrestrial species. Individuals of some species would be displaced or killed by construction activities. After the selection of a rail corridor, DOE would perform preconstruction surveys of potentially disturbed areas to identify and locate special status species that would need to be protected during construction.

Construction could affect the following biological resources:

- *Game and Game Habitat and Wild Horses and Burros.* Each candidate rail corridor or its variations would cross or be near [within 5 kilometers (3 miles)] several areas the Bureau of Land Management and the Nevada Division of Wildlife have designated as game habitat or wild horse and burro management areas (DIRS 104593-CRWMS M&O 1999, pp. 3-23 to 3-32). Construction activities in these areas would result in a loss of some habitat. Each rail corridor has the potential to disrupt movement patterns of game animals and wild horses and burros. The design of fences, if built along a rail corridor, would accommodate the movement of these animals. Large animals including game species (elk, bighorn sheep, mule deer, etc.), wild horses, and burros probably would avoid contact with humans at construction locations and would temporarily move to other areas during construction. Larger game animals occupy large home ranges and could easily traverse the distance between their designated habitat and a proposed corridor. Construction activities probably would disturb individuals or groups of animals and they would avoid the areas where construction was occurring. Fencing of the rail line could disrupt movements of horses, burros, and game animals, but the branch rail line would be designed to accommodate animal movement, to the extent possible, with such features as underpasses to enable large animals to cross from one side to the other. In the absence of fencing, movements of large animals would not be disrupted by the long-term presence of a rail line, but the possibility of trains colliding with game animals would be greater.

- *Special Status Species.* The construction of a branch rail line in any of the five rail corridors or their variations would involve the loss of varying amounts [3 to 11 square kilometers (740 to 2,700 acres)] of desert tortoise habitat. None of the corridors cross areas designated by the Fish and Wildlife Service as critical desert tortoise habitat (50 CFR 17.95). The abundance of tortoises varies from very low to medium along the proposed corridors (DIRS 101840-Karl 1980, pp. 75 to 87; DIRS 103281-Karl 1981, pp. 76 to 92; DIRS 101914-Rautenstrauch and O'Farrell 1998, pp. 407 to 411), but some desert tortoise deaths could occur during land-clearing operations. Numerous special status species occur along each of the proposed branch rail lines. Construction of a branch rail line could lead to habitat loss and fragmentation for the special status species, as well as to mortality of individuals.

- *Wetlands and Riparian Areas.* Each corridor could affect wetlands, springs, and riparian areas (DIRS 104593-CRWMS M&O 1999, pp. 3-23 to 3-32). These areas are generally important for biological resources and typically have high biodiversity. Potential impacts to these areas include destruction, alteration, or fragmentation of habitat; increased siltation in streams during construction; changes in stream flow; and loss of biodiversity.

- *Prime Farmland.* DOE identified no prime farmland for any corridor or route.

Section 6.3.2.2 describes the impacts to biological resources that would be unique for each corridor.

All of the candidate rail corridors and their variations would cross perennial or ephemeral streams that could be classified as jurisdictional waters of the United States. Section 404 of the Clean Water Act regulates discharges of dredged or fill material into such waters. After the selection of a rail corridor, DOE would identify any jurisdictional waters of the United States that the construction of a rail line would affect; develop a plan to avoid when possible, and otherwise minimize, impacts to those waters;

and, as applicable, obtain an individual or regional permit from the U.S. Army Corps of Engineers for the discharge of dredged or fill material. By implementing the plan and complying with other permit requirements, DOE would ensure that impacts to waters of the United States would be small.

The general design criteria for a branch rail line would include a requirement that a 100-year flood would not inundate the rails at channels fed by sizable drainage areas. During the operation and monitoring phase of the repository, conditions more intense than those that would generate a 100-year storm could occur in the area. Such conditions, depending on their intensity, could wash out access roads and possibly even the rail line. Although DOE would have to repair these structures, there is no reason to believe that such an occurrence would unduly affect area resources. If necessary, a permit would be obtained from the U.S. Army Corps of Engineers for discharge of dredge and fill material to repair the rail line. There would be no contamination that floodwaters could spread and, with the exception of areas of steep terrain, debris would not travel far. The operation of a branch rail line would stop during conditions that could lead to the flooding of track areas and would not resume until DOE had made necessary repairs.

Soil impacts from branch rail line construction would be primarily the direct impacts of land disturbance in the selected corridor. The amount of land disturbance, both inside and outside the corridor, would vary by corridor. The disturbed areas probably would be subject to an increase in erosion potential during construction. DOE would use dust suppression measures to reduce this potential. As construction proceeded, the railbed would be covered with ballast rock, which would virtually halt erosion from that area, and the access roads would be compacted, and gravelled, which would reduce erosion. As construction ended, disturbed areas (other than the railbed and access roads) would slowly recover. Other permanent erosion control systems would be installed as appropriate. Introduction of contaminants into the soil is also a potential concern. Proper control of hazardous materials during construction and prompt response to spills or releases would, however, reduce this concern. Impacts to soils would be limited to these areas disturbed and would be transitory and small.

Operations. Impacts to biological resources from shipments of spent nuclear fuel and high-level radioactive waste to the proposed repository along any of the five rail corridors, including their variations, would include periodic disturbances of wildlife from trains going by and from personnel servicing the corridor. Trains probably would kill individuals of some species.

Rail operations would not lead to additional habitat losses, although maintenance activities would prevent habitat recovery in the narrow band occupied by the branch rail line and access road. In addition, there could be loss of habitat due to inadvertent fires along the right-of-way from rolling equipment operations and maintenance activities. Although trains probably would kill individuals of some species, losses would be unlikely to affect regional populations of any species because all species are widespread geographically and trains would only use the corridor once or twice per day. Fewer individuals of large species would be likely to be killed during operations if the corridor was fenced, but fencing could restrict animal movement and disrupt migration patterns. Furthermore, fences would require continual surveillance to prevent individual animals or herds from becoming trapped. Nevertheless, the demographics of small herds could be adversely affected if individuals important to the viability of the herd were struck by a train. Fencing of the branch rail line and other features, such as tunnels (Jean Corridor), could lead to losses of individual animals or groups of animals. Individual animals could become caught inside fenced sections of the railroad and fail to find escape from oncoming trains. Game animals, horses, or burros could seek shelter in a tunnel and fail to escape if a train passed through.

Passing trains could disrupt wildlife, including game animals, horses, and burros, but such effects would be transitory. Noise from a train probably would disturb animals close to the track throughout operations, but this disturbance would diminish with distance from the track and over time as animals acclimated to daily disturbances from passing trains. The frequency of trains using the corridor (estimated to be 10 per week, 5 in each direction) indicates that disturbance of animals near the rail line would probably be minimal. Noise from the trains could cause animals to move away from the tracks and, possibly, cause changes in migratory patterns.

Trains, and the presence of the branch rail line, could lead to the death of individual desert tortoises. DOE would consult with the Fish and Wildlife Service under Section 7 of the Endangered Species Act on means of mitigating the potential for losses, and would implement all terms and conditions required by the Fish and Wildlife Service.

No additional habitat loss would occur during operations, although the loss of habitat could become permanent if a long-term use for the rail line became viable after completion of the repository project and operations continued.

Impacts to soils from operation of the branch rail line would be small because train movement would not disturb soils and maintenance of the railbed and rails would involve minimal disturbance beyond that which had occurred during the construction of the rail line.

6.3.2.1.5 *Common Rail Cultural Resources Impacts*

Construction. Chapter 3, Section 3.2.2.1.5 lists the archaeological information currently available in each corridor that branch rail line construction could affect, including tables that list linear historic properties (for example, the Pony Express Trail) and sites listed on State of Nevada and national historic registers, respectively. DIRS 155826-Nickens and Hartwell (2001, all) contains more information about known and potential cultural resources along the candidate corridors and their variations. Direct impacts to these cultural resources (such as disturbing the sites or crushing artifacts) could occur from a variety of construction-related activities, including building the rail line and the right-of-way. In addition, rail line construction activities would include borrow areas, areas for the disposal of excavated material, construction camps, and access roads that would be outside the defined right-of-way. Because archaeological sites sometimes include buried components, ground-disturbing actions could uncover previously unidentified cultural materials. If cultural resources were encountered, a qualified archaeologist would participate in directing activities to ensure that the resources would be properly protected or the impact mitigated. DOE would use procedures to avoid or reduce direct impacts to cultural resources in construction areas where surface-disturbing activities would occur (see Chapter 9).

Indirect impacts, such as non-project-related disturbances of archaeological sites by purposeful or accidental actions of project employees, could occur from construction activities as a result of increased access and increased numbers of workers near cultural resource sites. These factors would increase the probability for either intentional or inadvertent indirect impacts to cultural resources. Section 6.3.2.2 discusses potential impacts specific to each corridor.

Systematic studies would be completed for a selected corridor to identify sites, resources, or areas that might hold traditional value for Native American peoples or communities. Two of the corridors (Caliente and Carlin) could affect as-yet unidentified resources because they could pass through the Timbisha Shoshone Trust Lands parcel near Scottys Junction. If sites or resources important to Native Americans were discovered in the future, either in or near an identified right-of-way, adverse effects could occur through direct means, such as construction activities, or indirectly through visual or auditory (sound and vibration) impacts.

In the viewpoint of Native Americans, the construction and operation of a branch rail line would constitute an intrusion on the holy lands of the Southern Paiute and Western Shoshone. In addition, some corridors pass through or near several significant places (see Chapter 3, Section 3.2.2.1.5). The American Indian Writers Subgroup has commented that the overall significance of these places and potential impacts from operation of a rail line on them cannot be fully understood until DOE has identified the rail alignment and completed ethnographic field studies and consultations (DIRS 102043-AIWS 1998, p. 4-6). If DOE selected a rail corridor, it would initiate additional engineering and environmental studies (including cultural resource surveys), conduct consultations with Federal agencies, the State of Nevada, and tribal governments, and perform additional National Environmental Policy Act reviews as a basis for final alignment selection and construction. DOE would address the mitigation of potential impacts to archaeological and historic sites during the identification, evaluation, and treatment planning phases of the cultural resource surveys.

Operations. No additional direct or indirect impacts would be likely at archaeological and historic sites from the operation of a branch rail line. However, if Native Americans identified specific concerns during the preconstruction consultations described above, DOE would address them at that time.

6.3.2.1.6 *Common Rail Occupational and Public Health and Safety Impacts*

Incident-Free Transportation. Incident-free impacts of rail transportation in Nevada would be unique for each of the five Nevada rail transportation implementing alternatives; these are discussed for each implementing alternative in Section 6.3.2.2. Incident-free impacts to hypothetical maximally exposed individuals would be similar among the Nevada rail transportation implementing alternatives. Table 6-21 lists the impacts to hypothetical maximally exposed individuals in Nevada who would be exposed to all rail shipments along a branch rail line. Appendix J, Section J.1.3.2.2 describes assumptions for estimating doses to maximally exposed individuals along routes in Nevada.

Table 6-21. Estimated doses and radiological impacts to maximally exposed individuals for Nevada rail implementing alternatives.[a,b]

Individual	Dose (rem)	Probability of latent cancer fatality
Involved workers		
Inspector	34	0.012
Railyard crew member	4.2	0.002
Public		
Nevada resident along route (rail)[c]	0.002	0.0000008
Person in traffic jam (legal-weight truck)[d]	0.02	0.000008
Person at service station (legal-weight truck)[e]	0.08	0.00004
Resident near rail stop	0.29	0.0001

a. The assumed external dose rate is 10 millirem per hour at 2 meters (6.6 feet) from the vehicle for all shipments.
b. Totals for 24 years of operation.
c. This represents a Nevada resident approximately 30 meters (98 feet) from the branch rail line. See Appendix J, Section J.1.3.2.2.
d. Person in a traffic jam is assumed to be exposed one time only.
e. Assumes the person works at the service station for all 24 years of operations. Mitigation would be required to reduce doses to members of the public to below 100 millirem per year.

Accidents. Accident risks and maximum reasonably foreseeable accidents for rail shipments of spent nuclear fuel and high-level radioactive waste would be common to the Nevada rail transportation implementing alternatives. This section, therefore, discusses these risks.

Table 6-22 lists accident risks for transporting spent nuclear fuel and high-level radioactive waste in Nevada for the five Nevada rail transportation implementing alternatives. The data show that the risks, which are listed for 24 years of operations, would be low for each alternative. These risks include risks associated with transporting 1,079 legal-weight truck shipments made from the commercial sites that could not load rail casks while operational. Small variations in the risk values, principally evident for the Jean branch rail line, are a result of risks that would be associated with transporting rail casks arriving from the east on the Union Pacific Railroad's mainline through the Las Vegas metropolitan area. The values that would apply for a Valley Modified or Caliente-Chalk Mountain branch line would be lower

Table 6-22. Estimated health impacts[a] to the public from potential accident scenarios for Nevada rail implementing alternatives.

Risk	Caliente	Carlin	Caliente-Chalk Mountain	Jean	Valley Modified
Radiological accident risk[b]					
Dose risk (person-rem)	0.0017	0.0026	0.0017	0.0071	0.0021
LCFs[c]	0.0000009	0.0000013	0.0000009	0.000004	0.000001
Traffic fatalities	0.07	0.09	0.05	0.06	0.05

a. Data are reported for 24 years of operations.
b. In this table, radiological accident dose risk is the sum of the products of the probabilities (dimensionless) and consequences (in person-rem) of all potential transportation accidents. This sum is converted to latent cancer fatalities using the conversion factor of 0.0005 latent cancer fatality per person-rem.
c. LCF = latent cancer fatality.

because of a shorter corridor (Valley Modified), or a more remote and mid-length corridor (Caliente-Chalk Mountain).

Consequences of Maximum Reasonably Foreseeable Accidents. The national transportation analysis evaluated impacts of maximum reasonably foreseeable accidents (see Section 6.2.4.2).

6.3.2.1.7 *Common Rail Socioeconomics Impacts*

The common social and economic activities and changes associated with the construction of a branch rail line include:

- A period of brief, intense elevation in project-related employment followed by an abrupt decrease in associated employment opportunities as construction workers move to other projects.
- Transition of workers associated with construction of the branch rail line to other construction work in Nevada (if these workers did not move into positions associated with rail line operations).
- Population increases and then subsequent net declines as related employment requirements decline.
- A very slightly slower rate of growth in the level of employment as the economy moved from construction of a rail line to operations.
- A rise in the economic measures of real disposable income, Gross Regional Product, and State and local government expenditures during construction. Gross Regional Product, which is extremely sensitive to employment fluctuations, would be affected. Real disposable income, which consists of all forms of income including transfer payments (primarily unemployment compensation), is less responsive to changes in employment.

DOE performed detailed analyses for the corridors of the five branch rail line implementing alternatives. The results of these analyses, driven by the length of the corridor, are representative of the potential variations (options and alternates) of each corridor as listed in Appendix J, Section J.3.1.2. The lengths of the variations for each corridor are similar to the original corridor, as listed in Section 6.3.2.2.

Section 6.3.2.2 describes socioeconomic impacts for each particular implementing alternative.

6.3.2.1.8 *Common Rail Noise and Vibration Impacts*

Construction. For the most part, the rail corridors would pass through areas that are remote from human habitation. Thus, the potential for noise impacts from the construction of a branch rail line would be limited. Nonetheless, some people could be affected, including persons living near the corridor, using nearby recreational areas, seeking quiet and solitude at nearby locations, or living in nearby small rural communities. Noise from railroad construction could affect wild animals that inhabit the areas through which the corridors pass. However, construction noise would be transient and its sources would be gone when construction was complete.

Estimated noise levels for railroad construction would range from 62 to 74 A-weighted decibels (dBA) within 150 meters (500 feet) of the noise source and from 54 to 67 dBA at 600 meters (2,000 feet) (DIRS 104892-ICC 1992, p. 4-97). At distances up to 6 kilometers (3.7 miles), sound could exceed levels required for solitude (20 dBA). Trips to borrow and spoil areas would be another source of noise. Rail line construction would occur primarily during daylight hours, so nighttime noise would not be an issue unless there was a need to use accelerated construction to meet schedule constraints. There is a possibility that the construction of some structures associated with the rail line would occur during hours not in the normal workday, but the frequency and associated noise levels would be unlikely to be great. Because construction would progress along a corridor, construction noise would be transient in nearby communities. Noise levels could approach generally accepted limits for some residential and commercial areas, but this would be for a brief time. Because there are no permanent residences, construction noise would not be an issue for activities inside the boundaries of the Nellis Air Force Range, the Nevada Test Site, or the land withdrawal area that DOE analyzed for the proposed repository. Occupational Health and Safety Administration regulations (29 CFR) establish hearing protection standards for workers. DOE would meet those standards for workers involved in building a branch rail line.

Ground vibration from the construction of engineered structures, such as bridge foundations, could be discernible in some areas. The areas that would be affected would be determined by engineering surveys and detailed alignment analyses conducted after the selection of a corridor.

Operations. About five rail round trips (10 one-way trips) of spent nuclear fuel, high-level radioactive waste, or other material would occur weekly for 24 years on the branch rail line during normal operations. Noise from these trains could affect the same group of individuals and animals as construction of the rail line. To estimate noise impacts, the analysis assumed that trains would travel as fast as 80 kilometers (50 miles) an hour. The equivalent-continuous (average) sound level at 2,000 meters (6,600 feet) from a train consisting of two locomotives and 10 cars traveling at 80 kilometers an hour would be 51 dBA (DIRS 148155-Hanson, Saurenman, and Towers 1998, pp. 1 to 8), which is near the nighttime standard for residential areas (50 dBA). The estimated noise level at 200 meters (660 feet) would be 62 dBA (DIRS 148155-Hanson, Saurenman, and Towers 1998, pp. 1 to 8). This is slightly higher than the daytime standard for residential communities. In isolated regions, few people would be affected. In addition, trains traveling through or near communities would normally operate at reduced speed, so their noise levels would be lower. The combination of sparse population in the vicinity of the rail corridors, remoteness of a branch rail line from populated areas, substantial diminishing of the level of train noise with distance, and infrequent passage of trains indicates that the potential for noise impacts would be low for any of the corridors. In addition, in areas where a branch rail line or a variation could pass near a community, DOE would limit operating speeds to the extent necessary to ensure safety and noise levels below those listed in accepted noise standards.

DOE is not aware of traditional cultural properties or other areas along the rail corridors or variations where noise from trains or construction of a branch rail line could interfere with conditions necessary for meditation by, or religious ceremonies of, Native Americans. Similarly, there are no known ruins or other culturally sensitive structures that ground vibration could affect.

Ground vibration from trains using a branch rail line to Yucca Mountain would have the potential to cause impacts (see Section 6.3). Sections 6.3.2.2.1 to 6.3.2.2.5 discuss specific issues related to vibration for each corridor.

DIRS 155939-Nelson (2000, Appendix F, Table 1, p. 4) discussed vibration criteria for protection of historic buildings and presented data on vibration (peak particle velocity) for unit coal trains. Unit coal trains can consist of many loaded coal cars (usually more than 100) and multiple locomotives. The data (DIRS 155939-Nelson 2000, Appendix F) show that at distances of 100 meters (330 feet) from the track and for track not specially selected to reduce vibration, vibration from trains traveling at 56 kilometers (35 miles) per hour would be below the criterion for preservation of historic structures. Vibration from trains traveling on track that does not have rolling-mill undulation falls below the criterion at distances as close as 10 meters (33 feet) and speeds as high as 80 kilometers (50 miles) per hour. For shorter trains, such as those that would transport railcars with spent nuclear fuel and high-level radioactive waste to Yucca Mountain, attenuation of vibration with distance would be greater than that reported (DIRS 155939-Nelson 2000, p. 23).

6.3.2.1.9 *Common Rail Aesthetics Impacts*

Construction. The greatest impact on visual resources from the construction of a branch rail line would be the presence of workers, camps, vehicles, large earth-moving equipment, laydown yards, borrow areas, and dust generation. These activities, however, would have a limited duration (about 40 to 46 months depending on the corridor). The potential rail corridors and variations have all been affected to some extent by human activity, as described in Chapter 3, Section 3.2.2.1.1. Construction would progress along the selected corridor from its starting point to the proposed repository. Only a small portion of the overall construction time would be spent in one place; the exception to this would be places where major structures, such as bridges, would be built. In general, an individual construction camp would be active only for part of the construction period; after the completion of construction in an area, the camp would close.

Dust generation would be controlled by implementing best management practices such as misting or spraying disturbed areas. Construction activities would not exceed the criteria in the Bureau of Land Management Visual Resource Management guidelines (DIRS 101505-BLM 1986, all) with the exception of the Wilson Pass Option of the Jean Corridor. If the rail line crossed Class II lands, more stringent management and reclamation requirements would be necessary to retain as much as possible of the existing character of the landscape. The short duration of branch rail line construction activities, combined with the use of best management practices, would help mitigate the impacts of activities that could exceed the management requirements for Class II lands. Visual impacts to scenic quality Class C lands on the Nevada Test Site would not occur because of the remoteness and inaccessibility of the location. Impacts to the viewshed during construction of a branch rail line would include loss of vegetation in the areas surrounding the rail line. This loss could result in a long-term loss of viewshed along the corridor.

Operations. During proposed repository operations, visual impacts would be due to the existence of the branch rail line, access road, and borrow pits in the landscape and the passage of trains to and from the repository. The passage of 10 trains a week (5 coming and 5 returning) would have a small impact, temporarily attracting the attention of the casual observer. In limited access recreational areas classified as primitive or semiprimitive, the passage of these trains would have a greater impact. In addition, the noise generated by the trains would attract attention to them, temporarily increasing their impact on the scenic quality of the landscape. There would be no aesthetic impacts unique to any of the rail implementing alternatives.

6.3.2.1.10 *Common Rail Utilities, Energy, and Materials Impacts*

Construction. Because all five corridors would pass through sparsely populated areas with little access to support services, portable generators would provide electricity to support construction activities. The total fossil-fuel consumption in Nevada was about 3.8 billion liters (1 billion gallons) in 1996 (DIRS 148094-BTS 1997, Table MF-21). Fuel consumption estimates for construction of a branch rail line indicate low impacts compared to the statewide consumption of petroleum fuel.

Steel for rails and concrete, principally for rail ties, bridges, and drainage structures, and rock for ballast would be the primary materials consumed in the construction of a branch rail line. DOE would buy precast concrete railbed ties, culverts, bridge beams, and overpass components from a number of suppliers. Actual onsite pouring of concrete [less than 120,000 metric tons (132,000 tons)] would account for less than 30 percent of the total mass of concrete, which would be less than 0.5 percent of the concrete use in Nevada in 1998 (DIRS 104926-Bauhaus 1998, all). Because DOE would buy precast concrete components from suppliers and because onsite concrete construction would involve a small amount of material for some abutments, the localized impact of concrete use in rail corridor construction would not be great for any of the corridors.

Because sources for rails and railroad ties are well established in the southwest and nationally, none of the quantities of materials required for constructing a rail line in Nevada would create demand or supply impacts in southern Nevada (DIRS 105033-Zocher 1998, all).

Impacts on utilities, energy, and materials differ among the implementing alternatives, as described in Section 6.3.2.2.

Operations. Impacts to utilities, energy, and materials from the operation of a branch rail line in Nevada would be small. Use of fossil fuel for train operations would be small. Chapter 10 discusses fossil fuel used for rail operations. No impacts would be unique to any of the branch rail line implementing alternatives.

6.3.2.1.11 *Common Rail Waste Management Impacts*

Construction. The construction of a branch rail line would require materials such as rail ties and steel; rock ballast; concrete; oils, lubricants, and coolants for heavy machinery; and compressed gasses (hazardous materials) for welding. DOE could order construction materials in correct sizes and number, resulting in very small amounts of waste (DIRS 152540-Hoganson 2000, all). In addition, much of the residual material from rail line construction would be saved for reuse or recycled. Construction of the branch rail line, service road, and access roads would require land clearing. Excavated soil would be used for fill as much as possible. Vegetation would be disposed of in accordance with State of Nevada requirements. Construction in any of the five corridors would result in small amounts of waste that would require disposal. Wastes would consist of construction debris such as banding material that bound ties and rails (DIRS 152540-Hoganson 2000, all) that DOE would dispose of in permitted landfills. Hazardous waste such as lubricants and solvents, if any, would be shipped to a permitted hazardous waste treatment and disposal facility.

Sanitary solid waste and sanitary sewage from flush toilets and showers would be generated in construction camps. The estimated peak annual generation would be 940 metric tons (1,000 tons) of sanitary solid waste and 37 million liters (10 million gallons) of sanitary sewage. The solid waste would be disposed of in a permitted landfill. Nevada has 24 operating municipal solid waste landfills (DIRS 155564-NDEP 2001, p. 1) with a combined capacity to accept 11,000 metric tons (12,000 tons) of waste per day (DIRS 155563-NDEP 2001, landfill inventory). In 2000, approximately 3.5 million metric tons (3.9 million tons) of sanitary solid waste were disposed of in Nevada (DIRS 155565-NDEP 2001, Section 2.1), so the construction camp waste would add approximately 0.03 percent. The sanitary sewage could be treated in an onsite treatment facility for which the contractor had obtained the necessary permits. In addition, a commercial vendor would provide portable restroom facilities where needed and manage the sanitary sewage.

All waste would be handled in accordance with applicable environmental, occupational safety, and public health and safety requirements to minimize the possibility of adverse impacts from construction to plants, animals, soils, water resources, and air quality inside or outside the region of influence.

Operations. The use of a branch rail line in any of the five corridors would result in wastes from the maintenance of rolling and stationary railroad equipment and track. These wastes would include lubricants from equipment and machinery; solvents, paint, and other hazardous material; sanitary waste; and industrial wastes typical for operations of a small branch rail line. Operational wastes would include those generated during equipment maintenance. Maintenance of each locomotive would generate about 420 liters (110 gallons) of waste oil (DIRS 155559-Best 2001, all) that would be reclaimed rather than disposed. Worn or damaged parts and components would be repaired or remanufactured and returned to use. Routine maintenance of newer model rail cars would consist primarily of inspection and replacement of worn or damaged components. However, these cars are designed to last many years. In addition, sealed components would minimize the need for lubrication (DIRS 155558-Hoganson 2001, all). Routine maintenance and repair of rolling equipment would be performed at maintenance and repair yards operated by an independent contractor. Wastes from the maintenance of fixed rail line equipment such as signals and rail crossings would be minimal (DIRS 155560-Hoganson 2001, all). Crossties, ballast, rails, and bridges would be unlikely to require replacement before 2033 (DIRS 152540-Hoganson 2000, all). The management and disposition of operational wastes would comply with applicable environmental, occupational safety, and public health and safety regulations. Wastes would be handled such that adverse impacts from rail corridor operation waste to plants, animals, soils, air quality, and water resources along the right-of-way would be minimized.

There would be no waste management impacts unique to any of the branch rail line implementing alternatives.

6.3.2.2 Impacts Specific to Individual Rail Corridor Implementing Alternatives

6.3.2.2.1 *Caliente Corridor Implementing Alternative*

The Caliente Corridor would originate at an existing siding to the Union Pacific mainline railroad at Eccles siding near Caliente, Nevada (Figure 6-15). The corridor travels west, traversing the Chief, North Pahroc, Golden Gate, and Kawich Mountain Ranges. The Caliente and Carlin corridors converge near the northwest boundary of the Nellis Air Force Range. Past this point, the corridors are identical. The Caliente Corridor is 513 kilometers (319 miles) long from the Union Pacific line connection to the Yucca Mountain site. Variations of the route range from 512 to 553 kilometers (318 to 344 miles). Figure 6-15 shows this corridor, along with possible variations identified by engineering studies (DIRS 131242-CRWMS M&O 1997, all). The corridor variations provide flexibility in addressing engineering, land-use, or environmental resource issues that could arise in a future, more detailed survey along the corridor. This section addresses impacts that would occur along the corridor shown in Figure 6-15. With the exception of the differences identified in Appendix J, Section J.3.1.2, the impacts would be generally the same among the possible variations.

Construction of a branch rail line in the Caliente corridor would require approximately 46 months. Construction would take place simultaneously at multiple locations along the corridor. An estimated six construction camps at roughly equal distances along the corridor would provide temporary living accommodations for construction workers and construction support facilities. A train would take about

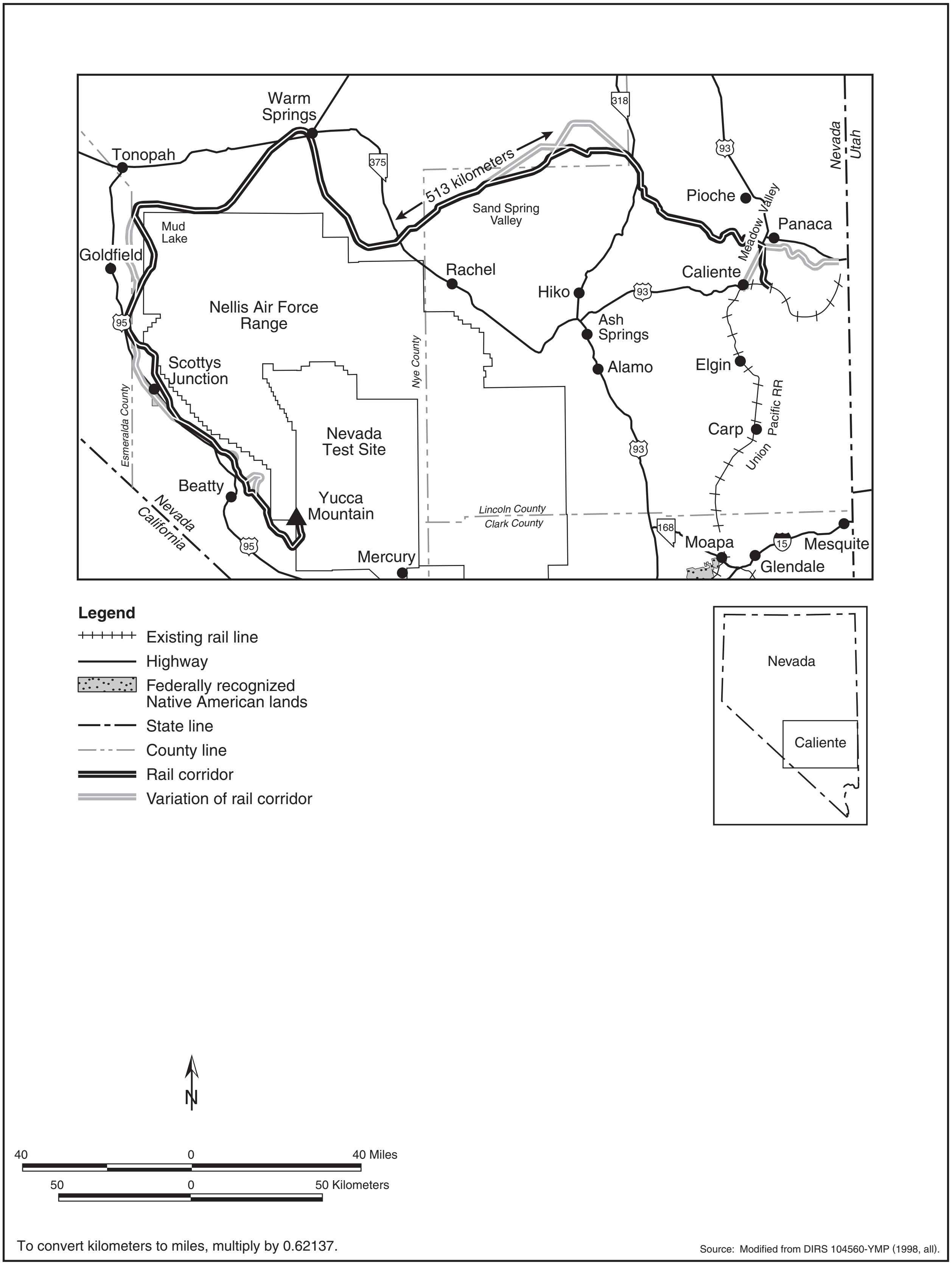


Figure 6-15. Caliente Corridor.

10 hours to travel from the junction with the Union Pacific mainline to a Yucca Mountain Repository on a Caliente branch rail line (DIRS 101214-CRWMS M&O 1996, Volume 1, Section 4, Branch Line Operations Plan). The estimated life-cycle cost of constructing and operating a branch rail line in the Caliente Corridor would be $880 million in 2001 dollars.

The following sections address impacts that would occur to land use; biological resources and soils; cultural resources; hydrology including surface water and groundwater; occupational and public health and safety; socioeconomics; noise and vibration; and utilities, energy, and materials. Impacts that would occur to air quality, aesthetics, and waste management would be the same as those described in Section 6.3.2.1 and are not repeated here. Section 6.3.4 discusses the potential for transportation activities to cause environmental justice impacts in Nevada.

6.3.2.2.1.1 Caliente Rail Land Use and Ownership

Table 6-23 summarizes the amount of land required for the Caliente corridor, its ownership, and the estimated amount of land that would be disturbed, as well as ranges for the variations. Table 6-24 summarizes the amount of land required for the Caliente Corridor variations and its ownership.

Table 6-23. Land use in the Caliente Corridor.[a]

Factor	Corridor (percent)	Range due to variations
Corridor length (kilometers)[b]	513	512 - 553
Land area in 400-meter[c]*-wide corridor (square kilometers)*[d]	205 (100)	205 - 221
Land ownership in 400-meter-wide corridor (square kilometers)		
Bureau of Land Management	188 (92)[e]	188 - 216
Air Force	10.9 (5.3)	0 - 10.9
DOE	4.6 (2.3)	4.6 - 4.6
Private	0.9 (0.46)	0.9 - 2.5
Tribal	None	0 - 1.6
Land area in 60-meter[f] right-of-way *(square kilometers)*	30.7	30.7 - 33.2
Disturbed land (square kilometers)		
Inside 60-meter right-of-way	14.7	14.7 - 15.9
Outside 60-meter right-of-way	3.6	3.6 - 3.9

a. Source: DIRS 155549-Skorska (2001, all).
b. To convert kilometers to miles, multiply by 0.62137.
c. 400 meters = about 0.25 mile.
d. To convert square kilometers to acres, multiply by 247.1.
e. Percentages do not total 100 due to rounding.
f. 60 meters = 200 feet.

Construction. This corridor crosses several telephone, pipeline, highway, and power line rights-of-way, areas designated as available for sale or transfer, and oil and gas leases (DIRS 104993-CRWMS M&O 1999, Table 2, p. 10 and Table 3, p. 11). The corridor crosses Bureau of Land Management lands used for recreation, nine grazing allotments (Bennett Springs, Highland Peak, Black Canyon, Reveille, Ralston, Stone Cabin, Montezuma, Magruder Mountain, and Razorback), and seven wild horse and burro herd management areas. Section 6.3.2.1 discusses impacts common to all rail implementing alternatives. This section discusses impacts unique to a branch rail line in the Caliente Corridor.

The corridor passes just east of the Weepah Spring Wilderness Study Area and just north of the Worthington Mountains Wilderness Study Area. It also passes near the Kawich Wilderness Study Area and crosses a portion of the South Reveille Wilderness Study Area. The Kawich Area in the Kawich Range and the South Reveille Area in the Reveille Range and along Reveille Valley form a narrow corridor through which the Caliente Corridor passes. A portion of the Kawich and South Reveille Ranges have Bureau of Land Management Class II aesthetic classifications. Construction activities in the vicinity of a Wilderness Study Area could affect the experience in the wilderness environment. As indicated in Appendix J, Section J.3.1.2, the White River Alternate would be more distant from the Area. This route

Table 6-24. Possible variations in the Caliente Corridor.[a]

Variation	Length (kilometers)[b]	Land area in variation (square kilometers)[c]	Ownership in variation [square kilometers (percent)] Bureau of Land Management	Private	Tribal
Eccles Option	16.7	6.7	6.3 (95)	0.4 (5)	--[e]
Caliente Option	17.2	6.9	6.2 (90)	0.69 (10)	--
Crestline Option	37.8	15.1	14.5 (95.9)	0.6 (4.1)	--
White River Alternate	47.5	19	18.98 (99.9)	0.02 (< 0.1)	--
Garden Valley Alternate	37.7	15.1	15.1 (100)	0	--
Mud Lake Alternate	(f)	(f)	(f)	--	--
Goldfield Alternate	45.8	18.3	17.6 (96)	0.7 (4)	--
Bonnie Claire Alternate	42.2[g]	16.9	14.8 (87.4)	0.5 (3)	1.6 (10)
Oasis Valley Alternate	5.57	2.2	2.0 (89)	0.2 (11)	--
Beatty Wash Alternate	23.0	9.2	9.2 (100)	0	--

a. Source: DIRS 155549-Skorska (2001, all).
b. To convert kilometers to miles, multiply by 0.62137.
c. To convert square kilometers to acres, multiply by 247.1.
d. NA = not applicable; length included in total corridor distance.
e. -- = none.
f. Mud Lake Alternate on Bureau of Land Management land included in other variations.
g. Includes 4.5 kilometers (2.8 miles) through Timbisha Shoshone Trust Lands.

variation would cross a small additional amount of private property. Impacts of constructing a branch rail line between the Kawich and South Reveille Areas would be less if DOE implemented Bureau of Land Management Class II requirements for building in these areas.

The Bonnie Claire Alternate of this corridor, in the vicinity of Scottys Junction, would pass through and bisect an 11.3-square-kilometer (2,800-acre) portion of the Timbisha Shoshone Trust Lands (DIRS 155930-Reynolds, Pool, and Abbey 2001, all). Bisecting this parcel could limit its proposed use, which includes tourism and housing for the Timbisha Shoshone.

If the Bonnie Claire Alternate was not used, the corridor would encroach on the Nellis Air Force Range (also known as the Nevada Test and Training Range). In addition, the Mud Lake Alternative would encroach on the Range. The U.S. Air Force has noted the potential for safety risks of crossing lands that are hazard areas and encompass weapons safety footprints for live weapons deployment. For each of the sections that could enter the Nellis Range, DOE has identified a corridor variation that would avoid the potential land-use conflict (see Appendix J, Section J.3.1.2).

If DOE decided to build and operate a branch rail line in the Caliente Corridor, it would consult with the Bureau of Land Management, the U.S. Air Force, and other affected agencies and Native American governments to help ensure that it avoided or mitigated potential land-use conflicts associated with the alignment of a right-of-way. Because the Military Lands Withdrawal Act of 1999 (Public Law 106-65, 113 Stat. 885) withdraws and reserves the Nellis Air Force Range for use by the Secretary of the Air Force, the Secretary would need to concur with a decision to build and operate a branch rail line through any part of the Range.

The presence of a rail line could influence future development and land use along the railroad in the communities of Beatty, Caliente, Goldfield, Scottys Junction, and Warm Springs (that is, zoning and land use might differ depending on the presence or absence of a railroad), as well as a potential Timbisha Shoshone community at their Trust Lands parcel near Scottys Junction.

Operations. DOE expects operations along the Caliente Corridor to cause fewer impacts than the construction phase of the project.

The operation of a rail line in the vicinity of the Weepah Spring Wilderness Study Area could affect the experience of visitors to the Area. The White River Alternate would not pass near the Area, as indicated in Appendix J, Section J.3.1.2. The proximity of an operational rail line to the Kawich and South Reveille Wilderness Study Areas probably would affect these areas by drawing attention to the rail line during operational or maintenance activities.

The operation of a rail line along the Bonnie Claire Alternate could limit or potentially enhance economic development in the Timbisha Shoshone Trust Lands parcel and could limit the use for housing by restricting access. The alternate currently passes almost directly through the center of the parcel.

6.3.2.2.1.2 Caliente Rail Hydrology

Surface Water

Surface-water resources along the Caliente Corridor are discussed in Chapter 3, Section 3.2.2.1.3, and summarized in Table 6-25. The table indicates that the number of surface-water resources in the vicinity of the corridor could vary if DOE used corridor variations, but only by small numbers. In fact, the Caliente Corridor has the smallest number of nearby water resources with the possible exception of the Oasis Valley Alternate. This alternate would be farther away from one identified spring such that the spring's location would no longer be within the 400-meter (0.25-mile)-wide corridor. The spring would, however, still be within 1 kilometer (0.6 mile) of the corridor. As discussed in Section 6.3.2.1, impacts during construction or operations from the possible spread of construction-related materials by precipitation or intermittent runoff events, releases to surface water, or the alteration of natural drainage patterns or runoff rates that could affect downgradient resources would be unlikely.

Table 6-25. Surface-water resources along Caliente Corridor and its variations.[a,b,c]

	Resources in 400-meter[d] corridor			Resources outside corridor within 1 kilometer[e]		
Description	Spring	Stream/ riparian area	Reservoir	Spring	Stream/ riparian area	Reservoir
Caliente Corridor	1	3	--[f]	5	--	--
with Crestline Option	1	3	--	7	--	--
with Caliente Option	2	3	--	7	--	--
with Goldfield Alternate	1	3	--	7	--	--
with Oasis Valley Alternate	--	3	--	6	--	--

a. Source: reduced from tables in Chapter 3, Section 3.2.2.1.3.
b. Resources are the number of locations; that is, a general location with more than one spring was counted as one water resource.
c. Resources shown for variations are for the entire corridor with only the identified changes. Variations not listed (White River Alternate, Garden Valley Alternate, Mud Lake Alternate, Bonnie Claire Alternate, and Beatty Wash Alternate) are not associated with any identified water resources, nor would they avoid any resources along the corridor.
d. 400 meters = about 1,300 feet.
e. 1 kilometer = 0.6 mile.
f. -- = none.

Flood zones identified along the Caliente Corridor and its variations are listed in Table 6-26. As indicated in the table's footnotes, the 100-year flood zone information is summarized from Federal Emergency Management Agency maps, which provide coverage for about half the corridor's length. Based on the available data, this corridor would cross nine different 100-year flood zones or flood zone groups between its beginning near Caliente and when it enters the Nevada Test Site. None of the variations would change this number notably. Use of the Crestline Option would decrease the number of flood zones by one, and the other applicable variations would leave the number unchanged or increased by one. As indicated in Section 6.3.2.1, impacts associated with altering drainage patterns or changing erosion and sedimentation rates or locations would be minor and localized.

Table 6-26. 100-year flood zones crossed by the Caliente Corridor and its variations.[a,b]

Rail corridor portion	Crossing distance (kilometers)	Flood zone feature(s)	Avoided by variation (Yes or No)
Eccles Siding to Meadow Valley	0.2[c]	Clover Creek (intermittent)	Y-1
	0.8[c]	Meadow Valley Wash (wet)	Y-1, 2
Meadow Valley Wash to Sand Spring Valley	0.5[c]	White River (intermittent)	N
Sand Spring Valley to Mud Lake	1.1	Unnamed drainage gully on FEMA map in East/Central Nye County; crosses twice (dry)	N
	17.5	Mud Lake basin and drainage tributaries (normally dry)	N
Mud Lake to Yucca Mountain	0.8	Unnamed washes to the north and south of Ralston (dry)	N
	0.3	Tolicha Wash (intermittent)	Y-7
	1.1	Amargosa River (wet in sections, intermittent in others)	Y-8
	0.1	Beatty Wash (intermittent)	Y-9
Variations			
1. Crestline Option	0.8	Crosses Meadow Valley Wash (wet)	
2. Caliente Option	0.8	Crosses Meadow Valley Wash (wet)	
	0.2	Crosses Clover Creek (intermittent)	
	0.9	Crosses Meadow Valley Wash (wet) three times, rail corridor runs adjacent to Meadow Valley Wash. Passes in and out of flood zone	
3. White River Alternative	None	Located to the north of the corridor	
4. Garden Valley Alternative	None	Located to the north of the corridor	
5. Mud Lake Alternative	3.1	Crosses a larger amount of the Mud Lake flood zone (3.1 kilometers vs. 1.8 kilometers for the corridor)	
6. Goldfield Alternative	None	Located to west of corridor.	
7. Bonnie Claire Alternative	1.3	Crosses an unnamed wash south of Ralston	
	0.7	Crosses Tolicha Wash (intermittent)	
8. Oasis Valley Alternative	1.0	Crosses Amargosa River (wet in segments, intermittent in others)	
9. Beatty Wash Alternative	0.1	Crosses Beatty Wash (intermittent)	

a. Areas where natural floodwater movement might be altered and where erosion and sedimentation rates and locations could change. Sources:
   1. Federal Emergency Management Agency Flood Insurance Rate Maps for Lincoln and Nye Counties, Nevada.
   2. DIRS 154961-CRWMS M&O (1998, all).

b. About 47 percent of the Caliente Corridor is not available on maps, due primarily to limited coverage in Lincoln County, the Nellis Air Force Range, and the Nevada Test Site.

c. Projected from limited data. The specific area is not covered by Federal Emergency Management Agency maps; values were extrapolated from the closest maps.

d. Certain 100-year flood zones can be avoided by alternate corridor segments. These are identified with a "Y" (yes) and a number representing the specific variations from the second half of the table that avoids the specific flood zone. The same flood zone could be crossed by the corridor and its variations at different locations. In such cases, the feature will be marked "Avoided" for the corridor, but will appear again for the variation.

Groundwater

Construction. The water used during construction would come largely from groundwater resources. The annual demands would be a fraction of the perennial yields of most producing aquifers (see Chapter 3, Section 3.2.2.1.3, for estimated perennial yields for the hydrographic areas over which a branch rail line in the Caliente Corridor would pass).

HYDROGRAPHIC AREA

The Nevada Division of Water Planning has divided the State into groundwater basins, or *hydrographic areas*. These areas are used in the management of groundwater resources. Hydrographic areas are generally based on topographic divides (that is, they typically comprise a valley, a portion of a valley, or a terminal basin), but can also be based on administrative divisions. The State classifies a hydrographic area as a Designated Groundwater Basin when the permitted water rights (or appropriations) approach or exceed the area's estimated perennial yield and the water resources are depleted or require additional administration. The Division of Water Planning's home page *http://www.state.nv.us/cnr/ndwp* identifies the hydrographic areas that are Designated Groundwater Basins.

The amount of water needed for the construction of a branch rail line in the Caliente Corridor for soil compaction, dust control, and workforce use would be about 880,000 cubic meters (710 acre-feet) (DIRS 104914-DOE 1998, all). For planning purposes, DOE assumed that this water would come from 64 wells installed along the rail corridor. The average amount of water withdrawn from each well would be approximately 14,000 cubic meters (11 acre-feet). Most (91 percent) of the water need would be for use in the compaction of fill material. The estimate of fill quantities needed for construction would change if variations were used. However, no single variation applicable to the Caliente Corridor would increase the estimate of water demand by more than 5 percent.

Chapter 3, Section 3.2.2.1.3, discusses the hydrographic areas over which the Caliente rail corridor would pass, their perennial yields, and whether the State of Nevada considers each a Designated Groundwater Basin. If the hydrographic area is a Designated Groundwater Basin, permitted groundwater rights approach or exceed the estimated perennial yield, depleting water resources or requiring additional administration. Table 6-27 summarizes the status of the hydrographic areas associated with the Caliente Corridor and the approximate portion of the corridor that would pass over Designated Groundwater Basins. Use of corridor variations would make no notable difference in the portion of the corridor that crosses Designated Groundwater Basins.

Table 6-27. Hydrographic areas along Caliente Corridor and its variations.

		Designated Groundwater Basins	
Corridor description	Hydrographic areas	Number	Percent of corridor length
Caliente Corridor	17	6	40
Variations[a]	16 to 18	6	40

a. Several of the variations would involve small changes in the hydrographic areas crossed or the crossing distances. However, all (Caliente Option, Crestline Option, White River Alternate, Garden Valley Alternate, Mud Lake Alternate, Goldfield Alternate, Bonnie Claire Alternate, and Oasis Valley Alternate) would cross the same six Designated Groundwater Basins which, rounded to the nearest 10 percent, would represent the same portion of the total corridor.

The withdrawal of about 14,000 cubic meters (11 acre-feet) a year from a well would have little impact on the hydrographic areas associated with the Caliente Corridor based on their perennial yields (Chapter 3, Section 3.2.2.1.3). However, the installation of 64 wells along the corridor would mean that many hydrographic areas would have multiple wells. As Table 6-27 indicates, about 40 percent of the corridor length would be over Designated Groundwater Basins, which the Nevada State Engineer's office watches carefully for groundwater depletion. This does not mean that DOE could not obtain water appropriations in these areas; the State Engineer would have the authority to approve such appropriations. Because the DOE requests would be for a short-term construction action, the State Engineer would have even more discretion. Rather than spacing the wells evenly along the corridor, DOE could use locations that would make maximum use of groundwater areas that are not Designated Groundwater Basins. Another option would be to lease temporary water rights from individuals along the corridor. Obtaining a water appropriation from the State Engineer for short-term construction use or using an approved allocation should ensure that groundwater resources would not be adversely affected.

As an alternative, DOE could transport water by truck to meet construction needs. The construction of a branch rail line in the Caliente Corridor would require about 47,000 tanker-truck loads of water or about eight truckloads each day for each work camp along the corridor. Again, water obtained from permitted sources, which would be within allocations determined by the Nevada State Engineer, would not affect groundwater resources.

Operations. Operations along a completed rail line would have little impact on groundwater resources. There would be no changes in recharge beyond those at the completion of construction.

6.3.2.2.1.3 Caliente Rail Biological Resources and Soils

Construction. The construction of a rail line in the Caliente Corridor including possible variations (see Appendix J, Section J.3.1.2) would disturb approximately 18 square kilometers (4,500 acres) of land (Table 6-23). The analysis assumed that the types of land cover in disturbed areas outside the corridor would be the same as that within the corridor. Areas within 12 of the land-cover types identified in the State of Nevada (DIRS 104593-CRWMS 1999, pp. C1 to C5) would be affected by construction of a branch rail line in the Caliente Corridor (see Table 6-28). The greatest amounts of disturbance would occur in the salt desert scrub and sagebrush land-cover types, but would involve less than 0.001 percent of the existing area of Nevada in those land-cover types. The 0.001 fraction that would be disturbed for each cover type would be very small. The disturbance would have no discernible impact on the availability of habitat in any cover type. Although some alignment variations could lead to a small increase in the total amount of land disturbed, the portion of the corridor, including its variations, in each land-cover type would be similar to the unvaried corridor.

Table 6-28. Maximum area disturbed (square kilometers)[a] in each land-cover type for the Caliente Corridor.[b,c]

Land-cover type	Percent of corridor length	Area disturbed	Area in Nevada	Percent disturbed
Agriculture	0.3	0.05	5,200	0.001
Blackbrush	0.1	0.02	9,900	<0.001
Creosote-bursage	6.0	1.1	15,000	0.007
Grassland	0.2	0.04	2,800	0.001
Greasewood	0.4	0.07	9,500	<0.001
Hopsage	2.0	0.36	630	0.06
Juniper	0.3	0.05	1,400	0.003
Mojave mixed scrub	4.5	0.82	5,600	0.01
Pinyon-juniper	0.0	0	15,000	0.00
Playa	0.1	0.02	7,000	<0.001
Sagebrush	30	5.4	67,000	0.01
Sagebrush/grassland	0.3	0.05	52,000	<0.001
Salt desert scrub	56	10	58,000	0.02
Urban		ND[d]	2,400	ND

a. To convert square kilometers to acres, multiply by 247.1.
b. Based on the proportion of the route in each land-cover type; percent disturbed was based on the variation with the greatest disturbance within a particular land-cover type. Percentages add to more than 100 because maximum values were used.
c. Source: DIRS 104593-CRWMS M&O (1999, Appendix D).
d. ND = not determined.

About 50 kilometers (31 miles) along the southern end of the corridor, including variations in this area, is in desert tortoise habitat. Assuming that a maximum of about 0.06 square kilometer (15 acres) of land would be disturbed for each kilometer of rail line in this area, construction activities would disturb as much as 3 square kilometers (740 acres) of desert tortoise habitat, none of which is classified as critical habitat. In addition, these activities could kill individual desert tortoises; however, their abundance is low in this area (DIRS 103281-Karl 1981, pp. 76 to 92; DIRS 101914-Rautenstrauch and O'Farrell 1998, pp. 407 to 411) so losses would be few. Relocation of tortoises along the route prior to construction would minimize losses of individuals. The presence of the branch rail line could interfere with the normal movements of individual tortoises. DOE would consult with the Fish and Wildlife Service (under Section 7 of the Endangered Species Act) regarding this species if it selected this corridor and would implement all terms and conditions required by the Fish and Wildlife Service.

Although the southwestern willow flycatcher occurs near some portions of the corridor, including the variations, there is no suitable habitat of dense riparian vegetation for this Federally endangered species in the Caliente Corridor (DIRS 152511-Brocoum 2000, pp. A-9 to A-13).

The only other Federally listed species near the corridor and its variations is the Railroad Valley springfish (Federally threatened), which has been found about 3 kilometers (1.9 miles) north of the corridor, and it should not be affected. The Eccles, Crestline, or Caliente variations of this corridor cross a portion of the Meadow Valley Wash, which is habitat for an unnamed subspecies of the Meadow Valley Wash speckled dace and the Meadow Valley Wash desert sucker, both of which are sensitive species. Construction of a branch rail line in this corridor could temporarily affect populations of these fish by increasing the sediment load in the wash during construction. Four other special status species occur along this corridor and its variations but could be avoided during land-clearing activities (DIRS 104593-CRWMS M&O 1999, p. 3-23) and, therefore, would not be affected.

One population of the Nevada sanddune beardtongue, a sensitive plant species, occurs within the 400-meter (0.25-mile) corridor and could be directly or indirectly affected by land-clearing activities and construction of the branch rail line. The location of this population would be identified through surveys before these activities, and disturbance of the plants would be avoided if possible.

In addition, there are six known populations of four sensitive plant species outside the 400-meter (0.25-mile) corridor, but within 5 kilometers (3 miles). Several additional populations of these four species and one other sensitive plant species occur within 5 kilometers of one or more of the variations listed in Appendix J, Section J.3.1.2. One population of one species (Needle Mountain milkvetch) outside the 400-meter corridor would be avoided by the Caliente Option and three populations of this species would be avoided by the Crestline Option. DOE anticipates that corridor activities would not affect these populations because land disturbance would not extend to these areas and changes would be unlikely in the aquatic or soil environment as a result of construction or the long-term presence of a railroad.

The rail corridor crosses 15 areas designated as game habitat and 8 areas designated as wild horse and burro management areas (see Chapter 3, Section 3.2.2.1.4). Construction activities would reduce habitat in these areas. Depending on the variation, several other designated game habitat areas could be within 5 kilometers (3 miles) of a rail line in the Caliente Corridor. Wild horses, burros, and game animals near these areas during construction would be disturbed and their migration routes could be disrupted.

At least one group of springs and three stream or riparian areas are within the 400-meter (0.25-mile) corridor including its variations (Table 6-26). Although formal delineations have not been made, these springs and riparian areas may be jurisdictional wetlands or other waters of the United States. Construction could increase sedimentation in these areas. In addition, the corridor, including its variations, crosses a number of ephemeral streams that could be classified as waters of the United States. DOE would work with the U.S. Army Corps of Engineers to minimize impacts to these areas and would obtain individual or regional permits if necessary. DOE anticipates some changes to local drainage along a branch rail line, and would design the rail line to accommodate existing drainage patterns.

In addition, as many as 25 known springs and riparian areas occur outside of the 400-meter (0.25-mile) corridor, but within 5 kilometers (3 miles) of the corridor, including its variations. Eight known populations of three sensitive animal species are associated with these aquatic resources. DOE anticipates that corridor activities would not affect these populations because land disturbance would not extend to these areas and these areas would not be disturbed during the construction or long-term presence of a railroad.

Construction activities would temporarily disturb about 18 square kilometers (4,500 acres) of soils in and adjacent to the corridor. The impacts to soils of disturbing 18 square kilometers along the 513-kilometer-(319-mile)-long corridor would be transitory and small. However, several soil characteristics could influence construction activities and the amount of disturbed area. Soils susceptible to water or wind erosion occur along much of the corridor and its variations as do soils exhibiting relatively high shrink-swell characteristics (see Chapter 3, Section 3.2.2.1.4). Disturbance of erodible soils could lead to increased silt loads in water courses or increased soil transport by winds. Erosion control during construction and revegetation, or other means of soil stabilization after construction, would minimize these concerns. The presence of soils with poor (that is, high) shrink-swell characteristics could influence the amount of disturbed area if soils from outside areas were brought in for replacement or mixing with the native soil.

As stated in Chapter 3, Section 3.2.2.1.4, the variations identified for the Caliente Corridor could avoid some biological resources, as listed in Table 6-29.

Table 6-29. Biological resources avoided by Caliente Corridor variations.[a]

Alignment variation resource	Occurrence of resource: For unvaried segment of corridor – In corridor[b]	Within 5 km[c]	Occurrence avoided by variation – In corridor	Within 5 km
Caliente variation[d]				
Sensitive species–Needle Mountain milkvetch	0	3	0	1
Springs or groups of springs	4	24	0	1
Crestline variation				
Sensitive species–Needle Mountain milkvetch	0	3	0	3
Springs or groups of springs	4	24	0	4

a. The only corridor variations listed are those that would result in the avoidance of biological resources along the corridor.
b. In the corridor [or springs within 400 meters (0.25-mile)], but avoided by the corridor variation.
c. Within 5 kilometers (3 miles) of the corridor, but more than 5 kilometers from the corridor variation.
d. Appendix J, Section J.3.1.2, lists variations for the Caliente Corridor implementing alternative.

6.3.2.2.1.4 Caliente Rail Cultural Resources

Construction. Site file searches for the Caliente Corridor and its variations (see Appendix J, Section J.3.1.2) yielded 97 recorded archaeological sites, 36 of which are either potentially eligible or have not been fully evaluated for the *National Register of Historic Places* (Chapter 3, Section 3.2.2.1.5). If DOE selected this corridor, it would conduct on-the-ground surveys of the 400-meter (0.25-mile)-wide corridor before and during construction activities to determine if construction of a branch rail line in this corridor could disturb sites or crush artifacts at archaeologic and historic sites.

At various points along the route, the Caliente Corridor and its variations intersect physical vestiges of historic railroads, including the Caliente and Pioche, Tonopah and Goldfield, and Las Vegas and Tonopah Railroads. The corridor also intersects the 1849 Jayhawker Emigrant Trail in Lincoln and Nye Counties. It passes close to three *National Register of Historic Places* properties—the Union Pacific Depot in Caliente (Caliente variation), the Tonopah Multiple Resource Area, and the Goldfield Historic District (Goldfield variation). However, the corridor and its variations passes these resources at a distance where adverse impacts would be unlikely. Southeast of Tonopah, the route passes through the former bombing range of the World War II Tonopah Army Air Station. Features related to that activity would be likely to occur on the landscape, but precise identification would not be possible until the completion of a cultural resource field inventory.

No areas or properties of interest to Native Americans have been identified and field-verified in the Caliente Corridor or its variations. However, the proposed right-of-way is near several potentially significant areas, including the Wild Horse and Willow Springs vicinity east of Goldfield (Caliente Corridor and Goldfield variation), the Oasis Valley north of Beatty (Oasis Valley Alternate), Crater Flat, and the Busted Butte-Fortymile Canyon area near the repository (DIRS 155826-Nickens and Hartwell 2001, all). In addition, the Bonnie Claire Alternate of the Carlin and Caliente Corridors passes through the land at Scottys Junction recently transferred to the Timbisha Shoshone Tribe.

Operations. As stated in Section 6.3.2.1, additional impacts to these resources during the operation of the branch rail line would be unlikely.

6.3.2.2.1.5 Caliente Rail Occupational and Public Health and Safety

Construction. Industrial safety impacts on workers from the construction and use of the Caliente branch rail line would be small. The analysis evaluated the potential for impacts in terms of total reportable cases of injury and illness, lost workday cases, and fatality risks to workers and the public from construction and operation activities. Table 6-30 lists these results.

The analysis also evaluated traffic fatality impacts that would occur during the moving of equipment and materials for construction, worker commutes to and from construction sites, and transport of water to construction sites if wells were not available. Table 6-31 lists these results.

Operations. Incident-free radiological impacts would occur during the routine transportation of spent nuclear fuel and high-level radioactive waste in the Caliente Corridor. Table 6-32 lists the incident-free impacts, which include transportation along the Caliente Corridor and along railways in Nevada leading to a Caliente branch line. The table includes the impacts of 1,079 legal-weight truck shipments from commercial sites that do not have the capability to load rail casks while operational.

Table 6-30. Impacts to workers from industrial hazards during rail construction and operations in the Caliente Corridor.

Group and industrial hazard category	Construction[a]	Operations[b]
Involved workers		
Total recordable cases[c]	110	95
Lost workday cases	55	52
Fatalities	0.2	0.3
Noninvolved workers		
Total recordable cases	6.7	5.4
Lost workday cases	2.5	2.0
Fatalities	0.01	0.01
Totals[d]		
Total recordable cases	120	100
Lost workday cases	57	54
Fatalities	0.2	0.3

a. Totals for 46 months of construction.
b. Totals for 24 years of operations.
c. Total recordable cases includes injury and illness.
d. Totals might differ from sums due to rounding.

6.3.2.2.1.6 Caliente Rail Socioeconomics

The following paragraphs discuss potential socioeconomic impacts associated with the construction and operation of a branch rail line in the Caliente Corridor.

Construction. The length of the Caliente Corridor—513 kilometers (319 miles)—is the most important factor for determining the number of workers that would be required. To construct a branch rail line in this corridor would require workers laboring approximately 2.8 million hours or 1,410 worker years during the 46-month construction period (DIRS 154822-CRWMS M&O 1998, all). The route would require six construction camps to house workers temporarily.

Employment

DOE anticipates that total (direct and indirect) employment in the region of influence attributable to the Caliente branch rail line would peak in the first year of construction, 2006, at about 842 workers. Clark County would gain about 664 workers and Nye County would gain 101. The increase in employment

Table 6-31. Estimated number of fatalities from construction material delivery vehicles and construction and operations worker commuting traffic for the Caliente Corridor.

Activity	Kilometers[a]	Traffic fatalities	Emissions fatalities
Construction			
Material delivery vehicles	20,000,000	0.3	0.04
Commuting workers	85,000,000	0.8	0.11
Subtotals	*100,000,000*	*1.2*	*0.15*
Operations			
Commuting workers	68,000,000	0.7	0.09
Totals	***170,000,000***	***1.9***	***0.24***

a. To convert kilometers to miles, multiply by 0.62137.

Table 6-32. Health impacts from incident-free Nevada transportation for the Caliente Corridor implementing alternative.[a]

Category	Legal-weight truck shipments	Rail shipments	Totals[b]
Involved workers			
Collective dose (person-rem)	38	810	850
Estimated LCFs[c]	0.02	0.32	0.34
Public			
Collective dose (person-rem)	7	12	19
Estimated LCFs	0.003	0.01	0.01
Estimated vehicle emission-related fatalities	0.0016	0.0056	0.0071

a. Impacts are totals for 24 years.
b. Totals might differ from sums of values due to rounding.
c. LCF = latent cancer fatality.

represents less than 1 percent of the baseline employment in Clark and Nye Counties. The additional 77 workers would represent a 3.2-percent increase of the employment baseline for Lincoln County. Changes in the Lincoln County level of employment would be the result primarily of indirect employment created by the presence of the transient construction workers.

Employment of Caliente Corridor construction workers and some indirect support workers would end in 2009. As a result, the projected total growth (2009 to 2010) of 15,240 jobs in the region of influence would be reduced by 827. The expected addition of 14,886 jobs in Clark County would be reduced by 788, and the expected growth of 330 jobs in Nye County would be reduced by 53. The expected growth of 24 jobs in Lincoln County would be supplemented by a net gain of 14. DOE anticipates that project-related workers not moving to Caliente Corridor operational jobs would be absorbed in other work in the State. These changes in employment would represent less than 1 percent of the applicable baselines.

Population

Population increases in the region of influence associated with the construction of a Caliente branch rail line would peak in 2009 at about 822 persons. About 728 individuals would live in Clark County, 64 in Nye County, and 29 in Lincoln County. The estimated population increase attributable to the rail construction in the three counties is less than 1 percent of each county's population baseline. Because the change in population in relation to the population baseline would be small and transient, impacts to housing or schools would be unlikely.

Economic Measures

The expected peak annual changes in economic measures in the region of influence attributable to the Caliente Corridor would be increases of $24.3 million in real disposable income in 2009; $40.3 million in Gross Regional Product in 2007; and $2.8 million in State and local expenditures in the final year of construction, 2009. Clark County would generate more than 94 percent of the Gross Regional Product, experience more than 94 percent of the increase in real disposable income, and absorb more than 83 percent of the increase in expenditures by State and local governments. Nye and Lincoln Counties would share the remainder. (All dollar values in this section are in 2001 dollars unless otherwise stated).

Construction-related impacts to real disposable income, Gross Regional Product, and State and local government expenditures would be a less-than-1 percent increase for Clark and Nye Counties. Although the estimated increase in Lincoln County's Gross Regional Product would be about 1.6 percent of the baseline in 2006, increases in Gross Regional Product during the other years of construction. The increases in real disposable income would be about 1.2 percent in 2006 and less than 1 percent in other years. Increases in State and local government expenditures during all years of construction would be less than 1 percent from the County's baselines.

Transition and Operations Period. Employment opportunities associated with the construction of the branch rail line would probably dissipate at the project's completion and reduce the region's employment by 46 positions annually for 4 years. However, Nye County would have a net gain of 6 jobs and Lincoln County would have a net gain of 56 employment positions above the baseline. The additional job gain in Lincoln County represents a 2.2-percent average increase over the employment baseline in the referenced 4-year period. The employment gain in Nye County would be less than 1 percent. Constructing and operating a Caliente branch rail line would contribute to the growth in residential population throughout the transition period and to the employment base after 2013.

Employment and Population

Estimated annual direct employment for Caliente branch rail line operations would be 47 workers. Increased employment in the three counties comprising the region of influence would average about 79 jobs annually over the 24-year operations period (2010 to 2033). DOE anticipates that, on average, approximately 56 of these individuals would work in Lincoln County, representing a 2.1-percent increase of the employment baseline for Lincoln County. Increases in Clark and Nye Counties would be less than 1 percent of the baselines. In the region of influence, the average change to population because of a Caliente branch rail line would be about 351 additional people. DOE anticipates that approximately 95 individuals probably would choose to live in Lincoln County, an addition of 2 percent of the population baseline. The impact due to increases in population in Clark and Nye Counties would be much less than 1 percent of the applicable baseline. Because the impacts to population and employment would be so small in Clark and Nye Counties, impacts to housing or schools would be unlikely in either county. As discussed in Chapter 3, Section 3.1.7.4, Lincoln County has a low occupancy rate for housing; therefore, the impact to Lincoln County's housing market would be very small despite a 2-percent increase in population. The annual impact to schools in Lincoln County resulting from the increase in population would average about 22 additional pupils.

Economic Measures

Within the three-county region of influence, the estimated greatest annual increase above the baseline in real disposable income attributable to operations would occur in 2033, the last year of operation, and would be $6.2 million; annual increases during the 24 years of operation would average $5.2 million. Increases in Gross Regional Product would average about $4.5 million. As discussed above, the region would experience a slower growth in employment for several years. In the case of the Caliente branch rail line, on average during operation, changes in real disposable income would exceed changes in Gross Regional Product. Annual State and local government expenditures during operations, averaging $1.8 million, would be much lower than those reported above for construction. Impacts to real disposable income, Gross Regional Product, and State and local government expenditures from the operation of a Caliente branch rail line would be less than 1 percent of the baseline for Clark and Nye Counties.

In Lincoln County, the impact of the change to the baseline in real disposable personal income and in government spending would be to increase levels by averages of 1.6 percent and 2.4 percent, respectively, for the duration of operations. Changes to the Gross Regional Product would average 2.6 percent above the baseline. Workers associated with operation of a Caliente rail line would purchase many goods and services in Lincoln County. These dollars would continue to circulate largely in the area, creating a positive economic impact.

DOE performed detailed analyses for the Caliente Corridor branch rail line implementing alternative. The results of the analyses are representative of the potential variations listed in Appendix J, Section J.3.1.2.

In addition, DOE analyzed a sensitivity case that assumed all Lincoln County socioeconomic impacts would occur only in the City of Caliente. Under this assumption, City population would rise by 3 percent (29 persons) during construction and by 6.9 (67 persons) percent during operations. Employment would rise by about 5 percent during construction and about 7.2 percent during operations.

6.3.2.2.1.7 Caliente Rail Noise and Vibration

Over most of its length, the Caliente Corridor passes through undeveloped land managed by the Bureau of Land Management, where human inhabitants are mostly isolated ranchers and persons involved with outdoor recreation. The Towns of Caliente and Panaca are near or along the eastern end of the corridor. The Caliente variation for connecting to the Union Pacific Railroad mainline would follow an old railroad bed through the center of the Town of Caliente. Corridor variations (see Appendix J, Section J.3.1.2) with the exception of Caliente are close enough to the rail line for noise impacts to be significant (Table 6-33). Noise levels in Caliente would not differ much from existing background noise levels associated with normal rail traffic through the community. Noise levels associated with waste shipments would occur at most three times a day and probably not within any given hour. Where the branch rail line passed through Caliente, train speed would be reduced for safety and noise levels would be minimized. There is one traffic crossing in the Town of Caliente where traffic could be delayed. Adverse community response to the added rail noise would be unlikely because of the long-term presence of railroad traffic in Caliente, the short trains associated with transport of waste shipments, and the low frequency of rail trips to and from the Yucca Mountain site.

Table 6-33. Estimated propagation of noise from the operation of waste transport train using two locomotives in communities near the Caliente Corridor.

Community	Distance (kilometers)[a]	Estimated noise (dBA)[b]
Caliente Option		
Caliente	0	>90 at 15 meters[c]
Panaca	6[d]	26.0
Crestline Option		
Panaca	4.5[d]	26.3
Eccles Option		
Caliente	6.5[d]	<26[e]
Tonopah	12[d]	<26
Goldfield	6.2[d]	<26
Beatty	9.6[d]	<26
Beatty Wash Alternate		
Beatty	11.2[d]	<26
Amargosa Valley	9.6[d]	<26

a. To convert kilometers to miles, multiply by 0.62137.
b. Estimated values do not include noise loss due to interactions with the ground that could account for decreases in estimated noise levels from 10 to 20 dBA at 100 meters (330 feet) from the tracks.
c. 15 meters = 49 feet.
d. Noise estimates at distances greater than 2 kilometers (1.2 miles) have large uncertainty.
e. At these distances, the A-weighted sound pressure level is dominated by lower frequencies (lower than 63 Hertz) and would not be distinguishable from normal background levels of noise.

In addition to passing near communities, the Caliente Corridor, including its variations, would pass through areas with farms and ranches. Some rural residences could fall within the region of influence for noise. The corridor, except the Caliente Option that would pass through Caliente, would be at least 4 kilometers (2.5 miles) from every town or community along its length. The noise from trains in these remote communities would not exceed daytime or nighttime noise standards for residential areas (60 or 50 dBA, respectively). Similarly, there would be little potential for noise impacts from construction and operation activities.

The estimated population residing within 2 kilometers (1.2 miles) of the Caliente Corridor in 2035 would be about 350 persons.

The Caliente Corridor would pass within 1.9 kilometers (1.2 miles) of the border of the Timbisha Shoshone Homeland. The Bonnie Claire Alternate would pass through 4.1 kilometers (2.5 miles) of the Timbisha Shoshone Trust Lands parcel near the intersection of State Route 267 and U.S. Highway 95. Noise levels from trains passing through the homeland would be 90 dBA at 15 meters (49 feet) for the Bonnie Claire Alternate. At the closest point of the Caliente Corridor, the estimated noise levels would be 44 dBA. Ethnographic responses to noise have not been determined (see Section 6.1.2.5). However, the noise levels associated with the Caliente Corridor would be lower than those associated with the Bonnie Claire Alternate.

Vibration. With the exception of the historic railroad station in Caliente, which is near the existing Union Pacific Railroad mainline, a branch rail line in the Caliente Corridor would be distant from historic structures, ruins, and buildings. Therefore, vibration impacts would be unlikely except at the Caliente Rail Station. However, the vibrations added by the relatively few trains carrying spent nuclear fuel and high-level radioactive waste at slow speeds through Caliente would not add appreciably to the vibrations to which the station is exposed from commercial train traffic. The small number of trips (two per day) and the small train size would result in low levels of rail-induced ground vibration.

6.3.2.2.1.8 Caliente Rail Utilities, Energy, and Materials

Table 6-34 lists the use of fossil fuel and other materials for the construction of a Caliente branch rail line.

Table 6-34. Construction utilities, energy, and materials for a Caliente branch rail line.

Length (kilometers)[a]	Diesel fuel use (million liters)[b]	Gasoline use (thousand liters)	Steel (thousand metric tons)[c]	Concrete (thousand metric tons)[c]
510 - 550	42 - 45	870 - 940	72 - 78	420 - 460

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. To convert metric tons to tons, multiply by 1.1023.

6.3.2.2.2 *Carlin Corridor Implementing Alternative*

The Carlin corridor originates at the Union Pacific main line railroad near Beowawe in north-central Nevada. Figure 6-16 shows this corridor along with possible variations identified by engineering studies (DIRS 131242-CRWMS M&O 1997, all). The variations provide flexibility in addressing engineering, land-use, or environmental resource issues that could arise in a future, more detailed survey along the corridor. This section addresses impacts that would occur along the corridor shown in Figure 6-16. With the exception of the differences identified in Appendix J, Section J.3.1.2, the impacts would be generally the same among the possible variations.

The corridor travels south through Crescent, Grass, and Big Smoky Valleys, passing west of the City of Tonopah and east of the City of Goldfield. The corridor then travels south following and periodically

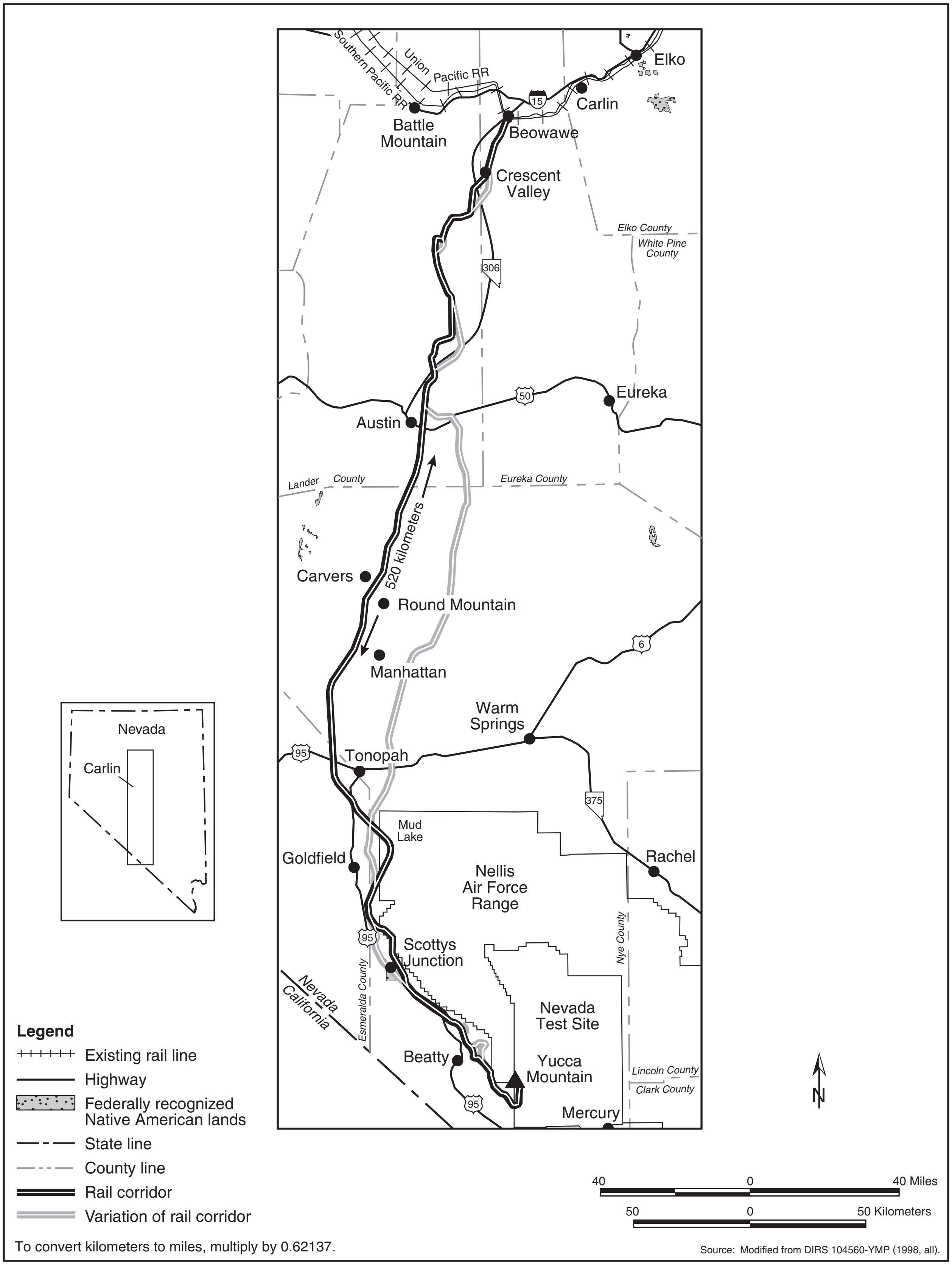


Figure 6-16. Carlin Corridor.

crossing the western boundary of the Nellis Air Force Range, passing through Oasis Valley and Beatty Wash. It travels along Fortymile Wash to the proposed repository location. The Carlin Corridor is about 520 kilometers (323 miles) long from its link with the Union Pacific line to the Yucca Mountain site. Variations of the route range from 513 to 544 kilometers (319 to 338 miles).

The construction of a branch rail line in the Carlin Corridor would require approximately 46 months. Construction would take place simultaneously at multiple locations along the corridor. DOE would establish an estimated five construction camps at roughly equal distances along the corridor. These camps would provide temporary living accommodations for construction workers and construction support facilities. A train would take about 9 hours to travel from the junction with the Union Pacific mainline to the Yucca Mountain site on a Carlin branch rail line (DIRS 101214-CRWMS M&O 1996, Volume 1, Section 4, Branch Line Operations Plan). The estimated life-cycle cost to construct and operate a branch rail line in the Carlin Corridor would be about $821 million in 2001 dollars.

The following sections address impacts that would occur to land use; biological resources and soils; cultural resources; hydrology including surface water and groundwater; occupational and public health and safety; socioeconomics; noise and vibration; and utilities, energy, and materials. Impacts that would occur to air quality, aesthetics, and waste management would be the same as those common impacts discussed in Section 6.3.2.1 and are, therefore, not repeated here. Section 6.3.4 discusses the potential for transportation activities to cause environmental justice impacts in Nevada.

6.3.2.2.2.1 Carlin Rail Land Use and Ownership

Table 6-35 summarizes the amount of land required for the Carlin Corridor, its ownership, and the estimated amount of land that would be disturbed, as well as ranges for the variations. Table 6-36 summarizes the amount of land required for the Carlin Corridor variations and its ownership.

Table 6-35. Land use in the Carlin Corridor.[a]

Factor	Corridor (percent)	Range due to variations
Corridor length (kilometers)[b]	520	513 - 544
Land area in 400-meter[c]*-wide corridor (square kilometers)*[d]	208 (100)	205 - 218
Land ownership in 400-meter-wide corridor (square kilometers)		
Bureau of Land Management	179 (86)	177 - 201
Air Force	11 (5.2)	0 - 10.9
DOE	4.6 (2.2)	4.6 - 4.6
Private	14 (6.7)	7.3 - 15.2
Tribal	None	0 - 1.6
Land area in 60-meter[e] *right-of-way (square kilometers)*	31.2	30.8 - 32.6
Disturbed land (square kilometers)		
Inside 60-meter right-of-way	17	16.7 - 17.7
Outside 60-meter right-of-way	2.3	2.2 - 2.4

a. Source: DIRS 155549-Skorska (2001, all).
b. To convert kilometers to miles, multiply by 0.62137.
c. 400 meters = about 0.25 mile.
d. To convert square kilometers to acres, multiply by 247.1.
e. 60 meters = 200 feet.

Construction. The Carlin Corridor crosses various telephone, highway, and utility rights-of-way. The corridor also crosses a Desert Land Entry withdrawal, 12 Bureau of Land Management grazing allotments (Carico Lake, Dry Creek, Grass Valley, Kingston, Simpson Park, Wildcat Canyon, Big Smoky, Francisco, San Antone, Montezuma, Magruder Mountain, and Razorback) and six wild horse and burro herd management areas. Other areas crossed by the corridor include the Bates Mountain antelope release area,

Table 6-36. Possible variations in the Carlin Corridor.[a]

Variation	Length (kilometers)[b]	Land area in variation (square kilometers)[c]	Ownership in variation [square kilometers (percent)]		
			Bureau of Land Management	Private	Tribal
Crescent Valley Alternate	24.4	9.8	7.2 (77)	2.3 (23)	--[d]
Wood Spring Canyon Alternate	11.7	4.7	4.7 (100)	0	--
Rye Patch Alternate	35.3	14.1	14.1 (100)	0	--
Steiner Creek Alternate	41.5	16.6	16.6 (100)	0	--
Big Smoky Valley Option	197	78.9	78.9 (100)	0	--
Monitor Valley Option	225.4	90.2	90.2 (100)	0	--
Mud Lake Alternate	(e)	(e)	(e)	--	--
Goldfield Alternate	43.1	18.3	17.6 (96)	0.7 (4)	--
Bonnie Claire Alternate	42.2[f]	16.9	14.3 (87)[g]	0.4 (3)	1.6 (10)
Oasis Valley Alternate	5.57	2.2	2.0 (89)	0.2 (11)	--
Beatty Wash Alternate	23.0	9.2	9.2 (100)	0	--

a. Source: DIRS 155549-Skorska (2001, all).
b. To convert kilometers to miles, multiply by 0.62137.
c. To convert square kilometers to acres, multiply by 247.1.
d. -- = none.
e. Mud Lake Alternate included in other variations.
f. Includes 4.5 kilometers (2.8 miles) of Timbisha Shoshone Tribal land.
g. Includes 18 square kilometers (450 acres) of Timbisha Shoshone Tribal land.

three designated riparian habitats, and the Simpson Park habitat management area. It does not cross any oil or gas exploration and extraction areas. However, Bureau of Land Management lands are open to mineral and oil and gas exploration. The corridor passes through Bureau lands that are used for recreation, but does not pass through state or national forests. It does pass through areas adjacent to such facilities.

The construction of a branch rail line through Desert Land Entry withdrawal areas could affect the economic development of such properties by removing a portion of the lands and transferring it to DOE. If such property was divided, continued access to the property would be required. Construction impacts would be similar to those discussed in Section 6.3.2.1. As with the Caliente Corridor, the Bonnie Claire Alternate in the vicinity of Scottys Junction would pass through and divide an 11.3-square-kilometer (2,800-acre) portion of the Timbisha Shoshone Trust Lands (DIRS 155930-Reynolds, Pool, and Abbey 2001, all). The construction of a branch rail line in the Bonnie Claire Alternate could limit or potentially enhance economic development in the Timbisha Shoshone Trust Lands parcel and could limit the use for housing by restricting access.

The withdrawal of property from the private sector and the transfer of public lands would occur under existing government protocols. The withdrawal of lands from private ownership could impact area city and county economic expansion through the loss of tax revenues.

There are current mining operations in the Cortez Mine area of Crescent Valley. These operations, along with the historic mines in the area, make continued mining of this area a probability. Although the Carlin Corridor crosses no current leases, access through the valley could be affected for a short period during the construction of a branch rail line. The corridor also passes through areas of potential future exploration. The Crescent Valley Alternate (see Appendix J, Section J.3.1.2) passes just west of the Cortez Gold Mines. This corridor variation crosses an existing road right-of-way leading from the Gold Acres Mine to the ore mills at the Cortez mining facility. It also crosses a proposed pipeline right-of-way from the Cortez Gold Mine to the Dean Ranch. This pipeline would deliver water to the ranch (DIRS 155095-BLM 2000, all). Construction activities could deny or interfere with access to the milling facility at Cortez. The pipeline right-of-way would have to be modified to include DOE or the property rights would have to be transferred to DOE. Impacts to the road right-of-way would be slight if access to the area's mining facilities was maintained. The pipeline could require modifications to allow the building of a rail line through the right-of-way.

The Steiner Creek Alternate passes close to and might encroach on the Simpson Park Wilderness Study Area. Construction activities in the vicinity of a wilderness study area could affect the experience in the wilderness environment.

One segment of the Carlin Corridor and the Mud Lake Alternate would encroach on the Nellis Air Force Range (also known as the Nevada Test and Training Range). The U.S. Air Force has noted the potential for safety risks of crossing lands that are hazard areas and encompass weapons safety footprints for live weapons deployment. For each of the sections that could enter the Nellis Range, DOE has identified a corridor variation that would avoid the potential land-use conflict (see Appendix J, Section J.3.1.2). If DOE decided to build and operate a branch rail line in the Carlin Corridor, it would consult with the Bureau of Land Management, the U.S. Air Force, and other affected agencies and Native American governments to help ensure that it avoided or mitigated potential land-use conflicts associated with alignment of a right-of-way. Because the Military Lands Withdrawal Act of 1999 (Public Law 106-65, 113 Stat. 885) withdraws and reserves the Nellis Air Force Range for use by the Secretary of the Air Force, the Secretary would need to concur with a decision to build and operate a branch rail line through any part of the Range.

The presence of a rail line could influence future development and land use along the railroad in the communities of Austin, Beatty, Carver's Station, Cortez, Crescent Valley, Manhattan, Round Mountain, Scottys Junction, and Tonopah (that is, zoning and land use might differ depending on the presence or absence of a railroad), as well as a potential Timbisha Shoshone community at their Trust Lands parcel near Scottys Junction.

Operations. DOE expects operations along the Carlin Corridor, including its variations, to cause fewer impacts than the construction phase of the project, even though the branch rail line would pass through areas of private ownership and a number of other unique areas (see Table 6-2 in Section 6.1.2.1). The presence of an operational rail line near the Simpson Park Wilderness Study area could detract from the wilderness experience. The operation of a branch rail line along the Bonnie Claire Alternate could limit economic development in the Timbisha Shoshone parcel and could limit the parcel's use for reservation housing by restricting access. The Bonnie Claire Alternate passes almost directly through the center of the parcel.

6.3.2.2.2.2 Carlin Rail Hydrology

Surface Water

Surface-water resources along the Carlin Corridor and its variations are discussed in Chapter 3, Section 3.2.2, and summarized in Table 6-37. As listed in the table, the number of surface-water resources in the vicinity of the corridor would change by small numbers if DOE used any of the variations. Both the Rye Patch and Oasis Valley Alternates would involve one less surface-water resource in the 400-meter (0.25-mile)-wide corridor, and a corresponding increase in the number of resources outside the corridor but within 1 kilometer (0.6 mile). As discussed in Section 6.3.2.1, impacts during construction or operations from the possible spread of construction-related materials by precipitation or intermittent runoff events, releases to surface waters, and the alteration of natural drainage patterns or runoff rates that could affect downgradient resources would be unlikely.

Flood zones identified along the Carlin Corridor and its variations are listed in Table 6-38. The Federal Emergency Management Agency maps from which DOE derived the flood zone information provided coverage for about 83 percent of the corridor's length. This corridor would cross 11 different 100-year

Table 6-37. Surface water resources along Carlin Corridor and its variations.[a,b,c]

Corridor description	Resources in 400-meter[d] corridor			Resources outside corridor within 1 kilometer[e]		
	Spring	Stream/ riparian area	Reservoir	Spring	Stream/ riparian area	Reservoir
Carlin Corridor	1	5	--[f]	10	2	1
with Wood Spring Canyon Alternate	1	5	--	8	2	1
with Steiner Creek Alternate	1	5	--	10	1	1
with Rye Patch Alternate	1	4	--	11	3	1
with Monitor Valley Option	1	5	--	9	2	--
with Gold Field Alternate	1	5	--	12	2	1
with Oasis Valley Alternate	--	5	--	11	2	1

a. Source: Reduced from tables in Chapter 3, Section 3.2.2.1.3.
b. Resources are the number of locations; that is, a general location with more than one spring was counted as one water resource.
c. Resources shown for variations are for the entire corridor with only the identified variation changed. Variations not shown (that is, Crescent Valley Alternate, Mud Lake Alternate, Bonnie Claire Alternate, and Beatty Wash Alternate) are neither associated with any identified water resources, nor would they avoid any resources along the Corridor.
d. 400 meters = about 1,300 feet.
e. 1 kilometer = 0.6 mile.
f. -- = none.

flood zones or flood-zone groups before entering the Nevada Test Site. Eight of the 10 variations would change the number of flood zones crossed but, with one exception, changes would be up or down by one. The exception would be the Monitor Valley Option, which would increase the number of 100-year flood zones crossed by four. As indicated in Section 6.3.2.1, impacts associated with altering drainage patterns or changing erosion and sedimentation rates or locations would be minor and localized.

Groundwater

Construction. The water used during construction would come largely from groundwater resources. The annual demands would be a fraction of the perennial yields of most producing aquifers (see Chapter 3, Section 3.2.2.1.3, for estimated perennial yields for the hydrographic areas over which the potential branch rail line in the Carlin Corridor passes).

The estimated amount of water needed for the construction of a branch rail line in the Carlin Corridor for soil compaction, dust control, and workforce use would be about 810,000 cubic meters (660 acre-feet) (DIRS 104914-DOE 1998, all). For planning purposes, DOE assumed that this water would come from 67 groundwater wells installed along the rail corridor. The average amount of water withdrawn from each well would be approximately 12,000 cubic meters (10 acre-feet). Most (91 percent) of the water would be used for compaction of fill material. The estimate of fill quantities for construction varies according to the variation. However, no single variation applicable to the Carlin Corridor would increase the estimate of water demand by more than 5 percent.

Chapter 3, Section 3.2.2.1.3, discusses the hydrographic areas over which the corridor would pass, their perennial yields, and whether the State of Nevada considers each a Designated Groundwater Basin. If the hydrographic area is a Designated Groundwater Basin, permitted groundwater rights approach or exceed the estimated perennial yield, depleting water resources or requiring additional administration.
Table 6-39 summarizes the status of the hydrographic areas associated with the Carlin Corridor, and the approximate portion of the corridor that passes over Designated Groundwater Basins. As listed in Table 6-39, use of the Monitor Valley Option would result in an approximate 20-percent decrease in the portion of the corridor crossing Designated Groundwater Basins.

Table 6-38. 100-year flood zones crossed by the Carlin Corridor and its variations.[a,b]

Corridor portion	Crossing distance (kilometers)[c]	Flood zone feature(s)	Avoided by variation[d] (Yes or No)
Beowawe to Austin	4.0	Flood zone associated with Coyote Creek drainage (dry)	N
	1.6	Indian Creek (dry) and unnamed wash to the south	Y-1
	0.9	Unnamed Callaghan tributary, Skull and Callaghan Creeks (intermittent)	Y-3
	0.1	Rye Patch Canyon Creek (intermittent)	Y-4, 5
	1.4	Simpson Park Canyon Creek (intermittent) and Canyon Creek drainage (intermittent)	Y-4, 5
	1.4	Canyon Creek and Canyon Creek drainage (intermittent)	Y-5
Austin to Mud Lake	0.3	Peavine Creek tributary (intermittent)	Y-5
Mud Lake to Yucca Mountain	0.8	Unnamed washes to the north and south of Ralston (dry)	N
	0.3	Tolicha Wash	Y-8
	1.1	Amargosa River (wet in sections, intermittent in others)	Y-9
	0.1	Beatty Wash	Y-10
Variations			
1. Crescent Valley Alternate	2.0	Crosses Indian Creek (intermittent)	
	3.2	Crosses an unnamed wash to the south	
2. Wood Spring Alternate	None	Located to the west of the primary rail corridor	
3. Steiner Creek Alternate	4.9	Crosses Callaghan and Canyon Creeks (intermittent)	
4. Rye Patch Alternate	1.4	Crosses Canyon Creek and Canyon Creek drainage (intermittent)	
5. Monitor Valley Option[d]	0.6	Crosses Mosquito Creek (intermittent)	
	0.5	Crosses Corcoran Creek and Meadow Creek (intermittent)	
	1.5	Crosses Meadow Creek drainage; (dry)	
	0.6	Crosses Hunts Canyon Creek (intermittent)	
	0.2	Crosses Willow Creek (intermittent)	
	2.0	Crosses drainage areas approaching Mud Lake (dry)	
	5.7	Crosses drainage areas approaching Mud Lake (dry)	
	4.8	Crosses Mud Lake drainage (dry)	
6. Mud Lake Alternate	3.1	Crosses the Mud Lake flood zone	
7. Goldfield Alternate	None	Located to west of rail Corridor	
8. Bonnie Claire Alternate	1.3	Crosses an unnamed wash south of Ralston	
	0.7	Crosses Tolicha Wash (intermittent)	
9. Oasis Valley Alternate	1.0	Crosses Amargosa River (wet in segments, intermittent in others)	
10. Beatty Wash Alternate	0.1	Crosses Beatty Wash (intermittent)	

a. Areas where natural floodwater movement might be altered and where erosion and sedimentation rates and locations could change. Sources:
   1. Federal Emergency Management Agency Flood Insurance Rate Maps for Eureka, Lander, and Nye Counties, Nevada.
   2. DIRS 154961-CRWMS M&O (1998, all).

b. About 17 percent of the primary Carlin Corridor is not available on Federal Emergency Management Agency maps, due primarily to limited coverage in Esmeralda County, the Nellis Air Force Range, and the Nevada Test Site.

c. To convert kilometers to miles, multiply by 0.62137.

d. Certain 100-year flood zones can be avoided by alternate corridor segments. These are identified with a "Y" (yes) and a number representing the specific alternate(s) from the second half of the table that avoids the specific flood zone. The same flood zone might be crossed by the corridor and its variations at different locations. In such cases, the feature will be marked "Avoided" for the corridor, but will appear again for the variations.

Table 6-39. Hydrographic areas along Carlin Corridor and its variations.[a]

Corridor description	Hydrographic areas	Designated Groundwater Basins Number	Designated Groundwater Basins Percent of corridor length
Carlin Corridor	12	6	70
with Monitor Valley Option	12	5	50
with Goldfield Alternate	11	5	70
other alternates[a]	12	6	70

a. Crescent Valley, Wood Spring, Rye Patch, Steiner Creek, Mud Lake, Bonnie Claire, Oasis Valley, and Beatty Wash.

The withdrawal of about 12,000 cubic meters (10 acre-feet) a year from a well would have little impact on the hydrographic areas associated with the corridor based on their perennial yields (Chapter 3, Section 3.2.2.1.3). However, the installation of 67 wells along the corridor would mean that many hydrographic areas would have multiple wells. As indicated in Table 6-39, about 70 percent of the length of the Carlin Corridor is in Designated Groundwater Basins, which the Nevada State Engineer's office watches carefully for groundwater depletion. This does not mean that DOE could not obtain water appropriations in these areas; the State Engineer would have the authority to approve such appropriations. Because the DOE requests would be for a short-term construction action, the State Engineer would have even more discretion. Rather than spacing the wells evenly along the corridor, DOE could use locations that would make maximum use of groundwater areas that are not Designated Groundwater Basins. With such a large portion of the corridor over these basins, however, this would mean that DOE would truck water for long distances. Another option would be to lease temporary water rights from individuals along the corridor. Obtaining a water appropriation from the State Engineer for short-term construction use or using an approved allocation would ensure no adverse effects to groundwater resources. Use of the Monitor Valley Option would decrease the portion of the corridor crossing Designated Groundwater Basins and possibly increase DOE's flexibility in obtaining water along the corridor.

As an alternative, DOE could transport water by truck to meet construction needs. The construction of a branch rail line in the Carlin Corridor would require about 43,000 tanker-truck loads of water or about 9 truckloads each day for each work camp along the corridor. Again, water obtained from permitted sources, which would be within allocations determined by the Nevada State Engineer, would not affect groundwater resources.

Operations. Operations along a completed rail line would have little impact on groundwater resources. Possible changes in recharge, if any, would be the same as those at the completion of construction.

6.3.2.2.2.3 Carlin Rail Biological Resources and Soils

Construction. The construction of a rail line in the Carlin Corridor, including its variations, would disturb approximately 19 square kilometers (4,700 acres) (Table 6-35). Areas in nine of the land-cover types identified in Nevada (DIRS 104593-CRWMS M&O 1999, pp. C1 to C5) would be affected by the construction of a branch rail line in the Carlin Corridor (Table 6-40). The analysis assumed that the types of land cover in disturbed areas outside the corridor would be the same as that within the corridor. The EIS analysis assumed that the composition of land-cover types in these areas would be similar to the cover types in the corridor. The greatest amounts of disturbance would occur in the sagebrush, salt-desert scrub, and creosote bursage land-cover types for both the Big Smoky Valley Option and Monitor Valley Option, but would involve far less than 0.01 percent of the existing area in those land-cover types. The fraction disturbed for each cover type would be very small. The disturbance would have no discernible impact on the availability of habitat for plants or animals associated with any cover type. Although some alignment variations could lead to a small increase in the total amount of land disturbed, the portion of the corridor, including its variations, in each land-cover type would be similar to that in the unvaried corridor.

About 50 kilometers (31 miles) of its length along the southern end of the corridor occurs in desert tortoise habitat. Assuming 0.06 square kilometer (15 acres) disturbed per linear kilometer of railroad, construction activities would disturb about 3 square kilometers (740 acres) of this habitat. Such activities could kill individual desert tortoises; however, the abundance of this species is low in this area (DIRS 103281-Karl 1981, pp. 76 to 92; DIRS 101914-Rautenstrauch and O'Farrell 1998, pp. 407 to 411) so losses would be few. Relocation of tortoises along the corridor prior to construction would minimize losses of individuals. The presence of a branch rail line could interfere with movement of individual tortoises. If DOE selected this corridor, it would consult with the Fish and Wildlife Service (under Section 7 of the Endangered Species Act) regarding this species, and would implement all terms and conditions required by the Fish and Wildlife Service.

Table 6-40. Maximum area disturbed (square kilometers)[a] in each land-cover type for the Carlin Corridor.[b,c]

Land-cover type	Big Smoky Valley Option: Percent of corridor length	Big Smoky Valley Option: Land area	Monitor Valley Option: Percent of corridor length	Monitor Valley Option: Land area	Area in Nevada	Percent disturbed
Agriculture	0	0	0	0	5,200	0
Blackbrush	0.1	0.02	0.1	0.02	9,900	<0.001
Creosote-bursage	5.9	1.1	5.9	1.2	15,000	0.007
Grassland	0	0	0	0	2,800	0
Greasewood	6.4	1.2	4.3	0.86	9,500	0.013
Hopsage	1.9	0.37	1.9	0.38	630	0.057
Juniper	0	0	0	0	1,400	0
Mojave mixed scrub	4.5	0.87	4.5	0.9	5,600	0.015
Pinyon-juniper	0.6	0.12	0.6	0.12	15,000	<0.001
Playa	0	0	0	0	7,000	0
Sagebrush	24.9	4.8	43.1	8.7	67,000	0.012
Sagebrush/grassland	2.3	0.44	5.9	1.2	52,000	0.002
Salt desert scrub	53.4	10	33.7	6.8	58,000	0.018
Urban	ND[d]	ND	ND	ND	2,400	ND
Total[e]	100	19.3	100	20.1	250,000	N/A[f]

a. To convert square kilometers to acres, multiply by 247.1.
b. Based on the proportion of the route in each land-cover type; percent disturbed was based on the variation with the greatest disturbance within a particular land-cover type. Percentages add to more than 100 because maximum values were used.
c. Source: DIRS 104593-CRWMS M&O (1999, Appendix D).
d. ND = not determined.
e. Totals might differ from sums of values due to rounding.
f. N/A = not applicable.

Three other sensitive species occur in the 400-meter- (0.25-mile)-wide corridor: one population of a sensitive plant species, the Nevada sanddune beardtongue; and one population each of two sensitive animal species (a ferruginous hawk nesting area and the San Antonio pocket gopher). Use of the Monitor Valley Option rather than the Big Smoky Valley Option would avoid the pocket gopher population, and the Steiner Creek Alternate would avoid the hawk nesting area (Appendix J, Section J.3.1.2 lists corridor variations). These populations could be disturbed during construction activities. Adverse impacts to the hawk nesting area could be long term because periodic disturbances associated with the presence of a railroad could cause the hawks to abandon the area.

At least three populations of three sensitive plant species occur outside the corridor, but within 5 kilometers (3 miles). Use of the Monitor Valley Option would avoid one of these populations. DOE anticipates no impacts to these populations because land disturbance would not extend to these areas and changes in the aquatic or soil environment in these areas as a result of construction or long-term presence of a railroad would be unlikely.

Fourteen populations of eight sensitive animal species occur outside the corridor, but within 5 kilometers (3 miles). Ten populations of five of these species are associated with springs or aquatic habitat. These populations would not be affected by construction activities due to their distance from the corridor. The Monitor Valley Option would avoid one population each of two of these species.

This rail corridor, including its variations, crosses seven areas designated as game habitat and six areas designated as wild horse and burro management areas (see Chapter 3, Section 3.2.2.1.4). Construction activities would reduce habitat in these areas. Wild horses, burros, and game animals near these areas during construction would be disturbed, and their migration routes could be disrupted. In addition, there are 17 areas designated as game habitat outside the 400-meter (0.25-mile)-wide corridor but within 5 kilometers (3 miles). Larger game animals occupy large home ranges and could easily traverse the distance between the designated habitat and the proposed corridor. Four of these areas are associated with sage grouse (1 nesting and 3 strutting) and probably would not be affected by construction of the rail line.

One group of springs and three to four stream or riparian areas are within the 400-meter (0.25-mile)-wide corridor, and its variations (Table 6-37). Although no formal delineations have been made, these areas may be jurisdictional wetlands or other waters of the United States. Construction could increase sedimentation in these areas. In addition, the corridor crosses a number of ephemeral streams that may be classified as waters of the United States. DOE would work with the U.S. Army Corps of Engineers to minimize impacts to these areas and would obtain individual or regional permits if necessary. DOE anticipates some changes to local drainage along a branch rail line and would design the rail line to accommodate existing drainage patterns.

In addition, as many as 60 known springs and 6 riparian areas occur outside the corridor, but within 5 kilometers (3 miles), including the corridor variations. Nine known populations of four sensitive animal species are associated with these aquatic resources. DOE anticipates no impacts to these populations because these areas would not be disturbed during construction or by the long-term presence of a railroad. Although there are differences in the number of springs or riparian areas that some corridor variations would avoid, the Monitor Valley Option would avoid 13 of the springs and four of the riparian areas that are outside of the corridor but within 5 kilometers.

Construction activities would temporarily disturb about 19 square kilometers (4,700 acres) of soils in and adjacent to the corridor. The impacts to soils of disturbing 19 square kilometers (4,700 acres) along the 520-kilometer (323-mile)-long corridor would be transitory and small. However, several soil characteristics could influence construction activities and the amount of disturbed area. Soils susceptible to water or wind erosion occur along much of the corridor and its variations as do soils exhibiting relatively high shrink-swell characteristics (see Chapter 3, Section 3.2.2.1.4). Disturbance of erodible soils could lead to increased silt loads in water courses or increased soil transport by wind. Erosion control during construction, and revegetation or other means of soil stabilization after construction, would minimize these concerns. The presence of soils with poor (that is, high) shrink-swell characteristics could influence the amount of area disturbed by construction if soils from outside areas had to be brought in for replacement or mixing with native soil.

As stated in Chapter 3, Section 3.2.2.1.4, potential variations identified for the Carlin Corridor could avoid some biological resources, as listed in Table 6-41.

6.3.2.2.2.4 Carlin Rail Cultural Resources

Construction. This section discusses the segment of the Carlin Corridor from the existing Union Pacific main line railroad near Beowawe in north-central Nevada to its junction with the Caliente Corridor, northwest of Mud Lake. The remainder of the corridor is the same as the final segment of the Caliente Corridor from that point to the proposed repository; impact potential along that segment is discussed in Section 6.3.2.2.1.4.

Archaeological site file searches for the overall Carlin Corridor, including its variations (see Appendix J, Section J.3.1.2), resulted in the identification of 110 known sites (see Chapter 3, Section 3.2.2.1.5), 47 of which are eligible or potentially eligible for inclusion in the *National Register of Historic Places*. The segment of the Carlin Corridor north of the junction point with the Caliente Corridor crosses or passes through several potentially important areas for archaeological and historical sites. Based on currently available information (DIRS 155826-Nickens and Hartwell 2001, p. 27), each of the valleys through which the corridor and its variations pass—Crescent, Grass, Big Smoky, Monitor, and Ralston—have medium to high potential for prehistoric and historic Native American sites. Late 19th- and early 20th-century Western Shoshone village sites are collocated with the historic Grass Valley Ranch; similar situations might occur at other historic ranches the Corridor passes.

Table 6-41. Biological resources avoided by Carlin Corridor variations.[a]

Alignment variation resource	Occurrence of resource: For unvaried segment of corridor — In corridor[b]	Within 5 km[c]	Occurrence avoided by variation — In corridor	Within 5 km
Steiner Creek Variation				
Sensitive species–ferruginous hawk nesting	1	2	1	0
Game habitat–sage grouse strutting	2	3	1	1
Springs or groups of springs	4	59	0	2
Riparian areas	3	7	2	1
Rye Patch Variation				
Springs or groups of springs	4	59	1	0
Riparian areas	3	7	1	0
Monitor Valley Variation				
Sensitive species				
Big Smoky Valley speckled dace	0	1	0	1
Crescent Dune aegialian scarab	0	1	0	1
Nevada sanddune beardtongue	1	1	0	1
San Antonio pocket gopher	1	0	1	0
Game habitat				
Pronghorn–year round	1	0	1	0
Waterfowl	0	1	0	1
Springs or groups of springs	4	59	0	13
Riparian areas	3	7	0	4

a. Variations listed are those that would result in the avoidance of biological resources along the corridor.
b. In the corridor [or springs within 400 meters (0.25 mile)], but avoided by the corridor variation.
c. Within 5 kilometers (3 miles) of the corridor, but more than 5 kilometers from the corridor variation.

Between Beowawe and U.S. Highway 50, the Carlin Corridor intersects with the California Emigrant Trail and the Pony Express Trail, both designated by Congress as *National Historic Trails* under the National Trails System Act, and the historic Pacific Telegraph Line, Butterfield Overland Mail and Stage route, and Lincoln Highway routes (DIRS 155826-Nickens and Hartwell 2001, p. 15). None of these resources has been evaluated for eligibility for the *National Register of Historic Places*, although the segment of the Pony Express Trail intersected by the Carlin Corridor, Rye Patch Alternate, and Monitor Valley Option has been designated a High Potential segment by the National Park Service. The Monitor Valley Option passes within view of the Belmont Historic District at the southern end of the valley, and to the south in Ralston Valley passes close to known but unrecorded and unevaluated archaeological sites, as well as the former bombing range for the Tonopah Army Air Station.

Construction of a branch rail line in this corridor could affect two historic Native American cemeteries, one in Crescent Valley and the other in Grass Valley (DIRS 155826-Nickens and Hartwell 2001, p. 27). The corridor passes within 3 kilometers (2 miles) of another cemetery southeast of Beowawe that local Western Shoshone families still use. Crescent Valley itself is part of the disputed Western Shoshone homelands, and grazing rights throughout the valley have been the subject of litigation between local Western Shoshone ranchers and the Bureau of Land Management.

Operations. As stated in Section 6.3.2.1, additional impacts to these resources during the operation of the branch rail line would be unlikely.

6.3.2.2.2.5 Carlin Rail Occupational and Public Health and Safety

Construction. Industrial safety impacts on workers from the construction and use of the Carlin branch rail line would be small (see Table 6-42). The analysis evaluated the potential for impacts in terms of

Table 6-42. Impacts to workers from industrial hazards during rail construction and operations for the Carlin Corridor.

Group and industrial hazard category	Construction[a]	Operations[b]
Involved workers		
Total recordable cases[c]	99	95
Lost workday cases	49	52
Fatalities	0.14	0.26
Noninvolved workers		
Total recordable cases	5.9	5.4
Lost workday cases	2.2	2.0
Fatalities	0.006	0.006
Totals[d]		
Total recordable cases	110	100
Lost workday cases	51	54
Fatalities	0.14	0.27

a. Totals for 46 months for construction.
b. Totals for 24 years for operations.
c. Total recordable cases includes injury and illness.
d. Totals might differ from sums due to rounding.

total reportable cases of injury, lost workday cases, and fatalities to workers from construction and operation activities.

The analysis also evaluated traffic fatality impacts that would occur during the moving of equipment and materials for construction, worker commutes to and from construction sites, and transport of water to construction sites if wells were not available. Table 6-43 lists these results.

Operations. Incident-free radiological impacts would occur during the routine transportation of spent nuclear fuel and high-level radioactive waste in the Carlin Corridor. Table 6-44 lists the incident-free impacts, which would include transportation along the Carlin Corridor and transportation along railways in Nevada that led to a Carlin branch line. The table includes the impacts of 1,079 legal-weight truck shipments from commercial sites that would not have the capability to load rail casks while operational.

Table 6-43. Estimated number of fatalities from construction material delivery vehicles and construction and operations worker commuting traffic for the Carlin Corridor.

Activity	Kilometers[a]	Traffic fatalities	Emissions fatalities
Construction[b]			
Material delivery vehicles	19,000,000	0.3	0.04
Commuting workers	76,000,000	0.8	0.10
Subtotals	*95,000,000*	*1.1*	*0.14*
Operations[c]			
Commuting workers	68,000,000	0.7	0.09
Totals	*160,000,000*	*1.8*	*0.23*

a. To convert kilometers to miles, multiply by 0.62137.
b. Totals for 46 months for construction.
c. Totals for 24 years for operations.

Table 6-44. Health impacts from incident-free Nevada transportation for the Carlin Corridor.[a]

Category	Legal-weight truck shipments	Rail shipments	Totals[b]
Involved workers			
Collective dose (person-rem)	38	940	980
Estimated latent cancer fatalities	0.02	0.38	0.39
Public			
Collective dose (person-rem)	7	32	38
Estimated latent cancer fatalities	0.003	0.02	0.02
Estimated vehicle emission-related fatalities	0.002	0.017	0.018

a. Impacts are totals for 24 years.
b. Totals might differ from sums of values due to rounding.

6.3.2.2.2.6 Carlin Rail Socioeconomics

The following paragraphs discuss potential socioeconomic impacts associated with the construction of a branch rail line in the Carlin Corridor and with the operation of the line.

The Carlin Corridor passes through Lander County, very small portions of Eureka and Esmeralda Counties, and Nye County. DOE considered potential socioeconomic impacts in Lander, Eureka, and Esmeralda Counties collectively as part of the Rest of Nevada, the portion of the State outside the region of influence.

Construction. The length of the Carlin Corridor, 520 kilometers (323 miles), would determine the number of workers required. The construction of a branch rail line in this corridor would require workers laboring for 2.5 million hours or 1,230 worker-years during the 46-month construction period (DIRS 154822-CRWMS M&O 1998, all). During the work week, the workers would commute to and temporarily live in five construction camps.

Employment

DOE anticipates that total (direct and indirect) employment in Nevada attributable to the construction of a Carlin branch rail line would peak in the first year of construction, 2006, at about 783 jobs, 85 percent of which would be in the region of influence. The increase in employment represents less than 1 percent of the baseline for employment in each of the three counties in the region of influence (Clark, Nye, and Lincoln Counties) and in the Rest of Nevada. Clark County would supply about 574 workers, Nye County 95, and Lincoln County 1. The balance of the workers, 113, would come from the Rest of Nevada. Employment of Carlin Corridor construction workers and some indirect support workers would end in 2009. As a result, the projected total growth of 19,915 jobs (2009 to 2010) in the State of Nevada would be reduced by approximately 700. The expected 14,886 additional jobs in Clark County would be reduced by 690, and the expected growth of 330 jobs in Nye County would be reduced by 46. The expected growth of 24 jobs in Lincoln County would be unaffected. The expected 4,675 additional jobs in the Nevada counties outside the region of influence would be supplemented by 37. DOE anticipates that project-related workers not moving to Carlin Corridor operational jobs would be absorbed in other work in the State. These changes in employment would represent less than 1 percent of the applicable baselines.

Population

Population increases in Nevada attributable to the construction of a Carlin rail line, which would lag increases in employment, would peak 2 years later in 2009 at about 728 persons. About 683 persons, or 94 percent of the expected additional residents, would live in the region of influence. Clark County would gain about 625 residents, Nye County would gain about 57 residents, and Lincoln County would gain 1. The Rest of Nevada, would gain approximately 44 residents. Because Clark County has a larger population, the expected impact from the change in population would be less than 1 percent. The impacts of projected increases in population in Nye and Lincoln Counties, and in the Rest of Nevada would also be less than 1 percent. Because the increases in population resulting from the construction of a rail line in the Carlin Corridor would be small and transient in Clark, Nye, and Lincoln Counties, and in the Rest of Nevada, impacts to schools or housing would be unlikely.

Economic Measures

The expected peak annual changes in economic measures in the State due to the construction of a branch rail line in the Carlin Corridor would be increases of $21.4 million in real disposable income in 2009; $36.0 million in Gross Regional Product during 2007; and $2.5 million in State and local expenditures in 2009 with 90 percent concentrated in the region of influence. More than 90 percent of the increase in Gross Regional Product and real disposable income would be generated in Clark County. Clark County would absorb approximately 83 percent of the increases in State and local government expenditures. About 3 percent of the increase in Gross Regional Product and real disposable income would be generated in Nye County as would 7 percent of the expenditures by State and local governments. Because there would be virtually no change to employment or population in Lincoln County attributable to a rail line in the Carlin Corridor, there would be virtually no impact or change to Gross Regional

Product, real disposable income, or expenditures by State and local government. (Dollar values reported in this section are in 2001 dollars unless otherwise stated.)

Construction-related impacts to employment, population, real disposable income, Gross Regional Product, and State and local government expenditures for a branch rail line in the Carlin Corridor would be less than 1 percent of the applicable baselines for Clark, Nye, and Lincoln Counties and the Rest of Nevada.

Transition and Operations Period. In the period from 2010 to 2012, the State of Nevada would have an average of 27 fewer jobs. For perspective, the State of Nevada would have an average employment of about 1.5 million during this same period. Slightly slower growth would be confined to Clark County from 2010 to 2016. Growth in employment in Clark County during this transitional period would be approximately 66 fewer jobs than if DOE did not build a branch rail line in the Carlin Corridor. The Lincoln County employment baseline during this period would average about 75,000 jobs. During this period, Nye County would gain 5 jobs. There would be no change in employment in Lincoln County. A Carlin branch rail line would accelerate the rate of growth in the region's employment starting in 2016. The area outside the region of influence, the Rest of Nevada, would gain approximately 78 project-related jobs during this transition period. A Carlin rail line would contribute to growth in residential populations in and outside the region of influence throughout the transition period and to the employment base in the State after 2012.

Employment and Population

Estimated direct employment for operations in the Carlin Corridor would be 47 workers during the 24 years of operations. The change in total employment would average about 86 jobs in Nevada. DOE assumed that 6 of the additional workers would be employed in Clark County, about 6 in Nye County, and none in Lincoln County. The rest of the individuals would work in the Rest of Nevada, primarily in Elko County. The average annual addition to population in the State attributable to a branch rail line in the Carlin Corridor would be about 294 persons. About 160 of these persons would live in Clark County, 31 in Nye County, and none in Lincoln County. The rest of the individuals would live elsewhere within the State. DOE assumed that half of the Carlin rail operational personnel (approximately 24 directly employed individuals) would live at each end of the branch rail line. Rail operations employees and indirectly employed individuals who would live near the Beowawe end of the rail line would live in or near the Town of Elko in Elko County. Impacts due to changes in population and employment attributable to a Carlin rail line in Elko County, which had an estimated 2000 population of about 45,500 and about 21,100 jobs, would be less than 0.5 percent. Because impacts from increases in population and employment in each county would be small, impacts to schools or housing would be unlikely. The average annual impact, in relation to the baselines for population and employment in Clark, Nye, and Lincoln Counties and the Rest of Nevada, would be less than 1 percent.

Economic Measures

From 2010 until 2033 the estimated average annual increase in Nevada from operating a branch rail line in the Carlin Corridor in real disposable income would be $5.7 million. Approximately 33 percent would be generated in the region of influence, and the balance would be generated primarily in Elko County. The average increase in annual Gross Regional Product in the State attributable to a Carlin rail line would be about $5.3 million, of which $4.9 million would come from goods and services outside the region of influence. On average, during operation of a Carlin rail line, changes in real disposable income would exceed changes in Gross Regional Product. The increase in annual State and local government expenditures would be about $1.2 million, much lower than those reported above for construction. Approximately 46 percent of these additional expenditures would come from outside the region of influence. The impact of changes in Gross Regional Product, real disposable income, and expenditures by State and local governments would be less then 1 percent for Clark, Nye, and Lincoln Counties and for the Rest of Nevada.

DOE performed a detailed analysis for the Carlin rail line because of its length. The results of this analysis are representative of the potential variations (options and alternates) listed in Appendix J, Section J.3.1.2. The lengths of the variations are similar to those listed in Table 6-36.

6.3.2.2.2.7 Carlin Rail Noise and Vibration

Over most of its length, the Carlin Corridor, including the Monitor Valley and Big Smoky Valley Options, passes through undeveloped land managed by the Bureau of Land Management. Human inhabitants of this land consist primarily of isolated ranchers and persons involved with outdoor recreation. DOE identified 12 communities along or near the Carlin Corridor (including its Monitor Valley and Big Smoky Valley Options) and estimated the distances from a branch rail line to the community's nearest boundary (Table 6-45). The estimated maximum railroad noise from a two-locomotive train would occur at the boundary of the community. Estimated noise levels would not exceed the 60-dBA benchmark for residential communities during daytime hours. Communities within 1 kilometer (0.6 mile) of the rail line would experience single episodes of noise higher than the nighttime 50-dBA benchmark. A limitation of 10 dBA above the benchmark is allowable if its duration is less than 5 minutes in an hour (Washington Administrative Code-170-60). The estimated duration of noise that peaked at 57 dBA would be less than 2 minutes in communities 1 kilometer from the rail line at a speed of 50 kilometers (30 miles) per hour. For distances of 5 kilometers (3 miles) or greater, the estimate of 26 dBA would be subject to large uncertainty.

Table 6-45. Estimated propagation of noise (dBA) from the operation of a waste transport train with two locomotives in communities near the Carlin Corridor.

Corridor/community	Distance (kilometers)[a]	Estimated noise (dBA)[b]
Carlin Corridor		
Beowawe	3.2[c]	32
Crescent Valley	1.9	44
Austin	16	< 26
Big Smoky Valley Option		
Carver	1.0	57
Round Mountain	1.0	57
Manhattan	1.0	57
Monitor Valley Option		
Belmont	2.0	43
Tonopah (east alignment)	8[c]	< 26[d]
Tonopah (west alignment)	13[c]	< 26
Goldfield	6.0	< 26
Beatty	9.6[c]	< 26
Amargosa Valley	9.6[c]	< 26

a. To convert kilometers to miles, multiply by 0.62137.
b. Estimated values do not include noise loss due to interactions with the ground that could account for decreases in estimated noise levels of from 10 to 20 dBA at 100 meters (330 feet) from the tracks.
c. Noise estimates at distances greater than 2.0 kilometers (1.2 miles) have large uncertainty.
d. At these distances, the A-weighted sound pressure level is dominated by lower frequencies (lower than 63 Hertz) and would not be distinguishable from normal background levels of noise.

In addition to passing near communities, the variations of the Carlin Corridor pass through areas with farms and ranches. Therefore, some rural residences could fall in the region of influence for noise. The corridor and its 10 variations (see Appendix J, Section J.3.1.2) are at least 1 kilometer (0.6 mile) or more from every town along its length. The noise from trains would not exceed daytime noise standards for residential areas (60 dBA) more than 1 kilometer from a branch rail line. Because a Carlin rail line would pass near some communities, there would be a potential for noise impacts from both construction and operations. As discussed in Section 6.3.2.1, in areas where a branch rail line or variation passed near a community, train speeds could be limited to the extent necessary to ensure that noise was below levels listed in accepted noise standards.

The Carlin Corridor passes within 1.9 kilometers (1.2 miles) of the border of the Timbisha Shoshone Trust Lands parcel. The Bonnie Claire Alternate of the corridor passes through 4.1 kilometers (2.5 miles) of the Timbisha Shoshone Trust Lands parcel near the intersection of State Route 267 and U.S. Highway 95. Noise levels from trains passing through the parcel would be at 90 dBA at 15 meters (49 feet) for the Bonnie Claire Alternate. At the closest point of the Carlin Corridor, the estimated noise levels would be 44 dBA.

The estimated population residing within 2 kilometers (1.25 miles) of the Carlin Corridor in 2035 would be about 3,200 persons. The potential for human annoyance would be small.

Vibration. There are no known ruins of cultural significance along the Carlin Corridor. A branch rail line in the corridor or its variations would be distant from historic structures and buildings, so vibration impacts to such structures would be unlikely. The small number of trips (three per day) and the small train size would result in low levels of rail-induced ground vibration.

6.3.2.2.2.8 Carlin Rail Utilities, Energy, and Materials

Table 6-46 lists the projected use of fossil fuels and other materials in the construction of a Carlin branch rail line.

Table 6-46. Construction utilities, energy, and materials for a Carlin branch rail line.

Length (kilometers)[a]	Diesel fuel use (million liters)[b]	Gasoline use (thousand liters)	Steel (thousand metric tons)[c]	Concrete (thousand metric tons)
510 - 540	39 - 41	790 - 840	71 - 75	400 - 420

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. To convert metric tons to tons, multiply by 1.1023.

6.3.2.2.3 *Caliente-Chalk Mountain Rail Corridor Implementing Alternative*

The Caliente-Chalk Mountain Corridor is identical to the Caliente Corridor until it reaches the northern boundary of the Nellis Air Force Range. At this point the Caliente-Chalk Mountain Corridor turns south through the Nellis Air Force Range and the Nevada Test Site to the Yucca Mountain site. Figure 6-17 shows this corridor along with possible variations identified by engineering studies (DIRS 154822-CRWMS M&O 1998, all). The corridor variations provide flexibility in addressing engineering, land-use, or environmental resource issues that could arise in a future survey along the corridor. This section addresses impacts that would occur along the corridor shown in Figure 6-17. With the exception of differences identified in Appendix J, Section J.3.1.2, the impacts would be generally the same among the possible corridor variations. The corridor is 345 kilometers (214 miles) long from its link at the Union Pacific railroad near Caliente to Yucca Mountain. Variations of the route range from 340 to 380 kilometers (210 to 240 miles).

The construction of a branch rail line in the corridor would require approximately 43 months. Construction would take place simultaneously at a number of locations. An estimated four construction camps would be established at roughly equal distances along the corridor. These camps would provide temporary living accommodations for construction workers and construction support facilities. A train would take about 8 hours to travel from the junction with the Union Pacific mainline to a Yucca Mountain Repository on a Caliente-Chalk Mountain branch rail line (DIRS 101214-CRWMS M&O 1996, Volume 1, Section 4, Branch Line Operations Plan). The estimated life-cycle cost to construct and operate a branch rail line in the Caliente-Chalk Mountain Corridor would be $622 million in 2001 dollars.

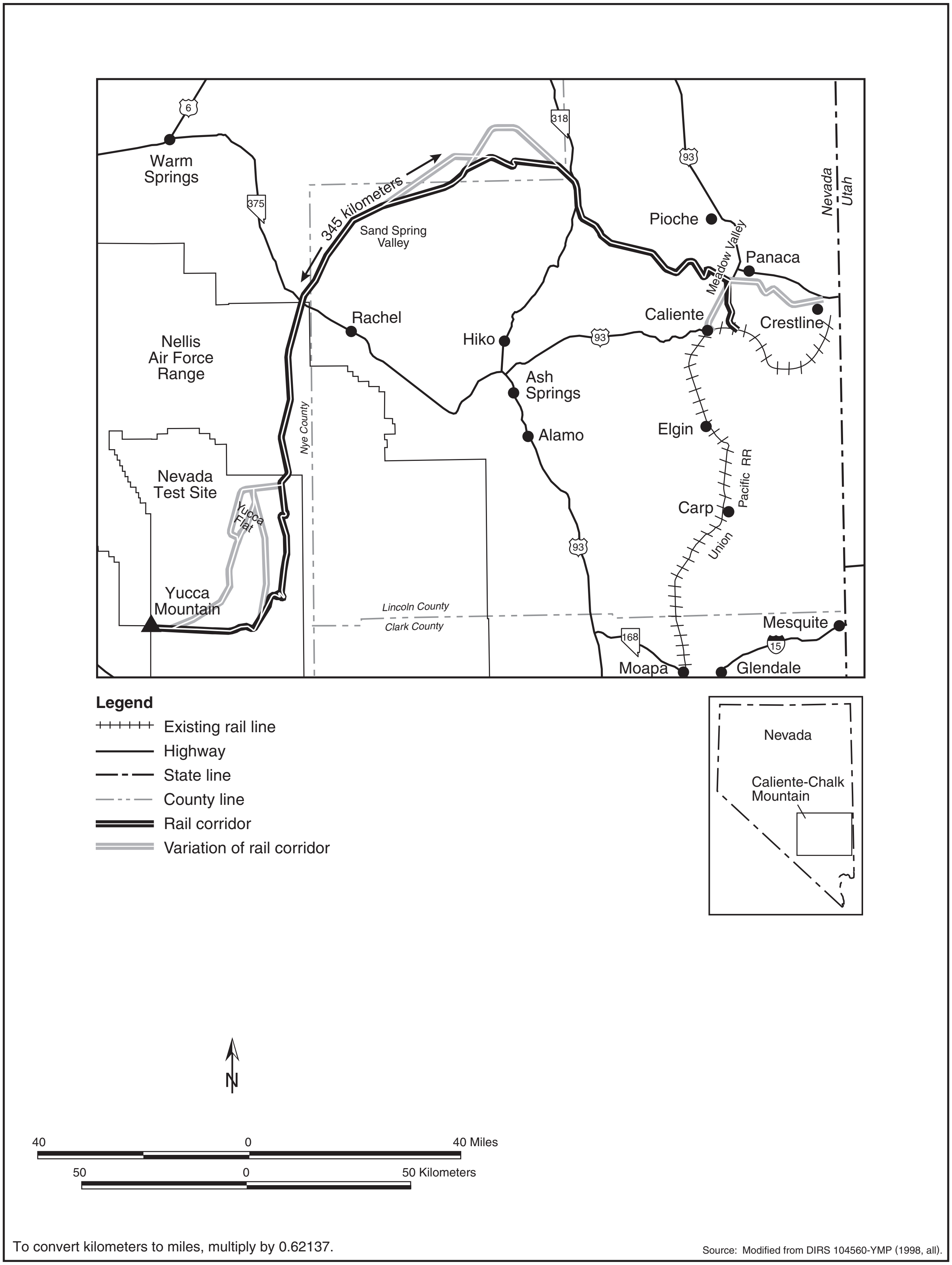


Figure 6-17. Caliente-Chalk Mountain Corridor.

The following sections address impacts that would occur to land use; biological resources and soils; cultural resources; hydrology including surface water and groundwater; occupational and public health and safety; socioeconomics; noise and vibration; and utilities, energy, and materials. Impacts that would occur to air quality, aesthetics, and waste management would be the same as those discussed in Section 6.3.2.1 and are, therefore, not repeated here. Section 6.3.4 discusses the potential for transportation activities to cause environmental justice impacts in Nevada.

6.3.2.2.3.1 Caliente-Chalk Mountain Rail Land Use and Ownership

Construction. Table 6-47 summarizes the amount of land required for the Caliente-Chalk Mountain corridor, its ownership, and the estimated amount of land that would be disturbed. Table 6-48 summarizes the amount of land required for the Caliente-Chalk Mountain corridor variations and its ownership.

Table 6-47. Land use in the Caliente-Chalk Mountain Corridor.[a]

Factor	Corridor (percent)	Range due to variations
Corridor length (kilometers)[b]	345	344 - 382
Land area in 400-meter[c]*-wide corridor (square kilometers)*[d]	138 (100)	138 - 153
Land ownership in 400-meter-wide corridor (square kilometers)		
Bureau of Land Management	78 (56)[e]	77.4 - 88.5
Air Force	21.5 (16)	21.5 - 21.5
DOE	37.8 (27)	31.5 - 37.8
Private	0.8 (0.6)	0.8 - 1.1
Other	None	None
Land area in 60-meter[f] *right-of-way (square kilometers)*	20.7	20.6 - 22.9
Disturbed land (square kilometers)		
Inside 60-meter right-of-way	9.6	9.6 - 10.6
Outside 60-meter right-of-way	3	3 - 3.4

a. Source: DIRS 155549-Skorska (2001, all).
b. To convert kilometers to miles, multiply by 0.62137.
c. 400 meters = about 0.25 mile.
d. To convert square kilometers to acres, multiply by 247.1.
e. Percentages do not total 100 due to rounding.
f. 60 meters = 200 feet.

The Caliente-Chalk Mountain Corridor would involve several road, power line, and utility rights-of-way before it entered the Nellis Air Force Range west of Groom Mountain and then the Nevada Test Site. The rights-of-way are similar to those discussed in relation to the Caliente Corridor and therefore the land-use impacts for this section of the corridor would be similar (see Sections 6.3.2.1 and 6.3.2.2.1). South of Rachel, Nevada the corridor crosses an additional road right-of-way (DIRS 104993-CRWMS M&O 1999, Table 5, p. 18). Variations of the corridor, as indicated in Appendix J, Section J.3.1.2, provide flexibility to address engineering, land use, or environmental constraints. Included are variations identified to provide flexibility to circumvent Test Site surface areas and associated facilities and radiologically contaminated areas. The corridor would also cross five oil and gas leases and three grazing allotments (Highland Peak, Bennett Springs, and Black Canyon). Many of the impacts along the Caliente-Chalk Mountain Corridor would be similar to those described for the Caliente Corridor (see Section 6.3.2.2.1) or are common to all five rail corridors as discussed in Section 6.3.2.1. The following paragraphs discuss impacts unique to the Caliente-Chalk Mountain Corridor.

Table 6-48. Possible variations in the Caliente-Chalk Mountain Corridor.[a]

Variation	Length (kilometers)[b]	Land area in variation (square kilometers)[c]	Land ownership [square kilometers (percent)] Bureau of Land Management	Private	DOE
Eccles Option	16.7	6.7	6.3 (95)	0.4 (5)	--[e]
Caliente Option	17.2	6.9	6.21 (90)	0.69 (10)	--
Crestline Option	37.8	15.1	14.5 (95.9)	0.6 (4.1)	--
White River Alternate	47.5	19	18.98 (99.9)	0.02 (<0.1)	--
Garden Valley Alternate	37.7	15.1	15.1 (100)	--	--
Orange Blossom Road Option	85.9	34.4	--	--	34.4 (100)
Topopah Option	78.4	31.4	--	--	31.4 (100)
Topopah Option with Mine Mountain Alternate	77.8	31.1	--	--	31.1 (100)
Topopah Option with Area 4	72.1	28.8	--	--	28.8 (100)
Mercury Highway Option	52.3	20.9	--	--	20.9 (100)

a. Source: DIRS 155549-Skorska (2001, all).
b. To convert kilometers to miles, multiply by 0.62137.
c. To convert square kilometers to acres, multiply by 247.1.
d. NA = not applicable; the Eccles Option and Orange Blossom Road Option lengths are included in the overall corridor length.
e. -- = none.

The Caliente-Chalk Mountain Corridor passes just east of the Weepah Springs Wilderness Study Area and just north of the Worthington Mountains Wilderness Study Area. The corridor involves land controlled by the Nellis Air Force Range (also known as the Nevada Test and Training Range) and, according to the Air Force, would affect Range operations. Because the Military Lands Withdrawal Act of 1999 (Public Law 106-65, 113 Stat. 885) withdraws and reserves the Nellis Air Force Range for use by the Secretary of the Air Force, the Secretary would need to concur with a decision to build and operate a branch rail line through any part of the Range before DOE could build and operate this line.

Operations. DOE expects operations along the Caliente-Chalk Mountain Corridor to cause smaller impacts than the construction phase of the project.

The Air Force has identified national security issues related to a Chalk Mountain route (DIRS 104887-Henderson 1997, all), citing interference with Nellis Air Force Range testing and training activities. In response to Air Force concerns, DOE regards the route as a "non-preferred alternative."

6.3.2.2.3.2 Caliente-Chalk Mountain Rail Hydrology

Surface Water

Chapter 3, Section 3.2.2.1.3, discusses surface-water resources along the Caliente-Chalk Mountain Corridor; Table 6-49 summarizes these resources. The use of corridor variations could result in changes to the number of surface-water resources in the vicinity of the corridor. However, the changes would be primarily to the number of resources outside, but within 1 kilometer (0.6 mile), of the corridor. As discussed in Section 6.3.2.1, impacts during construction or operations from the possible spread of construction-related materials by precipitation or intermittent runoff events, releases to surface waters, and the alteration of natural drainage patterns or runoff rates that could affect downgradient resources would be unlikely.

Table 6-50 lists flood zones identified along the Caliente-Chalk Mountain Corridor and its variations. This corridor would cross at least three 100-year flood zones or flood-zone groups before entering the Nellis Air Force Range. Two of the four variations would change the number of flood zones crossed by one (up or down). The low number of flood zones identified for the Caliente-Chalk Mountain Corridor must be qualified by the fact that the Federal Emergency Management Agency maps, from which DOE

Table 6-49. Surface-water resources along Caliente-Chalk Mountain Corridor and its variations.[a,b,c]

Corridor description	Resources in 400-meter[d] corridor			Resources outside corridor within 1 kilometer[e]		
	Spring	Stream/ riparian area	Reservoir	Spring	Stream/ riparian area	Reservoir
Caliente-Chalk Mountain Corridor	--[f]	2	--	5	--	--
with Crestline Option	--	2	--	7	--	--
with Caliente Option	1	2	--	7	--	--
with Topopah Option	--	2	--	4	--	--
with Topopah-Area 4 Alternate	--	2	--	3	--	--
with Topopah-Mine Mountain Alternate	--	2	--	4	--	--

a. Source: Reduced from table in Chapter 3, Section 3.2.2.1.3.
b. Resources are the number of locations; that is, DOE counted a general location with more than one spring as one water resource.
c. Resources listed for variations are for the entire corridor with only the identified variations changed. Variations not listed (White River Alternate, Garden Valley Alternate, Mercury Highway Connection, Orange Blossom Road Option) are not associated with identified water resources, nor would they avoid resources along the corridor.
d. 400 meters = about 0.25 mile.
e. 1 kilometer = about 0.6 mile.
f. -- = none.

derived the flood zone information, provided coverage for only about 10 percent of the corridor length. As indicated in Section 6.3.2.1, impacts associated with altering drainage patterns or changing erosion and sedimentation rates or locations would be minor and localized.

Groundwater

Construction. The water used during construction would come largely from groundwater resources. The annual demands would be a fraction of the perennial yields of most producing aquifers (Chapter 3, Section 3.2.2.1.3, discusses estimated perennial yields for the hydrographic areas over which the Caliente-Chalk Mountain Corridor passes).

The estimated amount of water needed for construction of a branch rail line in the corridor for soil compaction, dust control, and workforce use would be about 594,000 cubic meters (480 acre-feet) (DIRS 104914-DOE 1998, all). For planning purposes, DOE assumed that this water would come from 43 wells installed along the corridor. The average amount of water withdrawn from each well would be approximately 14,000 cubic meters (11 acre-feet). DOE would use most (90 percent) of the water for compaction of fill material, and the estimate of fill quantities needed for construction would vary if the Department used variations. Use of either the Topopah or Mercury Highway Options on the Nevada Test Site would involve the largest increase in fill material and could increase the total water needed for this corridor by as much as 16 percent.

Chapter 3, Section 3.2.2.1.3, discusses the hydrographic areas over which the corridor would pass, their perennial yields, and if the State of Nevada considers each a Designated Groundwater Basin. If the hydrographic area is a Designated Groundwater Basin, permitted groundwater rights approach or exceed the estimated perennial yield, depleting the basin and water resources or requiring additional administration. Table 6-51 summarizes the status of the hydrographic areas associated with the Caliente-Chalk Mountain Corridor and the approximate portion of the corridor that passes over Designated Groundwater Basins. Use of the variations (Caliente Option, Crestline Option, White River Alternate, Garden Valley Alternate, Mercury Highway Option, Topopah Option, Mine Mountain Alternate, Orange Blossom Road Option, and Area 4 Alternate) would change the number of hydrographic areas crossed, but would have no effect on the portion of the corridor crossing Designated Groundwater Basins.

Table 6-50. 100-year flood zones crossed by the Caliente-Chalk Mountain Corridor and its variations.[a,b]

Corridor portion	Crossing distance (kilometers)[c]	Flood zone feature(s)	Avoided by variation[d] (yes or no)
Eccles Siding to Meadow Valley	0.2[e]	Clover Creek (intermittent)	Y-1
	0.8[e]	Meadow Valley Wash (wet)	Y-1,2
Meadow Valley Wash to Sand Spring Valley	0.5[e]	White River (intermittent)	N
Sand Spring Valley to Yucca Mountain	--[f,g]	Not available	
Variations			
1. Crestline Option	0.8	Crosses Meadow Valley Wash (wet)	
2. Caliente Option	0.8	Crosses Meadow Valley Wash (wet)	
	0.2	Crosses Clover Creek (intermittent)	
	0.9	Crosses Meadow Valley Wash (wet) three times, rail corridor runs adjacent to Meadow Valley Wash. Passes in and out of flood zone	
3. White River Alternate	None	Located to the north of the corridor	
4. Garden Valley Alternate	None	Located to the north of the corridor	
5. Topopah Option	--[g]	Located adjacent to corridor	
5a. Area 4 Alternate	--[g]	Variation along the Topopah Option	
5b. Mine Mountain Alternate	--[g]	Variation along the Topopah Option	
6. Mercury Highway Option	--[g]	Located adjacent to corridor	

a. Areas where natural floodwater movement might be altered and where erosion and sedimentation rates and locations could change. Sources:
   1. Federal Emergency Management Agency Flood Insurance Rate Maps for Lincoln and Nye Counties, Nevada.
   2. DIRS 154961-CRWMS M&O (1998, all).

b. About 91 percent of the Caliente-Chalk Mountain Corridor is not available on Federal Emergency Management Agency maps, due primarily to limited coverage in Lincoln County, the Nellis Air Force Range, and the Nevada Test Site.

c. To convert kilometers to miles, multiply by 0.62137.

d. Certain 100-year flood zones can be avoided by corridor variations. These are identified with a "Y" (yes) and a number representing the specific variation(s) that avoid the specific flood zone. The same flood zone might be crossed by both the corridor and variations at different locations. In such cases, the feature will be marked "Avoided" for the corridor route, but will appear again for the variations.

e. Projected from limited data. Specific area not covered by Federal Emergency Management Agency maps; values were extrapolated from the closest maps.

f. No information available on Federal Emergency Management Agency maps.

g. Limited information due to the Nellis Air Force Range or the Nevada Test Site.

Table 6-51. Hydrographic areas along Caliente-Chalk Mountain Corridor and its variations.

		Designated Groundwater Basins	
Description	Hydrographic areas	Number	Percent of corridor length
Caliente-Chalk Mountain Corridor	11	2	30
Variations[a]	10 to 12	2	30

a. Several of the variations would involve small changes in the hydrographic areas crossed or the crossing distances. However, all (Caliente Option, Crestline Option, White River Alternate, Garden Valley Alternate, Mercury Highway Option, Topopah Option, Mine Mountain Alternate, Orange Blossom Road Option, and Area 4 Alternate) would cross the same two Designated Groundwater Basins. Rounded to the nearest 10 percent, this would represent the same portion of the total corridor.

The withdrawal of about 14,000 cubic meters (11 acre-feet) a year from a well would have little impact on the hydrographic areas associated with the corridor based on their perennial yields (Chapter 3, Section 3.2.2.1.3). However, the installation of 43 wells along the corridor would mean that many hydrographic areas would have multiple wells. As listed in Table 6-51, about 30 percent of the corridor length is over

Designated Groundwater Basins, which the Nevada State Engineer's office watches carefully for groundwater depletion. This does not mean that DOE could not obtain water appropriations in these areas; the State Engineer would have the authority to approve such appropriations. Because the DOE requests would be for a short-term construction action, the State Engineer would have even more discretion. Rather than spacing the wells evenly along the corridor, DOE could use well locations that would make maximum use of groundwater areas that are not Designated Groundwater Basins. Another option would be to lease temporary water rights from individuals along the corridor. Obtaining a water appropriation from the State Engineer for short-term construction use or using an approved allocation should ensure that groundwater resources did not receive adverse impacts.

As an alternative, DOE could transport water by truck to meet construction needs. The construction of a branch rail line in the Caliente-Chalk Mountain Corridor would require about 32,000 tanker-truck loads of water or about eight truckloads each day for each work camp area along the corridor. Again, water obtained from permitted sources, which would provide water in allocations determined by the Nevada State Engineer, would not affect groundwater resources.

Operations. Operations along a completed rail line would have little impact on groundwater resources. Possible changes in recharge, if any, would be the same as those at the completion of construction.

6.3.2.2.3.3 Caliente-Chalk Mountain Rail Biological Resources and Soils

Construction. The construction of a branch rail line in the Caliente-Chalk Mountain Corridor, including potential variations, would disturb about 12 square kilometers (3,000 acres) of land (Table 6-47). The analysis assumed that the types of land cover in disturbed areas outside the corridor would be the same as that within the corridor. Areas in eight of the land-cover types identified in Nevada (DIRS 104593-CRWMS M&O 1999, pp. C1 to C5) would be affected (Table 6-52). The greatest amounts of disturbance would occur in the salt desert scrub, sagebrush, and blackbrush land cover types, but would involve far less than 0.01 percent of the existing area in those types. The fraction disturbed for each cover type would be very small. The disturbance would have no discernable impact on the availability of habitat for plants or animals associated with any cover type. Although some alignment variations could lead to a small increase in the total amount of land disturbed, the portion of the corridor, including its variations, in each land-cover type would be similar to the unvaried corridor.

About 40 kilometers (25 miles) of the corridor length at its southern end, including potential variations, crosses desert tortoise habitat. Assuming that 0.06 square kilometer (15 acres) would be disturbed for each linear kilometer of railroad, construction activities would disturb as much as 2.4 square kilometers (590 acres) of desert tortoise habitat, some of which is classified as critical habitat. Such activities could kill individual desert tortoises; however, their abundance is low in this area (DIRS 101914-Rautenstrauch and O'Farrell 1998, pp. 407 to 411) so losses would be few. The presence of a branch rail line could interfere with movements of individual tortoises. Relocation of tortoises along the corridor prior to construction would minimize losses of individuals. If DOE selected this corridor, it would consult with the Fish and Wildlife Service (under Section 7 of the Endangered Species Act) in relation to this species and would implement all terms and conditions required by the Fish and Wildlife Service.

Although the southwestern willow flycatcher occurs near some portions of the Caliente-Chalk Mountain Corridor, there is no suitable habitat of dense riparian vegetation for this listed endangered species in the corridor (DIRS 152511-Brocoum 2000, pp. A-9 to A-13).

The Eccles, Crestline, and Caliente variations for this corridor cross a portion of the Meadow Valley Wash, which is habitat for an unnamed subspecies of the Meadow Valley Wash speckled dace and the Meadow Valley Wash desert sucker, both of which are sensitive species (see Chapter 3, Section 3.2.2.1.4). The construction of a branch rail line near Caliente could temporarily affect populations of these fish by increasing the sediment load in the wash during construction. Three special status plant

Table 6-52. Maximum area disturbed (square kilometers)[a] in each land-cover type for the Caliente-Chalk Mountain Corridor.[b,c]

Land cover type	Percent of corridor length	Area disturbed	Area in Nevada	Percent disturbed
Agriculture	0.5	0.05	5,200	0.01
Blackbrush	24.8	2.45	9,900	0.02
Creosote-bursage	0.0	0	15,000	0
Grassland	0.4	0.04	2,800	0.001
Greasewood	0.0	0	9,500	0
Hopsage	1.9	0.19	630	0.03
Juniper	0.0	0	1,400	0
Mojave mixed scrub	2.4	0.24	5,600	0.004
Pinyon-juniper	0.0	0	14,700	0
Playa	0.0	0	7,000	0
Sagebrush	30.1	3	67,000	0.004
Sagebrush/grassland	0.4	0.04	52,000	<0.001
Salt desert scrub	39.3	3.89	58,000	0.007
Urban		ND[d]	2,400	ND

a. To convert square kilometers to acres, multiply by 247.1.
b. Based on the proportion of the route in each land-cover type; percent disturbed was based on the variation with the greatest disturbance within a particular land-cover type. Percentages add to more than 100 because maximum values were used.
c. Source: DIRS 104593-CRWMS M&O (1999, Appendix D).
d. ND = not determined.

species are found along this corridor and its variations but could be avoided during land-clearing activities and would not be affected.

At least 40 populations of five sensitive plant species occur outside the 400-meter (0.25-mile)-wide corridor, but within 5 kilometers (3 miles) of the corridor. Several other populations of three other sensitive plant species occur within 5 kilometers of one or more of the corridor variations listed in Appendix J, Section J.3.1.2. DOE anticipates that these populations would be unaffected because land disturbance would not extend to these areas and changes in the aquatic or soil environment in these areas as a result of construction or the long-term presence of a railroad would be unlikely.

This rail corridor, including variations, would cross seven areas designated as game habitat and two areas designated as wild horse or wild horse and burro management areas. Construction activities would reduce habitat in these areas. Depending on the variation, several other designated game habitat areas could be within 5 kilometers (3 miles) of a rail line in the corridor. Game animals, burros, and horses near areas of active construction would be disturbed and their migration routes could be disrupted.

Two stream or riparian areas and possibly one spring (with the Caliente Option) are within the 0.4-kilometer (0.25-mile)-wide corridor, including its variations (Table 6-50). Although no formal delineations have been made, these areas may be jurisdictional wetlands or other waters of the United States. Construction could increase sedimentation in these areas. The corridor, including its potential variations, also crosses a number of ephemeral streams that may be classified as waters of the United States. DOE would work with the U.S. Army Corps of Engineers to minimize impacts to these areas and would obtain individual or regional permits if necessary. DOE anticipates some changes to local drainage along the branch rail line and would design the rail line to accommodate existing drainage patterns.

As many as 14 springs and riparian areas occur outside the 400-meter (0.25-mile)-wide corridor and its variations, but within 5 kilometers (3 miles) of the corridor under the variations. Eight known populations of three sensitive animal species are associated with these aquatic resources. DOE anticipates that these populations would be unaffected and these areas would not be disturbed during construction or by the long-term presence of a railroad.

Soils in and adjacent to the corridor would be disturbed on approximately 12 square kilometers (3,000 acres) of land. The impacts of disturbing 12 square kilometers of soil along the 345-kilometer (214-mile)-long corridor would be transitory and small. However, several soil characteristics could influence construction activities and the amount of area disturbed. Soils susceptible to water or wind erosion occur along much of the corridor and its variations as do soils exhibiting relatively high shrink-swell characteristics (see Chapter 3, Section 3.2.2.1.4). Disturbance of erodible soils could lead to increased silt loads in water courses or increased soil transport by wind. Erosion control during construction and revegetation, or other means of soil stabilization after construction, would minimize these concerns. The presence of soils with poor (that is high) shrink-swell characteristics could influence the amount of area disturbed by construction if soils from outside areas had to be brought in for replacement or mixing with native soil.

As stated in Chapter 3, Section 3.2.2.1.4, variations identified for the Caliente-Chalk Mountain Corridor could avoid some biological resources, as listed in Table 6-53.

Table 6-53. Biological resources avoided by Caliente-Chalk Mountain Corridor variations.[a,b,c]

	Occurrence of resource			
	For unvaried segment of corridor		Occurrence avoided by variation	
Alignment variation resource	In corridor[b]	Within 5 km[c]	In corridor	Within 5 km
Caliente Variation				
Sensitive species–Needle Mountain Milkvetch	0	3	0	1
Springs or groups of springs	1	14	0	1
Crestline Variation				
Sensitive species–Needle Mountain Milkvetch	0	3	0	3
Springs or groups of springs	1	14	0	4
Mercury Highway, Topopah, Mine Mountain, and Area 4 Variations				
Sensitive species				
Beatley's scorpionweed	0	17	0	17
Funeral Mountain milkvetch	0	1	0	1
Largeflower suncup	1	18	1	17
Ripley's springparsley	1	1	1	0
Mine Mountain Variation only				
Sensitive species				
Largeflower suncup	0	1	0	1
Oasis Valley springsnail	0	1	0	1
Springs or groups of springs	1	14	0	1

a. Variations listed are those that would result in the avoidance of biological resources along the corridor.
b. In the corridor [or springs within 400 meters (0.25 mile)], but avoided by the corridor variation.
c. Within 5 kilometers (3 miles) of the corridor, but more than 5 kilometers from the corridor variation.

6.3.2.2.3.4 Caliente-Chalk Mountain Rail Cultural Resources

Construction. The potential for cultural resource impacts in the Caliente-Chalk Mountain Corridor would be identical to that for the Caliente Corridor, as discussed in Section 6.3.2.2.1.4, until the Caliente-Chalk Mountain Corridor diverges at the northern boundary of the Nellis Air Force Range. From that point south the corridor passes through the Range and the Nevada Test Site to the repository site.

Archaeological site file searches have identified the presence of 100 recorded sites in the Caliente-Chalk Mountain Corridor (see Chapter 3, Section 3.2.2.1.5), including the variations (Appendix J, Section J.3.1.2). Of these, 34 are potentially eligible for inclusion in the *National Register of Historic Places.* Precise impacts to any of these resources cannot be specified until the rail alignment has been identified and its relationship to the known archaeological sites evaluated. At some point on the Nevada

Test Site, the Caliente-Chalk Mountain Corridor would intersect the 1849 Jayhawker's Emigrant Trail, but because physical expressions of the trail are unlikely, no direct impacts would occur. Although there are no known Native American resources in the corridor, there have been no field ethnographic studies. If DOE selected this corridor, this assessment of the potential for such impacts would have to wait until the completion of field studies involving Native Americans.

Operations. As stated in Section 6.3.2.1, additional impacts to these resources during the operation of the branch rail line would be unlikely.

6.3.2.2.3.5 Caliente-Chalk Mountain Rail Occupational and Public Health and Safety

Construction. Industrial safety impacts on workers from the construction and use of the Caliente-Chalk Mountain branch rail line would be small (Table 6-54). The analysis evaluated the potential for impacts in terms of total reportable cases of injury, lost workday cases, and fatalities to workers and the public from construction and operation activities. The analysis also evaluated traffic fatality impacts that would occur in moving equipment and materials for construction, worker commutes to and from construction sites, and transport of water to construction sites if wells were not available. Table 6-55 lists these results.

Table 6-54. Impacts to workers from industrial hazards during rail construction and operations for the Caliente-Chalk Mountain Corridor.

Group and industrial hazard category	Construction[a]	Operations[b]
Involved workers		
Total recordable cases[c]	79	95
Lost workday cases	39	52
Fatalities	0.11	0.26
Noninvolved workers		
Total recordable cases	4.8	5.4
Lost workday cases	1.8	2.0
Fatalities	0.005	0.006
Totals[d]		
Total recordable cases	84	100
Lost workday cases	41	54
Fatalities	0.12	0.27

a. Totals for 43 months for construction.
b. Totals for 24 years for operations.
c. Total recordable cases includes injury and illness.
d. Totals might differ from sums due to rounding.

Operations. Incident-free radiological impacts would occur during the routine transportation of spent nuclear fuel and high-level radioactive waste in the Caliente-Chalk Mountain rail corridor.

Table 6-56 lists the incident-free impacts, which include transportation along the corridor and along railways in Nevada leading to a Caliente-Chalk Mountain branch line. The table includes the impacts of 1,079 legal-weight truck shipments from commercial sites that do not have the capability to load rail casks while operational.

6.3.2.2.3.6 Caliente-Chalk Mountain Rail Socioeconomics

The following paragraphs discuss potential socioeconomic impacts associated with the construction and operation of a branch rail line in the Caliente-Chalk Mountain Corridor.

Table 6-55. Estimated number of fatalities from construction material delivery vehicles and construction and operations worker commuting traffic for the Caliente-Chalk Mountain Corridor.

Activity	Kilometers[a]	Traffic fatalities	Emissions fatalities
Construction[b]			
Material delivery vehicles	14,000,000	0.2	0.03
Commuting workers	61,000,000	0.6	0.08
Subtotals	*75,000,000*	*0.8*	*0.11*
Operations[c]			
Commuting workers	68,000,000	0.7	0.09
Totals	***140,000,000***	***1.5***	***0.2***

a. To convert kilometers to miles, multiply by 0.62137.
b. Totals for 43 months for construction.
c. Totals for 24 years for operations.

Table 6-56. Health impacts from incident-free Nevada transportation for the Caliente-Chalk Mountain implementing alternative.[a]

Category	Legal-weight truck shipments	Rail shipments	Totals[b]
Involved workers			
Collective dose (person-rem)	38	700	740
Estimated latent cancer fatalities	0.02	0.28	0.3
Public			
Collective dose (person-rem)	7	12	18
Estimated latent cancer fatalities	0.003	0.01	0.01
Estimated vehicle emission-related fatalities	0.002	0.0055	0.0071

a. Impacts are totals for 24 years.
b. Totals might differ from sums of values due to rounding.

Construction. The length of the Caliente-Chalk Mountain Corridor, 345 kilometers (214 miles), would determine the number of workers required. The construction of a branch rail line in this corridor would require workers laboring for approximately 2 million hours or about 1,000 worker-years over a 43-month construction period. The route would require four construction camps to house workers temporarily (DIRS 154822-CRWMS M&O 1998, all).

Employment

Estimated employment in the region of influence attributable to the construction of a Caliente-Chalk Mountain branch rail line, would peak in 2007 at about 647 jobs. Clark County would supply approximately 569 of the workers and Nye County would supply about 22. These additional workers would represent an increase of less than 1 percent of the Clark and Nye County employment baselines. About 56 individuals would work in Lincoln County, adding about 2.3 percent to employment in the county. DOE anticipates changes in Lincoln County's employment would be primarily the result of indirect employment caused by the presence of transient construction workers. Employment of Caliente-Chalk Mountain Corridor construction workers and some indirect support workers would end in 2009. As a result, the projected total growth (2009 to 2010) of 15,240 jobs in the region of influence would be reduced by 612. The expected addition of 14,886 jobs in Clark County would be reduced by 594, and the expected growth of 330 jobs in Nye County would be reduced by 17. The expected growth of 24 jobs in Lincoln County would be reduced by 1. DOE anticipates that project-related workers not moving to Caliente-Chalk Mountain Corridor operational jobs would be absorbed in other work in the State. These changes in employment would represent less than 1 percent of the applicable baselines.

Population

Population increases in the region of influence attributable to the construction of a Caliente-Chalk Mountain rail line would peak in 2009 at 589 persons. Clark County would gain about 527 residents, Nye County about 24, and Lincoln County about 38. The increase in population would be less than 1 percent of the baselines for Clark, Nye, and Lincoln Counties. Because the change in the population, relative to the population baselines, would be small and transient in Clark, Nye, and Lincoln Counties, impacts to housing or schools would be unlikely.

Economic Measures

The expected peak year changes in economic measures in the region of influence attributable to a branch rail line in the Caliente-Chalk Mountain Corridor would be increases of $18.6 million in real disposable income in 2009; $30.9 million in Gross Regional Product in 2007; and $2.1 million in State and local expenditures in the last year of construction, 2009. More than 93 percent of the real disposable income and Gross Regional Product would accrue to Clark County, which would experience about 78 percent of the additional spending by State and local governments. Lincoln County would gain slightly less than 4.6 percent of the change in real disposable income, 3.7 percent of the change in Gross Regional Product, and 16 percent of the expenditures by State and local governments. The increases in each economic measure would be less than 1 percent of the baseline in each affected county, except the increase of expenditures by State and local governments in Lincoln County would be 1.1 percent. (Dollar values reported in this section are in 2001 dollars unless otherwise stated.)

Transition and Operations Period. A period of slightly slower growth in employment in the region of influence would occur from 2010 to 2012. Following this period, employment to operate a Caliente-Chalk Mountain branch rail line would stimulate growth in the region. Growth in employment in the region of influence during the transitional period would average 19 fewer jobs than would occur without a Caliente rail line. Clark County would absorb the entire slower rate of growth, with an average of 82 fewer jobs. The Clark County employment baseline would average about 1 million during this period. Nye County would gain an average of 5 jobs and Lincoln County would gain 57 jobs during this period. The job gain in Lincoln County would represent a 2.2-percent average increase over the employment baseline in the 3-year period. The employment gain in Nye County would be less than 1 percent. A Caliente-Chalk Mountain rail line would contribute to the growth in residential population throughout the transition period and into the employment base after 2012.

Employment and Population

Estimated direct employment to operate a Caliente-Chalk Mountain rail line would be 47 jobs. Increased total employment in the region of influence would average about 78 jobs over the 24-year operations period (2010 to 2033). The majority, 57, would work in Lincoln County. The increases in Lincoln County employment attributable to a Caliente-Chalk Mountain branch rail line would be 2.1 percent of the baseline. On average, 14 jobs would be created in Clark County and 6 in Nye County. The change in the population in the region from the operation of a Caliente-Chalk Mountain branch line would average about 290 persons. DOE anticipates that 99 of these individuals would settle in Lincoln County, representing a 2.1-percent increase of the population baseline for the County. An additional 171 would live in metropolitan Clark County and represent less than 1 percent of the County's population baseline. The remaining individuals would live in Nye County and would affect the community by less than 1 percent. There would be no impacts to the school system or the housing market in Clark or Nye Counties. The increase in population in Lincoln County would add an average of about 22 students a year to the rolls of the school system. There would be no impact to housing in Lincoln County given the high housing vacancy rate in the County (see Chapter 3, Section 3.1.7.4).

Economic Measures

The estimated average, real disposable income increase attributable to the operation of a Caliente-Chalk Mountain branch rail line in the three-county region of influence would be $4.7 million per year. Contributions to real disposable personal income would range from $3.2 million in the early years of operation to $5.6 million in the last year. The annual increase in Gross Regional Product would average $4.6 million. On average, changes in real disposable income would exceed changes in Gross Regional Product. The increases in annual State and local government expenditures would average $1.6 million. The average impacts to real disposable income, Gross Regional Product, and State and local government expenditures from operating a Caliente-Chalk Mountain branch rail line would be less than 1 percent of the baselines for Clark and Nye Counties.

In Lincoln County, the changes in real disposable income and Gross Regional Product of operating a Caliente-Chalk Mountain branch rail line would range from about 1.7 percent for real disposable income to 2.6 percent for Gross Regional Product. State and local government spending would be higher by about 2.5 percent of the baseline. Workers associated with a Caliente-Chalk Mountain branch rail line would purchase many goods and services in the Lincoln County community. These dollars would continue to circulate largely within the area creating a positive economic impact. These impacts would not exceed historic short-term changes in the various socioeconomic measures.

DOE performed a detailed analysis was for the Caliente-Chalk Mountain Corridor. The results of this analysis, driven by the length of the Corridor, is representative of the potential variations (options and alternates) listed in Appendix J, Section J.3.1.2. The lengths of the variations are similar to those listed in Table 6-48.

In addition, DOE analyzed a sensitivity case that assumed all Lincoln County socioeconomic impacts would occur only in the City of Caliente. Under this assumption, City population would rise by 3 percent during construction and by 6.9 percent during operations. Employment would rise by about 5 percent during construction and about 7.2 percent during operations. If DOE selected this rail corridor, it would initiate additional engineering and environmental studies (including socioeconomic analyses); consult with Federal, State of Nevada, Native American, and local governments; and perform additional National Environmental Policy Act reviews as a basis for constructing and operating a Caliente-Chalk Mountain Corridor.

6.3.2.2.3.7 Caliente-Chalk Mountain Rail Noise and Vibration

Over most of its length, the Caliente-Chalk Mountain Corridor passes through undeveloped land managed by the Bureau of Land Management where human inhabitants are mostly isolated ranchers and persons involved with outdoor recreation. Almost half of the corridor's length is on the Nellis Air Force Range and Nevada Test Site, where there is little potential for noise impacts. The Caliente and Caliente-Chalk Mountain Corridors are the same in most of Lincoln County and in the northeastern part of Nye County. The Towns of Caliente and Panaca are along the eastern end of the corridor. This corridor includes the Caliente Option, Eccles Option, and Crestline Option as starting points; these are fairly remote from any rural communities.

The five variations on restricted government land (see Appendix J, Section J.3.1.2), the White River Alternate, and the Garden Valley Alternate would not affect rural communities. The variations outside restricted government land pass through areas that are farmed. Hence, some rural residences in this area could fall within the region of influence for noise.

None of the communities along the Caliente-Chalk Mountain Corridor and its nine variations (see Appendix J, Section J.3.1.2), with the exception of Caliente, would be close enough to the rail line for noise impacts to approach the noise guidelines of 50 dBA for evenings and 60 dBA during the day (Table 6-57). The Caliente Option for connecting to the Union Pacific Railroad mainline would follow an old railroad bed through the center of the Town of Caliente. Noise levels in Caliente would not differ much from existing background noise levels associated with normal rail traffic through the community. Noise levels associated with waste shipments would occur at most three times a day and probably not in a given hour. Where a branch rail line passed through Caliente, train speed would be reduced for safety and noise levels would be minimized. Traffic could be delayed at one traffic crossing in the Town of Caliente. Adverse community response to the added rail noise would be unlikely because of the long-term presence of railroad traffic in Caliente, the short trains associated with the transport of waste shipments, and the low frequency of rail shipments to and from the site.

The estimated population residing within 2 kilometers (1.3 miles) of the Caliente-Chalk Mountain Corridor in 2035 would be about 28 persons.

Vibration. Except for the historic railroad station in Caliente, which is near the existing Union Pacific Railroad mainline, the branch rail line in the Caliente-Chalk Mountain Corridor and associated variations would be sufficiently distant from historic structures, cultural ruins, and buildings to preclude building damage as a result of ground vibration. Vibration levels at reduced train speeds would be unlikely to damage the Caliente Railroad station. Moreover, the vibrations added by the relatively few trains carrying waste to Yucca Mountain at slow speeds would not add appreciably to the total vibration to

Table 6-57. Estimated propagation of noise from the operation of a waste transport train with two locomotives in communities near the Caliente-Chalk Mountain Corridor.

Corridor[a]/community	Distance (kilometers)[b]	Noise (dBA)[c]
Caliente Option		
Caliente	0	>90 at 15 meters[d]
Panaca	6[e]	26.0
Crestline Option		
Panaca	4.5[e]	26.3
Eccles Option		
Caliente	6.5[e]	<26[f]
Rachel	>20[e]	<26

a. The White River, Garden Valley, Mercury Highway, Topopah, Mine Mountain, Area 4, and Orange Blossom Road variations occur on Nellis Air Force Range or Nevada Test Site lands, too far from any community to cause noise impacts.
b. To convert kilometers to miles, multiply by 0.62137.
c. Estimated values do no include noise loss due to interactions with the ground that could account for decreases in estimated noise levels of from 10 to 20 dBA at 100 meters (330 feet) from the tracks.
d. 15 meters = 49 feet.
e. Noise estimates at distances greater than 2 kilometers (1.2 miles) have large uncertainty.
f. At these distances, the A-weighted sound pressure level is dominated by lower frequencies (less than 63 hertz) and would not be distinguishable from normal background levels of noise.

which the station is exposed from commercial trains that pass through Caliente. The small number of trips (three per day) and the small train size would result in low levels of rail-induced ground vibration.

6.3.2.2.3.8 Caliente-Chalk Mountain Rail Utilities, Energy, and Materials

Table 6-58 lists the use of fossil fuels and other materials in the construction of a Caliente-Chalk Mountain branch rail line.

Table 6-58. Construction utilities, energy, and materials for a Caliente-Chalk Mountain branch rail line.

Length (kilometers)[a]	Diesel fuel use (million liters)[b]	Gasoline use (thousand liters)	Steel (thousand metric tons)[c]	Concrete (thousand metric tons)[c]
340 - 370	32 - 36	610 - 680	47 - 52	280 - 310

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. To convert metric tons to tons, multiply by 1.1023.

6.3.2.2.4 *Jean Corridor Implementing Alternative*

The Jean Corridor originates at the existing Union Pacific mainline railroad near Jean, Nevada. It travels northwest, passing near the Towns of Pahrump and Amargosa Valley before reaching the Yucca Mountain site. The Jean Corridor is about 181 kilometers (114 miles) long from its link at the Union Pacific line to the site. Variations of the route range from 181 to 204 kilometers (112 to 127 miles). Figure 6-18 shows this corridor along with possible variations identified by engineering studies (DIRS 154822-CRWMS M&O 1998 p. 1, Item 6; see Appendix J, Section J.3.1.2). The corridor variations provide flexibility in addressing engineering, land-use, or environmental resource issues that could arise in a future survey along the corridor. This section addresses impacts that would occur along the corridor shown in Figure 6-18. With the exception of differences identified in Appendix J, Section J.3.1.2, the impacts would be generally the same among the possible corridor variations.

The construction of a branch rail line in the corridor would require approximately 43 months. Construction would take place simultaneously at a number of locations. An estimated two construction camps would be established at roughly equal distances along the corridor. These camps would provide temporary living accommodations for construction workers and construction support facilities. A train would take about 4 hours to travel from the junction with the Union Pacific mainline to a Yucca Mountain

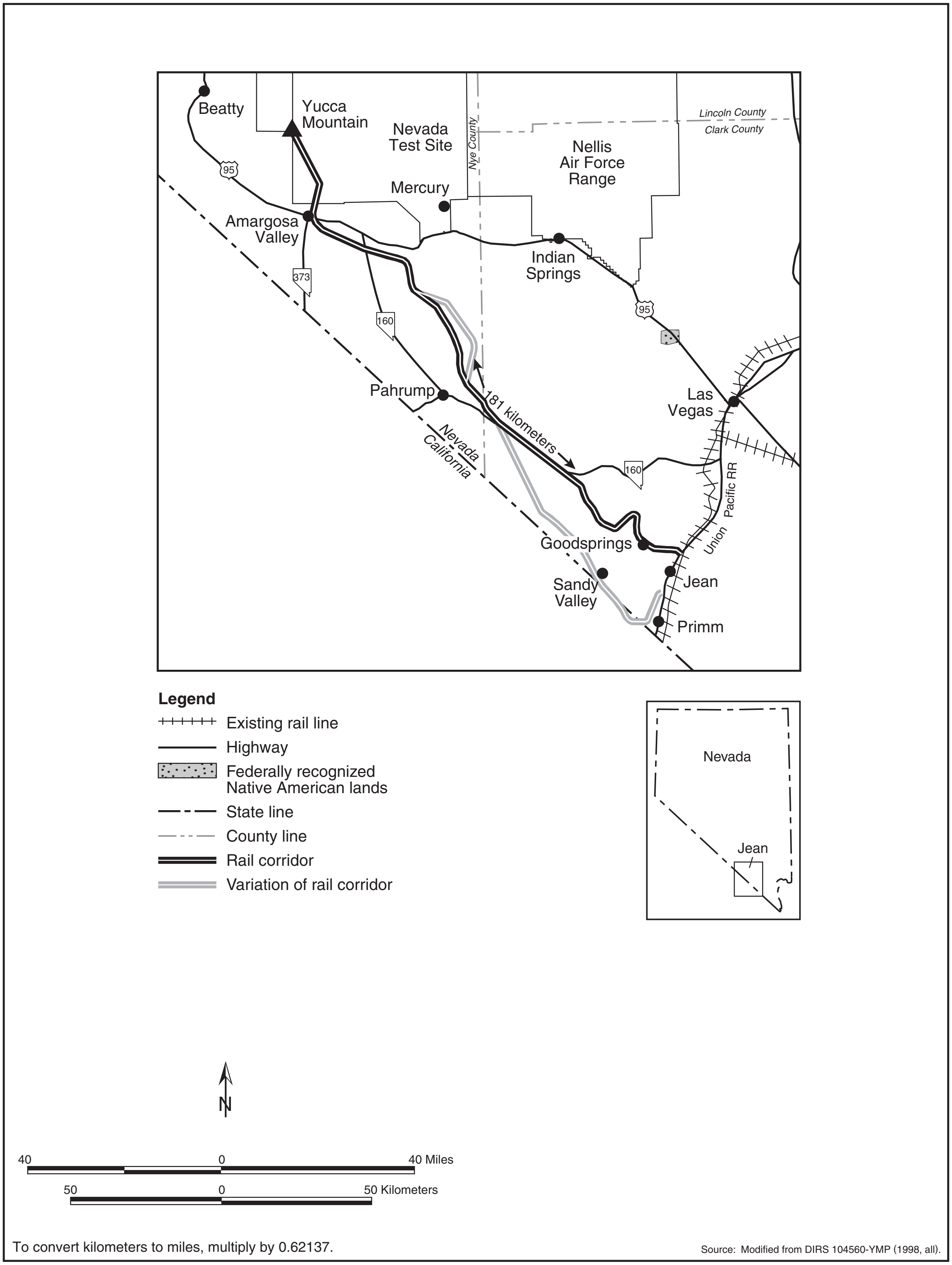


Figure 6-18. Jean Corridor.

Repository on a Jean branch rail line (DIRS 101214-CRWMS M&O 1996, Volume 1, Section 4, Branch Rail Operations Plan). The estimated life-cycle cost to construct and operate a branch rail line in the Jean Corridor would be $462 million in 2001 dollars.

The following sections address impacts that would occur to land use; biological resources and soils; cultural resources; hydrology, including surface water and groundwater; occupational and public health and safety; socioeconomics; noise and vibration; aesthetics; and utilities, energy, and materials. Impacts that would occur to air quality and waste management would be the same as those discussed in Section 6.3.2.1 and are, therefore, not repeated here. Section 6.3.4 discusses the potential for transportation activities to cause environmental justice impacts in Nevada.

6.3.2.2.4.1 Jean Rail Land Use and Ownership

Table 6-59 summarizes the amount of land required for the Jean Corridor, its ownership, and the estimated amount of land that would be disturbed, as well as ranges for the variations. Table 6-60 summarizes the amount of land required for the Jean Corridor variations and its ownership.

Table 6-59. Land use in the Jean Corridor.[a]

Factor	Corridor (percent)	Range due to variations
Corridor length (kilometers)[b]	181	181 - 204
Land area in 400-meter[c]*-wide corridor (square kilometers)*[d]	72 (100)	72 - 82
Land ownership in 400-meter-wide corridor (square kilometers)		
Bureau of Land Management	60 (83)	60 - 69
Air Force	None	None
DOE	8.5 (12)	8.5 - 8.5
Private	3.5 (5)	0.1 - 3.5
Other	None	None
Land area in 60-meter[e] *right-of-way (square kilometers)*	10.9	10.8 - 12.2
Disturbed land (square kilometers)		
Inside 60-meter right-of-way	6.6	6.6 - 7.4
Outside 60-meter right-of-way	2.6	2.6 - 2.9

a. Source: DIRS 155549-Skorska (2001, all).
b. To convert kilometers to miles, multiply by 0.62137.
c. 400 meters = about 0.25 mile.
d. To convert square kilometers to acres, multiply by 247.1.
e. 60 meters = 200 feet.

Table 6-60. Variations in the Jean Corridor.[a]

Variation	Length (kilometers)[b]	Area in variation (square kilometers)[c]	Land ownership [square kilometers (percent)]	
			Bureau of Land Management	Private
Wilson Pass Option	73.5	29.4	29.4 (99.98)	0.01 (0.02)
Pahrump Valley Alternate	32.1	12.8	12.7 (99.2)	0.1 (0.8)
Stateline Pass Option	91.9	36.8	36.79 (99.97)	0.01 (0.03)

a. Source: DIRS 155549-Skorska (2001, all).
b. To convert kilometers to miles, multiply by 0.62137.
c. To convert square kilometers to acres, multiply by 247.1.

Construction. The Jean Corridor (Wilson Pass Option) crosses eight Bureau of Land Management grazing allotments (Mount Stirling, Spring Mountain, Stump Springs, Table Mountain, Wheeler Wash, and three unnamed and unallotted areas); two wild horse and burro herd management areas (both in Pahrump Valley); the Old Spanish Trail/Mormon Road special recreation management area; and four areas designated as available for sale or transfer. It also crosses several telephone, pipeline, highway, and power line rights-of-way. The corridor is within 1.6 kilometers (1 mile) of the Toiyabe National Forest and three mines (Bluejay, Snowstorm, and Pilgram). The Wilson Pass Option also passes through Bureau of Land Management Class II lands in the vicinity of Wilson Pass in the Spring Mountains, potentially affecting the recreational use of this area.

The Stateline Pass Option origination location along an existing Union Pacific rail line conflicts directly with lands set aside for the proposed Ivanpah Valley Airport under the Ivanpah Valley Airport Public Lands Transfer Act (Public Law 106-362, 114 Stat. 1404). The Stateline Pass Option crosses the California-Nevada boundary line along Bureau of Land Management lands and passes near the Stateline Wilderness Area established by the California Desert Conservation Act. Construction activities could affect recreational use of the Stateline Wilderness Area. Impacts would be similar to the construction impacts discussed in Section 6.3.2.1. Corridor variations are listed in Appendix J, Section J.3.1.2. Impacts common to the rail implementing alternates are discussed in Section 6.3.2.1. The following paragraphs discuss impacts unique to this corridor.

The transfer of land from Bureau of Land Management for the Ivanpah Valley Airport would require DOE to realign the Stateline Pass Option for constructing a branch rail line.

Construction activities could affect the Old Spanish Trail/Mormon Road special recreation management area. Ease of access from one portion of the management area to the other would be reduced. These impacts could be mitigated by providing access to connect the parcels separated by the railroad right-of-way.

In the vicinity of Pahrump, Nevada, a branch rail line in the Jean Corridor would pass through approximately 9 kilometers (5.5 miles) of private property. As discussed in Section 6.3.2.1, DOE would have to make arrangements with owners to use this land. As indicated in Appendix J, Section J.3.1.2, the North Pahrump Alternate includes no private property. The North Pahrump Alternate would abut a Bureau of Land Management utility corridor and a section of the Toiyabe National Forest and could affect access to these recreational areas.

During the construction and operation and monitoring phases of the Proposed Action, there would be a potential for encroachment of the Jean Corridor by private interests. If encroachment occurred, conflicts could result as impediments to the full use of the land. Areas most likely for use by private interests are those already privately owned in the vicinity of Pahrump and those that are currently designated for sale or transfer by the Bureau of Land Management.

If DOE decided to build and operate a branch rail line in the Jean corridor, it would consult with the Bureau of Land Management and other affected agencies and with Native American tribal governments to help ensure that it avoided or mitigated potential land-use conflicts associated with alignment of a right-of-way.

Although there are no known community development plans that would conflict with the rail line, the presence of a rail line could influence future development and land use along the railroad in the communities of Amargosa Valley, Goodsprings, Jean, Johnnie, and Pahrump (that is, zoning and land use might differ depending on the presence or absence of a railroad). Construction of a branch rail line within the Jean corridor would require conversion of land within wild horse or wild horse and burro management areas; however, because the railroad would be unlikely to interfere with animal movements, the functionality of these areas would not be affected.

Operations. As with the other corridors, DOE expects the operation of a branch rail line in the corridor to cause fewer impacts than construction. Impacts due to rail operations would be similar to those described in Section 6.3.2.1.

6.3.2.2.4.2 Jean Rail Hydrology

Surface Water

Chapter 3, Section 3.2.2.1.3, notes that there are no surface-water resources along the Jean Corridor, including its variations.

Table 6-61 lists flood zones identified along the Jean Corridor and its variations. The Federal Emergency Management Agency maps from which DOE derived the flood zone information provided coverage for 90 percent of the corridor length. This corridor would cross seven 100-year flood zones or flood-zone groups before entering the Nevada Test Site. One of the two variations would increase the number of flood zones crossed by 1; the other segment would have no change. As indicated in Section 6.3.2.1, impacts associated with altering drainage patterns or changing erosion and sedimentation rates or locations would be minor and localized.

Table 6-61. 100-year flood zones crossed by the Jean Corridor and its variations.[a,b]

Corridor portion	Crossing distance (kilometers)[c]	Flood zone feature(s)	Avoided by variation[d] (Yes or No)
Jean to Yucca Mountain	0.6	Three tributaries leading to Roach Lake (intermittent)	Y-2
	0.7	Lovell Wash with drainage (intermittent)	Y-2
	0.4	Two unnamed washes northwest of Lovell Wash	N
	4.1	Peak Springs Alluvial Fan (dry)	N
	1.9	Wheeler Wash (dry)	N
	0.3	Wash drainage leading to Alkali Flats (dry)	N
	0.1	Rock Valley Wash (intermittent)	N
Variations			
1. Pahrump Valley Alternate	None	Located northeast of corridor.	
2. Stateline Pass Option	0.4	Crosses two tributaries to Roach Lake (dry).	
	0.8	Crosses Potasi Wash, an unnamed wash, and Lovell Wash drainage.	
	1.1	Crosses four unnamed washes and Peak Springs Fan (intermittent).	

a. Areas where natural floodwater movement could be altered and where erosion and sedimentation rates and locations could change. Sources:
   1. Federal Emergency Management Agency Flood Insurance Rate Maps for Clark and Nye Counties, Nevada.
   2. DIRS 154961-CRWMS M&O (1998, all).

b. About 10 percent of the Jean Corridor is not available on Federal Emergency Management Agency maps because a portion of the route is on the Nevada Test Site.

c. To convert kilometers to miles, multiply by 0.62137.

d. Certain 100-year flood zones can be avoided by alternative corridor segments. These are identified with a "Y" (yes) and a number representing the variation(s) that avoid the specific flood zone. The same flood zone might be crossed by both the corridor and variations at different locations. In such cases, the feature will be marked "Avoided" for the corridor route, but will appear again for the variation.

Groundwater

Construction. The water used during construction would come largely from groundwater resources. The annual demands would be a fraction of the perennial yields of most producing aquifers (Chapter 3, Section 3.2.2.1.3, discusses estimated perennial yields for the hydrographic areas over which the Jean Corridor passes).

The estimated amount of water needed for construction of a rail line in the corridor for soil compaction, dust control, and workforce use would be about 500,000 cubic meters (410 acre-feet) (DIRS 104914-DOE 1998, all). For planning purposes, DOE assumed that this water would come from 23 wells installed along the corridor. The average amount of water withdrawn from each well would be approximately 22,000 cubic meters (18 acre-feet). Most (89 percent) of the water would be used for compaction of fill material. The estimate of fill quantities needed for construction would vary if DOE used a variation. Use of the Pahrump Valley Alternate or Stateline Pass Option would involve an increase in fill material (over that required for the corridor) and would increase the total water demand by 12 or 27 percent, respectively.

Chapter 3, Section 3.2.2.1.3, discusses the hydrographic areas over which the corridor would pass, their perennial yields, and whether the State of Nevada considers each a Designated Groundwater Basin. If the hydrographic area is a Designated Groundwater Basin, permitted groundwater rights approach or exceed the estimated perennial yield, depleting the basin and water resources or requiring additional administration. Table 6-62 summarizes the status of the hydrographic areas associated with the Jean Corridor and the approximate portion of the corridor that passes over Designated Groundwater Basins. The use of variations would change the number of hydrographic areas crossed, but would have no effect on the portion of the corridor crossing Designated Groundwater Basins.

Table 6-62. Hydrographic areas along the Jean Corridor and its variations.

		Designated Groundwater Basins	
Description	Hydrographic areas	Number	Percent of corridor length
Jean Corridor	7	5	90
With Stateline Pass Option	6	4	90
With Pahrump Valley Alternate	7	5	90

The withdrawal of 22,000 cubic meters (18 acre-feet) a year from a well would have little impact on the hydrographic areas associated with the corridor based on their perennial yields (Chapter 3, Section 3.2.2.1.3). However, the installation of 23 wells along the corridor would mean that several of the hydrographic areas would have multiple wells. As indicated in Table 6-62, about 90 percent of the corridor length is over Designated Groundwater Basins, which the Nevada State Engineer's office watches carefully for groundwater depletion. This does not mean that DOE could not obtain water appropriations in these areas; the State Engineer would have the authority to approve such appropriations. Because the DOE requests would be for a short-term construction action, the State Engineer would have even more discretion. Rather than spacing the wells evenly along the corridor, DOE could use locations that would make maximum use of groundwater areas that are not Designated Groundwater basins. With such a large portion of the corridor over these basins, however, this would mean trucking water for long distances. Another option would be to lease temporary water rights from individuals along the corridor. Obtaining a water appropriation from the State Engineer for short-term construction use or using an approved allocation should ensure that groundwater resources are not adversely affected.

As an alternative, DOE could transport water by truck to meet construction needs. The construction of a branch rail line in the Jean corridor would require about 27,000 tanker-truck loads of water or about 14 truckloads each day for each work camp area along the corridor. Again, water obtained from permitted sources, which would provide water within allocations determined by the Nevada State Engineer, would not affect groundwater resources.

Operations. Operations along a completed rail line would have little impact on groundwater resources. Possible changes in recharge, if any, would be the same as those at the completion of construction.

6.3.2.2.4.3 Jean Rail Biological Resources and Soils

Construction. The construction of a branch rail line in the Jean Corridor would disturb approximately 9.3 square kilometers (2,300 acres) of land (Table 6-59). The analysis assumed that the types of land cover in disturbed areas outside the corridor would be the same as that within the corridor. Table 6-63 compares the approximate area of disturbance in each land-cover type along all variations of the Jean Corridor to the area in each land-cover type in Nevada. In addition, the table lists the percentage of the area that would be disturbed. The fraction disturbed for each cover type would be very small. The disturbance would not have a discernible impact on any land-cover type. Although some alignment variations could lead to a small increase in the total amount of land disturbed, the portion of the corridor, including its variations, in each land-cover type would be similar to that in the unvaried corridor.

Table 6-63. Maximum area disturbed (square kilometers)[a] in each land-cover type for the Jean Corridor.[b,c]

Land-cover type	Wilson Pass Option: Percent of corridor length	Wilson Pass Option: Land area	Stateline Pass Option: Percent of corridor length	Stateline Pass Option: Land area	Area in Nevada	Percent disturbed
Agriculture	0	0	0	0	5,200	0
Blackbrush	18.4	1.69	0.1	0.01	9,900	0.017
Creosote-bursage	58.6	5.39	80.8	8.32	15,000	0.055
Grassland	0	0	0	0	2,800	0
Greasewood	0	0	0	0	9,500	0
Hopsage	0	0	0	0	630	0
Juniper	0	0	0	0	1,400	0
Mojave mixed scrub	21.1	1.94	14.6	1.5	5,600	0.035
Pinyon-juniper	0	0	0	0	15,000	0
Playa	0	0	0	0	7,000	0
Sagebrush	0	0	0	0	67,000	0
Sagebrush/grassland	0	0	0	0	52,000	0
Salt desert scrub	2	0.18	1.8	0.19	58,000	<0.001
Urban	ND[d]	ND	ND	ND	2,400	ND
Total[e]	100	9.2	97.3[f]	10	250,000	N/A[g]

a. To convert square kilometers to acres, multiply by 247.1.
b. Based on the proportion of the route in each land-cover type; percent disturbed was based on the variation with the greatest disturbance within a particular land-cover type. Percentages add to more than 100 because maximum values were used.
c. Source: DIRS 104593-CRWMS M&O (1999, Appendix D).
d. ND = not determined.
e. Totals might differ from sums of values due to rounding.
f. About 2.7 percent of land would be in California for the proposed Jean corridor with the Stateline Pass Option.
g. N/A = not applicable.

The Jean Corridor, including its variations passes through desert tortoise habitat along its entire length, so construction activities would disturb approximately 9.3 square kilometers (2,300 acres) of desert tortoise habitat, some of which is designated as critical habitat. Construction activities could kill individual desert tortoises, and the presence of a rail line could disrupt movements of individuals. The abundance of tortoises is low along much of this corridor; however, some areas in the Ivanpah, Goodsprings, Mesquite, and Pahrump Valleys have higher abundance (DIRS 101521-BLM 1992, Map 3-13; DIRS 101914-Rautenstrauch and O'Farrell 1998, pp. 407 to 411). DOE anticipates that losses would be few and would be unlikely to affect the regional population of the desert tortoise. Relocation of tortoises along the corridor prior to construction would minimize losses of individuals. DOE would consult with the Fish and Wildlife Service (under Section 7 of the Endangered Species Act) in relation to this species if it selected this corridor and would implement all terms and conditions required by the Fish and Wildlife Service.

Two populations of Pinto beardtongue (a Bureau of Land Management sensitive species) occur in the corridor and could be affected directly or indirectly by land-clearing activities. The locations of these populations would be identified though surveys prior to disturbance and would be avoided to the extent possible. No populations of sensitive species occur in the Stateline Pass Option.

There are 33 populations of seven sensitive plant species outside the 400-meter (0.25-mile)-wide corridor, but within 5 kilometers (3 miles) of the corridor. Thirteen populations of five sensitive plant species are outside the corridor but within 5 kilometers of the Stateline Pass Option. These populations would not be affected because land disturbance would not extend to these areas. Changes in the aquatic or soil environment in these areas as a result of construction would be unlikely.

Ten designated game habitat areas for bighorn sheep, mule deer, or quail occur within the corridor and 16 areas occur within 5 kilometers (3 miles) of the corridor. The Stateline Pass Option avoids five of the designated game habitat areas in the corridor.

The Wilson Pass Option crosses three Herd Management Areas for wild horses and burros (DIRS 104593-CRWMS M&O 1999, p. 3-29). The Stateline Pass Option would avoid two of these areas. Construction activities in these areas would result in the loss of a small amount of habitat and probably would disturb animals or their movements for the duration of the activities.

No springs, perennial streams, or riparian areas occur in the Jean Corridor. Eleven springs or groups of springs are outside the corridor, but within 5 kilometers (3 miles) of the corridor. Impacts to biological resources associated with these areas are not anticipated. The corridor crosses a number of ephemeral streams that may be classified as waters of the United States, although formal delineations have not been made (DIRS 104593-CRWMS M&O 1999, p. 3-29). DOE would work with the U.S. Army Corps of Engineers to minimize impacts to these areas and would obtain individual or regional permits if necessary. The Department anticipates some changes to local drainage along the potential branch rail line and would design the rail line to accommodate existing drainage patterns.

Soils in and adjacent to the corridor would be disturbed on approximately 9.3 square kilometers (2,300 acres) of land during construction of a railroad. Impacts to soils in the corridor, including its variations [6.5 square kilometers (1,600 acres)], would be small, but could occur throughout construction. However, several soil characteristics could influence construction activities and the amount of area disturbed. Soils susceptible to wind erosion occur along much of the corridor and its variations (see Chapter 3, Section 3.2.2.1.4.). Soils considered to be highly susceptible to water erosion and having poor stability characteristics are also present, but along much smaller portions of the corridor. Disturbance of erodible soils could lead to increased silt loads in water courses or increased soil transport by wind. Erosion control during construction and revegetation, or other means of soil stabilization after construction, would minimize these concerns. The presence of soils with poor (that is, high) shrink-swell and stability characteristics could influence the amount of area disturbed by construction if soils from outside areas had to be brought in for replacement or mixing with native soil. The source of suitable fill material and the land area that would be disturbed in obtaining the material is presently unknown, so the potential for impacts to soils and biological resources associated with the borrow areas cannot be determined.

Soils classified as unstable fill also occur along portions of the Jean corridor, including its variations. The amount of land disturbance in the corridor for stabilization of a rail line and outside the corridor at the source of fill material could increase due to the presence of these soils. The source of suitable fill material and the land area that would be disturbed in obtaining the material is unknown at present, so DOE cannot determine the potential for impacts to soils and biological resources associated with the borrow areas.

As stated in Chapter 3, Section 3.2.2.1.4, variations identified for the Jean Corridor could avoid some biological resources, as listed in Table 6-64.

6.3.2.2.4.4 Jean Rail Cultural Resources

Construction. The Jean Corridor passes through the Goodsprings and Johnnie historic mining districts, and intersects the historic Yellow Pine Mining Company Railroad grade. In the southern part of the Pahrump Valley, the corridor, including the Wilson Pass and Stateline Options, crosses the Old Spanish Trail, which is under consideration for designation as a National Historic Trail. Based on Bureau of Land Management resource planning, both the Goodsprings and Pahrump Valleys are expected to contain fairly high numbers of potentially significant archaeological and historic sites. Precise impacts from rail line construction activities would be identified after completion of a cultural resource study of the corridor.

Table 6-64. Biological resources avoided by Jean Corridor variations.[a]

Alignment variation resource	Occurrence of resource: For unvaried segment of corridor: In corridor[b]	Within 5 km[c]	Occurrence avoided by variation: In corridor	Within 5 km
Stateline Pass Variation				
Sensitive species				
Allen's big-eared bat	0	1	0	1
Desert bearpoppy	0	3	0	1
Fringed myotis	0	1	0	1
Gila monster	0	1	0	1
Long-legged myotis	0	1	0	1
Pinto beardtongue	2	18	2	17
Sheep fleabane	0	1	0	1
Spring Mountain milkvetch	0	2	0	2
Townsend's big-eared bat	0	1	0	1
White-margined beardtongue	0	5	0	3
Yuma myotis	0	1	0	1
Game habitat				
Bighorn sheep–crucial	1	1	1	1
Bighorn sheep–migration corridor	2	0	1	0
Bighorn sheep-winter	1	7	0	3
Chukar–crucial	1	0	1	0
Mule deer–summer crucial	0	2	0	1
Mule deer–winter	2	2	1	1
Quail–crucial	3	4	1	3
Springs or groups of springs	0	11	0	5
Herd Management Units	3	0	2	0

a. Variations listed are those that would result in the avoidance of biological resources along the corridor.
b. In the corridor [or springs within 400 meters (0.25 mile)], but avoided by the corridor variation.
c. Within 5 kilometers (3 miles) of the corridor, but more than 5 kilometers from the corridor variation.

Archaeological site file searches for the Jean Corridor and its variations (Appendix J, Section J.3.1.2) revealed six recorded archaeological sites, four of which have been evaluated as being not eligible for the *National Register of Historic Places.*

There are no known Native American resources in this corridor, although the corridor passes through the traditional homelands of the Pahrump Paiute Band. In the early historic period, there were several village sites in the northern area at the base of the Spring Mountains; a branch rail line could affect some of these locations. Pending completion of field ethnographic studies, there could be other sites or resources of importance to Native Americans along this corridor that rail construction activities could affect.

Operations. As stated in Section 6.3.2.1, additional impacts to these resources during the operation of the branch rail line would be unlikely.

6.3.2.2.4.5 Jean Rail Occupational and Public Health and Safety

Construction. Industrial safety impacts on workers from the construction and use of the Jean branch rail line would be small (Table 6-65). The analysis evaluated the potential for impacts in terms of total reportable cases of injury, lost workday cases, and fatalities to workers from construction and operation activities. The analysis also evaluated traffic fatality impacts that would occur during the moving of equipment and materials for construction, worker commutes to and from construction sites, and transport of water to construction sites if wells were not available. Table 6-66 lists these results.

Operations. Incident-free radiological impacts would occur during the routine transportation of spent nuclear fuel and high-level radioactive waste in using the Jean Corridor. Table 6-67 lists the incident-free

Table 6-65. Impacts to workers from industrial hazards during rail construction and operations for the Jean Corridor.

Group and industrial hazard category	Construction[a]	Operations[b]
Involved workers		
Total recordable cases[c]	67	73
Lost workday cases	33	40
Fatalities	0.09	0.20
Noninvolved workers		
Total recordable cases	4.0	4.1
Lost workday cases	1.5	1.5
Fatalities	0.004	0.004
Totals		
Total recordable cases	71	77
Lost workday cases	35	41
Fatalities	0.10	0.20

a. Totals for 43 months for construction.
b. Totals for 24 years for operations.
c. Total recordable cases includes injury and illness.

impacts, which include transportation along the corridor and along railways in Nevada leading to a Jean branch line. The table includes the impacts of 1,079 legal-weight truck shipments from commercial sites that would not have the capability to load rail casks while operational.

6.3.2.2.4.6 Jean Rail Socioeconomics

The following paragraphs discuss potential socioeconomic impacts associated with the construction and operation of a branch rail line in the Jean Corridor.

Construction. The length of the Jean Corridor, 181 kilometers (112 miles), is the principal factor that would determine the number of workers required to construct a branch rail line. The construction of a branch rail line in this corridor would require workers laboring approximately 1.7 million hours or 855 worker years over a 43-month construction period. The workers would be temporarily housed in two construction camps (DIRS 154822-CRWMS M&O 1998, all).

Table 6-66. Estimated number of fatalities from construction material delivery vehicles and construction and operations worker commuting traffic for the Jean Corridor.

Jean	Kilometers[a]	Traffic fatalities	Emissions fatalities
Construction[b]			
Materials delivery vehicles	10,000,000	0.2	0.02
Commuting workers	52,000,000	0.5	0.07
Subtotals	*62,000,000*	*0.7*	*0.09*
Operations[c]			
Commuting workers	52,000,000	0.5	0.07
Totals	***110,000,000***	***1.2***	***0.16***

a. To convert kilometers to miles, multiply by 0.62137.
b. Totals for 43 months for construction.
c. Totals for 24 years for operations.

Table 6-67. Health impacts from incident-free Nevada transportation for the Jean Corridor implementing alternative.[a]

Category	Legal-weight truck shipments	Rail shipments	Totals[b]
Involved workers			
Collective dose (person-rem)	38	720	760
Estimated latent cancer fatalities	0.02	0.29	0.3
Public			
Collective dose (person-rem)	7	150	160
Estimated latent cancer fatalities	0.003	0.08	0.08
Estimated vehicle emission-related fatalities	0.002	0.08	0.08

a. Impacts are totals for 24 years.
b. Totals might differ from sums of values due to rounding.

Employment

DOE anticipates that the total (direct and indirect) employment in the region of influence attributable to rail line construction would peak in 2007 at about 526 jobs. DOE anticipates that 92 percent or 483 workers, would come from Clark County. Approximately 42 workers would come from Nye County and 1 from Lincoln County. The increase in employment represents less than 1 percent of the baseline for Clark, Nye, and Lincoln Counties. Employment of Jean Corridor construction workers and some indirect support workers would end in 2009. As a result, the projected total growth (2009 to 2010) of 15,240 jobs in the region of influence would be reduced by 490. The expected addition of 14,886 jobs in Clark County would be reduced by 449, and the expected growth of 330 jobs in Nye County would be reduced by 41. The expected growth of 24 jobs in Lincoln County would be unaffected. DOE anticipates that project-related workers not moving to Jean Corridor operational jobs would be absorbed in other work in the State. These changes in employment would represent less than 1 percent of the applicable baselines.

Population

Population increases in the region of influence attributable to the construction of a Jean branch rail line, which would lag behind increases in employment, would peak in 2009 at about 492 persons. DOE anticipates that approximately 449 would live in Clark County, 42 in Nye County, and 1 in Lincoln County. The increase in population would be less than 1 percent of each county's population baseline. Because the impacts to population in each county would be small and transient, impacts to schools or housing would be unlikely.

Economic Measures

The expected peak changes in the region of influence attributable to constructing a branch rail line in the Jean Corridor would be increases of about $15.2 million in real disposable income in 2009; about $25.7 million in Gross Regional Product in 2007; and about $1.6 million in State and local expenditures in 2009. More than 96 percent of the increases in real disposable income and Gross Regional Product and about 91 percent of the increase in State and local government expenditures would occur in Clark County. Most of the remainder of the increase would occur in Nye County. The impacts to Clark, Nye, and Lincoln Counties for each of these measures would be less than 1 percent for each county's applicable baseline. (Dollar values reported in this section are in 2001 dollars unless otherwise stated.)

Transition and Operations Period. A period of slightly slower employment growth would occur from 2010 to 2012, and then employment to operate a branch rail line would contribute to an increased rate of growth. Growth in employment in the region of influence during this transitional period would be approximately 15 fewer jobs annually than would occur without a rail line in the Jean Corridor. Clark County would experience all of the slower rate of growth. During this period, the Clark County employment baseline would be about 1 million jobs. Nye County would gain 1 job during this period. The Jean rail line would contribute to the growth in residential population throughout the transition period.

Employment and Population

Estimated direct employment for the operation of a branch rail line in the Jean Corridor would be 36 workers. The total increase in employment in the region of influence would average 54 jobs over the 24-year operation period (2010 to 2033). On average, 52 of these jobs would be in Clark County, 1 in Nye County, and none in Lincoln County. These increases represent less than 1 percent of the counties' employment baselines. An increase in the Clark and Nye County populations attributable to a Jean rail line would be about 208 individuals, 91 percent of whom would live in Clark County. The balance would live in Nye County. The impact to the baseline population in both counties would be less than 1 percent. Because the increase to the population baseline would be small, impacts to the school system or housing would be unlikely. There would be no change in employment or the number of residents in Lincoln County due to a Jean rail line.

Economic Measures

In the three-county region of influence the greatest increase in real disposable income above the baseline attributable to operations would occur in 2033, the last year of operation. This increase would be $4.3 million; the average increase in each of the 24 years of operation would be about $3.7 million. The increase in Gross Regional Product would average about $3.6 million. On average during rail line operations, changes in real disposable income would exceed changes in Gross Regional Product. Annual State and local government expenditures would average $722,000. Nearly all of the economic activity would occur in Clark County; virtually none would occur in Lincoln and Nye Counties. Annual impacts to real disposable income, Gross Regional Product, and State and local government expenditures from the operation of a branch rail line in the Jean Corridor would be less than 1 percent of the baseline for each county.

The results of the detailed analysis performed for the Jean Corridor driven by the corridor length are representative of the variations (options and alternates) listed in Appendix J, Section J.3.1.2. The lengths of the variations are similar to those listed in Table 6-60.

6.3.2.2.4.7 Jean Rail Noise and Vibration

The Wilson Pass and Stateline Pass Options in the southern portion of the Jean Corridor and the Pahrump Valley Alternate pass through mostly U.S. Government land set aside for use by DOE or managed by the Bureau of Land Management. They also cross a small amount of private land. The Wilson Pass Option passes the communities of Amargosa Valley, Goodsprings, Jean, and Pahrump. In addition, the Stateline Pass Option passes the small communities of Sandy Valley and Primm. The smaller rural communities associated with the Jean Corridor and its variations (Appendix J, Section J.3.1.2) would be likely to experience noise levels from the operation of trains in excess of the benchmark nighttime noise level of 50 dBA, but not the daytime residential noise level of 60 dBA (Table 6-68). Jean and Primm are principally commercial business communities consisting of gaming industry, retail, and Primm businesses. In addition, the potential for growth and development in the Jean and Pahrump areas could place residents and businesses close to a Jean branch rail line, leading to noise impacts from both construction and operations.

Table 6-68. Estimated propagation of noise (dBA) from the operation of a waste transport train with two locomotives in communities near the Jean Corridor.

Corridor/community	Distance (kilometers)[a]	Noise (dBA)[b]
Wilson Pass Option		
Jean	1.6	48
Goodsprings	1.2	54
Pahrump	2.0	43
Amargosa Valley	1.0	57
Stateline Pass Option		
Stateline	1.6	48
Sandy Valley	1.0	57
Goodsprings	1.2	54
Pahrump	2.0[c]	43
Amargosa Valley	1.0	57

a. To convert kilometers to miles, multiply by 0.62137.

b. Estimated values do not include noise loss due to interactions with the ground that could account for decreases in estimated noise levels of from 10 to 20 dBA at 100 meters (33 feet) from the tracks.

c. Noise estimates at distances greater than 2 kilometers (1.2 miles) have large uncertainty.

Noise impacts for the Jean Corridor would be limited because, at distances more than 0.8 kilometer (0.5 mile) daytime noise from trains would be below noise standards for residential areas (60 dBA) and because few residents and businesses are this close to the corridor. Nonetheless, because a Jean branch rail line could pass near some communities, there would be a potential for noise impacts from both construction and operations. As discussed in Section 6.3.2.1, in areas where a branch rail line or variation passed near a community, transports could be limited to the extent necessary to ensure that noise was below levels listed as accepted noise hazards.

The estimated population that would reside within 2 kilometers (1.3 miles) of the Jean Corridor in 2035 is about 1,300 persons.

Vibration. The Jean Corridor and its variations would be distant [more than 200 meters (660 feet)] from historic structures and buildings. There are no known ruins of cultural significance along the corridor. Therefore, vibration impacts to structures would be unlikely. The small number of trips (three per day) and the small train size would result in low levels of rail-induced ground vibration.

6.3.2.2.4.8 Jean Rail Aesthetics

The Wilson Pass Option of the Jean Corridor would pass through Class II lands in the Goodsprings Valley and Spring Mountains. The objective of Bureau of Land Management Visual Resource Class II lands is to preserve the existing character of the landscape. According to the Bureau, the level of changes to the landscape should be low. Management activities could be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture of the characteristic landscape. Because of this, the building of a rail line in the Wilson Pass Option probably would require more stringent construction practices to limit visual resource impacts. Although impacts due to construction activities would be short term, visual impacts to recreational land use in this area would be likely. If DOE selected this option, additional consultation with the Bureau would be necessary to address aesthetic impacts.

The operation of a branch rail line through the Class II visual resource lands in the vicinity of Wilson Pass in the Spring Mountains would draw attention to the rail line and degrade the aesthetics of the area, thereby reducing the quality of recreational use of the area.

6.3.2.2.4.9 Jean Rail Utilities, Energy, and Materials

Table 6-69 lists the use of fossil fuels and other materials in the construction of a Jean branch rail line.

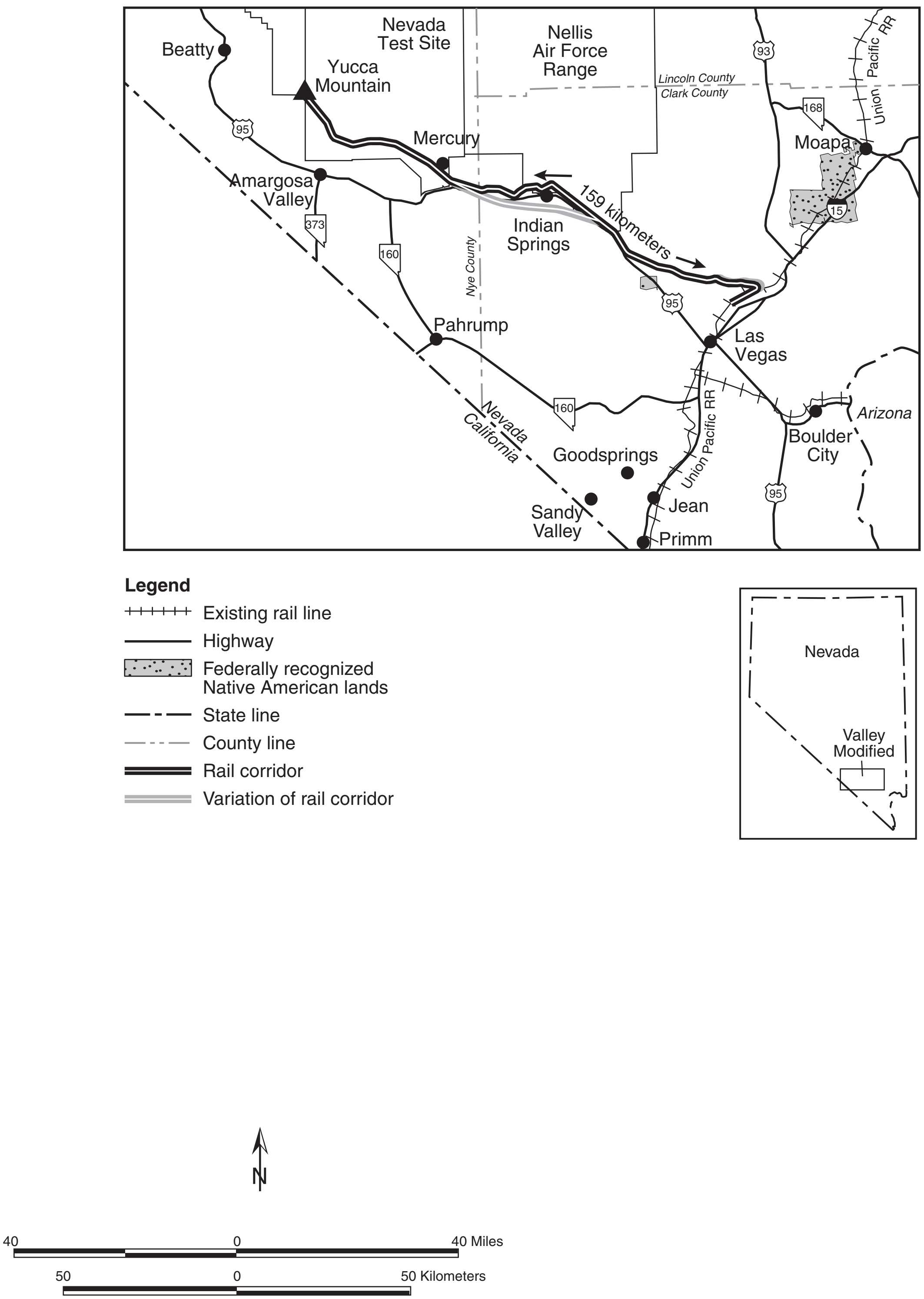
Table 6-69. Construction utilities, energy, and materials for a Jean branch rail line.

Route	Length (kilometers)[a]	Diesel fuel use (million liters)[b]	Gasoline use (thousand liters)	Steel (thousand metric tons)[c]	Concrete (thousand metric tons)
Jean	180 - 200	26 - 30	500 - 570	26 - 29	150 - 170

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. To convert metric tons to tons, multiply by 1.1023.

6.3.2.2.5 *Valley Modified Corridor Implementing Alternative*

The Valley Modified Corridor originates near the existing Apex rail siding off the Union Pacific mainline railroad. It travels northwest passing north of the City of Las Vegas, north of the Town of Indian Springs, parallel to U.S. 95 before entering the southwest corner of the Nevada Test Site and reaching the Yucca Mountain site. The Valley Modified Corridor is about 159 kilometers (98 miles) long from its link with the Union Pacific line to the site. Variations of the route range from 157 to 163 kilometers (98 to 101 miles). Figure 6-19 shows this corridor along with possible variations identified by engineering studies (DIRS 154960-CRWMS M&O 1998, all). The variations provide flexibility in addressing engineering, land-use, or environmental resource issues that could arise in a future, more detailed survey along the corridor. This section addresses impacts that would occur along the corridor shown in Figure 6-19. With the exception of differences identified in Appendix J, Section J.3.1.2, the impacts would be generally the



To convert kilometers to miles, multiply by 0.62137.

Source: Modified from DIRS 104560-YMP (1998, all).

Figure 6-19. Valley Modified Corridor.

same among the possible variations. The Indian Hills Alternate of the Valley Modified Corridor also crosses the original route of the historic Las Vegas-to-Bullfrog Stage Road.

The construction of a branch rail line in the corridor would require approximately 40 months. Construction would take place simultaneously at a number of locations along the corridor. Two construction camps would be established to provide temporary living accommodations for construction workers and construction support facilities. A train would take about 3 hours to travel from the junction with the Union Pacific mainline to the Yucca Mountain Repository on a Valley Modified branch rail line (DIRS 101214-CRWMS M&O 1996, Volume 1, Section 4, Branch Rail Operations Plan). The estimated life-cycle cost to construct and operate a branch rail line in the Valley Modified Corridor would be $283 million in 2001 dollars.

The following sections address impacts that would occur to land use; air quality; biological resources and soils; hydrology including surface water and groundwater; cultural resources; occupational and public health and safety; socioeconomics; noise and vibration; and utilities, energy, and materials. Impacts that would occur to aesthetics, and waste management would be the same as those discussed in Section 6.3.2.1 and are, therefore, not repeated here. Section 6.3.4 discusses the potential for transportation activities to cause environmental justice impacts in Nevada.

6.3.2.2.5.1 Valley Modified Rail Land Use and Ownership

Table 6-70 summarizes the amount of land required for the Valley Modified corridor, its ownership, and the estimated amount of land that would be disturbed, as well as ranges for the variations. Table 6-71 summarizes the amount of land required for the variations of the Valley Modified Corridor and its ownership.

Table 6-70. Land use in the Valley Modified Corridor.[a]

Factor	Corridor (percent)	Range due to variations
Corridor length (kilometers)[b]	159	157 - 163
Land area in 400-meter[c]*-wide corridor (square kilometers)*[d]	63 (100)	63 - 65
Land ownership in 400-meter-wide corridor (square kilometers)		
Bureau of Land Management	34 (53)[e]	29.9 - 36.7
Air Force	7 (11)	3.6 - 7.5
DOE	21 (32)	20. 6 - 20.6
Private	0.2 (0.3)	0 - 0.18
Fish and Wildlife Service	1.8 (3)	1.7 - 4.1
Land area in 60-meter[f] *right-of-way (square kilometers)*	9.6	9.4 - 9.8
Disturbed land (square kilometers)		
Inside 60-meter right-of-way	4.4	4.3 - 4.5
Outside 60-meter right-of-way	0.6	0.68 - 0.7

a. Source: DIRS 155549-Skorska (2001, all).
b. To convert kilometers to miles, multiply by 0.62137.
c. 400 meters = about 0.25 mile.
d. To convert square kilometers to acres, multiply by 247.1.
e. Percentages do not total 100 due to rounding.
f. 60 meters = 200 feet.

Construction. The corridor crosses three Bureau of Land Management grazing allotments (Wheeler Slope, Indian Springs, and Las Vegas Valley), two wilderness study areas (Nellis ABC and Quail Spring, both recommended by the Bureau as unsuitable for inclusion in the National Wilderness System), and one area designated as available for sale or transfer (DIRS 104993-CRWMS M&O 1999, Table 7, p. 22). It also crosses several telephone, pipeline, highway, and power line rights-of-way, and the Nellis Air Force Base small arms range. Impacts common to rail implementing alternates are discussed in Section 6.3.2.1. The following paragraphs discuss impacts unique to this corridor.

Table 6-71. Variations in the Valley Modified Corridor.[a]

Variation	Length (kilometers)[b]	Land area in variation (square kilometers)[c]	Land ownership [square kilometers (percent)]			
			Bureau of Land Management	Fish and Wildlife Service	Department of Defense	Private
Indian Hills Alternate	45.2	18.1	18.1 (100)	--[d]	--	--
Sheep Mountain Alternate	23.3	9.8	3.2 (33)	3.4 (35)	3.1 (32)	--
Valley Connection	21.1	2.7	2.5 (93)	--	0.01 (0.4)	0.2 (6.6)

a. Source: DIRS 155549-Skorska (2001, all).
b. To convert kilometers to miles, multiply by 0.62137.
c. To convert square kilometers to acres, multiply by 247.1.
d. -- = none.

Variations to this corridor are listed in Appendix J, Section J.3.1.2. The Indian Hills Alternate would avoid Nellis Air Force Range by traveling south of Indian Springs. This variation would cross Fish and Wildlife Service lands and pass almost entirely within a Bureau of Land Management utility corridor. It would also pass through a Bureau Land Withdrawal Area (N50945) for a power project. The Sheep Mountain Alternate would pass through the Nellis Small Arms Range and Nellis Wilderness Study Areas A, B, and C, as well as the Quail Mountain Wilderness Study Area and the Desert National Wildlife Range. Although the Bureau considers these Wilderness Study Areas unsuitable for inclusion in the National Wilderness System, DOE would have to consult with the Bureau before it could build a branch rail line.

The corridor passes along the Las Vegas metropolitan area's northern boundary, in an area that is currently undergoing growth and where future commercial and residential growth might occur. However, metropolitan area growth might not extend to the corridor area until after the operations phase of the repository, when DOE assumes that it would no longer have use for a branch rail line. The corridor also passes next to the Dry Lake siding and within about 1.6 kilometers (1 mile) of the Las Vegas Paiute Indian Reservation north of Las Vegas. There would be no significant land-use impact to this reservation because of its distance from the corridor.

During the construction and operation and monitoring phases of the Proposed Action, there would be a potential for encroachment of the Valley Modified Corridor by private interests. If encroachment occurred, conflicts could result as impediments to the full use of lands. Areas most likely for use by private interests are those currently designated for sale or transfer by the Bureau of Land Management.

Two segments of the corridor encroach slightly on the Nellis Air Force Range. The U.S. Air Force has noted the potential for safety risks of crossing lands that are hazard areas and encompass weapons safety footprints for live weapons deployment. DOE has identified the Indian Hills Alternate, which would avoid the larger encroachment (see Appendix J, Section J.3.1.2). If DOE decided to build and operate a branch rail line in the Valley Modified corridor, it would consult with the Bureau of Land Management, U.S. Air Force, other affected agencies and Native American Tribal governments, and other DOE program operations on the Nevada Test Site to help ensure that it avoided or mitigated potential land-use conflicts associated with alignment of a rail line right-of-way. Because the Military Lands Withdrawal Act of 1999 (Public Law 106-65; 113 Stat. 885) withdraws and reserves the Nellis Air Force Range for use by the Secretary of the Air Force, the Secretary would need to concur with a decision to build and operate a branch rail line through any part of the Range.

Although there are no known community development plans that would conflict with the rail line, the presence of a rail line could influence future development and land use along the railroad in the communities of Indian Springs and North Las Vegas (that is, zoning and land use might differ depending on the presence or absence of a railroad).

Operations. DOE anticipates that operations along the Valley Modified Corridor would cause fewer impacts than construction. Operations impacts would be similar to those discussed in Section 6.3.2.1.

6.3.2.2.5.2 Valley Modified Rail Air Quality

Construction. The Valley Modified Corridor and some of its variations would involve construction in the Las Vegas Valley air basin, which is in nonattainment for particulate matter (PM_{10}) and carbon monoxide (DIRS 101826-FHWA 1996, pp. 3-53 and 3-54). To assess nonradiological air quality impacts from branch rail line construction in this air basin, DOE compared emissions from earthmoving activities and vehicles to General Conformity and Prevention of Significant Deterioration thresholds. Appendix G, Section G.1.4.1, describes the method used to determine PM_{10} emissions from earthmoving activities. This method takes no credit for dust suppression measures; however, the analysis for transportation construction activities included dust suppression measures. Appendix G, Section G.1.4.5 describes the method used to determine criteria pollutant emissions from construction vehicle activity which, for the Valley Modified Corridor, would consume an estimated 7.1 million liters (about 1.9 million gallons) of diesel fuel and 150,000 liters (38,000 gallons) of gasoline in the nonattainment area over the length of the construction period.

Eighty-four kilometers (52 miles) of the total 160 kilometers (98 miles) of a branch rail line in the Valley Modified Corridor would be in the nonattainment area. Table 6-72 lists emission rates of PM_{10} and carbon monoxide from earthmoving activities and vehicle emissions in the nonattainment area assuming a work crew completed this section over 21 months and used standard construction techniques. There would be five borrow areas, five spoils areas, and one construction camp along the 84-kilometer (52-mile) construction corridor. Estimated emission rates would exceed the PM_{10} General Conformity threshold for a nonattainment area (see Table 6-73). The PM_{10} exceedance would primarily be the result of earthmoving activities. Dust abatement measures, assumed to be 70 percent effective (DIRS 155557-Clark County 2001, p. 4-63), would reduce emissions by a significant amount.

Table 6-72. Emission rates from Valley Modified Corridor construction in the nonattainment area.

Activity and emission	Emission rate (kilograms per year)
Earthmoving, PM_{10}	110,000
Vehicle, PM_{10}	14,000
Vehicle, carbon monoxide	98,000

a. To convert kilograms to pounds, multiply by 2.2046.

Table 6-73. Particulate matter (PM_{10}) and carbon monoxide air quality impacts (kilograms per year)[a] from Valley Modified Corridor construction in the nonattainment area.

Criteria pollutant/threshold	Threshold level[b]	Percent of threshold[c]		
		Earthmoving	Vehicles	Total
PM_{10}				
General Conformity	63,500 (serious)	170	22	190
Prevention of Significant Deterioration	227,000	48	6	54
Carbon monoxide				
General Conformity	90,700	NA[d]	110	110
Prevention of Significant Deterioration	227,000	NA	43	43

a. Kilograms per year; to convert kilograms to pounds, multiply by 2.2046.
b. Sources: 40 CFR 52.21 and 93.153.
c. Numbers are rounded to two significant figures.
d. NA = not applicable.

If DOE selected the Valley Modified Corridor for the construction and operation of a branch rail line, the final plans, specifications, and estimates would require adherence to the Clark County Health District PM_{10} emissions control measures. These measures are being developed in the Particulate Matter State Implementation Plan (DIRS 155557-Clark County 2001, all). Implementation of the comprehensive measures should enable rail line construction to start. The purpose of the measures under development is not to prohibit construction activity, but to enable it within the Environmental Protection Agency air quality requirements. Because the estimated impacts to air quality in the Las Vegas Valley air basin would exceed the General Conformity thresholds for carbon monoxide and PM_{10} in a nonattainment area, DOE would have to implement mitigation measures if it selected the Valley Modified Corridor. Under the construction design analyzed above, one crew at a time would construct the branch rail line from beginning to end over about 40 months, and the emissions in the Las Vegas Valley air basin would occur over about 21 months. A potential mitigation measure would be to have two crews construct the line at half the pace from each end of the corridor. Under this plan, the emissions in the basin would occur over the full 40 months, which would result in a decrease of about half in the emission rates, which would reduce the impacts listed above to levels at or less than the General Conformity thresholds. In addition, as part of final construction planning DOE would plan to use dust control measures and ensure fuel efficiency to reduce emissions. These measures should result in emissions below the General Conformity threshold levels.

The Valley Modified Corridor includes the Indian Hills Alternate, Sheep Mountain Alternate, and Valley Connection. The Sheep Mountain Alternate and Valley Connection are entirely in the nonattainment area, whereas only half of the Indian Hills Alternate is in the nonattainment area. The rail extents of the Indian Hill Alternate and the Valley Modified Corridor in the nonattainment area are equivalent. Therefore, no greater or smaller air quality impacts would result from selection of the Indian Hill Alternate. The Sheep Mountain Alternate and Valley Connection, if used, would add 3 and 7 kilometers (1.9 and 4.3 miles) of rail, respectively, to the length of the Corridor. Therefore, air quality impacts would be slightly but not significantly (less than 10 percent) greater if these variations were used.

Operations. Fuel consumption by diesel train engines operating along the rail corridor would emit carbon monoxide, nitrogen dioxide, and particulate matter (PM_{10} and $PM_{2.5}$). Based on the Federal standards for locomotives (40 CFR 92.005), there are no emission standards for sulfur dioxide.

In attainment areas, the pollutant concentrations in the air would increase slightly during the passage of a train, but the emissions from one or two trains a day would not exceed the ambient air quality standards. However, the Valley Modified Corridor would include a route through the Las Vegas Valley air basin, which is in nonattainment for carbon monoxide and PM_{10}. The air quality impacts to this air basin from train operation along the Valley Modified Corridor would be a small contribution in comparison to the amount of pollutants emitted by automotive travel in the basin. Thus, emissions from train operations in the Las Vegas Valley air basin would not produce further violations of the ambient air quality standards.

6.3.2.2.5.3 Valley Modified Rail Hydrology

Surface Water

Chapter 3, Section 3.2.2.1.3, notes that there are no surface-water resources along the Valley Modified Corridor, including its variations.

Table 6-74 lists flood zones identified along the Valley Modified Corridor and its variations. The Federal Emergency Management Agency maps from which DOE derived the flood zone information provided coverage for about 75 percent of the corridor length. The corridor crosses only two different 100-year flood zones or flood zone groups before entering the Nevada Test Site. Of the three variations, the Indian Hills Alternate would lessen the number of flood zones to one; the other two segments would have no change. As indicated in Section 6.3.2.1, impacts associated with altering drainage patterns or changing erosion and sedimentation rates or locations would be minor and localized.

Groundwater

Construction. The water used during construction would come largely from groundwater resources. The annual demands would be a fraction of the perennial yields of most producing aquifers (Chapter 3,

Table 6-74. 100-year flood zones crossed by the Valley Modified Corridor and its variations.[a,b]

Corridor portion	Crossing distance (kilometers)[c]	Flood zone feature(s)	Avoided by variation[d] (Yes or No)
Dry Lake to Yucca Mountain	0.1[e]	Unnamed creek NW of the city of Las Vegas (intermittent)	N
	1.2[f]	Drainage (projected) west of Indian Springs Air Force Auxiliary Base (intermittent)	Y-3
Variation			
1. Valley Connection	None	Located at the origin of the corridor	
2. Sheep Mountain Alternate	None	Located to the north of the corridor	
3. Indian Hills Alternate	None	Located to the south of the corridor	

a. Areas where natural floodwater movement could be altered and where erosion and sedimentation rates and locations could change. Sources:
   1. Federal Emergency Management Agency Flood Insurance Rate Maps for Clark and Nye Counties, Nevada.
   2. DIRS 154961-CRWMS M&O (1998, all).
b. Approximately 25 percent of the Valley Modified Corridor is not available on Federal Emergency Management Agency maps because that portion of the route is on the Nevada Test Site and the Nellis Air Force Range.
c. To convert kilometers to miles, multiply by 0.62137.
d. Certain 100-year flood zones can be avoided by corridor variations. These are identified with a "Y" (yes) and a number representing the specific variation(s) from the second half of the table that avoids the specific flood zone.
e. Limited information due to the Nellis Air Force Range.
f. Projected from limited data. Specific area not covered by Federal Emergency Management Agency maps; values were extrapolated from the closest maps.

Section 3.2.2.1.3, discusses estimated perennial yields for the hydrographic areas over which the Valley Modified corridor passes).

The estimated amount of water needed for construction of a rail line in the Valley Modified Corridor for soil compaction, dust control, and workforce use would be about 395,000 cubic meters (320 acre-feet) (DIRS 104914-DOE 1998, all). For planning purposes, DOE assumed that this water would come from 20 groundwater wells installed along the corridor. The average amount of water withdrawn from each well would be approximately 20,000 cubic meters (16 acre-feet). Most (90 percent) of the water would be used for compaction of fill material. The estimate of fill quantities needed for construction would vary if DOE used either of the variations. The Indian Hills Alternate would increase the total water demand for the Valley Modified Corridor, but only by 6 percent.

Chapter 3, Section 3.2.2.1.3, discusses the hydrographic areas over which the Valley Modified Corridor would pass, their perennial yields, and whether the State of Nevada considers each a Designated Groundwater Basin. If the hydrographic area is a Designated Groundwater Basin, permitted groundwater rights approach or exceed the estimated perennial yield, depleting the basin and water resources or requiring additional administration. Table 6-75 summarizes the designation status of the hydrographic areas associated with the Valley Modified Corridor and the approximate portion of the corridor that passes over Designated Groundwater Basins. Use of either variation would make no notable change in the status of hydrographic areas crossed.

Table 6-75. Hydrographic areas along the Valley Modified Corridor and its variations.[a]

		Designated Groundwater Basins	
Corridor description	Hydrographic areas	Number	Percent of corridor length
Valley Modified Corridor	6	3	70
Variations	6	3	70

a. All three variations (Indian Hills Alternate, Sheep Mountain Alternate, and Valley Connection) would cross the same six hydrographic areas (two with slightly different crossing distances) and the same three designated groundwater basins which, rounded to the nearest 10 percent, would represent the same portion of the total corridor.

The withdrawal of 20,000 cubic meters (16 acre-feet) a year from a well would have little impact on the hydrographic areas associated with the corridor based on their perennial yields (Chapter 3, Section 3.2.2.1.3). However, the installation of 20 wells along the corridor would mean that hydrographic areas would have multiple wells. As indicated in Table 6-75, about 70 percent of the corridor length is over Designated Groundwater Basins, which the Nevada State Engineer's office watches carefully for groundwater depletion. This does not mean that DOE could not obtain water appropriations in these areas; the State Engineer would have the authority to approve such appropriations. Because the DOE requests would be for a short-term construction action, the State Engineer would have even more discretion. Rather than spacing the wells evenly along the corridor, DOE could use locations that would make maximum use of groundwater areas that are not Designated Groundwater Basins. With such a large portion of the corridor over these basins, however, this would mean trucking water for long distances. Another option would be to lease temporary water rights from individuals along the corridor. Obtaining a water appropriation from the State Engineer for short-term construction use or using an approved allocation should ensure that groundwater resources are not adversely affected.

As an alternative, DOE could transport water by truck to meet construction needs. The construction of a branch rail line in the Valley Modified corridor would require about 21,000 tanker-truck loads of water or about 20 truckloads each day. Again, water obtained from permitted sources, which would provide water in allocations determined by the Nevada State Engineer, would not affect groundwater resources.

Operations. Operations along a completed rail line would have little impact on groundwater resources. Possible changes in recharge, if any, would be the same as those at the completion of construction.

6.3.2.2.5.4 Valley Modified Rail Biological Resources and Soils

Construction. The construction of a rail line in the Valley Modified corridor, including its variations, would disturb approximately 5 square kilometers (1,200 acres) of land (Table 6-71). The analysis assumed that the types of land cover in disturbed areas outside the corridor would be the same as that within the corridor. Table 6-76 compares the approximate area of disturbance in each land-cover type along the Valley Modified Corridor, including its possible variations, to the amount of land area within each land-cover type in Nevada. In addition, the table lists the percentage of the area that would be disturbed. The fraction disturbed for each cover type would be very small. The disturbance would not have a discernible impact on any land-cover type. Although some alignment variations could lead to a small increase in the total amount of land disturbed, the portion of the corridor, including its variations, in each land-cover type would be similar to that in the corridor.

This corridor, including its variations, passes through desert tortoise habitat along its entire length, so construction activities would disturb approximately 5 square kilometers (1,200 acres) of desert tortoise habitat, some of which is designated as critical habitat. Construction activities could kill individual desert tortoises, and the presence of a rail line could disrupt movements of individuals. However, desert tortoise abundance is low along this corridor (DIRS 101521-BLM 1992, Map 3-13; DIRS 101914-Rautenstrauch and O'Farrell 1998, pp. 407 to 411) so losses would be few, and would be unlikely to affect the regional population. Relocation of tortoises along the route prior to construction would minimize losses of individuals. The long-term presence of a rail line could block movements of individual tortoises. DOE would consult with the Fish and Wildlife Service (under Section 7 of the Endangered Species Act) regarding this species if it selected this corridor, and would implement all terms and conditions required by the Service.

Two populations of Parish scorpionweed and one of Ripley's springparsley (a Bureau of Land Management sensitive species) occur in the corridor and could be affected directly or indirectly by land-clearing activities. The locations of these populations would be identified though surveys prior to disturbance and would be avoided to the extent possible.

Table 6-76. Maximum area disturbed (square kilometers)[a] in each land-cover type for the Valley Modified Corridor.[b,c]

Land cover type	Percent of corridor length	Area disturbed	Area in Nevada	Percent disturbed
Agriculture	0.0	0.00	5,200	0.00
Blackbrush	0.0	0.00	9,900	0.00
Creosote-bursage	79.0	4.03	15,000	0.026
Grassland	0.0	0.00	2,800	0.00
Greasewood	0.0	0.00	9,500	0.00
Hopsage	0.0	0.00	630	0.00
Juniper	0.0	0.00	1,400	0.00
Mojave mixed scrub	15.9	0.81	5,600	0.014
Pinyon-juniper	0.0	0.00	15,000	0.00
Playa	0.6	0.03	7,000	<0.001
Sagebrush	0.0	0.00	67,000	0.0
Sagebrush/grassland	0.0	0.00	52,000	0.0
Salt desert scrub	4.5	0.23	58,000	<0.001
Urban		ND[d]	2,400	ND

a. To convert square kilometers to acres, multiply by 247.1.
b. Based on the proportion of the route in each land-cover type; percent disturbed was based on the variation with the greatest disturbance within a particular land-cover type. Percentages add to more than 100 because maximum values were used.
c. Source: DIRS 104593-CRWMS M&O (1999, Appendix D).
d. ND = not determined.

There are 46 populations of 11 sensitive plant species outside of the 400-meter (0.25-mile)-wide corridor, but within 5 kilometers (3 miles) of Sheep Mountain Alternate (see Appendix J, Section J.3.1.2 for a list of corridor variations). An additional five populations of two sensitive plant species are outside the corridor but within 5 kilometers of the Indian Hills Alternate. The use of either alternate would avoid one population of desert bearpoppy. These populations would not be affected because land disturbance would not extend to these areas and changes would be unlikely in the aquatic or soil environment as a result of construction or the long-term presence of a railroad.

Several designated game habitat areas for bighorn sheep, mule deer, or quail occur within 5 kilometers (3 miles) of the corridor. Larger game animals occupy large home ranges and could easily traverse the distance between the designated habitat and the corridor. Construction activities probably would disturb individuals or groups of animals and they would avoid construction areas.

The Indian Hills Alternate would cross one herd management area for wild horses and burros (DIRS 104593-CRWMS M&O 1999, p. 3-29). Construction in this area would result in the loss of a small amount of habitat and probably would disturb animals or their movements for the duration of the activity.

No springs, perennial streams, or riparian areas occur in this corridor or its variations and, therefore, impacts to biological resources associated with these areas and located within 5 kilometers (3 miles) of the corridor would be unlikely. The corridor and variations cross a number of ephemeral streams that may be classified as waters of the United States, although no formal delineations have been made (DIRS 104593-CRWMS M&O 1999, p. 3-29). DOE would work with the U.S. Army Corps of Engineers to minimize impacts to these areas and would obtain individual or regional permits, if necessary. Some changes to local drainage along a branch rail line would be likely; DOE would design the rail line to accommodate existing drainage patterns.

This corridor would cross two Wilderness Study Areas. Construction of a railroad in these areas would be incompatible with a Wilderness designation. Although the Bureau considers these Wilderness Study

Areas unsuitable for inclusion in the National Wilderness System, DOE would have to consult with the Bureau before it could build a branch rail line.

Soils in and adjacent to the corridor would be disturbed on approximately 5 square kilometers (1,200 acres) of land during construction of the railroad. Impacts to soils in the corridor [4.4 square kilometers (1,100 acres)] would be small, but could occur throughout construction. Impacts to disturbed areas outside the corridor would be transitory. DOE could reclaim these areas as practicable.

Shrink-swell soils occur along much of the corridor, including its variations, as does the potential for blowing soils. The presence of such soils could influence the amount of area disturbed by construction because soils in the vicinity of the railroad would have to be stabilized. Disturbance during construction would increase the amount of soil that could be transported by wind because the existing vegetation would be disturbed, at least temporarily. Revegetation after construction or other means of soil stabilization could minimize the amount of wind-borne soil.

As stated in Chapter 3, Section 3.2.2.1.4, variations identified for the Valley Modified Corridor could avoid some biological resources, as listed in Table 6-77.

Table 6-77. Biological resources avoided by Valley Modified Corridor variations.[a]

	Occurrence of resource			
	For unvaried segment of corridor		Occurrence avoided by variation	
Alignment variation resource	In corridor[b]	Within 5 km[c]	In corridor	Within 5 km
Sheep Mountain Alternate				
Sensitive species–desert bearpoppy	0	1	0	11
Indian Hills Alternate				
Sensitive species–desert bearpoppy	0	1	0	11

a. Variations listed are those that would result in the avoidance of biological resources along the corridor.
b. In the corridor [or springs within 400 meters (0.25 mile)], but avoided by the variation.
c. Within 5 kilometers (3 miles) of the corridor, but more than 5 kilometers from the variation.

6.3.2.2.5.5 Valley Modified Rail Cultural Resources

Construction. Cultural field studies in the area of the Valley Modified Corridor indicated that the area crossed by the corridor has the potential for relatively high densities of archaeological and historic sites. The corridor, including the Sheep Mountain Alternate, passes within 3 kilometers (1.9 miles) of three properties listed on the *National Register of Historic Places*: Tule Springs Archaeological Site, Tule Springs Ranch District, and the Corn Creek Campsite (DIRS 155826-Nickens and Hartwell 2001, Table 6). Direct impacts on these properties from rail line construction activities would be unlikely. The Bureau of Land Management Las Vegas District predicts that the Indian Springs Valley has the highest possible density of unrecorded significant cultural resources in Clark County. An archaeological records search yielded 19 previously recorded sites along the corridor and its variations (see Appendix J, Section J.3.1.2), 11 of which are considered potentially eligible for the *National Register of Historic Places* (Chapter 3, Section 3.2.2.1.5). Known historic sites that could be affected by rail construction activities include early railroad construction camps along the Union Pacific line near Apex and the historic Las Vegas and Tonopah Railroad (unvaried corridor segment, Sheep Mountain Alternate, and Indian Springs Alternate), as well as the original grade of that railroad. This corridor passes through Camp Desert Rock, a significant historic military site southwest of Mercury.

The Southern Paiute used Indian Springs Valley. There were several early historic period villages at springs such as Indian Springs, Tule Springs, and Corn Creek, and at other locations north of Las Vegas. Some of these locations could be affected by rail line construction activities along the corridor or the Sheep Mountain or Indian Hills Alternates.

The Valley Modified Corridor passes within about 1 kilometer (0.6 mile) of the Las Vegas Paiute Indian Reservation in the northeastern part of the Las Vegas Valley. The corridor would not affect identified cultural resources on the reservation.

Operations. As stated in Section 6.3.2.1, additional impacts to these resources during the operation of the branch rail line would be unlikely.

6.3.2.2.5.6 Valley Modified Rail Occupational and Public Health and Safety

Construction. Industrial safety impacts on workers from the construction and use of the Valley Modified branch rail line would be small (Table 6-78). The analysis evaluated the potential for impacts in terms of total reportable cases of injury, lost workday cases, and fatalities to workers from construction and operation activities. The analysis also evaluated traffic fatality impacts that would occur during the moving of equipment and materials for construction, worker commutes to and from construction sites, and transport of water to construction sites if wells were not available (Table 6-79).

Table 6-78. Impacts to workers from industrial hazards during rail construction and operations for the Valley Modified Corridor.

Group and industrial hazard category	Construction[a]	Operations[b]
Involved worker		
Total recordable cases[c]	32	73
Lost workday cases	16	40
Fatalities	0.04	0.20
Noninvolved worker		
Total recordable cases	1.9	4.1
Lost workday cases	0.7	1.5
Fatalities	0.002	0.004
Totals		
Total recordable cases	34	77
Lost workday cases	16	41
Fatalities	0.05	0.20

a. Totals for 40 months for construction.
b. Totals for 24 years for operations.
c. Total recordable cases includes injuries and illness.

Operations. Incident-free radiological impacts would occur during the routine transportation of spent nuclear fuel and high-level radioactive waste in the Valley Modified rail corridor. Table 6-80 lists the incident-free impacts, which include transportation along the Valley Modified corridor and along railways in Nevada leading to a Valley Modified branch line. The table includes the impacts of 1,079 legal-weight truck shipments from commercial sites that do not have the capability to load rail casks while operational.

6.3.2.2.5.7 Valley Modified Rail Socioeconomics

The following paragraphs discuss potential socioeconomic impacts associated with the construction and operation of a branch rail line in the Valley Modified Corridor.

Construction. The length of the Valley Modified Corridor, 159 kilometers (98 miles), is the most important factor that would determine the number of construction workers required. The construction of a branch rail line in this corridor would require workers laboring for approximately 810,000 hours or 405 worker years during the 40-month construction period. This rail line would require two temporary construction camps to house workers (DIRS 104595-CRWMS M&O 1999, all).

Employment

DOE anticipates that the total (direct and indirect) employment in the region of influence would peak in 2007 at about 245 jobs. Approximately 243 of the workers would come from Clark County, 2 from Nye County, and none from Lincoln County. The increase in employment would represent less than 1 percent of the employment baselines. Employment of Valley Modified Corridor construction workers and some indirect support workers would end in 2009. As a result, the projected total growth (2009 to 2010) of 15,240 jobs in the region of influence would be reduced by 191. The expected addition of 14,886 jobs in Clark County would be reduced by 189, and the expected growth of 330 jobs in Nye County would be reduced by 2. The expected growth of 24 jobs in Lincoln County would be unaffected. DOE anticipates

Table 6-79. Estimated number of fatalities from construction material delivery vehicles and construction and operations worker commuting traffic for the Valley Modified Corridor.

Activity	Kilometers[a]	Traffic fatalities	Emissions fatalities
Construction[b]			
Material delivery vehicles	8,000,000	0.1	0.02
Commuting workers	24,000,000	0.2	0.03
Subtotals	*32,000,000*	*0.4*	*0.05*
Operations[c]			
Commuting workers	52,000,000	0.5	0.07
Totals	***84,000,000***	***0.9***	***0.12***

a. To convert kilometers to miles, multiply by 0.62137.
b. Totals for 40 months for construction.
c. Totals for 24 years for operations.

Table 6-80. Health impacts from incident-free Nevada transportation for the Valley Modified Corridor implementing alternative.[a]

Category	Legal-weight truck shipments	Rail shipments	Totals[b]
Involved workers			
Collective dose (person-rem)	38	670	710
Estimated latent cancer fatalities	0.02	0.27	0.28
Public			
Collective dose (person-rem)	7	20	26
Estimated latent cancer fatalities	0.003	0.01	0.01
Estimated vehicle emission-related fatalities	0.002	0.009	0.011

a. Impacts are totals for 24 years.
b. Totals might differ from sums of values due to rounding.

that project-related workers not moving to Valley Modified Corridor operational jobs would be absorbed in other work in the State. These changes in employment would represent less than 1 percent of the applicable baselines.

Population

Population increases in the region of influence from the construction of a Valley Modified branch rail line, which would lag behind increases in employment, would peak in 2009 at about 219 persons. About 216 persons would reside in Clark County and 3 in Nye County. Population increases would be unlikely in Lincoln County. The impact to the population would be less than 1 percent of the Clark and Nye County population baselines. Because the expected increase in population would be so small and transient, impacts to schools or housing would be unlikely.

Economic Measures

Real disposable income, Gross Regional Product, and State and local government expenditures would rise during construction. The expected peak change in annual levels of these economic measures in the region of influence for a Valley Modified Corridor would be about $7.4 million in 2009 for real disposable income; $12.5 million in 2007 for Gross Regional Product; and $722,000 in 2009 for State and local expenditures. The impacts of these changes would be primarily confined to Clark County, where the workers would live and where they would purchase goods and services. The construction-related impacts would be less than 1 percent of the baseline values for all measures. (Dollar values reported in this section are in 2001 dollars unless otherwise stated.)

Transition and Operations Period. As the economy bridged the period between construction and operation of a Valley Modified branch rail line, the region of influence would continue to experience growth in the labor force and in residential population.

Employment and Population

Estimated direct employment for the operation of a branch rail line in the Valley Modified Corridor would average 36 workers. Total increase in employment in the three-county region of influence would average about 52 jobs over the 24-year operations period (2010 to 2033). DOE anticipates that all jobs would be in Clark County. In the region of influence, the average change in population during operations would be about 137 persons, 134 of whom would reside in Clark County. The impact to Clark County population and employment would be less than 1 percent of the baselines. Because the impact from increases in employment and population would be small, impacts to schools or housing would be unlikely.

Economic Measures

In the region of influence the greatest estimated increase in real disposable income attributable to the operation of a branch rail line in the Valley Modified Corridor ($3.6 million) would occur in 2033; the average increase for the 24-year operation would be $3.1 million. The change in real disposable income would be less than 1 percent of the baseline in the three counties. The average increase in Gross Regional Product would be about $3.6 million, or less than 1 percent of the baselines. The average State and local government expenditures would be approximately $482,000. The impact of additional expenditures by State and local governments would be less than 1 percent of the baselines. Virtually all of the economic activity related to the branch rail line would occur in Clark County.

The results of the detailed analysis performed for the Valley Modified Corridor, driven by the length of the corridor, are representative of the variations listed in Appendix J, Section J.3.1.2. The lengths of the variations are similar those listed in Table 6-71.

6.3.2.2.5.8 Valley Modified Rail Noise and Vibration

The Valley Modified Corridor passes north of Las Vegas and follows U.S. Highway 95 west past the small communities of Indian Springs, Cactus Springs, and Mercury (a Federal installation). Over its full length, the corridor is on Federal land set aside for use by DOE or the U.S. Air Force or managed by the Bureau of Land Management. Land west of the North Las Vegas area has few farms and most of the land is undeveloped.

The corridor meets the Union Pacific mainline near the Apex and Dike sidings in northeast Clark County. The County and the Bureau of Land Management have set aside land for an industrial park in this area. The nighttime noise benchmark of 50 dBA would be exceeded by estimated noise levels north of Las Vegas (Table 6-81). The corridor passes within 1 kilometer (0.6 mile) of the Las Vegas Paiute Indian Reservation. The Indian Hills Alternate (Appendix J, Section J.3.1.2) passes about 0.5 kilometer (0.3 mile) south of the Nevada penal institution at Indian Springs. Estimated noise levels at the penal institution from the Indian Springs Alternate would be 65 dBA.

Because a branch rail line would pass near some communities (including the Indian Springs penal institution), there would be a potential for noise impacts from both construction and operations. Corridor variations west of Indian Springs would not affect rural communities (Appendix J, Section J.3.1.2). The estimated population residing within 2 kilometers (1.3 miles) of the Valley Modified Corridor in 2035 would be about 190 persons. As discussed in Section 6.3.2.1, in areas where a branch rail line or variation passes near a community, train speeds could be limited to the extent necessary to ensure that noise was below levels listed as accepted noise standards.

Vibration. The Valley Modified branch rail line and its variations would be distant [more than 200 meters (660 feet)] from historic structures and buildings. There are no known ruins of cultural significance along the corridor. Therefore, vibration impacts to structures would be unlikely. The small number of trips (two per day) and the small train size would result in low levels of rail-induced ground vibration.

Table 6-81. Estimated propagation of noise (dBA) from the operation of a waste transport train with two locomotives in communities near the Valley Modified Corridor.[a]

Corridor/community	Distance (kilometers)[a]	Estimated noise (dBA)[b]
Valley Modified		
North Las Vegas	1	57
Indian Springs	1.6	48.1
Cactus Springs	1.8	45.5
Indian Springs Alternate		
Indian Springs	2[c]	43.1
Cactus Springs	4[c]	27.6
Mercury[d]	2[c]	43.1

a. To convert kilometers to miles, multiply by 0.62137.
b. Estimated values do not include noise loss due to interactions with the ground that could account for decreases in estimated noise levels of from 10 to 20 dBA at 100 meters (330 feet) from the tracks.
c. Noise estimates at distances greater than 2 kilometers (1.2 miles) have large uncertainty.
d. Federal installation.

6.3.2.2.5.9 Valley Modified Rail Utilities, Energy, and Materials

Table 6-82 lists the use of fossil fuels and other materials in the construction of a Valley Modified branch rail line.

Table 6-82. Construction utilities, energy, and materials for a Valley Modified branch rail line.

Route	Length (kilometers)[a]	Diesel fuel use (million liters)[b]	Gasoline use (thousand liters)	Steel (thousand metric tons)[c]	Concrete (thousand metric tons)
Valley Modified	160	13 - 14	270 - 280	22 - 23	130

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. To convert metric tons to tons, multiply by 1.1023.

6.3.3 IMPACTS OF NEVADA HEAVY-HAUL TRUCK TRANSPORTATION IMPLEMENTING ALTERNATIVES

This section describes the analysis of human health and safety and environmental impacts for five implementing alternatives that would employ heavy-haul trucks to transport rail shipping casks containing spent nuclear fuel and high-level radioactive waste in Nevada. DOE has identified five highway routes in Nevada for potential use by the heavy-haul trucks to transport the casks. The casks would be transported to the repository from an intermodal transfer station along a mainline railroad where they would be loaded onto the heavy-haul trucks from railcars. The trucks would also transport empty casks from the repository back to the intermodal transfer station for loading back onto railcars.

INTERMODAL TRANSFER STATION AND NAVAL SPENT NUCLEAR FUEL

Under the mostly legal-weight truck scenario, DOE would use the services of a commercial intermodal operator for the transfer of naval spent nuclear fuel shipments. This EIS assumed that DOE would not build an intermodal transfer station to handle those shipments. Because only 300 naval spent nuclear fuel casks would arrive in Nevada by rail over 24 years, the impacts of intermodal transfer operations would be considerably less than those for the mostly rail scenario. On average, the intermodal transfers would occur for about 2 weeks every 5 months to remove five casks from each train shipment. A staff of 20 would work only during these rail shipments.

DOE would locate an intermodal transfer station at one of three potential locations in Nevada near existing rail lines and highways: (1) near Caliente, (2) northeast of Las Vegas (Apex/Dry Lake), or (3) southwest of Las Vegas (Sloan/Jean). Caliente is the originating location for three of the routes that heavy-haul trucks could use to ship spent nuclear fuel and high-level radioactive waste to the repository. There is one potential route each associated with the Apex/Dry Lake and Sloan/Jean locations (Figure 6-20).

For convenience and as shown in the figure, the five highway routes have been named the Caliente, Caliente/Chalk Mountain, Caliente/Las Vegas, Apex/Dry Lake, and Sloan/Jean routes. DOE considers these routes to be feasible for heavy-haul trucks to use in transporting large rail casks to and from the repository. The routes were compiled from a selection of highways in Nevada that the State has designated for use by heavy-haul trucks (DIRS 155347-CRWMS M&O 1999, Request #046). They include highways that were identified in a study by the College of Engineering at the University of Nevada, Reno, for the Nevada Department of Transportation (DIRS 103072-Ardila-Coulson 1989, all). This study provided a "preliminary identification of Nevada highway routes that could be used to transport current shipments of Highway Route-Controlled Quantities of Radioactive Materials and high-level radioactive waste." They also include highways studied by the Transportation Research Center at the University of Nevada, Las Vegas, that characterized "rail and highway routes which may be used for shipments of high-level nuclear waste to a proposed repository at Yucca Mountain, Nevada" (DIRS 103462-Souleyrette, Sathisan, and di Bartolo 1991, all).

This section evaluates impacts in Nevada for each route and associated intermodal transfer station. The evaluation addresses (1) upgrading highways to accommodate frequent heavy-haul truck shipments, (2) constructing and operating an intermodal transfer station, and (3) making heavy-haul truck shipments. With the exception of Interstate System Highways, upgrades to existing Nevada highways would be necessary to accommodate the heavy-haul trucks.

The analysis of impacts for each of the five Nevada heavy-haul truck implementing alternatives assumed the national mostly rail transportation scenario. Therefore, the analysis included the impacts of legal-weight truck transportation from six commercial generators that do not have the capability to handle or load a large rail cask. About 1,079 legal-weight truck shipments would enter Nevada and travel to the repository. These trucks would use the same transport routes and carry about the same amounts of spent nuclear fuel per shipment as those for the mostly legal-weight truck scenario discussed in Section 6.3.1.

The analysis evaluates impacts for the following environmental resource areas: land use and ownership; air quality; hydrology; biological resources and soils; cultural resources; occupational and public health and safety; socioeconomics; noise and vibration; aesthetics; utilities, energy, and materials; and waste management.

Section 6.3.4 discusses the potential for transportation activities to cause environmental justice impacts in Nevada.

6.3.3.1 Impacts Common to Nevada Heavy-Haul Truck Implementing Alternatives

Nevada highways upgraded for heavy-haul truck use would allow routine, safe use in year-round operations. Upgrades would include reconstruction of some highway sections, especially in areas where spring and fall thaws and freezes make the highways susceptible to damage by heavy vehicles (frost-restricted areas). In addition, new turnout lanes at frequent intervals along two-lane highways would allow other traffic to pass the slower heavy-haul vehicles. Highway shoulders would be widened and road surfaces would be improved in many areas. Interstate highways would not be improved because they already meet standards that upgrades to other Nevada highways for heavy-haul truck shipments would follow.

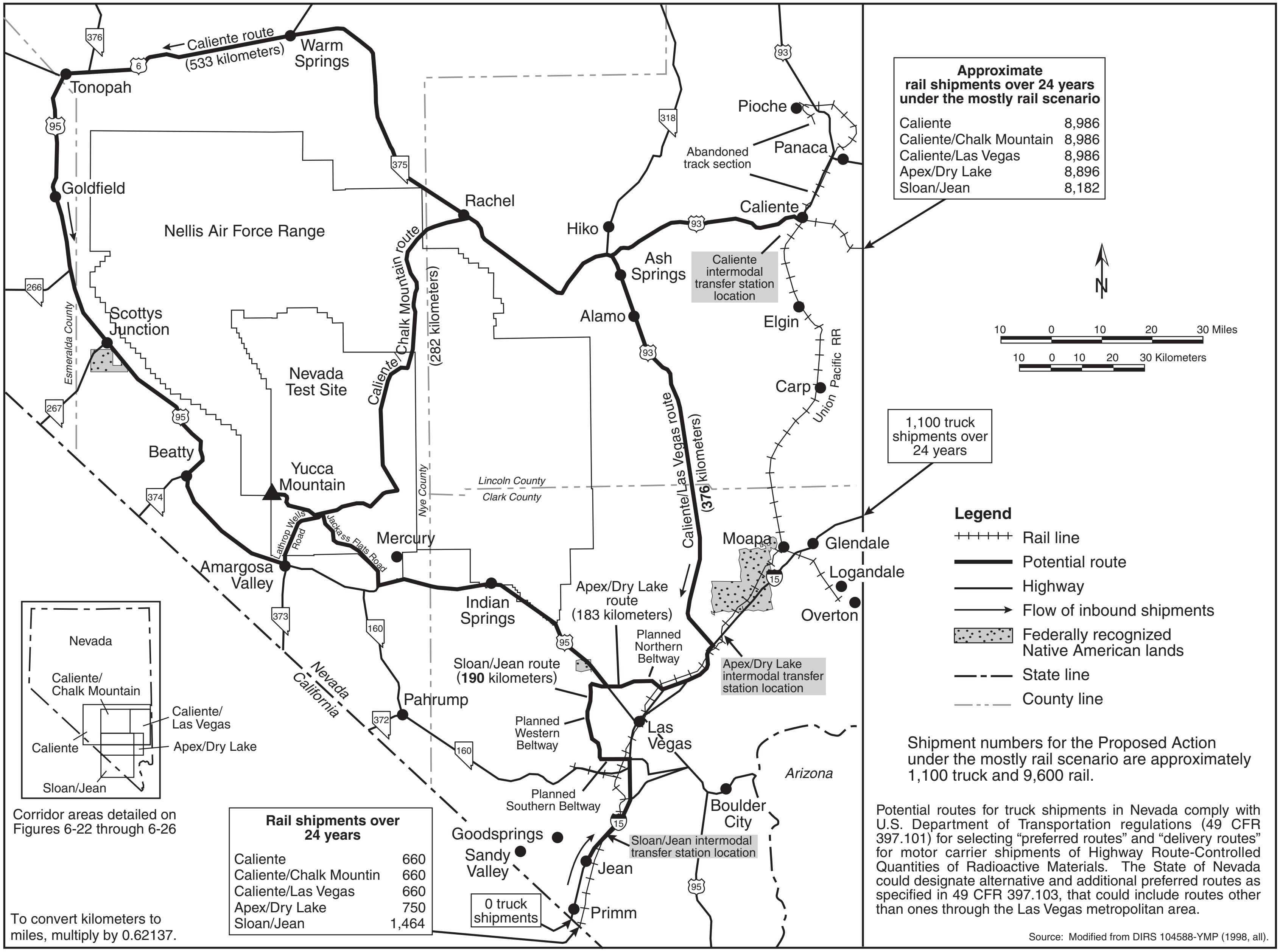


Figure 6-20. Potential routes in Nevada for heavy-haul trucks and estimated number of shipments for each route.

Even with the highway upgrades, heavy-haul trucks would cause delays for other vehicles because of their size and slower travel speeds. On most of the highways in Nevada that heavy-haul shipments would use, traffic volumes are classified as *level of service Class A* (DIRS 103255-CRWMS M&O 1999, p. 3-11), which means that traffic flows freely without delay (see Chapter 3, Section 3.2.2.2.11, for a description of all levels of service). The addition of 11 round trips each week to the traffic flow on these highways would not lead to a change in the average level of service. However, some traffic in lanes traveling with the vehicles would experience delays and short queues could form between turnout areas. In congested areas, such as the Las Vegas metropolitan area, where the level of service for the planned Las Vegas Beltway could be Class C or lower during non-rush-hour times, large slow-moving vehicles with their accompanying escort vehicles could present a temporary but large obstruction to traffic flow. Because disruptions on congested highways often continue after the removal of the cause, the duration of a traffic flow disruption would be longer than the time the vehicle would travel on the highway.

An intermodal transfer station would be common to all five heavy-haul truck implementing alternatives. Figure 6-21 shows the locations in Nevada that DOE is considering for such a station. Station construction would take about 18 months. The station would be a fenced area of about 250 by 250 meters (820 by 820 feet) and a rail siding that would be about 2 kilometers (1.25 miles) long. The estimated total area occupied by the facility and support areas would be 200,000 square meters (50 acres). It would include rail tracks, two shipping cask transfer cranes (one on a gantry rail and a backup rubber-tired vehicle), an office building, and a maintenance and security building. It would also have connecting tracks to an existing mainline railroad and storage and transfer tracks inside the station boundary. The maintenance building would provide space for routine service and minor repairs to the heavy-haul trailers and tractors. The station would have power, water, and other services. Diesel generators would provide a backup electric power source. The station would have the capacity to allow an intermodal transfer rate of 22 rail casks a week (11 loaded casks to the repository, 11 empty casks returned to the commercial and DOE sites).

Operations at an intermodal transfer station would include switching railcars carrying spent nuclear fuel and high-level radioactive waste casks from mainline railroad trains to the station's side track; queuing railcars on the side track for movement to the intermodal transfer area; moving railcars carrying loaded casks from the side track into position to transfer the casks to heavy-haul trucks; and using the facility crane to transfer loaded casks from railcars to heavy-haul trucks. The station would reverse this sequence of operations for empty casks returning from the repository.

The estimated life-cycle cost to construct and operate an intermodal transfer station and to operate heavy-haul trucks in Nevada would range from $387 million to $669 million (2001 dollars), depending on the alternative.

This section discusses impacts for the analysis areas that would be common to all five heavy-haul truck implementing alternatives. It includes impacts for upgrading Nevada highways for use by heavy-haul trucks, constructing and operating an intermodal transfer station, and heavy-haul truck transportation of shipping casks, both loaded and empty. DOE evaluated these impacts as described in Section 6.3. Section 6.3.3.2 discusses impacts that would be unique to each heavy-haul truck transportation implementing alternative.

6.3.3.1.1 *Common Route Land Use and Ownership Impacts*

Intermodal Transfer Station Construction. Land-use impacts from an intermodal transfer station would center on the station itself because the railroad lines and the highways that DOE would use already exist and their intended use would not change. The construction of an intermodal transfer station would change the land uses and ownership (organizational control) of about 0.2 square kilometer (50 acres) of property. This land would become the responsibility of DOE or possibly a transportation operating

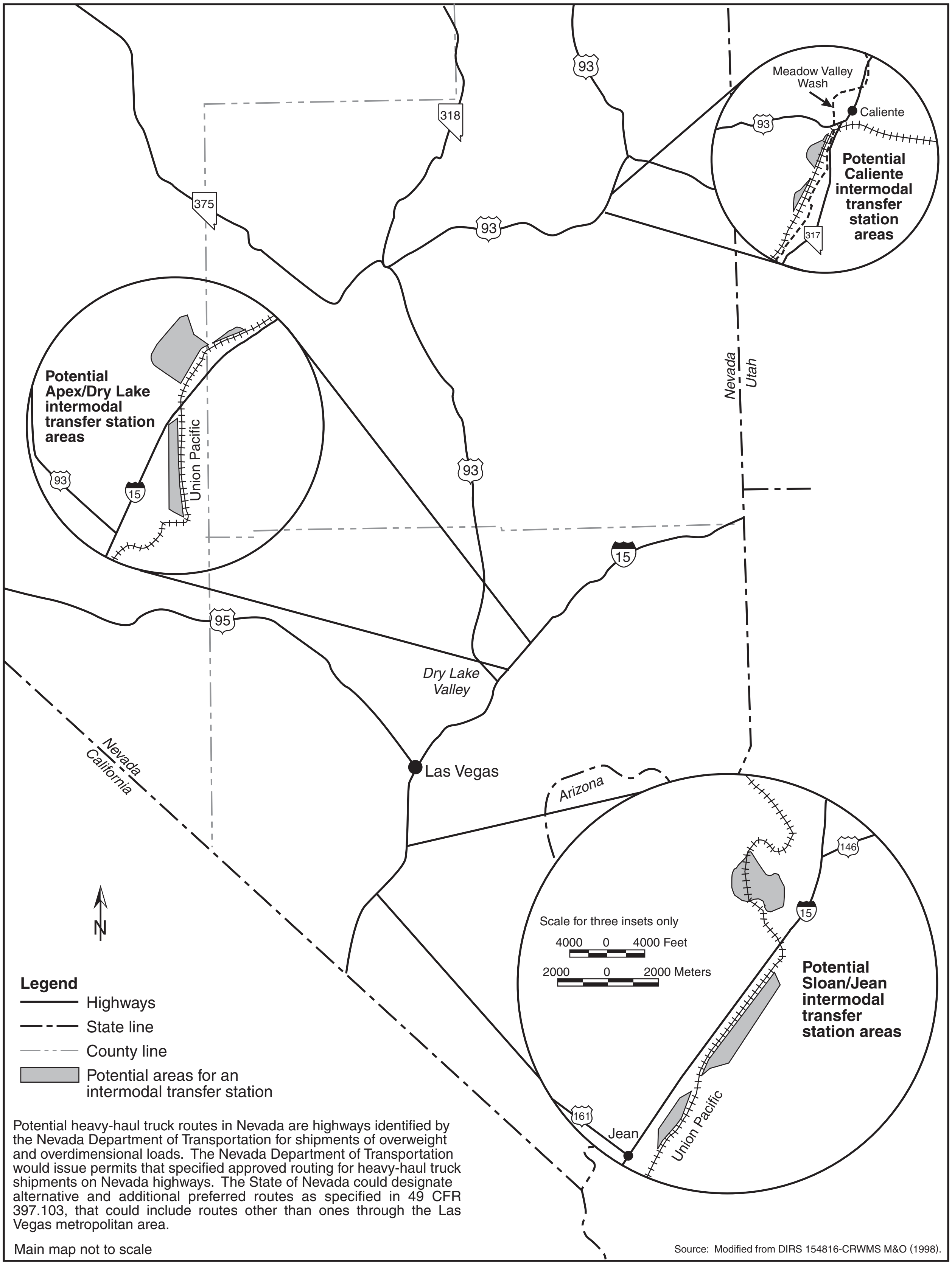


Figure 6-21. Potential locations for an intermodal transfer station.

company. An intermodal transfer station would be in an area used for industrial and commercial activities or adjacent to existing roads and railways. Because the land area would be small, fencing around an intermodal transfer station would have no significant impacts on other land uses. Because of the station's use and proximity to industrial and commercial facilities or existing roads and rail lines, land use impacts would be small. DOE would build a Caliente intermodal transfer station, located near the entrance to Kershaw-Ryan State Park, on lands currently used for industrial and commercial purposes. Because of this, there should be no additional impact to land use.

Heavy-Haul Truck and Intermodal Transfer Station Operations. Intermodal transfer station operations (arriving and departing trains, arriving and departing heavy-haul trucks, intermodal transfers, and maintenance and inspection activities) would be confined to the same areas that were disturbed during construction, so no additional land disturbance would take place. There would be no significant impacts to land use of the proposed facility locations. Only limited land-use impacts would result from heavy-haul truck operations on Nevada highways. Erosion along these highways would be managed as it is now. Because new road construction would not be needed, additional land and soil disturbance would occur only along existing roads and within existing rights-of way. Other land-use and ownership impacts would differ among the implementing alternatives. These impacts are described in Section 6.3.3.2.

6.3.3.1.2 *Common Route Air Quality Impacts*

The emissions of criteria pollutants [carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter (PM_{10}), lead, and ozone] are regulated under the Clean Air Act. Ozone would not be directly released during heavy-haul truck route construction and operation activities. However, ozone precursors (nitrogen dioxide and volatile organic carbon compounds) would be released due to fuel use by construction equipment. The estimated annual emission rates of nitrogen dioxide and volatile organic carbon compounds would be small in comparison with regulatory standards (40 CFR 52.21). In addition, lead emissions would not result from heavy-haul truck route construction and operation activities. The construction and operation activities discussed in this section would not be a significant source of ozone or lead.

DOE conducted a conformity review using the guidance in DIRS 155566-DOE (2000, all) for transportation activities under the heavy-haul truck implementing alternative. This review focused on the emission of carbon monoxide and PM_{10}. The Las Vegas air basin is in nonattainment status for carbon monoxide, which is largely a result of on-road sources (DIRS 156706-Clark County 2000, Appendix A, Table 1-3). During construction, transportation of personnel, materials, and supplies; construction of an intermodal transfer station; and highway construction and upgrade activities in the nonattainment area (including accelerated construction of the Las Vegas Beltway) would result in carbon monoxide emissions in the nonattainment area. During operations, transportation of personnel, materials, and supplies and transportation of spent nuclear fuel and high-level radioactive waste would result in carbon monoxide emissions in the nonattainment area. The review determined that during the construction phase total carbon monoxide emissions would exceed the General Conformity threshold level in the nonattainment area only for the Caliente/Las Vegas route (110 percent of threshold). All other nonattainment area construction and operations emissions in the nonattainment area would not exceed the General Conformity threshold level. The maximum emissions would be 100 metric tons (110 tons) per year (110 percent of threshold) during construction ; this estimate is 0.11 percent of the 2000 daily carbon monoxide inventory of the Las Vegas air basin. Maximum total emissions during operations would be 73 metric tons (80 tons) per year (80 percent of threshold); this estimate is 0.08 percent of the 2000 daily carbon monoxide inventory of the Las Vegas air basin.

The Las Vegas air basin is also in nonattainment status for PM_{10}, which is largely a result of construction activities (DIRS 155557-Clark County 2001, Tables 3-8 and 5-3). The conformity review determined that the fugitive dust emissions from the construction of the intermodal transfer facilities and highway construction and upgrade activities in the nonattainment area (including accelerated construction of the Las Vegas Beltway) would just exceed General Conformity threshold levels for the Caliente/Las Vegas route (100 percent of threshold). The maximum emissions would be 66 metric tons (73 tons) per year (100 percent of threshold) during construction; this estimate is 0.04 percent of the annual and daily 2001 PM_{10} inventory of the Las Vegas air basin.

The General Conformity Threshold levels are exceeded for carbon monoxide (110 percent of threshold) and PM_{10} (100 percent of threshold) during construction of the Caliente/Las Vegas route. The above-threshold emissions would occur over a 1.2-year period in the nonattainment area. During the remaining construction time for this route, construction activities and, therefore, emissions would occur largely outside the nonattainment area. Outside the nonattainment area, emissions levels would be significantly below the Prevention of Significant Deterioration levels (carbon monoxide—43 percent of threshold and PM_{10}—29 percent of threshold).

The DIRS 155112-Berger (2000, p. 56) estimate for transportation of radioactive materials only for heavy-haul truck transport for 2020 is 0.54 metric ton (0.59 ton) per day. The Berger estimate is largely the result of emissions from collateral traffic congestion. Although DOE believes the estimate is high, a value of 0.54 metric ton per day, 11 round trip shipments per week, 52 weeks per year, would result in about 123 metric tons (135 tons) of carbon monoxide per year, which would exceed the 91 metric tons (100 tons) per year General Conformity threshold, but would be 0.08 percent of the annual and daily 2001 PM_{10} inventory of the Las Vegas air basin.

Highway Construction and Upgrades. Construction and upgrade activities would occur in Nevada along any of the five heavy-haul alternatives (see disturbed area estimates under the Land Use and Ownership discussions in Section 6.3.3.2. These activities would result in the release of criteria pollutants. Fuel consumption during construction activities would result in releases of criteria pollutants [carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulate matter (PM_{10})]. Construction activities would also release particulate matter in the form of fugitive dust from such activities as excavation and truck traffic. The analysis for the three heavy-haul truck routes that would pass through the Las Vegas Valley air basin included acceleration of the Las Vegas Beltway project from its scheduled completion in 2020 to a completion date of 2010.

Most of the road upgrades would occur in areas that are in attainment for all criteria pollutants. If construction activities were conducted in the Las Vegas Basin, which is in nonattainment for PM_{10} and carbon monoxide, additional measures would be necessary to reduce the PM_{10} and carbon-monoxide emissions, in accordance with the Clark County PM_{10} State Implementation Plan (DIRS 155557-Clark County 2001, all). Appendix G, Section G.1.4.1, describes the method used to determine PM_{10} emissions from earthmoving activities. This method takes no credit for dust suppression measures. However, the analysis assumed dust suppression for the transportation construction emissions described here and in the conformity review; dust suppression was assumed to reduce PM_{10} emissions by 70 percent. Appendix G, Section G.1.4.5, describes the method used to determine criteria pollutant emissions from construction vehicle activity. Fuel consumption from route-specific construction vehicle use is assumed to be:

Caliente/Las Vegas route:	5.5 million liters (1.5 million gallons) diesel fuel, 110,000 liters (29,000 gallons) gasoline over 46 months
Sloan/Jean route:	1.7 million liters (450,000 gallons) diesel fuel, 29,000 liters (7,700 gallons) gasoline over 48 months
Apex/Dry Lake route:	1.6 million liters (420,000 gallons) diesel fuel, 25,000 liters (7,400 gallons) gasoline over 28 months

Accelerated Northern Beltway:	1.9 million liters (500,000 gallons) diesel fuel, 35,000 liters (9,200 gallons) gasoline over 28 months (add these emissions to Caliente/Las Vegas and Apex/Dry Lake results)
Accelerated Southern and Western Beltway:	3.9 million liters (1 million gallons) diesel fuel, 72,000 liters (19,000 gallons) gasoline over 48 months (add these emissions to Sloan/Jean results)

However, activities at any location would generate transient emissions that would be spread over a very large area because construction would be a moving source along various portions of the route. Construction activities in or near the nonattainment area would include intermodal transfer facility construction at Sloan/Jean and Apex/Dry Lake; highway upgrade activities for the Caliente/Las Vegas, Sloan/Jean, and Apex/Dry Lake routes; and accelerated Las Vegas Beltway construction.

Intermodal Transfer Station Construction. Construction of an intermodal transfer station would also generate emissions of criteria pollutants from fuel use and earthmoving activities. Each heavy-haul truck route would require the construction of such a facility. The Caliente intermodal transfer station could serve the Caliente, Caliente/Chalk Mountain, or Caliente/Las Vegas route. The Caliente station would be in an area in attainment of the National Ambient Air Quality Criteria (attainment area) and construction emissions would adhere to the Prevention of Significant Deterioration regulations (40 CFR 52.21). The Sloan/Jean or Apex/Dry Lake station would be in or near the Las Vegas Basin PM_{10} and carbon monoxide nonattainment area. New stationary emission sources in nonattainment areas are regulated under the General Conformity Rule (40 CFR 93.153).

Table 6-83 lists estimated annual emissions from the construction of an intermodal transfer station. These estimates would apply to each of the three potential site areas. Building an intermodal transfer station would disturb about 0.2 square kilometer (50 acres) over 18 months. Construction of the station would require about 130,000 liters (34,000 gallons) of diesel fuel and about 2,600 liters (690 gallons) of gasoline. The analysis used the method described above for highway construction and upgrades to estimate emissions from earthmoving and fuel use.

Table 6-83. Annual criteria pollutant releases from construction of an intermodal transfer station (kilograms per year).[a]

Pollutant	Construction emission (annual)	PSD limit[b]	Percent of limit[b]	GCR[c] emission threshold	Percent of GCR emission threshold
Nitrogen dioxide	3,400	230,000	1.4	NA[d]	NA
Sulfur dioxide	320	230,000	0.14	NA	NA
Carbon monoxide	2,100	230,000	0.91	91,000	2.3
PM_{10}	9,400	230,000	4.1	64,000 (serious)	15

a. To convert kilograms to tons, multiply by 0.0011023.
b. Prevention of Significant Deterioration (40 CFR 52.21).
c. GCR = General Conformity Rule (40 CFR 93). Applies for releases of pollutants in areas in nonattainment.
d. NA = not applicable.

Table 6-83 lists the percentage of each pollutant in relation to the Prevention of Significant Deterioration limit and the General Conformity Rule emission threshold. The estimated annual releases from the construction of the intermodal transfer station would be almost 4 percent of the Prevention of Significant Deterioration limit and 15 percent of the General Conformity Rule emission threshold (see 40 CFR 93) for PM_{10} and 2.3 percent for carbon monoxide. Construction activities in the Las Vegas nonattainment area would have to follow more stringent fugitive dust (PM_{10}) control measures described in the Clark County PM_{10} State Implementation Plan (DIRS 155557-Clark County 2001, all).

Heavy-Haul Truck and Intermodal Transfer Station Operations. Operations at the intermodal transfer station would include locomotive and heavy-haul truck emissions. Fuel use by heavy-haul trucks would result in emissions of carbon monoxide, nitrogen dioxide, sulfur dioxide, and PM_{10}. Based on the Federal standards for switch locomotives (40 CFR 92.006), there are no emission standards for sulfur dioxide. The locomotive would operate about 30 hours per week at the intermodal transfer station. The pollutant concentration in the area around the route would increase slightly during the passage of the heavy-haul trucks but would not exceed the General Conformity thresholds. About 11 heavy-haul trucks per week would travel to and from the intermodal transfer station.

Table 6-84 lists estimated annual emissions from the operation of an intermodal transfer station. These estimates would apply to each location.

Table 6-84. Annual emissions of criteria pollutants from operation of an intermodal transfer station over 24 years (kilograms per year).[a]

Pollutant	Operation[b] emissions (annual)	PSD limit[c]	Percent of PSD limit	GCR[d] emission threshold	Percent of GCR emission threshold
Nitrogen dioxide	38,000	230,000	17	NA[e]	NA
Sulfur dioxide	(f)	230,000	(f)	NA	NA
Carbon monoxide	11,000	230,000	4.8	91,000	12
Particulate matter (PM_{10})	1,100	230,000	0.48	64,000	1.7

a. To convert kilograms to tons, multiply by 0.0011023.
b. Operations emissions from a switchyard locomotive and heavy-haul trucks.
c. PSD limit = Prevention of Significant Deterioration definition of a major stationary source (40 CFR 52.21); applies for releases of criteria pollutants during operation.
d. GCR = General Conformity Rule (40 CFR Part 93); applies for releases of pollutants in areas in nonattainment.
e. NA = not applicable.
f. 40 CFR 92.006 does not define sulfur dioxide emission standards for locomotives.

The estimated annual releases for the operation of the intermodal transfer station would be about 17 percent or less of the definition of a major stationary source (see Chapter 3, Section 3.1.2.1, or 40 CFR 52.21). The operation of a midroute stopover would result only in small releases of pollutants.

The operation of a yard locomotive would not emit ozone directly, but would emit ozone precursors (nitrogen dioxide and hydrocarbons). The estimated annual releases of the ozone precursors would be small; nitrogen dioxide would be about 17 percent of a major stationary source. Therefore, DOE does not expect the operation of the intermodal transfer facility to be a significant source of ozone.

Because the shipping casks would not be opened, there would be no radiological air quality impacts from normal operations at an intermodal transfer station.

Other air quality impacts would differ among the implementing alternatives (see Section 6.3.3.2).

6.3.3.1.3 *Common Route Hydrology Impacts*

This section describes impacts common to the five heavy-haul truck implementing alternatives (including upgrades to Nevada highways and construction of a midroute stopover and an intermodal transfer station at one of three locations) for surface water and groundwater.

Surface Water

Highway Construction and Upgrades. For road improvement work and construction of a midroute stopover, a contractor could place fuel tank trucks or trailers along the route to support equipment operations. Such a practice would present some potential for spills and releases. As long as the contractor met the regulatory requirements for reporting and remediating spills and properly disposing of or recycling used materials, the probability of unrecovered spills due to negligence or improper work practices would be low. If a release occurred, the potential for chemical contaminants (principally petroleum products) to enter flowing surface water before cleanup would be the largest risk. Surface-water resources along routes for heavy-haul trucks and in the vicinity of intermodal transfer station sites are identified in Chapter 3, Section 3.2.2.2.3. Among all the routes and station sites, three identified surface-water resources cross or run immediately adjacent to a route and two others are as close as 10 to 30 meters (30 to 100 feet). Otherwise, all of the identified surface-water resources are at least 100 meters (330 feet) from the existing roads or intermodal transfer station sites. Two of the station sites and their associated routes for heavy-haul trucks (Sloan/Jean and Apex/Dry Lake) have no identified surface-water resources within 1 kilometer (0.6 mile). The potential for released contaminants to reach flowing surface water would be very low.

A portable asphalt plant to support roadway improvement work would be located along the paving area. Aggregate crushing plants would be located in borrow areas. DOE assumes that the borrow areas would be those normally used by the Nevada Department of Transportation. Spills and releases of asphalt materials, which are predominantly petroleum products but include chemical additives, could occur in the course of operating an asphalt plant. Spill reporting and remediation requirements would be in place for these operations, as described above. Once asphalt was in place, it would be susceptible to minor leaching or bleeding while it cured, similar to the leaching or bleeding that occurs during road construction for other highway projects.

Intermodal Transfer Station Construction. Potential impacts to surface water would include (1) the possible spread of contamination by precipitation, intermittent runoff events, or, where present, releases to flowing water in the single perennial stream, and (2) the alteration of natural drainage patterns or runoff rates that could affect downgradient resources.

Materials that could contaminate surface water would be present during construction; these would consist primarily of petroleum products (fuels and lubricants) and coolants (antifreeze) to support equipment operations. There would not be much bulk storage of these materials. Fuel for vehicles would be purchased from nearby commercial vendors. Minor amounts of building materials such as paints, solvents, and thinners could be present during construction.

The construction of an intermodal transfer station would include stormwater runoff control, as necessary; the completed station would have a stormwater detention basin. These measures would minimize the potential for contaminated runoff to reach a stream.

Appendix L contains a floodplain/wetlands assessment that examines the effects of highway route construction, operation, and maintenance (see Section L.4.1) on the following floodplains in the vicinity of Yucca Mountain: Fortymile Wash, Busted Butte Wash, Drill Hole Wash, and Midway Valley Wash. There are no delineated wetlands at Yucca Mountain.

The assessment in Appendix L compares what is known about the floodplains, springs, and riparian areas at the three candidate intermodal transfer station sites (see Sections L.3.2.6, L.3.2.7, L.3.2.8, and L.4.2.2). In general, wetlands have not been delineated at the three sites. The Appendix L assessment does not evaluate potential floodplain or wetland effects along routes for heavy-haul trucks because these are existing roads and DOE assumed upgrades would be limited to those construction activities necessary to accommodate the heavy-haul vehicles. If DOE selected heavy-haul trucks to transport spent nuclear fuel and high-level radioactive waste to the Yucca Mountain site, it would also select one of five routes (Figure 6-20) and one of three alternative intermodal transfer station sites (Figure 6-21). DOE would then prepare a more detailed floodplain/wetlands assessment of the selected alternatives to determine to what extent the routes and station locations might be subject to flooding and whether the upgrades would affect wetlands.

Heavy-Haul Truck and Intermodal Transfer Station Operations. Surface-water impacts during operations would be limited to those from maintaining and resurfacing highways and parking areas at a midroute stopover that the heavy-haul trucks would use. As discussed above, good construction practices overseen by the Nevada Department of Transportation would limit impacts that could result from spills of chemical contaminants in the course of highway maintenance and resurfacing activities. Contamination of surface water caused by contaminants leached from new asphalt would be similar to that which occurs in the periodic resurfacing of asphalt highways.

Operations at a completed intermodal transfer station would have little impact on surface waters beyond any permanent drainage alterations that occurred during construction. The station area runoff rates would differ from those of the natural or existing terrain but, given the relatively small size [0.2 square kilometer (50 acres)] of the potentially affected area, they would add little to overall runoff quantities for the area.

The general design criteria for a station would consider the potential for a 100-year flood. Because the spent nuclear fuel and high-level radioactive waste shipping casks would not be opened or otherwise disassembled, the use of industrial design standards for this facility would be appropriate. The analysis assumes that the station would have a diesel-powered generator to provide standby electric power and an associated diesel storage tank. The diesel tank would present a minor potential for spills and releases. Runoff retention areas would limit impacts of potential oil and diesel spills in parking areas.

6.3.3.1.4 *Common Route Groundwater Impacts*

Highway Construction and Upgrades. For highway upgrades, the most likely impacts would be changes to infiltration rates and new sources of contamination that could migrate to groundwater during construction. In this case, however, the potential for impacts would be small due to the relatively small areas affected by upgrading and the fact that highway construction [with the exception of 2 kilometers (1.2 miles) of new highway near Beatty, Nevada, and a midroute stopover], would be a modification of existing roadways. In addition, there would be no large sources of contamination.

Construction activities would disturb and loosen the ground, which could produce greater infiltration rates. However, this impact would be minor and short-lived as contractors completed their work and stabilized the disturbed areas.

Intermodal Transfer Station Construction. Construction activities for an intermodal transfer station would disturb and loosen the ground for some time, which could cause higher infiltration rates. However, this impact would be minor and short-lived as contractors completed the facility and stabilized the disturbed areas.

Water needs for construction would be met by trucking water to the site, installing a well (which would also be used for operations), or possibly by connection to a local water distribution system. In any case, water demand would be small for construction.

Heavy-Haul Truck and Intermodal Transfer Station Operations. The use of highways by heavy-haul trucks would have little impact on groundwater resources. There would be no continued need for water along the route, and there would be no changes to recharge beyond those at the completion of construction.

The operation of a completed midroute stopover and an intermodal transfer station would have little impact on groundwater. Infiltration rates would be as described above for the completion of construction;

the relatively small size of the facilities would minimize changes. Potential sources of contamination at the intermodal transfer station would consist primarily of a diesel fuel tank for the standby generator and heavy equipment. Water demand at the station and the midroute stopover would be small, consisting primarily of the needs of the operators, and would be obtained by the methods described above for construction. This demand would cause no noticeable change in water consumption rates for the area.

Other impacts to hydrology would differ among the implementing alternatives, as described in Section 6.3.3.2.

6.3.3.1.5 *Common Route Biological Resources and Soils Impacts*

Highway Construction and Upgrades. Highway upgrade activities would involve improving existing road surfaces and possibly building a bridge near Beatty, Nevada (Caliente route), a midroute stopover (Caliente routes), and about 2 kilometers (1.2 miles) of new highway to handle heavier vehicles (DIRS 155347-CRWMS M&O 1999, Request #048). Areas disturbed by these activities would be in, adjacent to, or near existing rights-of-way. These areas would consist of habitats previously degraded by human activities, which would limit impacts associated with the routes. Clearing of vegetation and soil disturbance would create habitat for colonization by exotic plant species that are present along the candidate routes. This could result in an increase in abundance of exotic species along the routes, which could result in suppression of native species and increased fuel loads for fire. Reclamation of disturbed areas would enhance the recovery of native vegetation and reduce colonization by exotic species. Slight alterations of habitat immediately adjacent to existing roads would have only small impacts on desert tortoises because work would occur in the existing right-of-way. Tortoise populations are depleted for more than a kilometer on either side of roads having average daily traffic greater than 180 vehicles (DIRS 103160-Bury and Germano 1994, pp. 57 to 72). Game species, wild horses and burros, and other animals could temporarily avoid habitat adjacent to roads during highway upgrades, but upgrades would not otherwise add to the effects of these roads on the movement patterns or behavior of these animals. The modification of bridges and culverts over perennial streams, if necessary, could temporarily disrupt stream flow and increase sedimentation in downstream aquatic environments. DOE anticipates that preconstruction surveys of potentially disturbed areas would identify and locate sensitive biological resources and best management practices would minimize the impacts of highway upgrades.

All of the heavy-haul truck implementing alternatives cross perennial or ephemeral streams that may be classified as jurisdictional waters of the Unites States. Discharge of dredged or fill material into those waters is regulated under Section 404 of the Clean Water Act. After the selection of a heavy-haul truck implementing alternative, if requested, DOE would assist the Nevada Department of Transportation to identify any jurisdictional waters of the United States that highway upgrades would affect; develop a plan to avoid when possible, and otherwise minimize, impacts to those waters; and obtain, as appropriate, an individual or regional permit from the U.S. Army Corps of Engineers for the discharge of dredged or fill material. By implementing the mitigation plan and complying with other permit requirements, the Nevada Department of Transportation would ensure that impacts to wetlands and other waters of the United States would be small.

The primary soil impacts from improvements to highways would be land disturbance. Road improvements would consist of widening existing roadways, constructing turnouts and truck lanes at designated stretches along the routes, and improving existing intersections. Water would be applied during construction to suppress dust and compact the soil; this would reduce the potential for erosion. Drainage control along the route probably would remain as it is now. These combined measures would minimize the potential for adverse impacts to soils.

Intermodal Transfer Station Construction. The biological settings of the three potential sites for an intermodal transfer station differ; Section 6.3.3.2 addresses impacts for each of the Nevada heavy-haul transportation implementing alternatives.

Soil impacts from the construction of an intermodal transfer station would arise primarily from the direct impacts of land disturbance and would apply to each station site and route. Chapter 3, Section 3.2.2.2.1, lists estimates of land area required for an intermodal transfer station. The disturbed areas probably would be subject to increased erosion for at least some of the construction phase. Water would be applied during construction to suppress dust and compact the soil; this would reduce the potential for erosion. At the beginning of station construction, the topsoil would be stripped and stockpiled; during construction, temporary erosion control systems would minimize erosion impacts. At the completion of construction, the topsoil would be replaced over areas not used for station facilities, the area disturbed surrounding the station would be revegetated, and other permanent erosion control systems would be installed as appropriate.

Heavy-Haul Truck and Intermodal Transfer Station Operations. Impacts to biological resources from operations along any of the five possible routes would be very small. Because existing roadways would not be greatly altered, operations and maintenance would not lead to additional habitat losses. Heavy-haul truck operations could kill individuals of some species, but losses would be unlikely to have a detectable impacts on the regional population of any species and would be small in comparison to losses caused due to other traffic on the highways. Passing trucks could disrupt wildlife, but such effects would be transitory. The use of an upgraded highway would have only a small impact on soils.

Impacts to biological resources from operations at an intermodal transfer station and a midroute stopover would be very small. Operations would not lead to additional habitat losses. Individuals of some species could be disturbed or killed by human activities at the station and stopover, but such losses would be unlikely to have a detectable impact on the regional population of any species.

The use of a completed intermodal transfer station and midroute stopover should have only small impacts on soils. The station and stopover would be maintained throughout the operations period, including the repair of erosion damage to the grounds around the station and the rail siding.

Other impacts to biological resources would differ among the heavy-haul truck implementing alternatives, as described in Section 6.3.3.2.

6.3.3.1.6 *Common Route Cultural Resources Impacts*

Highway Construction and Upgrades and Intermodal Transfer Station Construction. Impacts (such as disturbing sites or damaging artifacts) could occur, primarily from surface-disturbing activities, to archaeological, historic, and traditional Native American cultural sites from upgrading highways, constructing a midroute stopover, and building an intermodal transfer station. Cultural resource inventories by the Nevada Department of Transportation and others identify certain archaeological and historic sites in established rights-of-way [generally about 60 meters (200 feet) wide]. Section 6.3.3.2 discusses the impacts of individual routes.

Heavy-Haul Truck and Intermodal Transfer Station Operations. After the identification, evaluation, and mitigation of impacts to significant cultural sites prior to construction activities associated with the upgrading of highways or construction of an intermodal transfer station, there would be no additional impacts to these resources from the operation of a heavy-haul truck route.

Although existing highways would be used, American Indians have expressed concern about the transport of spent nuclear fuel and high-level radioactive waste through tribal lands and through the larger region that comprises their traditional holy lands (DIRS 102043-AIWS 1998, all). Use of the Caliente/Las Vegas, Apex/Dry Lake, or Sloan/Jean route would include travel on U.S. 95 across a 1.6-kilometer (1-mile) section of the Las Vegas Paiute Indian Reservation. The Caliente/Las Vegas and Apex/Dry Lake routes pass near the Moapa Indian Reservation. The Caliente route along U.S. Highway 95 runs adjacent to the Scottys Junction trust lands parcel that Congress recently transferred to the Timbisha Shoshone tribe.

Other impacts to cultural resources would differ among the heavy-haul truck implementing alternatives, as described in Section 6.3.3.2.

6.3.3.1.7 *Common Route Occupational and Public Health and Safety Impacts*

Highway Construction and Upgrades. Traffic-related fatalities could occur among workers and members of the public during the upgrading of Nevada highways for heavy-haul truck use. The number of fatalities would depend on the amount of construction activity needed to upgrade a route. There would be no other common impacts for highway construction under any of the implementing alternatives. Section 6.3.3.2 describes impacts for each of the implementing alternatives. The construction of a midroute stopover for routes originating in Caliente would not add much to the impacts of highway construction discussed in Section 6.3.3.2.

Intermodal Transfer Station Construction. Impacts to workers from industrial hazards during the construction of an intermodal transfer station would be the same for all three possible locations. These impacts would be small (see Table 6-85). The analysis estimated impacts to workers in terms of total recordable cases of injury or illness, lost workday cases, and fatalities to workers. In addition, it estimated that there would be less than 1 (0.03) construction and construction workforce traffic-related fatality.

Table 6-85. Health impacts to workers from industrial hazards during construction of an intermodal transfer station.

Group	Total recordable cases[a]	Lost workday cases	Fatalities
Involved	3.8	1.8	0.01
Noninvolved[b]	0.3	0.1	0
Totals[c]	4.1	1.9	0.01

a. Total recordable cases includes injuries and illness.
b. Noninvolved worker impacts based on 25 percent of the involved worker level of effort.
c. Impacts are totals for 18 months.

Heavy-Haul Truck and Intermodal Transfer Station Operations. Section 6.3.3.2 discusses impacts for heavy-haul truck transportation and operations for each of the heavy-haul truck implementing alternatives. Common impacts for intermodal transfer station operations would include those to workers from industrial hazards and exposure to ionizing radiation (radiological impacts). DOE has determined that, because worker exposures to hazardous or toxic materials would be unlikely, workers at the station would incur no impacts from such materials. Table 6-86 lists potential impacts to workers from industrial hazards. In addition, there would be less than one (0.38) traffic-related fatality involving intermodal transfer station workers during operations.

Table 6-86. Health impacts to workers from industrial hazards during operation of an intermodal transfer station.

Group	Total recordable cases[a]	Lost workday cases	Fatalities
Involved	52	29	0.14
Noninvolved[b]	3.0	1.1	0.003
Totals[c]	55	30	0.15

a. Total recordable cases includes injuries and illness.
b. Noninvolved worker impacts based on 25 percent of the involved worker level of effort.
c. Totals for 24 years of operations.

Intermodal transfer station workers would be exposed to direct radiation from the shipping casks the station would handle. Involved worker exposures would occur during both the inbound (to the proposed repository) and outbound (to the commercial and DOE sites) portions of the shipment campaign. The involved worker group would include as many as 20 personnel performing station operational tasks over a total shipment campaign of about 19,300 casks (9,650 inbound and 9,650 outbound).

The analysis assumed that noninvolved workers would not be exposed to direct radiation during intermodal transfer station operations. To assess potential radiological impacts at the intermodal transfer stations, the EIS analysis assumed that noninvolved workers would be persons involved with the day-to-day operations of the facility and would have no direct involvement with handling spent nuclear fuel and high-level radioactive waste.

Table 6-87 lists doses and radiological impacts to an individual worker and the involved worker population. The estimated doses are based on involved worker doses from DIRS 104791-DOE (1992, p. 4.2).

Table 6-87. Doses and radiological impacts to involved workers from intermodal transfer station operations.[a]

Group	Dose	Latent cancer fatality
Maximum individual worker	12 rem[b]	0.005[c]
Involved worker population	260 person-rem	0.11[d]

a. Totals for 24 years of operations.
b. Based on 500-millirem-per-year administrative dose limit.
c. The estimated probability of a latent cancer fatality in an exposed individual.
d. The estimated number of latent cancer fatalities in an exposed involved worker population.

Table 6-87 indicates that the involved group of workers could incur a collective dose of about 260 person-rem over the operating period of the intermodal transfer station. The analysis estimated that about 0.1 latent cancer fatality would occur in the exposed worker population. The maximum individual dose accumulated by these workers was assumed to be 500 millirem per year or 12 rem for a worker who worked at the facility for the 24-year operating period. This dose would result in a 0.005 probability of a latent cancer fatality (about a 1-in-200 chance). The assumed annual average dose to an involved worker is the administrative limit on occupational dose that DOE established for its facilities (DIRS 156764-DOE 1999, Article 211). Because vehicles would not be loaded or unloaded at a midroute stopover (Caliente routes), workers at the stopover would receive only small radiation doses.

Incident-Free Transportation. Incident-free impacts of heavy-haul truck transportation in Nevada to individual workers and the public would be unique for each of the five Nevada heavy-haul truck transportation implementing alternatives; these are discussed for each implementing alternative in Section 6.3.3.2. In addition, the incident-free impacts that would occur in Nevada from 1,079 legal-weight truck shipments, although common among the heavy-haul truck implementing alternatives, are reported along with the incident-free impacts for heavy-haul truck transportation in Section 6.3.3.2 for each heavy-haul truck implementing alternative.

Incident-free impacts to hypothetical maximally exposed individuals would be similar among the Nevada heavy-haul truck transportation implementing alternatives. Table 6-88 lists the impacts to maximally exposed individuals including a Nevada-specific individual exposed to heavy-haul truck shipments. Appendix J, Section J.1.3.2.2 describes assumptions for estimating doses to maximally exposed individuals along routes in Nevada.

Accidents. Accident risks and maximum reasonably foreseeable accidents for heavy-haul truck shipments of spent nuclear fuel and high-level radioactive waste would be similar among the Nevada heavy-haul truck transportation implementing alternatives, so this section discusses them.

Table 6-89 lists the accident risks from the transportation of spent nuclear fuel and high-level radioactive waste for the five Nevada heavy-haul truck transportation implementing alternatives. The data show that

Table 6-88. Estimated doses and radiological impacts to a maximally exposed individual for heavy-haul truck implementing alternatives.[a,b]

Individual	Dose (rem)	Probability of latent fatal cancer
Involved workers		
Crew member (rail, heavy-haul truck or legal-weight truck)	48[c]	0.02
Inspector	34	0.013
Railyard crew member	4.2	0.002
Public		
Resident along route (rail)	0.002	0.000001
Nevada resident along route (heavy-haul)[d]	0.53	0.00027
Person in traffic jam[e] (legal-weight truck)	0.02	0.000008
Person at service station[f] (legal-weight truck)	0.08	0.00004
Resident near rail stop[g]	0.002	0.000001

a. The assumed external dose rate is 10 millirem per hour at 2 meters (6.6 feet) from the vehicle for all shipments.
b. Totals for 24 years of operations.
c. Based on 2-rem-per-year administrative dose limit. If a lower dose limit, for example 500 millirem per year, was imposed for transportation workers or state inspectors, maximally exposed individual doses would be lower. See DIRS 156764-DOE (1999, Article 211) for DOE guidance on occupational dose limits.
d. This represents a Nevada resident approximately 15 meters (49 feet) from an intersection. This individual would be exposed for 1 minute per shipment plus 30 minutes per year due to traffic delays.
e. Person in a traffic jam is assumed to be exposed one time only.
f. Assumes the person works at the service station for all 24 years of operations. Mitigation would be required to reduce doses to members of the public to below 100 millirem per year.
g. This represents a Nevada resident approximately 30 meters (98 feet) from the branch rail line. See Section J.1.3.2.2.

Table 6-89. Health impacts[a] to the public from accidents for Nevada heavy-haul truck implementing alternatives.

Risk	Caliente	Caliente/Chalk Mountain	Caliente/Las Vegas	Apex/Dry Lake	Sloan/Jean
Radiological accident risk					
Dose risk (person-rem)	0.01	0.0019	0.056	0.056	0.12
LCF[b]	0.000005	0.000001	0.0000009	0.000028	0.00006
Traffic fatalities	0.6	0.33	0.43	0.23	0.25

a. Impacts are reported for 24 years of operations.
b. LCF = latent cancer fatality.

the risks, which are for 24 years of operations, are low for all five alternatives. These risks include those associated with transporting 1,079 legal-weight truck shipments from the commercial sites that would not have the capability to load rail casks while operational. Small variations in the risk values, principally evident for a Sloan/Jean route, are in part a result of the risks associated with transporting rail casks arriving from the east on the Union Pacific Railroad's mainline through the Las Vegas metropolitan area to a Sloan/Jean intermodal transfer station. The values that would apply for a Caliente/Chalk Mountain or Apex/Dry Lake route are lower because of a shorter route (Apex/Dry Lake), or a more remote and mid-length route (Caliente/Chalk Mountain).

Consequences of Maximum Reasonably Foreseeable Accident Scenarios. DOE evaluated the impacts of maximum reasonably foreseeable accident scenarios for national transportation (see Section 6.2). The results for the national transportation mostly rail scenario apply to transportation in Nevada.

6.3.3.1.8 *Common Route Socioeconomic Impacts*

DOE analyzed five Nevada heavy-haul truck transportation implementing alternatives for potential socioeconomic impacts from expenditures to upgrade and maintain Nevada highways, operate heavy-haul trucks, and construct and operate an intermodal transfer station.

Highway Construction and Upgrades. The dynamics of specific construction projects include a period of brief, intense elevation in project-related employment, followed by an abrupt decrease in associated employment opportunities as construction workers move on to other projects. Project dynamics can also include population increases followed by net declines in population as related employment requirements diminish. In general, increases in population lag behind increases in employment. For the most part, the projected impacts of highway upgrade work would occur in Clark County, which the analysis assumed would be the home county for construction workers because of its large workforce. Section 6.3.3.2 discusses the analysis of impacts to counties along each of the five candidate routes. The time and employment required to complete road upgrades would depend on the route.

Intermodal Transfer Station Construction. If a decision was made to construct an intermodal transfer station, DOE anticipates that preliminary architecture and engineering work would begin in 2007, followed by the start of construction at the selected site in 2008. Construction would last about 18 months. For this analysis, DOE assumed that construction workers would probably come from Clark County.

Although there would be small differences among the three candidate locations for an intermodal transfer station, the total statewide increase in employment (direct and indirect) that would result from the project would peak in 2008 and would be about 135 workers. Population increases resulting from a net influx of new workers would peak in 2009 with about 65 additional residents. These employment and population increases, which would occur mostly in Clark County, would be small and temporary for the affected counties.

Increases in real disposable income from constructing an intermodal transfer station would peak in 2008 at between about $3.6 million and $4.1 million. The increase in Gross Regional Product would also peak in 2008 at between $10.8 million and $11.4 million. State and local government expenditures would peak in 2009 between $198,000 and $243,000. These increases to real disposable income, Gross Regional Product, and government expenditures from construction would be short-term and less than 0.5 percent of the baselines in the affected counties. (All dollar values reported in this section are in 2001 dollars unless otherwise stated.)

Highway Maintenance for Heavy-Haul Truck Operations. If DOE decided to use heavy-haul trucks, annual maintenance would be required after the completion of the highway upgrades. In addition, DOE assumed the routes would be resurfaced approximately every 8 years. Thus, highway expenditures for resurfacing a selected route would occur in approximately 2016, 2024, and 2032. The employment required for road maintenance would depend on the selected route. Section 6.3.3.2 discusses route-specific impacts for each of the five candidate routes.

Heavy-Haul Truck and Intermodal Transfer Station Operations. The socioeconomic impacts of operating heavy-haul trucks and an intermodal transfer station largely would occur in the county in which the station was located. Section 6.3.3.2 discusses these impacts for each of the five candidate routes.

6.3.3.1.9 *Common Route Noise and Vibration Impacts*

Highway Construction and Upgrades and Intermodal Transfer Station Construction. Impacts would occur from construction noise associated with upgrading road surfaces, constructing a midroute stopover, and constructing an intermodal transfer station. The upgrades and construction would include the use of earth-moving equipment (bulldozers, graders, loaders, dump trucks) and asphalt-laying equipment. Earthmoving equipment would dominate maximum noise levels from construction and would achieve levels of 70 to 80 dBA at 15 meters (50 feet) from the source. The potential for noise impacts from construction would depend on the presence of humans along the routes and near the intermodal transfer station location. These persons would live in communities and possibly individual residences. Noise impacts from road upgrades and general construction would be transient, move with the construction, and end when the construction ended. The impacts, therefore, would be temporary for any location along affected highways. Construction noise, which would not occur at night, would be equivalent to the daytime standard (60 dBA) at distances of about 2,000 meters (6,600 feet). Construction upgrades of heavy-haul truck routes and construction of branch rail lines would be unlikely to cause vibration damage to historic buildings because of the distance of potentially sensitive buildings from construction sites.

The American Indian Writers Subgroup (DIRS 102043-AIWS 1998, p. 2-19) has identified noise generated along transportation routes as a concern because it could affect ceremonies and the solitude necessary for healing and praying. Areas or sites of interest to Native Americans have not been identified along these routes.

Heavy-Haul Truck and Intermodal Transfer Station Operations. Heavy-haul trucks would be double-tractor vehicles that this analysis assumed would travel at speeds of 32 to 80 kilometers (20 to 50 miles) an hour. Noise levels probably would be greatest when loaded heavy-haul trucks were moving up grades at speeds as slow as 8 kilometers (5 miles) an hour. This would occur as the trucks approached the proposed repository site and on portions of the Caliente route (see Chapter 2, Section 2.1.3.3). At 48 kilometers (30 miles) an hour, the estimated noise from a single heavy-haul truck moving up a 5-percent grade would be 45 dBA at a distance of 630 meters (about 2,100 feet) from the road with no background traffic. Elevated truck noise would not be a consideration on the Nevada Test Site, the Nellis Air Force Range, or the repository site. Transportation workers would use hearing protection as required by Occupational Safety and Health Administration regulations.

To assess the impact noise generated by heavy-haul trucks, DOE based the estimated increase in the 1-hour average sound level on traffic volumes along the routes for heavy-haul trucks (DIRS 156930-NDOT 2001, all). Noise estimates were based on a total of three double-tractor vehicles passing through a community or past a given point on a highway within 1 hour (DIRS 155778-Melnick 1998, all). The estimated increase in the 1-hour average sound level would not be perceptible in areas with high traffic volume and would be as high as 0.3 to 4.7 dBA in areas of low traffic volume. The estimated noise levels in this analysis were dominated by commercial tractor-trailers (20 percent of total traffic volume) on the open highway and in smaller communities.

During operations, DOE would transport 11 shipments a week of spent nuclear fuel and high-level radioactive waste to the proposed repository and 11 empty casks from the repository. Because the heavy-haul trucks probably would travel individually, elevated noise would occur during the brief time when a vehicle passed through communities. There would be no nighttime noise because trucks of this size would be restricted to operating during daylight hours. Truck noise at a midroute stopover would be similar to noise along the adjacent route. Therefore, the potential for adverse noise impacts from heavy-haul trucks would be low.

Noise associated with operations at an intermodal transfer station would occur as it received shipments and transferred them from railcars to heavy-haul trucks for transport to the proposed repository site. However, the baseline noise level is already elevated because of existing rail line operations at the potential station locations. Additional sources of noise at a station would include transferring railcars from trains into the station, moving the railcars in the station, and receiving returning empty transportation casks. Railcars could come to the station at night, so there would be a potential for nighttime sources of noise. However, shipments in the station could be handled during daylight hours, minimizing the potential for noise impacts.

Ground vibration resulting from the operation of heavy-haul trucks or trains would be unlikely to produce vibration levels of a magnitude sufficient to cause building damage. Heavy-haul trucks can create potentially damaging vibration if the vehicle hits a bump or pothole in the road. The magnitude of vibration produced depends on the speed of the vehicle and the size of the bump. Most of the energy of impact is absorbed by the inflated tires; as a consequence, ground vibration would not be a major impact for these operations. Heavy-haul trucks would operate at reduced speeds when operated at intermodal transfer stations. There are no known historic buildings or ruins of cultural significance that ground vibration could affect near intermodal transfer stations.

Other noise impacts would differ among the implementing alternatives, as described in Section 6.3.3.2.

6.3.3.1.10 *Common Route Aesthetics Impacts*

Highway Construction and Upgrades and Intermodal Transfer Station Construction. There could be impacts on visual resources during these activities because of the presence of workers, camps, vehicles, large earth-moving equipment, laydown yards, large cranes, and dust generation. However, this phase would be of limited duration (approximately 18 months for an intermodal transfer station and as long as 46 months for highway improvements). An intermodal transfer station would be in an already developed area, either for industrial or commercial use or adjacent to existing roads or rail corridors. Therefore, the facility would not change the character of land use in its vicinity. Dust generation during construction would be controlled by implementing best management practices such as misting or spraying disturbed areas. Construction activities would conform with the Bureau of Land Management Visual Resources Management guidelines (DIRS 101505-BLM 1986, all). If a route crosses Class II lands, more stringent management requirements would be necessary to retain the existing character of the landscape. However, the short duration of highway modification or construction activities, combined with the use of best management practices, would mitigate the impacts of activities, which could exceed the management requirements on any Class II lands.

Heavy-Haul Truck and Intermodal Transfer Station Operations. As many as 22 shipments would leave or arrive at the intermodal transfer station each week. Visual impacts would result from the presence of the station, increased worker activity in the area, the arrival and departure of trains, loading and unloading operations, and the arrival and departure of heavy-haul trucks. Noise and lighting impacts would occur at an intermodal transfer station but, due to the remote locations, there would be no significant impacts. Impacts would not exceed Bureau of Land Management Visual Resource Management Class III objectives, which require only the partial retention of the existing character of the landscape.

Other aesthetic impacts would differ among the implementing alternatives, as described in Section 6.3.3.2.

6.3.3.1.11 *Common Route Utilities, Energy, and Materials Impacts*

Highway Construction and Upgrades. The amounts of utilities, energy, and materials needed would depend on the amount of upgrading to be done, which would be specific to each route. The amount of utilities, energy, and materials for each route is given in the following sections. All of the required amounts are much less than current use rates in Nevada. For example, fossil-fuel consumption in Nevada was about 3.8 billion liters (1 billion gallons) in 1996 and none of the routes would require more than 0.5 percent of the annual consumption (DIRS 148094-BTS 1997, all).

Intermodal Transfer Station Construction. Intermodal transfer station design would be the same for any of the three sites and would include a small railyard with several sidings, a 180-metric-ton (200-ton) bridge crane, two steel prefabricated buildings (one for administration and one for maintenance), and a large paved area for heavy-haul truck parking and maneuvering. The basic facility would be a light industrial site with moderate utility requirements. During construction the electrical requirements would be supplied by portable generating equipment. Table 6-90 lists the materials that would be consumed during construction. The quantities of concrete, asphalt, and steel listed in the table are not substantial in comparison to annual use rates and would not affect the regional supply system. For example, the concrete required for an intermodal transfer station would be less than 1 percent of the concrete used in Nevada in 1998 (DIRS 104926-Bauhaus 1998, all). Similarly, the demand for electricity and fossil fuel during construction would not be great. The construction of a midroute stopover for heavy-haul trucks (routes originating in Caliente) is accounted for in the specific route data included in the following sections.

Table 6-90. Construction utilities, energy, and materials for an intermodal transfer station.

Electrical demand (kilowatts)	Fossil fuel (liters)[a]	Concrete (thousand metric tons)[b]	Asphalt (thousand metric tons)	Steel (thousand metric tons)
Onsite generation	Small	7.9	16	1.4

a. To convert liters to gallons, multiply by 0.26418.
b. To convert metric tons to tons, multiply by 1.1023.

Highway Maintenance for Heavy-Haul Truck Operations. Highways used by heavy-haul trucks would be maintained annually and resurfaced, on average, every 8 years. The amounts of utilities, energy, and materials for the annual and 8-year maintenance activities would be less than the initial amounts for upgrading the highways.

Heavy-Haul Truck and Intermodal Transfer Station Operations. The current estimate of electrical demand during the operation of an intermodal transfer station would be 165 kilowatts (DIRS 155347-CRWMS M&O 1999, Request #38). This would include 30 kilowatts for lighting, 50 kilowatts for each of the two buildings, 5 kilowatts for the guard station, and 30 kilowatts for the crane. The actual rate would be substantially less than peak capacity because operations would be intermittent. Only small amounts of fossil fuel would be used at an intermodal transfer station. Chapter 10 discusses fossil-fuel use for heavy-haul truck operations.

Other impacts on utilities, energy, and materials would differ among the implementing alternatives, as described in Section 6.3.3.2.

6.3.3.1.12 *Common Route Waste Management Impacts*

Highway Construction and Upgrades. Highway construction results in minimal waste. Excavated soil is used for fill elsewhere along the route and asphalt is recycled (DIRS 152538-Hoganson 2000, all; DIRS 152535-Hoganson 2000, all). Upgrading highways, including constructing a midroute stopover with a security trailer, could generate waste such as vegetation from land clearing (DIRS 152538-Hoganson 2000, all), construction debris from the trailer setup, and waste from onsite equipment maintenance (DIRS 152537-Hoganson 2000, all) that an independent contractor would dispose of in permitted landfills, or would recycle in the case of lubricants. In addition, construction materials for upgrading engineered structures such as bridges and culverts would be in correct sizes and numbers to minimize waste. Residual materials would be saved for reuse. A commercial vendor would provide portable restroom facilities and would manage the sanitary sewage. Waste would be handled in accordance with applicable environmental, occupational safety, and public health and safety requirements to minimize the possibility of adverse impacts to vegetation, wildlife, soils, surface and groundwater, and air quality from construction inside or outside of the region of influence.

Intermodal Transfer Station Construction. The administration building would be a prefabricated building and the maintenance building would be built on the site. Construction of the maintenance building would require traditional materials such as steel, lumber, and concrete that would result in debris requiring disposal or recycling. Excess construction materials would be salvaged. A maximum of 23 metric tons (26 tons) of construction debris would be disposed of in a local construction debris landfill. Approximately 750,000 metric tons (820,000 tons) of construction debris was disposed of in Nevada in 2000 (DIRS 155565-NDEP 2001, Section 2.1), so the maintenance building construction would add less than 0.01 percent. In addition, construction could require paints and resins that could become hazardous if discarded. Hazardous waste would be shipped to a permitted treatment and disposal facility. A commercial vendor would provide portable restroom facilities as necessary and manage the resulting sanitary sewage. Waste quantities from construction would be about the same for all sites. Impacts to treatment and disposal capacity from disposing of the construction debris, hazardous waste, and sanitary sewage would be small and consistent for all station locations.

Highway Maintenance for Heavy-Haul Truck Operations. Periodic maintenance of highways and resurfacing every 8 years would be unlikely to generate wastes, and asphalt would be recycled (DIRS 152535-Hoganson 2000, all). Environmental impacts from waste would be unlikely.

Heavy-Haul Truck Operations. Heavy-haul truck operations along any of the four routes would result in similar wastes from vehicle maintenance. Maintenance wastes are included in the intermodal transfer station operation discussion below.

The operation of a midroute stopover would generate sanitary solid waste and sanitary sewage at the security trailer. The waste would be proportional to the number of persons using the facility, about 5 kilograms (11 pounds) per day per person of solid waste (DIRS 155567-NDEP 2001, p. 5) and about 57 liters (15 gallons) of wastewater per day per person (DIRS 152492-Gibson 1974, p. 55) if potable water is supplied or less if chemical toilets are used. DOE would dispose of the sanitary solid waste in a permitted municipal landfill; the sanitary sewage would be trucked to a municipal sewage facility. The small quantities of solid and sanitary wastes would have a very small impact on treatment and disposal capacity. Management and disposition of the wastes from operations would comply with applicable environmental and occupational and public safety regulations to minimize the possibility of adverse impacts to vegetation, wildlife, air quality, soils, and water resources.

Intermodal Transfer Station Operations. Operations, regardless of the location, would generate (1) sanitary solid waste such as waste paper from office and personnel activities, (2) waste from maintenance activities, and (3) potentially a small amount [0.71 cubic meter (25 cubic feet) per month] of low-level radioactive waste such as the smear wipes from radiological surveys of shipping casks and vehicles (DIRS 104849-CRWMS M&O 1997, p. 10). The routine maintenance and minor repair of the estimated 20 tractor-trailers assigned to an intermodal transfer station would generate waste and recyclable materials. Lubricants, lead-acid batteries, tires, fuel, antifreeze, refrigerant, and miscellaneous used parts would be generated (DIRS 152534-Hoganson 2000, all). The majority of these wastes could be recycled, as is the case at another DOE fleet operation facility (DIRS 152532-Hoganson 2000, all). Estimated annual recyclable material would be 5.5 metric tons (6.0 tons), primarily lubricating oil. Waste requiring disposal would consist of 1,400 kilograms (3,000 pounds) of nonrecyclable tires per year and 23 kilograms (50 pounds) of drained oil filters per year (DIRS 152534-Hoganson 2000, all). About 83,000 metric tons (91,000 tons) of this type of waste was disposed of in Nevada in 2000 (DIRS 155565-NDEP 2001, Section 2.1), so the truck maintenance waste would add less than 0.01 percent. In addition, the intermodal transfer station would generate sanitary sewage that would be disposed of in an onsite septic system or through connection to a municipal sewage facility.

The intermodal transfer station operator would dispose of nonhazardous solid waste in a local permitted landfill with available capacity. Hazardous waste such as nonrecyclable lead-acid batteries and low-level radioactive waste, if any, would be shipped to treatment and disposal facilities with appropriate permits. The small quantities would have very little impact on the treatment and disposal facilities. Treatment and disposal capacity for hazardous waste would be above the expected demand until 2013 (DIRS 103245-EPA 1996, pp. 32, 33, 36, 46, 47, and 50). Disposal capacity for a broad range of low-level radioactive wastes would be available at two currently licensed facilities (DIRS 152583-NRC 2000, section on U.S. Low-level Radioactive Waste Disposal).

There would be no unique environmental impacts of waste management for any of the heavy-haul truck implementing alternatives. Waste would be managed in accordance with applicable environmental, occupational safety, and public health and safety requirements to minimize the possibility of adverse impacts to vegetation, wildlife, air quality, soils, and water resources. Impacts to the capacity of treatment and disposal facilities receiving wastes generated during Nevada transportation would be small due to the small quantities of waste expected.

6.3.3.2 Impacts Specific to Individual Nevada Heavy-Haul Truck Implementing Alternatives

6.3.3.2.1 *Caliente Route Implementing Alternative*

The Caliente route (Figure 6-22) is approximately 533 kilometers (331 miles) long. Heavy-haul trucks and escorts leaving an intermodal transfer station in the Caliente area would travel directly from the intermodal transfer station to U.S. Highway 93. The trucks would travel west on U.S. 93 to State Route 375, then on State Route 375 to the intersection with U.S. 6. The trucks would travel on U.S. 6 to the intersection with U.S. 95 in Tonopah. The trucks would travel into Beatty on U.S. 95 where a short alternative truck route would be built on the west side of town because an existing intersection is too constricted to allow a heavy-haul truck to turn. Heavy-haul vehicles would then travel south on U.S. 95 to Lathrop Wells Road at Amargosa Valley, which would access the Yucca Mountain site.

DOE would construct a parking area along a Caliente route to enable heavy-haul vehicles to park overnight. This parking area could be needed because the travel time (vehicle in motion plus periodic short stops for inspections) associated with a Caliente route would be as much as 16 hours and because DOE anticipates that the State of Nevada would issue special travel permits for the trucks that would include time-of-day and day-of-the-week travel restrictions that could preclude completing a trip in 1 day. This parking area would probably be near U.S. 6 between Warm Springs and Tonopah.

The potential siting areas for an intermodal transfer station are south of the City of Caliente in the Meadow Valley Wash area. DOE has identified two areas along the west side of the canyon, with a combined area of 0.74 square kilometer (180 acres). Areas along the east side of the canyon would not be used to avoid disrupting Meadow Valley Wash and because of poor access to the Union Pacific rail line. The estimated life-cycle cost to construct and operate an intermodal transfer station and to operate heavy-haul trucks along the Caliente route would be about $669 million in 2001 dollars.

The following sections address impacts that would occur to land use; biological resources and soils; cultural resources; hydrology including surface water and groundwater; occupational and public health and safety; socioeconomics; noise and vibration; aesthetics; and utilities, energy, and materials. Impacts that would occur to air quality and waste management would be the same as those discussed in Section 6.3.3.1 and are, therefore, not repeated here. Section 6.3.4 discusses the potential for transportation activities to cause environmental justice concerns in Nevada.

6.3.3.2.1.1 Caliente Route Land Use and Ownership

This section describes land-use impacts that could occur from the construction and operation of a Caliente intermodal transfer station and upgrade of highways and heavy-haul truck operation over the

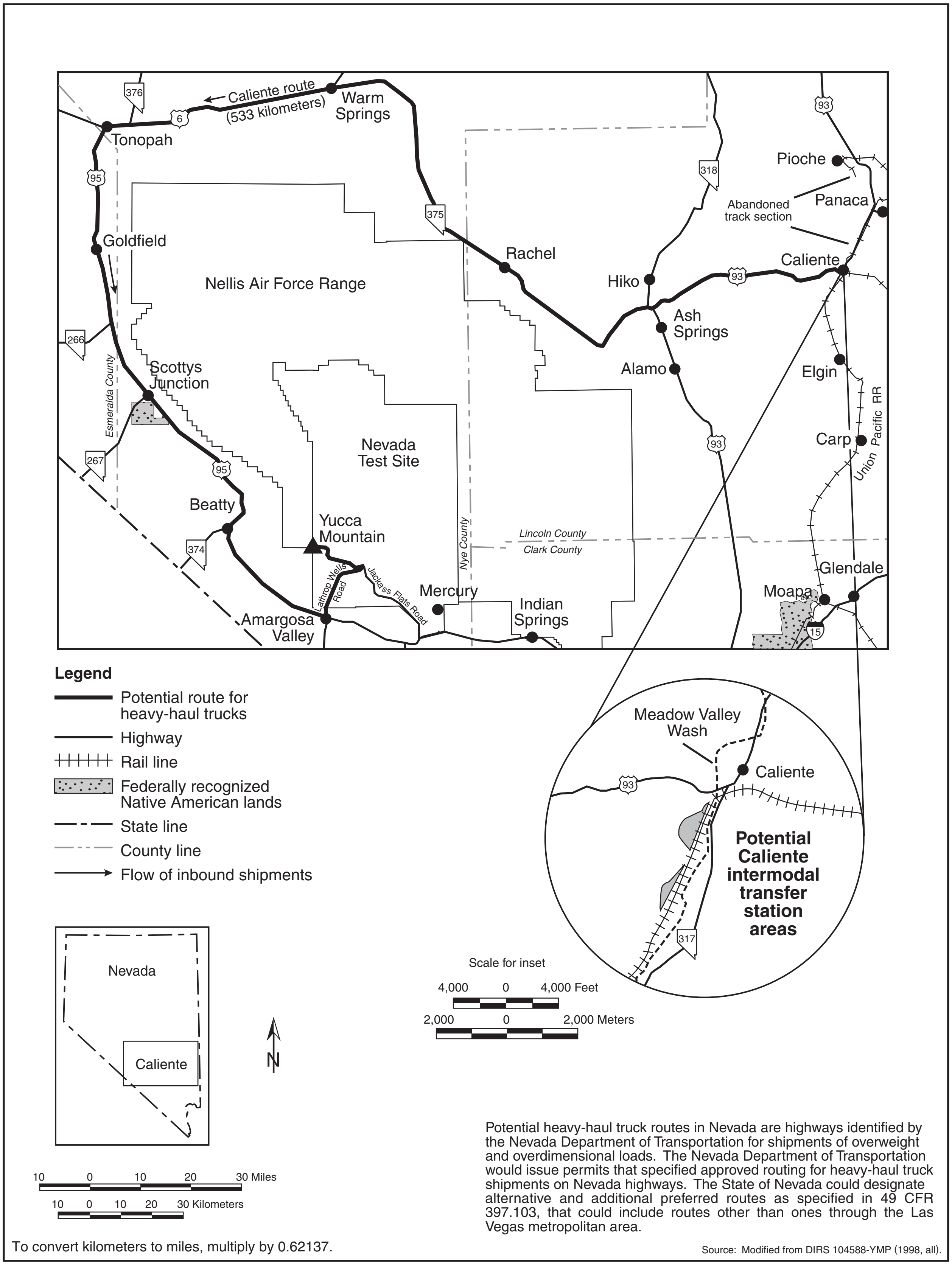


Figure 6-22. Caliente heavy-haul truck route.

Caliente route. Chapter 3, Section 3.2.2.2.1, describes the Caliente intermodal transfer station site and associated route.

With the exception of a small portion of the most northern part of the site area for an intermodal transfer station, the area is on patented land owned by the City of Caliente. The remaining part of the northern site is administered by the Bureau of Land Management. The northern site also includes an existing wastewater treatment plant (DIRS 104993-CRWMS M&O 1999, p. 21). A transfer of property from the Bureau, the City of Caliente, or other entities to DOE would be required.

Highway Construction and Upgrades. Land-use impacts that would be common to all locations are discussed in Section 6.3.3.1. The Caliente intermodal transfer station, located near the entrance to Kershaw-Ryan State Park, would be built on lands currently used for industrial or commercial purposes. Because of this, there should be no additional impacts to land use. Park visitors would receive short-term visual impacts from construction activities. In addition, park visitors could be affected by noise from construction activities that could lessen their recreational experience. These short-term impacts would exist only during construction.

In addition to the impacts on land use discussed in Section 6.3.3.1 for upgrading Nevada highways, approximately 3.4 square kilometers (834 acres) of land would be disturbed by the road upgrades and additional construction activities required for this route. Table 6-91 summarizes these disturbances. Approximately 0.04 square kilometer (10 acres) of land near Beatty, Nevada, would be acquired to construct approximately 2 kilometers (1.2 miles) of new highway. This section of highway would be needed to avoid conflicts between the requirement of wide turning areas for heavy-haul trucks and existing land uses in Beatty where U.S. 95 makes a 90-degree turn. In addition, approximately 0.04 square kilometer (10 acres) of land in the vicinity of Tonopah would be acquired for a midroute stopping area for heavy-haul trucks. This additional land requirement could require the purchase by or transfer of land to DOE.

Table 6-91. Land disturbances along the Caliente heavy-haul truck route.

Disturbance	Area disturbed[a] (square kilometers)[b]
Haul road disturbed area	1.9
Aggregate plants	0.3
Road widening	0.7
Passing lanes	0.2
Truck turnouts	0.08
Beatty truck alternate	0.04
Fortymile Wash new road	0.04
Overnight stops	0.04
Total disturbed area	3.4

a. Numbers approximate due to rounding.
b. To convert square kilometers to acres, multiply by 247.1.

Operations. There would be no direct land-use impacts associated with the operation of the Caliente intermodal transfer station or the Caliente route for heavy-haul trucks other than those described in Section 6.3.3.1.

6.3.3.2.1.2 Caliente Route Hydrology

DOE anticipates that limited impacts to surface water and groundwater would occur in the course of improving Nevada highways so they could accommodate daily use by heavy-haul trucks. This section discusses these potential impacts as well as those from the construction and operation of an intermodal transfer station and heavy-haul truck operations over the Caliente route. Section 6.3.3.1 discusses the hydrology impacts that would be common to all of the heavy-haul truck implementing alternatives. This section focuses on the hydrology impacts that are unique to the Caliente route.

Surface Water

Section 6.3.3.1 discusses impacts to surface water from the construction and operation of an intermodal transfer station and upgrades to highways. The common impacts discussed apply to surface water along the Caliente route.

Appendix L contains a comparison of what is known about the floodplains, springs, and riparian areas at the three candidate intermodal transfer station sites (see Sections L.3.2.6 and L.4.2.2). As noted in Section L.3.2.6, the two locations being considered for the Caliente intermodal transfer station are outside the 100-year flood zone of Meadow Valley Wash, but inside the 500-year flood zone.

Groundwater

Highway Construction and Upgrades. Section 6.3.3.1 discusses the impacts to groundwater from the construction of an intermodal transfer station. Groundwater impacts from upgrading highways would be limited to those caused by the use of water from construction wells. The upgrades to the Caliente route would require about 126,000 cubic meters (100 acre-feet) (DIRS 104917-LeFever 1998, all) of water which, for planning purposes, was assumed to come from 16 wells.

The average amount of water withdrawn from each well would be about 7,900 cubic meters (6 acre-feet). Chapter 3, Section 3.2.2.2.3, identifies the hydrographic areas over which the Caliente route would pass, their perennial yields, and whether the State considers each a Designated Groundwater Basin. Table 6-92 summarizes the status of the hydrographic areas associated with the Caliente route. It also identifies the approximate portion of the route that would pass over Designated Groundwater Basins.

Table 6-92. Hydrographic areas along Caliente route.

Hydrographic areas	Designated Groundwater Basins: Number	Designated Groundwater Basins: Percent of corridor length
19	8	40

The withdrawal of 7,900 cubic meters (6 acre-feet) a year from a well would have little impact on the hydrographic areas associated with the Caliente route based on their perennial yields (Chapter 3, Section 3.2.2.2.3), even if multiple wells were placed in the same hydrographic area. As indicated in Table 6-92, about 40 percent of the route's length would be in areas with Designated Groundwater Basins, where the Nevada State Engineer's office carefully watches the potential for groundwater depletion. This does not mean that a contractor could not obtain water appropriations in these areas; the State Engineer would have the authority to approve such appropriations. Requests for water appropriations under this action would be for minor amounts and for a short-term construction action, which should provide the State Engineer even more discretion. Other options would be to lease temporary water rights from individuals along the route, ship water from other permitted resources by truck to construction sites (about 7,000 truckloads), or use a combination of these two actions. Obtaining a water appropriation from the State Engineer for short-term construction use or using an approved allocation would ensure that groundwater resources would not be adversely affected.

Operations. Section 6.3.3.1 discusses the impacts to groundwater from the operation of an intermodal transfer station, highway maintenance, and heavy-haul truck operations.

6.3.3.2.1.3 Caliente Route Biological Resources

Section 6.3.3.1 discusses the impacts to biological resources from the construction and operation of an intermodal transfer station and upgrades to highways that would be common to all candidate sites for an intermodal transfer station and associated routes. This section discusses the construction- and operations-related impacts that would be unique to the Caliente intermodal station and route.

Highway Construction and Upgrades. Potential Caliente intermodal transfer station siting locations include two areas along the west side of the Meadow Valley Wash canyon. The land cover types are agriculture and salt desert scrub (DIRS 104593-CRWMS M&O 1999, pp. 3-30 and D-1). The construction site would disturb approximately 0.2 square kilometer (50 acres). No special status species occur in the proposed location of the Caliente intermodal transfer station. However, two species classified as sensitive by the Bureau of Land Management—the Meadow Valley Wash speckled dace and the Meadow Valley Wash desert sucker—occur in the adjacent Meadow Valley Wash (DIRS 104593-CRWMS M&O 1999, p. K-1). The construction of an intermodal transfer station could affect these fish by increasing the sediment load in the wash during construction. This construction would not affect southwestern willow flycatchers or their habitat in Meadow Valley Wash (DIRS 152511-Brocoum 2000, pp. A-9 to A-13). There is no designated game habitat at the proposed location for the intermodal transfer station, but the adjacent Meadow Valley Wash is classified as important habitat for water fowl and Gambel's quail (DIRS 104593-CRWMS M&O 1999, p. 3-30). Impacts to this habitat would be small.

Moist areas in the proposed location and the adjacent perennial stream and riparian habitat along Meadow Valley Wash could be classified as jurisdictional wetlands or other waters of the United States, although no formal wetlands delineation of the area has been conducted. If this site was selected, DOE would delineate the boundaries of any jurisdictional wetlands, develop a plan to mitigate impacts, and consult with the U.S. Army Corps of Engineers regarding the need to obtain a regional or individual permit under Section 404 of the Clean Water Act.

The predominant land cover types along the Caliente route are salt desert scrub, sagebrush, and creosote-bursage (DIRS 104593-CRWMS M&O 1999, p. 3-30). The regional area for each vegetation type is extensive (DIRS 104593-CRWMS M&O 1999, pp. C1 to C5). Because areas disturbed by upgrade activities would be in or adjacent to the existing rights-of-way, and have been previously degraded by human activities, impacts would be small. In addition, vegetation would be removed from approximately 0.04 square kilometer (10 acres) of undisturbed land for development of a midroute stopover. This area would be east of the City of Tonopah. The precise location is not known at this time, so the land cover type that would be disturbed cannot be identified. However, as noted above, all land cover types along the route are extensive and often degraded in the region, so loss of this area would be unlikely to cause adverse effects to the population of any plant or animal species.

Three threatened or endangered species occur along the Caliente route (DIRS 104593-CRWMS M&O 1999, p. 3-30). The desert tortoise occurs along the southern part of the route along U.S. 95 from Beatty to Yucca Mountain. Construction activities could kill or injure some tortoises; however, their abundance is low in this area (DIRS 103281-Karl 1981, pp. 76 to 92; DIRS 101914-Rautenstrauch and O'Farrell 1998, pp. 407 to 411), so losses would be small. One endangered species—the Hiko White River springfish—occurs in Crystal Springs (50 CFR 17.95). The outflow of the spring comes within about 10 meters (33 feet) of State Route 375 near its intersection with State Route 318 near U.S. 93 (DIRS 104593-CRWMS M&O 1999, p. 3-30). Therefore, any upgrading of the road in this area could have the potential to affect critical habitat. DOE would ensure that construction activities avoided the spring outflow channel and would implement mitigation measures to ensure that no sediment entered the stream. In addition, formal consultation with the U.S. Fish and Wildlife Service would be initiated if this heavy-haul truck route was selected, and DOE would implement all terms and conditions required by the Service.

An introduced population of the threatened Railroad Valley springfish occurs in Warm Springs (DIRS 103261-FWS 1996, p. 20), the outflow of which crosses U.S. 6. If improvements to the highway in the vicinity of the Warm Springs outflow were necessary, there could be temporary adverse impacts to this introduced population due to habitat disturbance and siltation if not properly mitigated. Six other special status species occur along this route (DIRS 104593-CRWMS M&O 1999, pp. 3-30 and 3-31) but, because construction activities would be limited to the road and adjacent areas and care would be taken to ensure no sediments entered the streams, species should not be affected.

This route would cross eight areas designated as game habitat (DIRS 104593-CRWMS M&O 1999, p. 3-31). The amount of habitat in these areas would be reduced slightly due to construction activities alongside existing roads. Game animals in these areas during construction could be disturbed.

Nineteen springs occur near this route (DIRS 104593-CRWMS M&O 1999, p. 3-31). Areas around these springs may be jurisdictional wetlands or waters of the United States. However, no formal delineation has been made. Construction could increase sedimentation in these areas. The corridor crosses a number of ephemeral streams that may be classified as waters of the United States. DOE would work with the State of Nevada and the U.S. Army Corps of Engineers to minimize impacts to these areas, and would obtain individual or regional permits, as appropriate.

Impacts on soils would be transitory and small and would occur only along the shoulders of existing roads.

Operations. Impacts from operations would include periodic disturbances of wildlife from activities at the intermodal transfer station and additional truck traffic along the route. Trucks probably would kill individuals of some species but losses would be few and unlikely to affect regional populations of any species. No additional habitat loss would occur during operations. Impacts to soils would be small.

6.3.3.2.1.4 Caliente Route Cultural Resources

Highway Construction and Upgrades. Previous surveys have recorded a total of 178 archaeological sites within the existing rights-of-ways of the highways that make up this alternative. Upgrade of highways associated with the Caliente heavy-haul truck route would affect (by disturbing the sites or crushing artifacts) two known archaeological sites in the existing highway right-of-way [about 60 meters (200 feet)] that have been evaluated as potentially significant (DIRS 155826-Nickens and Hartwell 2001, p. 12). In addition, another 20 archaeological sites occur in areas in the existing right-of-way that would experience upgrade activities. These sites have been recorded but not evaluated, and include one historic grave along the highway south of Tonopah. This route passes through the southern area of the Tonopah Multiple Resource Area historic mining district and the Goldfield Historic District, both of which are listed on the *National Register of Historic Places*. At Tonopah, the historic district lies north of the junction of U.S. Highways 6 and 95, and heavy-haul truck traffic would not affect the historic components of this district. Although U.S. 95 passes through the heart of the historic district at Goldfield, which includes commercial and private residence buildings in the downtown area, adverse effects from heavy-haul traffic would be unlikely. Two listed historic properties are located in downtown Caliente, near the highways leading from the Caliente intermodal transfer station site. Both of these, the State-listed Smith Hotel and the National Register-listed Union Pacific Depot, are far enough from the highway route that potential impacts are unlikely.

Preliminary studies have identified several areas important to Native Americans along the Caliente heavy-haul truck route that would require additional field ethnographic studies (DIRS 155826-Nickens and Hartwell 2001, Table 8). These include Oak Springs Summit and Six-Mile Flat/Pahroc Summit along U.S. 93 west of Caliente; Crystal Springs, at the junction of U.S. 93 and State Route 375; Twin Springs, Twin Springs slough, and Echo Lakes area, along State Route 375 between Rachel and Warm Springs; and the Warm Springs/Hot Creek Valley area, at the junction of State Route 375 and U.S. 6.

Archaeological surveys at the candidate Caliente intermodal transfer station site just south of the City of Caliente recorded four sites, none of which has been evaluated for eligibility to the *National Register of Historic Places.* Native Americans are familiar with some of these sites, which include a series of painted and pecked rock art, along the cliff immediately west of the candidate intermodal transfer station site (DIRS 155826-Nickens and Hartwell 2001, Table 8). The rock art is adjacent to the flat area where DOE could construct an intermodal transfer station. Although direct impacts to the site would be unlikely, indirect impacts are a possibility. Native Americans would view the presence of an intermodal transfer station near a traditional site as an impact to their cultural values.

Operations. The use of existing highways for heavy-haul truck transport of spent nuclear fuel and high-level radioactive waste would be unlikely to affect historic buildings listed in the National Register district in the Town of Goldfield. Transport of these materials could affect Native American feelings for the potentially significant cultural areas identified along the highways.

The operation of a Caliente intermodal transfer station could have a lasting impact on the cultural integrity of the location, which Native Americans have identified as an important place.

6.3.3.2.1.5 Caliente Route Occupational and Public Health and Safety

This section addresses potential impacts to occupational and public health and safety from upgrading highways and heavy-haul truck operations on the Caliente route. Impacts of the associated intermodal transfer station are the same for each heavy-haul truck implementing alternative and are in Section 6.3.3.1.

Highway Construction and Upgrades. Industrial safety impacts on workers from the upgrade of highways and use of the Caliente route would be small (see Table 6-93). The analysis evaluated the potential for impacts in terms of total reportable cases of injury, lost workday cases, fatality risks for workers, and traffic-related fatalities due to commuting workers and transporting construction materials and equipment. Table 6-94 lists the estimated fatalities from construction vehicle and commuter traffic.

Operations. The incident-free radiological impacts listed in Table 6-95 would occur during the routine transportation of spent nuclear fuel and high-level radioactive waste using the Caliente route. These impacts include transportation along the highway route as well as transportation along railways in Nevada to the Caliente intermodal transfer station. The table includes the impacts of 1,079 legal-weight truck shipments from commercial sites that do not have the capability to load rail casks while operational.

Table 6-93. Impacts to workers from industrial hazards during the Caliente route construction upgrades.

Group and industrial hazard category	Construction[a]	Operations[b]
Involved workers		
Total recordable cases[c]	66	220
Lost workday cases	33	120
Fatalities	0.09	0.61
Noninvolved workers[d]		
Total recordable cases	4.0	13
Lost workday cases	1.5	4.7
Fatalities	0.004	0.01
Totals[e]		
Total recordable cases	70	240
Lost workday cases	34	127
Fatalities	0.1	0.6

a. Impacts are totals for about 35 months.
b. Includes impacts from periodic resurfacing and maintenance; impacts are totals for 24 years.
c. Total recordable cases includes injury and illness.
d. The noninvolved worker impacts are based on 25 percent of the involved worker level of effort.
e. Totals might differ from sums due to rounding.

Table 6-94. Estimated number of fatalities from construction material delivery vehicles and construction and operations worker commuting traffic for the Caliente route for heavy-haul trucks.[a]

Activity	Kilometers[b]	Traffic fatalities	Vehicle emissions fatalities
Construction[c]			
Material delivery vehicles	60,000,000	1.0	0.12
Commuting workers	50,000,000	0.5	0.07
Subtotals[d]	*110,000,000*	*1.5*	*0.19*
Operations[e]			
Commuting workers	200,000,000	2.0	0.26
Totals	***310,000,000***	***3.5***	***0.45***

a. Includes impacts from the construction and operation of an intermodal transfer station.
b. To convert kilometers to miles, multiply by 0.62137.
c. Impact totals are for about 35 months.
d. Totals might differ from sums of values due to rounding.
e. Impact totals are for 24 years.

Table 6-95. Health impacts from incident-free Nevada transportation for the Caliente route implementing alternative.[a]

Category	Legal-weight truck shipments[b]	Rail and heavy-haul truck shipments[c]	Totals[d]
Involved workers			
Collective dose (person-rem)	38	1,600	1,600
Estimated latent cancer fatalities	0.02	0.64	0.66
Public			
Collective dose (person-rem)	7	70	77
Estimated latent cancer fatalities	0.003	0.04	0.04
Estimated vehicle emission-related fatalities	0.0016	0.015	0.016

a. Impacts are totals for 24 years.
b. Impacts of 1,079 legal-weight truck shipments from six commercial sites.
c. Includes impacts to workers at an intermodal transfer station and impacts to escorts.
d. Totals might differ from sums of values due to rounding.

6.3.3.2.1.6 Caliente Route Socioeconomics

This section describes potential socioeconomic impacts that would occur from upgrading highways on the Caliente route and building an intermodal transfer station for heavy-haul truck transportation. The discussion includes impacts from the operation of an intermodal transfer station at the Caliente site and periodic resurfacing of highways.

Highway Construction and Upgrades. Socioeconomic impacts from upgrading highways for a Caliente route and building an intermodal transfer station would be temporary, occurring over a short period and spread among the counties along the route. Upgrading the roads for the route would cost about $125 million, and would require about 653,000 worker hours and 35 months to complete. Constructing an intermodal transfer station would cost $25 million and require approximately 18 months to complete. (Dollar values reported in this section are 2001 dollars unless stated otherwise.)

Employment. In the region of influence, increased employment of construction workers involved with upgrading highways or with building an intermodal transfer station (direct workers) and other workers employed as a result of the economic activity generated by the project (indirect workers) would peak in 2008 at about 856 workers. The increase in employment in Clark County would be about 748 workers; Nye and Lincoln Counties would each gain 54. The increases in Clark and Nye Counties would be less than 1 percent of the employment baseline for each county. The increase in Lincoln County employment would be 2.2 percent of the county's employment baseline.

In the three-county region of influence, employment of Caliente route construction workers and of indirect workers would decrease by 738 jobs when the construction of an intermodal transfer station and highway upgrades ended in 2009. At the completion of the construction phase, Clark County would lose 720 of these jobs, Nye County would lose 6, and Lincoln County would lose 12. The impacts would be less than 1 percent of the baselines in Clark and Nye Counties. DOE anticipates that project-related workers would be absorbed in other work in Nevada. Employment projections for the State estimate 1.4 million jobs in 2010.

Population. Projected population increases in the region of influence as a consequence of upgrading highways and constructing an intermodal transfer station for the Caliente route would peak in 2009. During that year, the incremental increase in population would be about 688 individuals. Ninety-one percent (627) of these individuals would live in Clark County, 42 in Nye County, and 18 in Lincoln County. Population changes for Clark, Lincoln, and Nye Counties that would arise from increased employment opportunities would be less than 1 percent of each county's population baseline. Because the increases in each county could be small and transient, impacts to schools or housing would be unlikely.

Economic Measures. Economic measures would rise during the construction of an intermodal transfer station and upgrading of highways, and would decline at the project's end. The temporary change in real disposable income of people in the three-county region of influence would peak in 2008 at $26.5 million. The region-wide change in Gross Regional Product would peak in 2008 at $45.3 million. Increased State and local government expenditures resulting from activities to upgrade highways and construct an intermodal transfer station would peak in 2009 at $2.3 million. The Gross Regional Product, real disposable income, and expenditures by local and State governments would be less than 1 percent higher than the baseline for Clark and Nye Counties. Lincoln County would experience a less-than-1-percent increase in real disposable income and government spending. The increase in Gross Regional Product ($1.4 million) would be 1.2 percent of the county's baseline. (Dollar values reported in this section are in 2001 dollars unless otherwise stated.)

Transition to Operations. In the region of influence, employment of Caliente heavy-haul truck route workers and indirect (support) workers would decrease by 738 when construction of the intermodal transfer station and highway upgrades ended in 2009. Clark County would lose 721 (98 percent) of these jobs. Nye County would lose 5 jobs, and Lincoln County would lose 12 jobs. DOE anticipates that some of the displaced workers would move into operational positions on the Caliente route while others would find other work in the State. While this project would lose jobs, employment projections for the State estimate approximately 1.4 million jobs in 2010, or about 999,500 in the region of influence.

Operations. Operations at an intermodal transfer station and the use of heavy-haul trucks would begin in 2010 and continue until 2033. An annual operations workforce of about 26 would be required for an intermodal transfer station, which would operate throughout the year. The direct workforce for heavy-haul truck operations over a Caliente route, including shipment escorts, would be about 120 workers. The analysis assumed that operations workers would reside in Clark, Lincoln, or Nye Counties.

Employment. Employment probably would remain relatively level throughout the operations period. Total employment (direct and indirect) in the region of influence associated with heavy-haul truck transportation and an intermodal transfer station would average about 274 workers. The baseline employment in the region of influence in the 24-year operations period would be about 1.1 million. Firms in the region of influence would employ about 94 percent of these workers. Clark County would gain 111 workers. Nye County would gain 74, and Lincoln County would gain 88. The increases in Clark and Nye Counties would be less than 1 percent of the respective baselines. The increase in Lincoln County would represent 3.3 percent of the county's employment baseline.

Because of the periodic need to resurface highways used by heavy-haul trucks (every 8 years starting in 2016), employment would increase in the years these projects occurred. For these projects, employment (direct and indirect) in the region would increase by about 250 workers. Employment changes from periodic highway-resurfacing projects would be less than 1 percent of the baseline in Clark County. DOE assumed that Clark County-based firms would employ the resurfacing project workers. DOE included the employees who would resurface the roads and their families in the employment and population estimates discussed above for the operations period. Overall impacts to employment and population as a result of highway maintenance and shipment operations would be less than 1 percent of the baselines in each county.

Population. The average annual increase in population in the region of influence as a result of employment associated with a Caliente heavy-haul truck route would be about 638 persons. DOE estimates that about 387 of these would reside in Clark County, about 134 in Nye County, and 117 in Lincoln County. Population increases for Lincoln County, which would experience the largest change as a percentage of the baseline, would be about 2.4 percent.

The change in population in Lincoln County would include an average annual increase of approximately 27 school-aged children. The impact to housing in the county would be negligible given the county's historically high housing vacancy rates (see Chapter 3, Section 3.1.7.4). Impacts attributable to the operation of the Caliente heavy-haul truck route would be within the range of historic changes in the county.

Economic Measures. In the region of influence, real disposable income from the operation of an intermodal transfer station in Caliente, operation of heavy-haul trucks based in Caliente, and periodic resurfacing of the roads would rise during operations, starting at $4.1 million in 2010 and rising to $22 million in 2033. The average annual impact in real disposable income would be $12.9 million. Gross Regional Product would also rise during operations, increasing to $29 million in 2033 and averaging $15.3 million. Annual State and local government expenditures attributable to this heavy-haul truck implementing alternative would increase from $2.2 million in 2010 to $4.0 million in 2033, with an annual average of $2.9 million. The impact of changes in the economic measures of Gross Regional Product, real disposable income, and expenditures by State and local governments would be less than 1 percent for Clark and Nye Counties. The impact in Lincoln County would be more visible. Changes in real disposable income would average 2.4 percent of the baseline, the impact in Gross Regional Product would average 3.7 percent of the baseline, and the change in expenditures by State and local governments would average 2.9 percent of the baseline in the county.

In addition, DOE analyzed a sensitivity case that assumed all Lincoln County socioeconomic impacts would occur only in the City of Caliente. Under this assumption, City population would rise by 3 percent during construction and by about 8.7 percent during operations. Employment would rise by about 11 percent during construction and about 12 percent during operations.

6.3.3.2.1.7 Caliente Route Noise and Vibration

Section 6.3.3.1 discusses the noise impacts common to all heavy-haul truck implementing alternatives. This section focuses on noise impacts that would be unique to the Caliente heavy-haul truck implementing alternative.

Highway Construction and Upgrades. The Caliente intermodal transfer station would border a wastewater-treatment facility consisting of drain fields and ponds. There is a single dwelling about 500 meters (1,600 feet) to the northeast of a 0.26-square kilometer (64-acre) parcel that has been identified as a potential site for the Caliente intermodal transfer station. However, this residence is behind a small rise and would be partially shielded from operations at an intermodal transfer station. As a consequence, the potential for noise impacts from construction and operations would be very low at this location.

Operations. Existing traffic on the candidate routes for heavy-haul trucks includes a significant component of tractor-trailer vehicles. Because the intermodal transfer station would be on the western edge of Caliente, traffic to and from the station would not travel through town. Traffic noise impacts in Caliente would be inconsequential. The increase in 1-hour average noise levels would be greatest near Rachel, where traffic volumes are lowest. The estimated elevation of background traffic noise would be 4.7 dBA 15 meters (49 feet) from the road. The estimated baseline traffic noise level of 59.2 dBA would increase to 63.9 dBA when heavy-haul trucks passed Rachel. Estimated traffic noise levels in Tonopah, Goldfield, and Beatty would increase by 0.3 to 2.0 dBA. These small increases in noise levels would not be discernable when compared to existing background levels of current tractor-trailer noise in these communities. Heavy-haul trucks would add only a small increment to the existing baseline noise level associated with traffic on these routes. U.S. 95 is a major transportation corridor for the trucking industry from central California to Las Vegas. U.S. 6, State Route 373 and U.S. 93 (from Crystal Springs to Caliente) carry less traffic than U.S. 95. Ground vibrations would not affect any historic buildings because of the low speeds that heavy-haul trucks would use when passing through Goldfield. No sensitive ruins of cultural significance have been identified along this route.

The Caliente route passes the northeastern border of the Timbisha Shoshone Trust Lands parcel on U.S. 95. Estimated mean 1-hour increases in traffic noise due to heavy-haul trucks in this area would be 0.8 dBA over existing background traffic noise (DIRS 155825-Poston 2001, all). This level of increase would not cause adverse impacts.

6.3.3.2.1.8 Caliente Route Aesthetics

A Caliente intermodal transfer station would be located near the entrance to Kershaw-Ryan State Park. In addition, park visitors would receive short-term visual impacts from construction activities. Park visitors could also be affected by noise from construction activities that could lessen their recreational experience. These short-term impacts would exist only during construction.

During operation of the intermodal transfer station, noise and lighting probably would be discernible from Kershaw-Ryan State Park, especially during night operations, and would probably detract from the recreational experience. The use of shielded and directional-lighting would limit the amount of viewable light from outside the facility operational area.

6.3.3.2.1.9 Caliente Route Utilities, Energy, and Materials

Section 6.3.3.1 discusses the utilities, energy, and materials impacts that would be common to the heavy-haul truck implementing alternatives. This section focuses on the utilities, energy, and materials impacts that would be unique to the Caliente heavy-haul truck implementing alternative.

Highway Construction and Upgrades. The construction of the Caliente intermodal transfer station would have the same utilities, energy, and materials impacts as those discussed in Section 6.3.3.1.

Table 6-96 lists the estimated quantities of primary materials for the upgrade of Nevada highways for the Caliente route. These quantities are not likely to be very large in relation to the southern Nevada regional supply capacity (see Section 6.3.3.1).

Table 6-96. Utilities, energy, and materials required for upgrades along the Caliente route.

Route	Length (kilometers)[a]	Diesel fuel (million liters)[b]	Gasoline (thousand liters)	Asphalt (million metric tons)[c]	Concrete (thousand metric tons)	Steel[d] (metric tons)
Caliente	533	13	220	1.4	1.8	49.3

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. To convert metric tons to tons, multiply by 1.1023.
d. Steel includes rebar only.

Operations. Section 6.3.3.1 discusses the utilities, energy, and material needs for operation of an intermodal transfer station.

Fossil fuel that would be consumed by heavy-haul trucks during operations is discussed in Chapter 10, which addresses irreversible commitments of resources.

6.3.3.2.2 *Caliente/Chalk Mountain Route Implementing Alternative*

The Caliente/Chalk Mountain route (Figure 6-23) is approximately 282 kilometers (175 miles) long. Heavy-haul trucks and escorts leaving an intermodal transfer station in the Caliente area would travel directly from the station to U.S. 93. The trucks would travel on U.S. 93 to State Route 375, then on State Route 375 to the Town of Rachel. Next they would head south on Valley Road through the Nellis Air Force Range past Chalk Mountain to the Groom Pass Gate to the Nevada Test Site.

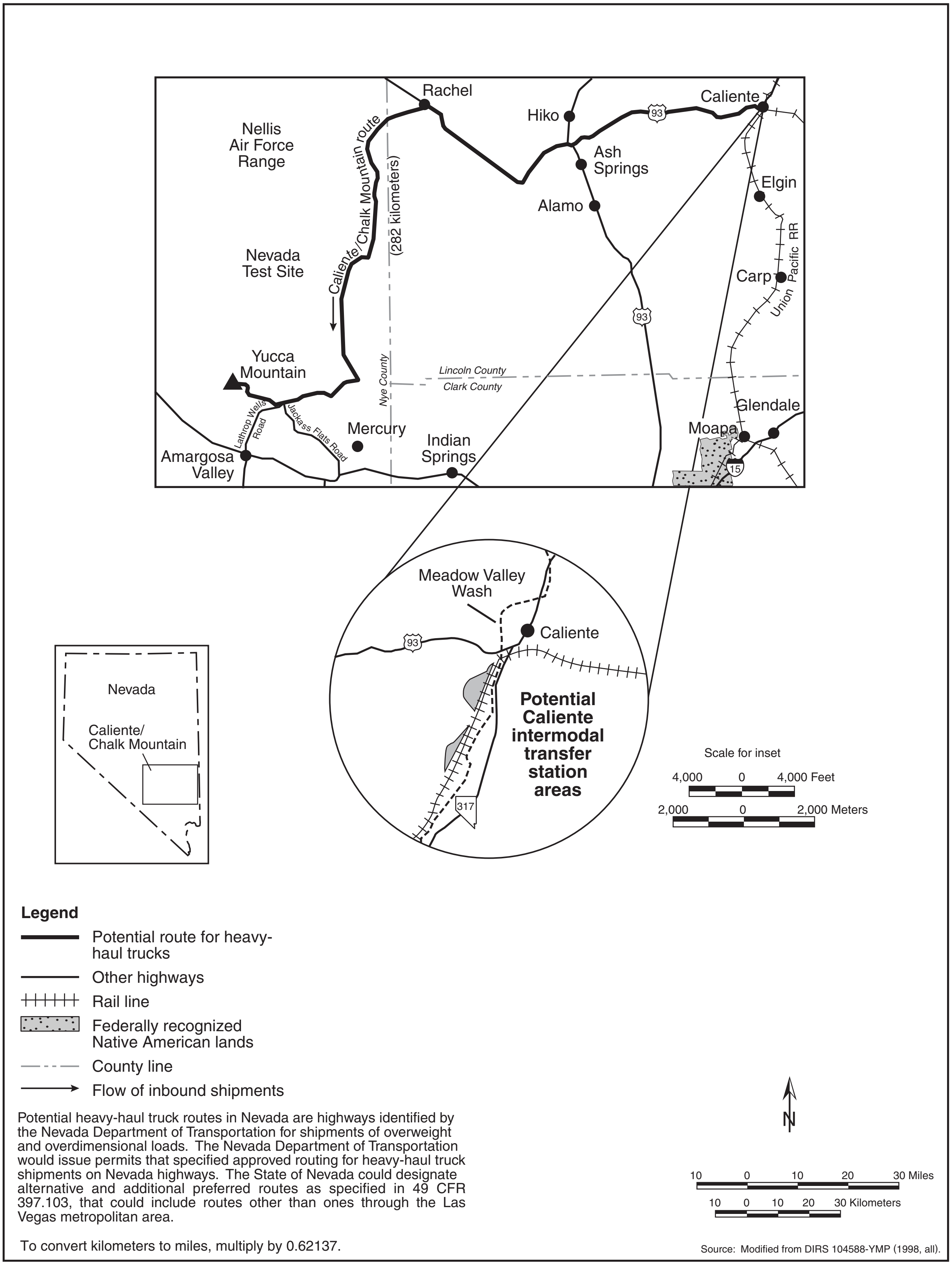


Figure 6-23. Caliente/Chalk Mountain heavy-haul truck route.

DOE would construct a parking area along a Caliente/Chalk Mountain route near the northern boundary of the Nellis Air Force Range to enable heavy-haul vehicles to park overnight. This parking area could be needed because the travel time (vehicle in motion plus periodic short stops for inspections) associated with a Caliente/Chalk Mountain route would be as much as 8 hours and because (1) DOE anticipates restrictions on the times trucks could travel across the Nellis Air Force Range and (2) special travel permits issued by the State of Nevada for the trucks would include time-of-day and day-of-the-week travel restrictions. The estimated life-cycle cost to construct and operate an intermodal transfer station and to operate heavy-haul trucks along the Caliente/Chalk Mountain route would be about $548 million in 2001 dollars.

Section 6.3.3.2.1 discusses the Caliente siting areas for an intermodal transfer station.

The following sections address impacts that would occur to land use; biological resources and soils; cultural resources; hydrology including surface water and groundwater; occupational and public health and safety; socioeconomics; noise and vibration; aesthetics and utilities, energy, and materials. Impacts that would occur to air quality, and waste management would be the same as those discussed in Section 6.3.3.1 and are, therefore, not repeated here. Section 6.3.4 discusses the potential for transportation activities to cause environmental justice impacts in Nevada.

6.3.3.2.2.1 Caliente/Chalk Mountain Route Land Use and Ownership

This section describes anticipated land-use impacts that could occur from the construction and operation of the Caliente intermodal transfer station, upgrades of highways, and heavy-haul truck operations over the Caliente/Chalk Mountain route. Chapter 3, Section 3.2.2.2.1, describes the Caliente intermodal transfer station site and the associated route to the Yucca Mountain site.

Highway Construction and Upgrades. Section 6.3.3.2.1 discusses Caliente intermodal transfer station impacts in relation to the current use of the land and the surrounding area. Section 6.3.3.1 describes impacts on land use from upgrading highways for use by heavy-haul trucks.

In addition to the impacts on land use discussed in Section 6.3.3.1 for upgrading Nevada highways, approximately 1.3 square kilometers (310 acres) of land would be disturbed by the road upgrades and additional construction activities required for this route. Table 6-97 summarizes these disturbances. Approximately 0.04 square kilometer (10 acres) of land in the vicinity of the northern boundary of the Nellis Air Force Range would be acquired for a midroute stopping area for heavy-haul trucks.

Table 6-97. Land disturbances along the Caliente/Chalk Mountain heavy-haul truck route.

Disturbance	Area disturbed[a] (square kilometers)[b]
Haul road disturbed area	0.6
Aggregate plants	0.1
Road widening	0.3
Passing lanes	0.1
Truck turnouts	0.02
Fortymile Wash new road	0.04
Overnight stops	0.04
Total disturbed area	1.3

a. Numbers approximate due to rounding.
b. To convert square kilometers to acres, multiply by 247.1.

The Caliente/Chalk Mountain route would involve land controlled by the Nellis Air Force Range (also known as the Nevada Test and Training Range), which, according to the Air Force, would affect Air Force operations. Because the Military Lands Withdrawal Act of 1999 (Public Law 106-65, 113 Stat. 885) withdraws and reserves the Nellis Air Force Range for use by the Secretary of the Air Force, the Secretary would need to concur with a decision to operate a heavy-haul truck route through any part of the Range. The Air Force has identified national security issues regarding a Caliente/Chalk Mountain route, citing interference with Nellis Air Force Range testing and training activities. In response to Air Force concerns, DOE has stated that it is acutely conscious of the security issues such a route would present and, because of the concerns expressed by the Air Force, regards the route as a "non-preferred alternative."

Operations. The Air Force has identified national security issues regarding operations of heavy-haul trucks on the Caliente/Chalk Mountain route, citing interference with Nellis Air Force Range testing and training activities. There would be no other direct land-use impacts associated with the operation of the Caliente intermodal transfer station or the Caliente/Chalk Mountain route except those described above and in Section 6.3.3.1.

6.3.3.2.2.2 Caliente/Chalk Mountain Route Hydrology

DOE anticipates that limited impacts to surface water and groundwater would occur in the course of improving Nevada highways so that they could accommodate daily use by heavy-haul trucks. This section discusses these potential environmental impacts as well as those from the construction and operation of an intermodal transfer station and operation of the Caliente/Chalk Mountain route. Section 6.3.3.1 discusses the hydrological impacts that would be common to all the heavy-haul truck implementing alternatives. This section focuses on the hydrology impacts that would be unique to the Caliente/Chalk Mountain route.

Surface Water

Section 6.3.3.1 discusses the impacts to surface water from the construction and operation of an intermodal transfer station and upgrades to highways.

Appendix L contains a comparison of what is known about the floodplains, springs, and riparian areas at the three candidate intermodal transfer station sites (see Sections L.3.2.6 and L.4.2.2). As noted in Section L.3.2.6, the two locations being considered for the Caliente intermodal transfer station are outside the 100-year flood zone of Meadow Valley Wash, but inside the 500-year flood zone.

Groundwater

Highway Construction and Upgrades. Section 6.3.3.1 discusses the impacts to groundwater from the construction of an intermodal transfer station. Groundwater impacts from upgrading highways would be limited to those caused by the use of water from construction wells. Upgrades to the Caliente/Chalk Mountain route would require about 75,000 cubic meters (60 acre-feet) of water (DIRS 104917-LeFever 1998, all) that the analysis assumed would come from five wells.

The average amount of water withdrawn from each well would be about 15,000 cubic meters (12 acre-feet). Chapter 3, Section 3.2.2.2.3, identifies hydrographic areas over which the Caliente/Chalk Mountain route would pass, their perennial yields, and whether the State considers each a Designated Groundwater Basin. Table 6-98 summarizes the status of the hydrographic areas associated with the Caliente/Chalk Mountain heavy-haul truck route. It also identifies the approximate percentage of the route that would pass over Designated Groundwater Basins.

Table 6-98. Hydrographic areas along Caliente-Chalk Mountain route.

Hydrographic areas	Designated Groundwater Basins: Number	Designated Groundwater Basins: Percent of corridor length
10	2	20

The withdrawal of 15,000 cubic meters (12 acre-feet) a year from a well would have little impact on the hydrographic areas associated with the Caliente/Chalk Mountain route based on their perennial yields (Chapter 3, Section 3.2.2.2.3), even if multiple wells were placed in the same hydrographic area. As indicated in Table 6-98, about 20 percent of the route's length would be in areas with Designated Groundwater Basins, which the Nevada State Engineer's office watches carefully for the potential for groundwater depletion. This does not mean that a contractor could not obtain water appropriations in these areas; the State Engineer would have the authority to approve such appropriations. The fact that requests for water appropriations under this action would be for minor amounts and for a short-term construction action should provide the State Engineer even more discretion. Other options would be to lease temporary water rights from individuals along the route, ship water from other permitted resources by truck (4,000 truckloads) to construction sites, or use a combination of these two actions. Obtaining a water appropriation from the State Engineer for short-term construction use or using an approved allocation should ensure that groundwater resources would not be adversely affected.

Operations. Section 6.3.3.1 discusses the impacts to groundwater from the operation of an intermodal transfer station, highway maintenance, and heavy-haul truck operations.

6.3.3.2.2.3 Caliente/Chalk Mountain Route Biological Resources and Soils

Section 6.3.3.1 discusses impacts to biological resources from the construction and operation of an intermodal transfer station and upgrades to highways that would be common to all candidate sites for an intermodal transfer station and routes. This section discusses the construction- and operations-related impacts that would be unique to the Caliente intermodal station and Caliente/Chalk Mountain route.

Highway Construction and Upgrades. Section 6.3.3.2.1 discusses potential Caliente intermodal transfer station site locations and impacts to biological resources from station construction.

The predominant land cover types along the Caliente/Chalk Mountain route are salt desert scrub, blackbrush, sagebrush, and creosote-bursage (DIRS 104593-CRWMS M&O 1999, p. 3-31). The regional area for each vegetation type is extensive (DIRS 104593-CRWMS M&O 1999, pp. C1 to C5). Because areas disturbed by highway upgrade activities would be in or adjacent to existing rights-of-way, and because these areas have been previously degraded by human activities, impacts would be small. In addition, vegetation would be removed from approximately 0.04 square kilometer (10 acres) of undisturbed land for development of a midroute stopover. This area would be near or outside the boundary of Nellis Air Force Range. The precise location is not known at this time, so the land cover type that would be disturbed cannot be identified. However, as noted above, all land cover types along the route are extensive and often degraded in the region, so the loss of this area would be unlikely to cause adverse effects to the population of any plant or animal species.

Two threatened or endangered species occur along the route (DIRS 104593-CRWMS M&O 1999, p. 3-32). The desert tortoise occurs along the southern part of the route from the northern end of Frenchman Flat to Yucca Mountain. Construction activities could kill or injure desert tortoises; however, their abundance is low in this area (DIRS 101914-Rautenstrauch and O’Farrell 1998, pp. 407 to 411), so losses would be few. One endangered species—the Hiko White River springfish—occurs in Crystal Springs (DIRS 103262-FWS 1998, p. 16), which is about 10 meters (33 feet) south of State Route 375 near its intersection with State Route 318 near U.S. 93. Construction or widening of the road would be unlikely to affect this species because construction activities would avoid the spring outflow channel, and DOE would implement mitigation measures to ensure that no sediment would enter the stream, which is critical habitat for this fish (50 CFR 17.95). Three other special status species occur along this route, but because construction activities would occur along existing roads, they should not be affected. Standard construction practices would be used to reduce erosion and runoff. In addition, formal consultation with the U.S. Fish and Wildlife Service would be initiated if this heavy-haul truck route was selected, and DOE would implement all terms and conditions required by the Service.

This route would cross six areas designated as game habitat (DIRS 104593-CRWMS M&O 1999, p. 3-32). The amount of habitat in these areas would be reduced very slightly due to construction activities along existing roads. Game animals could be disturbed if they were in these areas during construction.

Three springs or riparian areas occur near this route (DIRS 104593-CRWMS M&O 1999, p. 3-32). These springs and riparian areas may be jurisdictional wetlands or other waters of the United States; however, no formal delineation has been made. DOE would implement mitigation measures to ensure that construction would not increase sedimentation in these areas. The route crosses a number of ephemeral streams that may be classified as waters of the United States. DOE would work with the State of Nevada and the U.S. Army Corps of Engineers to minimize impacts to these areas and would obtain individual or regional permits, as appropriate.

Impacts to soils would be transitory and small and would occur only along the shoulders of existing roads.

Operations. Impacts from operations would include periodic disturbances of wildlife from additional truck traffic along this route. Trucks probably would kill individuals of some species but losses would be few and unlikely to affect regional populations of any species. No additional habitat loss would occur during operations. Impacts to soils would be small.

6.3.3.2.2.4 Caliente/Chalk Mountain Route Cultural Resources

Highway Construction and Upgrades. Upgrades to U.S. 93 and State Route 375 would create similar impacts (such as disturbing sites or crushing artifacts) for archaeological, historic, and Native American resources as those identified with the use of the Caliente heavy-haul truck route. Potential impacts at the Caliente intermodal transfer station would also be the same.

Surveys have recorded 31 archaeological sites, five of which have been evaluated as being potentially significant. One is a historic mining camp that has not been evaluated. Additional field surveys would be necessary to record and evaluate cultural resource sites along the route segment from State Route 375 to Yucca Mountain, along with field ethnographic studies. Within the Nevada Test Site, the National Register-listed historic property of Sedan Crater would be located close to, but at a presently unspecified distance, from the proposed new route heavy-haul segment. If this route is selected, final engineering of the alignment would determine if there would be any potential impacts to this historic property.

Table 6-99. Impacts to workers from industrial hazards from upgrading highways along the Caliente/Chalk Mountain route.

Group and industrial hazard category	Construction[a]	Operations[b]
Involved workers		
Total recordable cases[c]	35	220
Lost workday cases	17	120
Fatalities	0.05	0.61
Noninvolved workers		
Total recordable cases	2.1	13
Lost workday cases	0.8	4.7
Fatalities	0.002	0.01
otals[d]		
Total recordable cases	37	240
Lost workday cases	18	130
Fatalities	0.05	0.62

a. Impacts are totals over about 2 years.
b. Includes impacts from periodic maintenance and resurfacing. Impacts are totals over 24 years.
c. Total recordable cases includes injury and illness.
d. Totals might differ from sums due to rounding.

Operations. Impacts from the use of the Caliente/Chalk Mountain route from the Caliente intermodal transfer station to the point at which it leaves State Route 375 would be the same as those identified for the Caliente route in Section 6.3.3.2.1.

6.3.3.2.2.5 Caliente/Chalk Mountain Route Occupational and Public Health and Safety

This section addresses potential impacts to occupational and public health and safety from upgrading highways and heavy-haul truck operations on the Caliente/Chalk Mountain route. Impacts of the associated intermodal transfer station in Caliente would be the same as those discussed in Section 6.3.3.1.

Highway Construction and Upgrades. Industrial safety impacts to workers from upgrading highways for the Caliente/Chalk Mountain route would be small (Table 6-99). The analysis evaluated the potential for impacts in terms of total reportable cases of injury, lost workday cases, fatality risks for workers, and traffic-related fatalities related to commuting workers and the movement of construction materials and equipment. Table 6-100 lists the estimated fatalities from construction and commuter vehicle traffic.

Table 6-100. Estimated number of fatalities from construction material delivery vehicles and construction and operations worker commuting traffic for the Caliente/Chalk Mountain route for heavy-haul trucks.

Activity	Kilometers[a]	Traffic fatalities	Vehicle emissions fatalities
Construction[b]			
Material delivery vehicles	18,000,000	0.3	0.04
Commuting workers	30,000,000	0.3	0.04
Subtotals	*48,000,000*	*0.6*	*0.08*
Operations[c]			
Commuting workers	180,000,000	1.8	0.24
Totals[d]	***230,000,000***	***2.4***	***0.32***

a. To convert kilometers to miles, multiply by 0.62137.
b. Impacts are totals over about 2 years.
c. Impacts are totals over about 24 years.
d. Totals might differ from sums of values due to rounding.

Operations. The incident-free radiological impacts listed in Table 6-101 would occur during the routine transportation of spent nuclear fuel and high-level radioactive waste using the Caliente/Chalk Mountain route. These impacts include transportation along the route and along railways in Nevada leading to an intermodal transfer station. The table includes the impacts of 1,079 legal-weight truck shipments from commercial sites that do not have the capability to load rail casks while operational.

Table 6-101. Impacts from incident-free transportation for the Caliente/Chalk Mountain heavy-haul truck implementing alternative.[a]

Category	Legal-weight truck shipments	Rail and heavy-haul truck shipments[b]	Totals[c]
Involved workers			
Collective dose (person-rem)	38	1,200	1,200
Estimated latent cancer fatalities	0.02	0.48	0.5
Public			
Collective dose (person-rem)	7	60	70
Estimated latent cancer fatalities	0.003	0.03	0.03
Estimated vehicle emission-related fatalities	0.0016	0.0063	0.0079

a. Impacts are totals for 24 years.
b. Includes impacts to workers at an intermodal transfer station and impacts to escorts.
c. Totals might differ from sums of values due to rounding.

6.3.3.2.2.6 Caliente/Chalk Mountain Route Socioeconomics

This section describes potential socioeconomic impacts that would occur from upgrading highways along the Caliente/Chalk Mountain route and building an intermodal transfer station for heavy-haul truck transportation. The discussion includes the impacts from the operation of an intermodal transfer station at Caliente and periodic resurfacing of the highways.

Highway Construction and Upgrades. Socioeconomic impacts from upgrading public highways, roads on the Nellis Air Force Range, and roads on the Nevada Test Site for a Caliente/Chalk Mountain route and for building an intermodal transfer station would be temporary, occurring over a short period and spread among the counties along the route. Employment for highway upgrades and intermodal transfer station construction would involve workers laboring for about 241,000 worker hours. Upgrading the highways along this route would cost about $65.6 million and would require 26 months to complete.

Constructing an intermodal transfer station would cost $25 million and require 18 months. (Dollar values reported in this section are 2001 dollars unless otherwise stated.)

Employment

In the region of influence, increased employment of construction workers involved with upgrading the highways or with building an intermodal transfer station (direct workers) and of other workers employed as a result of the economic activity generated by the project (indirect workers) would peak in 2008 at about 751 new jobs. The increase in employment for Clark County would be about 650 workers and Nye County would gain 44 workers. These increases represent less than 1 percent of each county's employment baseline. For Lincoln County, the increase in employment would be as much as 57 workers or 2.3 percent of the employment baseline. Changes in Lincoln County would be primarily the result of indirect employment created by the spending of construction workers.

Population

Changes in population in the region of influence as a consequence of construction work would peak in 2009. During that year, the incremental increase in population would be about 463 individuals. Clark County would experience 91 percent of the change. Population changes for Clark, Lincoln, and Nye Counties from increased employment would be less than 1 percent of each county's baseline. Because employment and population impacts arising from highway upgrade and the construction of an intermodal transfer station for the Caliente/Chalk Mountain route projects would be small and transient, impacts to schools or housing would be unlikely.

Economic Measures

Economic measures would rise during the construction of an intermodal transfer station and upgrading of highways. The increase in real disposable income in the three counties in the region of influence would peak at about $21.8 million in 2009. Gross Regional Product would peak in 2008 at $39.8 million. Increased State and local government expenditures resulting from highway upgrades and the construction of an intermodal transfer station would reach their peak in 2009 at $1.6 million. Changes to government expenditures and real disposable income would be less than 1 percent of the respective baselines for Clark, Lincoln, and Nye Counties. Changes to Gross Regional Product in Clark and Nye Counties would also be less than 1 percent of the baselines. The increase in Gross Regional Product in Lincoln County would be about 1.2 percent of the county's baseline for that economic measure. (Dollar values reported in this section are in 2001 dollars unless otherwise stated.)

Transition to Operations. In the region of influence, employment of Caliente/Chalk Mountain heavy-haul truck route workers and indirect (support) workers would decrease by 677 when construction of the intermodal transfer station and highway upgrades ended in 2009. Clark County would lose 506 (83 percent) of these jobs. Nye County would lose 41 jobs, and Lincoln County would lose 33 jobs. DOE anticipates that some of the displaced workers would move into operational positions on the Caliente/Chalk Mountain route while others would find other work in the State. While this project would lose jobs, employment projections for the State estimate approximately 1.4 million jobs in 2010, or about 999,500 in the region of influence.

Operations. Operations at an intermodal transfer station and the use of heavy-haul trucks would begin in 2010 and would continue until 2033. An annual operations workforce of 26 would be required for the intermodal transfer station. The workforce for heavy-haul truck operations over a Caliente/Chalk Mountain route, including shipment escorts, would be 110 workers.

Employment

Employment probably would remain relatively level throughout operations. Total employment (direct and indirect) attributable to the Caliente/Chalk Mountain route in the region of influence would average about 237 jobs. Clark County would supply about 87 of the workers, Nye County about 17, and Lincoln

County about 133. The increase in employment in Clark and Nye Counties would be less than 1 percent of each county's employment baseline. The increase in employment in Lincoln County would represent an impact of 4.9 percent of the county's employment baseline.

Because of the periodic need to resurface highways used by heavy-haul trucks (every 8 years starting in 2016), employment would increase in the years during which these projects occurred. For these projects, total employment in the region of influence would increase by about 100 workers for a Caliente/Chalk Mountain route. Employment changes from periodic highway-resurfacing projects would be less than 1 percent of the baseline in Clark County. DOE assumed that resurfacing project workers would live in Clark County. DOE included the workers employed to resurface the roads and their families in the employment and population estimates for the operations period. Impacts to employment and population for the three counties in the region of influence as a consequence of the resurfacing projects would be less than 1 percent of the baselines.

Population

The impact on population in the region of influence would be approximately 506 additional residents. Clark County would gain 296 residents, Nye County would gain 43, and Lincoln County would gain 167. The impact from a population increase in Clark and Nye Counties would be less than 1 percent of each county's baseline. There would no impacts to housing or schools in Clark and Nye Counties. Population increases for Lincoln County, which would experience the largest change, would be approximately 3.5 percent of the baseline. These impacts to employment and population during the operations phase would be within the range of historic changes in the County.

The population change in Lincoln County would include an average annual increase of approximately 38 school-aged children. The impact to housing attributable to the Caliente/Chalk Mountain heavy-haul route would be negligible given the County's historically high housing vacancy rates (see Chapter 3, Section 3.1.7.4).

Economic Measures

In the region of influence, additional real disposable income from the operation of an intermodal transfer station in Caliente, operation of heavy-haul trucks, and periodic resurfacing of the roads would rise throughout operations, starting at $3.9 million in 2010 and increasing to $15.8 million in 2033. The average annual increment in real disposable income would be $11.1 million. Increments to Gross Regional Product would also rise during operations, starting at $2.4 million in 2010, increasing to $20.4 million in 2033, and averaging $13.7 million. Additional annual State and local government expenditures would increase from $1.6 million in 2010 to $3.8 million in 2033, and would average $2.8 million. The increases in real disposable income, Gross Regional Product, and expenditures by governments would be less than 1 percent of the applicable baseline in Clark and Nye Counties. Increases to real disposable income, Gross Regional Product, and government expenditures attributable to the Caliente/Chalk Mountain route would be more visible in Lincoln County. Changes in real disposable income and government expenditures for the county would be about 3.3 and 4.2 percent, respectively, of the baselines. The projected change in Gross Regional Product for the County would be 5.1 percent of the baseline.

In addition, DOE analyzed a sensitivity case that assumed all Lincoln County socioeconomic impacts would occur only in the City of Caliente. Under this assumption, City population would rise by 3 percent during construction and by about 8.7 percent during operations. Employment would rise by about 11 percent during construction and about 12 percent during operations.

6.3.3.2.2.7 Caliente/Chalk Mountain Route Noise and Vibration

Section 6.3.3.1 discusses the noise impacts common to all the heavy-haul truck implementing alternatives. This section focuses on noise impacts that would be unique to the Caliente/Chalk Mountain heavy-haul truck implementing alternative.

Noise impacts of the Caliente intermodal transfer station would be the same as those discussed in Section 6.3.3.2.1. A large portion of the route would be inside the boundaries of the Nevada Test Site and the Nellis Air Force Range. The small rural communities of Crystal Spring and Rachel and the Town of Caliente would be within the 2,000-meter (6,600-foot) region of influence for construction noise.

Existing traffic on the candidate routes for heavy-haul trucks includes a significant component of tractor-trailer vehicles. The increase in 1-hour average noise levels would be greatest near Rachel, where traffic volumes are lowest. The estimated elevation of background traffic noise would be 0.6 dBA 15 meters (49 feet) from the road. The estimated baseline traffic noise level would be 61.4 dBA, which would increase to 62.4 dBA with three heavy-haul trucks passing Rachel. Because the proposed intermodal transfer station would be on the western edge of Caliente and traffic would not travel through town, traffic noise impacts in Caliente would be inconsequential. No historic buildings would be affected by ground vibration.

6.3.3.2.2.8 Caliente/Chalk Mountain Route Aesthetics

A Caliente intermodal transfer station would be near the entrance to Kershaw-Ryan State Park. Park visitors would receive short-term visual impacts from construction activities. In addition, park visitors could be affected by noise from construction activities that could lessen their recreational experience. These short-term impacts would exist only during construction.

During operation of the intermodal transfer station, noise and lighting probably would be discernible from Kershaw-Ryan State Park, especially during night operations, and would probably detract from the recreational experience. The use of shielded and directional lighting would limit the amount of viewable light from outside the facility operational area.

6.3.3.2.2.9 Caliente/Chalk Mountain Route Utilities, Energy, and Materials

Section 6.3.3.1 discusses utilities, energy, and materials impacts that would be common to all the heavy-haul truck implementing alternatives. This section focuses on the utilities, energy and materials impacts that would be unique to the Caliente/Chalk Mountain heavy-haul truck implementing alternative.

Highway Construction and Upgrades. The construction of the Caliente intermodal transfer station would have the same utilities, energy and materials impacts as those discussed in Section 6.3.3.1.

Table 6-102 lists the estimated quantities of primary materials for the upgrade of highways for the Caliente/Chalk Mountain route. These quantities are not likely to be very large in relation to the southern Nevada regional supply capacity (see Section 6.3.3.1).

Table 6-102. Utilities, energy, and materials required for upgrades along the Caliente/Chalk Mountain route.

Route	Length (kilometers)[a]	Diesel fuel (million liters)[b]	Gasoline (thousand liters)	Asphalt (million metric tons)[c]	Concrete (thousand metric tons)	Steel[d] (metric tons)
Caliente-Chalk Mountain	282	4.7	77	0.41	0.5	14

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. To convert metric tons to tons, multiply by 1.1023.
d. Steel includes rebar only.

Fossil fuel that would be consumed by heavy-haul trucks during operations is discussed in Chapter 10, which addresses irreversible commitment of resources.

Operations. Section 6.3.3.1 discusses the utilities, energy, and materials needs for the operation of an intermodal transfer station.

6.3.3.2.3 *Caliente/Las Vegas Route Implementing Alternative*

The Caliente/Las Vegas route (Figure 6-24) is approximately 377 kilometers (234 miles) long. Heavy-haul trucks and escorts leaving an intermodal transfer station in the Caliente area would travel directly from the station to U.S. 93. The trucks would travel south on U.S. 93 to the intersection with I-15 northeast of Las Vegas. The trucks would then travel south on I-15 to the exit for the proposed Las Vegas Beltway, and would travel west on the beltway. They would exit the beltway to U.S. 95, and travel north on U.S. 95 to the Mercury entrance to the Nevada Test Site. The trucks would travel on Jackass Flats Road on the Nevada Test Site to the Yucca Mountain site.

DOE would construct a parking area along a Caliente/Las Vegas route to enable heavy-haul vehicles to park overnight. This parking area could be needed because the travel time (vehicle in motion plus periodic short stops for inspections) associated with a Caliente/Las Vegas route would be as much as 9 hours and because DOE anticipates (1) requirements to coordinate travel times with time of reduced traffic flow on the northern portion of the Las Vegas Beltway and (2) special travel permits issued by the State of Nevada for the trucks would include time-of-day and day-of-the-week travel restrictions that could preclude completing a trip in 1 day. This parking area would be near the U.S. 93 and I-15 intersection at Apex. The estimated life-cycle cost of constructing and operating an intermodal transfer station and of operating heavy-haul trucks along the Caliente/Las Vegas route would be about $607 million in 2001 dollars.

Section 6.3.3.2.1 discusses the Caliente siting areas for an intermodal transfer station.

The following sections address impacts that would occur to land use; air quality; biological resources and soils; hydrology including surface water and groundwater; cultural resources; occupational and public health and safety; socioeconomics; noise and vibration; aesthetics; and utilities, energy, and materials. Impacts that would occur to waste management would be the same as those discussed in Section 6.3.3.1 and are, therefore, not repeated here. Section 6.3.4 discusses the potential for transportation activities to cause environmental justice impacts in Nevada.

6.3.3.2.3.1 Caliente/Las Vegas Route Land Use and Ownership

Chapter 3, Section 3.2.2.2.1, describes the Caliente intermodal transfer station site and associated truck route.

Highway Construction and Upgrades. Section 6.3.3.2.1 discusses the Caliente intermodal station site area and impacts related to the current use of the land. Section 6.3.3.1.1 discusses the impacts on land use from upgrading Nevada highways for use by heavy-haul trucks.

In addition to the impacts on land use discussed in Section 6.3.3.1 for upgrading Nevada highways, approximately 2.1 square kilometers (520 acres) of land would be disturbed by the road upgrades and additional construction activities required. Table 6-103 summarizes these disturbances. Approximately 0.04 square kilometer (10 acres) of land in the vicinity of Apex northeast of Las Vegas would be acquired for a midroute stopping area for heavy-haul trucks.

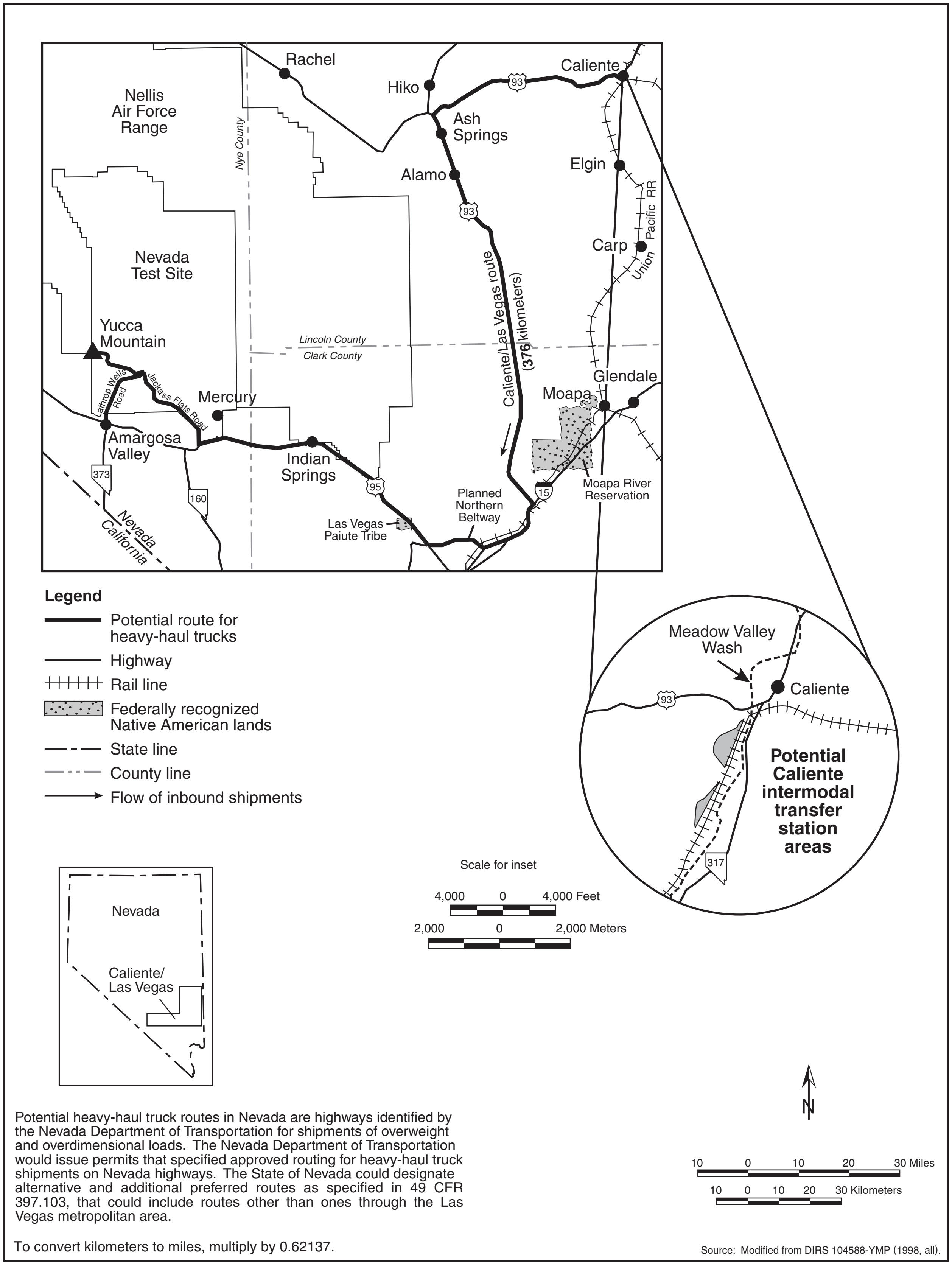


Figure 6-24. Caliente/Las Vegas heavy-haul truck route.

Operations. There would be no direct land-use impacts associated with the operation of the Caliente intermodal transfer station or use of the Caliente/Las Vegas route other than those described in Section 6.3.3.1.

Table 6-103. Land disturbances along the Caliente/Las Vegas heavy-haul truck route.

Disturbance	Area disturbed[a] (square kilometers)[b]
Haul road disturbed area	1.2
Aggregate plants	0.2
Road widening	0.5
Passing lanes	0.08
Truck turnouts	0.02
Fortymile Wash new road	0.04
Overnight stops	0.04
Mercury turnoff road	0.03
Total disturbed area	2.1

a. Numbers approximate due to rounding.
b. To convert square kilometers to acres, multiply by 247.1.

6.3.3.2.3.2 Caliente/Las Vegas Route Air Quality

This section describes anticipated nonradiological air quality impacts from the construction and operation of an intermodal transfer station and upgrades and heavy-haul truck operation along the Caliente/Las Vegas route. Such impacts would result from releases of criteria pollutants, including nitrogen dioxide, sulfur dioxide, carbon monoxide, and particulate matter (PM_{10}) (see Section 6.3.3.1).

Carbon dioxide and PM_{10} are of particular interest along the Caliente/Las Vegas heavy-haul truck route because highway construction and upgrades and operation of heavy-haul trucks would occur through the Las Vegas Valley air basin, which is classified as a serious nonattainment area for these pollutants (DIRS 101826-FHWA 1996, pp. 3-53 and 3-54).

Highway Construction and Upgrades. Section 6.3.3.1 discusses the method of evaluation of air quality impacts from these activities. The intermodal transfer station for this route would be outside the Las Vegas air quality nonattainment area.

PM_{10} emissions would be an estimated 66 metric tons (73 tons) per year, including estimated emissions for accelerated construction activities for the Northern Beltway. These emissions are 100 percent of the General Conformity threshold level. Extending the construction time and more diligent dust control measures would decrease annual emissions.

Carbon monoxide emissions would be an estimated 54 metric tons (59 tons) per year. These emissions are 59 percent of the General Conformity threshold level.

Operations. Section 6.3.3.1 discusses air quality impacts associated with the operation of the Caliente intermodal transfer station and from emissions of heavy-haul trucks. The Caliente/Las Vegas route would involve heavy-haul trucks passing through the Las Vegas Valley air basin. The air quality impacts to this air basin would be small [0.48 metric ton (0.53 ton) per year of carbon monoxide] with emissions of less than 1 percent of the General Conformity threshold level. These emissions would result from 11 round trips per week through the basin.

6.3.3.2.3.3 Caliente/Las Vegas Route Hydrology

DOE anticipates that limited impacts to surface water and groundwater would occur in the course of improving Nevada highways so they could accommodate daily use by heavy-haul trucks. This section discusses these potential impacts as well as those from the construction and operation of an intermodal transfer station and operation of the Caliente/Las Vegas route. Section 6.3.3.1 discusses the hydrology impacts that would be common to all the heavy-haul truck implementing alternatives. This section focuses on the hydrology impacts that would be unique to the Caliente/Las Vegas heavy-haul truck implementing alternative.

Surface Water

Section 6.3.3.1 discusses impacts to surface water from the construction and operation of an intermodal transfer station and upgrades to highways. The common impacts discussed would apply to surface water along the Caliente/Las Vegas route.

Appendix L contains a comparison of what is known about the floodplains, springs, and riparian areas at the three candidate intermodal transfer station sites (see Sections L.3.2.6 and L.4.2.2). As noted in Section L.3.2.6, the two locations being considered for the Caliente intermodal transfer station are outside the 100-year flood zone of Meadow Valley Wash, but inside the 500-year flood zone.

Groundwater

Highway Construction and Upgrades. Section 6.3.3.1 discusses impacts to groundwater from the construction of an intermodal transfer station. Groundwater impacts from upgrading highways would be limited to those caused by the use of water from construction wells. The upgrades to the Caliente/Las Vegas route would require about 54,000 cubic meters (44 acre-feet) of water (DIRS 104917-LeFever 1998, all) that the analysis assumed would come from seven wells.

Table 6-104. Hydrographic areas along Caliente/ Las Vegas route.

Hydrographic areas crossed	Designated Groundwater Basins: Number	Designated Groundwater Basins: Percent corridor length represented
13	5	50

The average amount of water withdrawn from each well would be about 7,700 cubic meters (6 acre-feet). Chapter 3, Section 3.2.2.2.3, identifies the hydrographic areas over which the Caliente/Las Vegas route would pass, their perennial yields, and whether the State considers each a Designated Groundwater Basin. Table 6-104 summarizes the status of the hydrographic areas associated with the Caliente/Las Vegas route and identifies the approximate portion of the route that would pass over Designated Groundwater Basins.

The withdrawal of 7,700 cubic meters (6 acre-feet) a year from a well would have little impact on the hydrographic areas associated with the Caliente/Las Vegas route based on their perennial yields (Chapter 3, Section 3.2.2.2.3), even if multiple wells were placed in the same hydrographic area. As indicated in Table 6-104, about 50 percent of the route's length would be in areas with Designated Groundwater Basins, where the potential for groundwater depletion is watched carefully by the Nevada State Engineer's office. This does not mean that a contractor could not obtain water appropriations in these areas; the State Engineer would have the authority to approve such appropriations. The fact that requests for water appropriations under this action would be for minor amounts and for a short-term construction action should provide the State Engineer even more discretion. Other options would be to lease temporary water rights from individuals along the route, ship water from other permitted resources by truck (about 3,000 truckloads) to construction sites, or use a combination of these two actions. Obtaining a water appropriation from the State Engineer for a short-term construction use or using an approved allocation should ensure that groundwater resources would not be adversely affected.

Operations. Section 6.3.3.1 discusses impacts to groundwater from the operation of an intermodal transfer station, highway maintenance, and heavy-haul truck operations.

6.3.3.2.3.4 Caliente/Las Vegas Route Biological Resources and Soils

Section 6.3.3.1 discusses impacts to biological resources from the construction and operation of an intermodal transfer station and upgrades to highways that would be common to all potential sites for an intermodal transfer station and routes. This section discusses construction- and operations-related impacts that would be unique to the Caliente intermodal station and Caliente/Las Vegas route.

Highway Construction and Upgrades. Section 6.3.3.2.1 discusses potential Caliente intermodal transfer station siting locations and impacts to biological resources and soils from construction of the station.

The predominant land cover types along the Caliente/Las Vegas route are creosote-bursage and Mojave mixed scrub (DIRS 104593-CRWMS M&O 1999, p. 3-32). The regional area for each vegetation type is extensive (DIRS 104593-CRWMS M&O 1999, pp. C1 to C5). Because areas disturbed by upgrade activities would be in or adjacent to the existing rights-of-way and the areas have been previously degraded by human activities, impacts would be small.

Four threatened or endangered species occur along the route (DIRS 104593-CRWMS M&O 1999, p. 3-33). The desert tortoise occurs along the southern part of the route from near Alamo to Yucca Mountain (DIRS 103160-Bury and Germano 1994, pp. 57 to 72). An approximately 100-kilometer (62-mile) section of U.S. 93 from Maynard Lake to the junction with I-15 is critical habitat for the desert tortoise (50 CFR 17.95). Slight alterations of habitat immediately adjacent to existing roads would affect desert tortoises because work would occur in the existing right-of-way. Tortoise populations are depleted for more than 1 kilometer (0.6 mile) on either side of roads with average daily traffic greater than 180 vehicles (DIRS 103160-Bury and Germano 1994, pp. 57 to 72). Two endangered species—the Pahranagat roundtail chub and the White River springfish—occur in Ash Springs or its outflow. The route crosses the outflow of Ash Springs, which is designated critical habitat for the White River springfish (50 CFR 17.95). Because improvements would occur on the existing roadway and the Nevada Department of Transportation would use standard practices to reduce erosion and runoff, road improvements would not adversely affect the species living there. Improvements to the existing highway would not affect southwestern willow flycatchers or their habitat in Pahranagat Valley (DIRS 152511-Brocoum 2000, pp. A-9 to A-13). Nine other special status species occur within 100 meters (330 feet) of this route (DIRS 104593-CRWMS M&O 1999, p. 3-33). Four of these species occur at Ash Springs or its outflow, and would not be affected for the reasons stated above for this site. The other five species would not be affected because construction activities would be restricted to the existing right-of-way, so occupied habitat would not be destroyed.

This route would cross eight areas designated as game habitat (DIRS 104593-CRWMS M&O 1999, p. 3-33). Habitat in these areas would be reduced slightly due to construction activities along existing roads. Game animals could be disrupted if they were in these areas during construction and would probably move away until the higher level of activity ceased.

Seven springs, riparian areas, or other wet areas occur near this route (DIRS 104593-CRWMS M&O 1999, p. 3-33). These areas may be jurisdictional wetlands or other waters of the United States. However, no formal delineation has occurred. Construction could increase sedimentation in these areas. The corridor crosses a number of ephemeral streams that may be classified as waters of the United States. DOE would work with the State of Nevada and the U.S. Army Corps of Engineers to mitigate impacts to these areas and would obtain individual or regional permits, as appropriate.

Impacts (such as increased water erosion and removal of land cover resulting in wind erosion) to soils would be transitory and small and would occur only along the shoulders of existing roads.

Operations. Impacts from operations would be minimal but would include periodic disturbances of wildlife by noise from the additional truck traffic along this route. Trucks probably would kill individuals of some species, but losses would be few and unlikely to affect regional populations of any species. No additional habitat loss would occur during operations.

6.3.3.2.3.5 Caliente/Las Vegas Route Cultural Resources

Section 6.3.3.1 discusses impacts to cultural resources that would be common to all the heavy-haul truck implementing alternatives.

Highway Construction and Upgrades. Highway upgrades and construction of the Caliente/Las Vegas heavy-haul truck route would be the same from the Caliente intermodal transfer station to the junction of U.S. 93 and State Route 375, just south of Hiko, as for the Caliente route (see discussion in Section 6.3.3.2.1). Following U.S. 93 south to the Apex area, the route passes through several sites and areas that have been tentatively identified as being important to American Indians (DIRS 155826-Nickens and Hartwell 2001, Table 8). The following places have been identified in the Pahranagat National Wildlife Refuge: the Black Canyon area, the Storied Rocks site farther south, and the Maynard Lake vicinity. The Black Canyon sites are listed on the *National Register of Historic Places.*

Archaeological surveys of the highway rights-of-way along this route have identified 128 archaeological sites, seven of which have been recommended as potentially significant (DIRS 155826-Nickens and Hartwell 2001, Appendix A). Three of the potentially significant archaeological sites are located in areas identified for highway upgrades. Another 86 remain unevaluated. Two of the unevaluated sites are historic graves.

Native Americans have identified the entire Pahranagat Valley, once home to the Pahranagat Paiutes, as an important cultural landscape (DIRS 155826-Nickens and Hartwell 2001, all). Earlier studies with Native Americans identified the Coyote Springs area and the Arrow Canyon Range valley south of Pahranagat as places of cultural importance.

Operations. Operation of the Caliente intermodal transfer station and the highways along Caliente/Las Vegas heavy-haul truck route would transport spent nuclear fuel and high-level radioactive waste through several areas identified as culturally important to Native Americans. In addition, the route passes through approximately 1.6 kilometers (1 mile) of the Las Vegas Paiute Reservation, and the U.S. 93 segment passes near the Moapa Reservation.

6.3.3.2.3.6 Caliente/Las Vegas Route Occupational and Public Health and Safety

This section addresses potential impacts to occupational and public health and safety from upgrading highways and heavy-haul truck operations on the Caliente/Las Vegas route. Impacts from the associated intermodal transfer station in Caliente would be the same as those discussed in Section 6.3.3.2.1.

Highway Construction and Upgrades. Industrial safety impacts on workers from upgrading highways for the Caliente/Las Vegas route would be small (Table 6-105). The analysis evaluated the potential for impacts in terms of total reportable cases of injury, lost workday cases, fatality risks for workers, and traffic-related fatalities from commuting workers and the

Table 6-105. Impacts to workers from industrial hazards from upgrading highways along the Caliente/Las Vegas route.

Group and industrial hazard category	Construction[a]	Operations[b]
Involved workers		
Total recordable cases[c]	44	200
Lost workday cases	22	110
Fatalities	0.06	0.55
Noninvolved workers[d]		
Total recordable cases	2.6	11
Lost workday cases	1.0	4.3
Fatalities	0.003	0.01
Totals[e]		
Total recordable cases	47	210
Lost workday cases	23	110
Fatalities	0.06	0.56

a. Impacts are totals over about 46 months.
b. Includes impacts from periodic maintenance and resurfacing activities. Impacts are totals over 24 years.
c. Total recordable cases includes injury and illness.
d. The noninvolved worker impacts are based on 25 percent of the involved worker level of effort.
e. Totals might differ from sums due to rounding.

movement of construction materials and equipment. Table 6-106 lists the estimated fatalities from construction and commuter vehicle traffic.

Table 6-106. Estimated number of fatalities from construction material delivery vehicles and construction and operations worker commuting traffic for the Caliente/Las Vegas route for heavy-haul trucks.[a]

Activity	Kilometers[b]	Traffic fatalities	Vehicle emissions fatalities
Construction[c]			
Material delivery vehicles	41,000,000	0.7	0.09
Commuting workers	37,000,000	0.4	0.05
Subtotals	*78,000,000*	*1.1*	*0.13*
Operations[d]			
Commuting workers	200,000,000	2.0	0.26
Totals	***280,000,000***	***3.0***	***0.39***

a. Includes impacts from construction and operations of an intermodal transfer station.
b. To convert kilometers to miles, multiply by 0.62137.
c. Impacts are totals over about 46 months.
d. Impacts are totals over about 24 years.

Operations. Incident-free radiological impacts listed in Table 6-107 would occur during the routine transportation of spent nuclear fuel and high-level radioactive waste on the Caliente/Las Vegas route. These impacts would include those from transportation along the route and along railways in Nevada leading to the Caliente intermodal transfer station. The table includes the impacts of 1,079 legal-weight truck shipments from commercial sites that do not have the capability to load rail casks while operational.

Table 6-107. Health impacts from incident-free Nevada transportation for the Caliente/Las Vegas route heavy-haul truck implementing alternative.[a]

Category	Legal-weight truck shipments	Rail and heavy-haul truck shipments	Totals[b]
Involved workers			
Collective dose (person-rem)	38	1,400	1,400
Estimated latent cancer fatality	0.02	0.56	0.58
Public			
Collective dose (person-rem)	7	220	230
Estimated latent cancer fatality	0.003	0.11	0.11
Estimated vehicle emission-related fatalities	0.002	0.062	0.064

a. Impacts are totals for 24 years.
b. Totals might differ from sums of values due to rounding.

6.3.3.2.3.7 Caliente/Las Vegas Route Socioeconomics

This section describes potential socioeconomic impacts that would occur from upgrading highways along the Caliente/Las Vegas route and building an intermodal transfer station for heavy-haul truck transportation. The discussion includes impacts from the operation of an intermodal transfer station at Caliente and periodic resurfacing of the highways and the planned Las Vegas Beltway.

The analysis of socioeconomic impacts assumed that Clark County would secure a loan to advance the construction schedule of the portion of the Las Vegas Beltway that would be part of the Caliente/Las Vegas route. The analysis based the estimates of impacts on two sources of information from Clark County on the cost of building a section of the Beltway. These sources estimate that modifications to the Northern Beltway would cost between $43.6 million (DIRS 103710-Clark County 1997, p. 2-7) and $463 million (DIRS 155112-Berger 2000, p. 29) (about $43.6 to $463 million in 2001 dollars). DOE believes the actual impact will be between the two values. The loan to Clark County for $43.6 million or $463 million, at a real rate of 3 percent, with repayment of the loan starting in 2010 and lasting for 30 years, is a part of the modeling to determine impacts to employment, population, real disposable income, and expenditures by State and local governments. (A *real* percentage rate is the premium paid in addition to the rate of inflation; a real rate plus the rate of inflation equals the nominal or quoted rate.) Clark County would repay the loan from tax revenues.

Highway Construction and Upgrades. Socioeconomic impacts from upgrading public highways for the Caliente/Las Vegas route, advancing the scheduled completion of a portion of the Las Vegas Beltway, and building an intermodal transfer station would be temporary, occurring over a short period and spread among the counties along the route. Employment for highway upgrades, excluding the Beltway, and construction of an intermodal transfer station would be about 832,000 worker-hours or 416 worker-years. The highway upgrades, excluding the Beltway, would cost $96.8 million, would take approximately 46 months, and would occur during the 48-month construction period anticipated for the Beltway. The analysis assumed that if DOE selected this route, Clark County would advance the construction schedule of the Beltway and would reconfigure the design to accommodate use by heavy-haul trucks. Constructing an intermodal transfer station would cost $25 million and require 18 months to complete. (Dollar values reported in this section are 2001 dollars unless otherwise stated.)

This section expresses values for socioeconomic measures (employment, population, real disposable income, Gross Regional Product, and State and local government expenditures) and for the potential impacts of change in those measures as a range of values. The first value refers to the outcome if the Beltway cost is $43.6 million; the second refers to the outcome if the cost is $463 million. DOE anticipates that the actual change would fall between the two values.

Employment

In the region of influence, increased employment of construction workers involved with upgrading the highways (including the Beltway) and with building an intermodal transfer station (direct workers) and other workers employed as a result of the economic activity generated by the project (indirect workers) would peak in 2008 at between 588 and 1,979 persons. The increase in employment in Clark County would be between 544 and 1,910 workers, Nye County would gain between 8 and 29 workers, and Lincoln County would gain between 36 and 40 workers. The increases in Clark and Nye Counties would be less than 1 percent of the employment baseline for each county. The increase in Lincoln County would be less than 2 percent of the County's employment baseline.

Population

Projected population increases in the region of influence that would result from construction work related to the Caliente/Las Vegas route would peak in 2009. During that year, population would be more than the baseline by between 500 and 2,002 individuals. The change in population for Clark County would be between 477 and 1,943 people, for Lincoln County between 13 and 17 people, and for Nye County between 10 and 42 people. The impacts from an increase in population as a result of increased employment opportunities would be less than 1 percent of each county's population baseline. Because the increases in population in each county would be so small and transient, impacts to schools or housing would be unlikely.

Economic Measures

Economic measures would rise during the construction of an intermodal transfer station and the upgrading of highways and the Las Vegas Beltway. The increase above the baseline in real disposable income of people in the region of influence would peak in 2008 at between $19.0 million and $65.3 million. The region-wide increase in Gross Regional Product would peak in 2008 at between $33.1 million and $104.1 million. Increased State and local government expenditures resulting from highway upgrades and the intermodal transfer station construction project would peak in 2009 at between $1.7 million and $6.6 million. The Gross Regional Product, real disposal personal income, and expenditures by State and local governments would rise by less than 1 percent in Clark, Nye, and Lincoln Counties. (Dollar values reported in this section are in 2001 dollars unless otherwise stated.)

Transition to Operations. In the region of influence, employment of Caliente/Las Vegas heavy-haul truck route workers and indirect (support) workers would decrease by 516 to 2,123 when construction of the intermodal transfer station and highway upgrades (including the Beltway portion) ended in 2009. Clark County would lose between 506 and 2,087 of these jobs, Nye County would lose between 5 and 27 of these jobs, and Lincoln County would lose between 4 and 9 jobs. DOE anticipates that some of the displaced workers would move into operational positions on the Caliente/Las Vegas route while others would find other work in the State. While this project would lose jobs, employment projections for the State estimate approximately 1.4 million jobs in 2010, or about 999,500 in the region of influence.

Operations. If DOE selected this route, operations at an intermodal transfer station near the City of Caliente and use of heavy-haul trucks would begin in 2010 and continue until 2033. A workforce of 26 would be required for the intermodal transfer station. Direct employment for heavy-haul truck operations, including escorts, would be 120 workers.

To analyze impacts of operations for a Caliente/Las Vegas heavy-haul truck route, DOE considered three activities: operation of the intermodal transfer station, operation of heavy-haul trucks, and maintenance of highways and the Las Vegas Beltway.

Employment and Population

Employment associated with an intermodal transfer station and heavy-haul trucks would remain relatively level throughout operations. Total employment in the region of influence attributable to operation of a Caliente/Las Vegas route would average about 209 workers. The analysis determined that about 110 workers would come from Clark County, about 11 from Nye County, and 88 from Lincoln County. The impact on population would be about 359 additional residents in the region. About 224 persons would live in Clark County, about 25 in Nye County, and about 110 in Lincoln County. Additional employment and population for Lincoln County, which would experience the largest changes as a percentage of the baselines, would be about 3.3 percent of the employment baseline and 2.3 percent of the population baseline. These impacts would be within the range of historic changes in the county.

During the operational period of heavy-haul truck shipments, periodic road resurfacing would be needed. Employment (direct and indirect) in the region would increase by about 191 workers during the 2-year duration of resurfacing projects. DOE assumed that all the workers would come from Clark County-based employers. Overall, employment increases from periodic (every 8 years starting in 2016) highway resurfacing projects would be less than 1 percent of the baseline for Clark County. Given the short duration of each resurfacing project, there would be no perceptible change in the region's population. Employees hired to resurface the highways and their families are included in the averages discussed below.

The net changes to employment and population from three operational activities associated with a Caliente/Las Vegas route during the 24 years of operations can be summarized. If the cost of the beltway was approximately $43.6 million, there would be an incremental increase of 225 jobs in the region of influence, 119 in Clark County, 13 in Nye County, and 93 in Lincoln County. This impact would be less than 1 percent of the baselines in Clark and Nye Counties, and 3.5 percent of the baseline in Lincoln County. If the cost of the beltway reaches $463 million, employment in the region of influence, while continuing to grow to approximately 1,137,000 positions, would have 108 fewer employment opportunities. Clark County would have 211 fewer positions, but Nye County would gain 10 positions and Lincoln County would gain 93 positions during the operations phase. Impacts to the baselines in Clark and Nye Counties would be less than 1 percent, but the change in Lincoln County would be 3.4 percent of the baseline.

The region of influence would experience a growth in population of an additional 440 residents, 292 in Clark County, 29 in Nye County, and 119 in Lincoln County. This impact would be less than 1 percent of the baselines in Clark and Nye Counties, but 2.5 percent of the baseline in Lincoln County. Because the impacts would be small in Clark and Nye Counties, impacts to housing or schools would be unlikely. The increase in population in Lincoln County would include an annual average of 32 school-age children. There would be no impact in the housing market in Lincoln County given the chronically high vacancy rate in housing (see Chapter 3, Section 3.1.7.4).

Economic Measures

Changes in employment and population would drive changes in economic measures attributable to the project. If the final loan amount was $43.6 million, real disposable income in the region of influence would rise throughout operations, starting at $3.9 million in 2010 and increasing to $14.7 million in 2033. The average would be $8.6 million. Gross Regional Product would also rise during operations; the average annual increase would be $13.4 million. State and local government expenditures would also increase with an average annual increase of $2.3 million. Increases to real disposable income, Gross Regional Product, and government expenditures would be less than 1 percent of the baselines for Clark and Nye Counties. The changes in Lincoln County would be more visible. Changes in real disposable income ($3.0 million annually) and government expenditures for the County would be approximately 2.5 and 3.0 percent of the baselines, respectively. The projected change in Gross Regional Product ($5.6 million annually) for the County would be 3.9 percent of the baseline. These changes would be within the range of historic short-term changes for Lincoln County.

If the final loan amount was $463 million, growth in real disposable income in the region of influence would slow throughout the operations period as the loan is repaid. Starting at $5.3 million above the baseline in 2010 and declining to $26.8 million below the baseline in 2033, growth in real disposable income would decline by an average of $24.2 million, or 0.043 percent of the region of influence's baseline during the operations phase. Real disposable income in Lincoln County would increase by an average of $3.0 million. This change would represent 2.5 percent of the County's baseline. Increases in Gross Regional product would average $468,000 in Nye County and $5.5 million in Lincoln County. The increase in Nye County would be less than 1 percent, but the change represents 3.8 percent of the baseline in Lincoln County. The rate of growth in Gross Regional Product would decline by an average of $12.1 million in Clark County and $6.1 million in the region of influence. These impacts would be less than 1 percent of the applicable baselines. Expenditures by State and local governments attributable to the project would average $100,000 in Nye County and $1.2 million in Lincoln County. The increase in Nye County would be less than 1 percent of the baselines, but the increase in Lincoln County would be 3.0 percent of the baseline. Growth in expenditures by State and local governments would slow by an average of $1.3 million in Clark County, an impact of less than 1 percent of the County's baseline. As population growth slows, there would also be a slowing in the rate of tax revenue collected and a slowing in the rate of population growth that would require a given level of public services.

In addition, DOE analyzed a sensitivity case in which all Lincoln County socioeconomic impacts were assumed to occur only in the City of Caliente. Under this assumption, city population would rise by 3 percent during construction and by about 8.7 percent during operations. Employment would rise by about 11 percent during construction and about 12 percent during operations.

6.3.3.2.3.8 Caliente/Las Vegas Route Noise and Vibration

Section 6.3.3.1 discusses noise impacts common to all the heavy-haul truck implementing alternatives. This section focuses on the noise impacts that would be unique to the Caliente/Las Vegas heavy-haul truck implementing alternative.

Noise impacts of the Caliente intermodal transfer station would be the same as those discussed in Section 6.3.3.2.1.

Highway Construction and Upgrades. Construction activities for upgrading highways along the Caliente/Las Vegas route would occur on all sections with the exception of the section of I-15 between its intersection with U.S. 93 and the planned North Las Vegas Beltway. North Las Vegas, the Towns of Caliente and Indian Springs, and the small rural communities of Crystal Springs, Ash Springs, and Alamo would fall within the 2,000-meter (6,600-foot) region of influence for construction noise. The potential number of inhabitants would be highest near the greater Las Vegas area. There are scattered residences along U.S. 93 in the Pahranagat Valley.

Because the shipments would pass through a large population area, there would be a potential for noise impacts along the route.

Operations. The Caliente/Las Vegas route would by pass mostly rural communities, and would be confined to established highway systems. Three public schools in Alamo are in the region of influence along U.S. 93 and the Indian Springs school is in the region of influence along U.S. 95. However, the incremental noise increase due to the infrequent heavy-haul truck shipments would not alter the existing noise environment. Because the proposed intermodal transfer station would be on the western edge of Caliente and traffic would not travel through the city, traffic noise impacts in Caliente would be inconsequential. Estimated noise levels (1-hour average sound levels) in Crystal Springs, Ash Springs, Alamo, Indian Springs and Cactus Springs would increase by 0.3 to 2.0 dBA due to heavy-haul truck traffic. A potential *receptor* is the public school in Indian Springs, which also serves students from Cactus Springs. The Indian Springs school is about 300 meters (980 feet) south of U.S. 95. The incremental contribution of heavy-haul trucks at this distance from the highway would not be perceptible. Background traffic noise levels would be greatest along I-15 and the North Las Vegas Beltway, reducing the potential for heavy-haul truck noise to produce adverse effects to public receptors during daylight hours. No historic buildings would be affected by ground vibration. No sensitive ruins of cultural significance have been identified along this route.

On the Caliente/Las Vegas heavy-haul truck route, U.S. 93 passes within 5 kilometers (3 miles) of the Moapa Reservation. However, the distance from the highway to the reservation makes noise impacts unlikely. The estimated mean 1-hour increase in traffic noise due to heavy-haul trucks in this area would be 0.1 dBA over existing background traffic noise (DIRS 155825-Poston 2001, all). This increase would not be perceptible on the reservation. The heavy-haul truck route on U.S. 95 passes through about 1.6 kilometer (1 mile) of the Las Vegas Paiute Reservation. Because of the relatively large traffic volume on U.S. 95, the increase in traffic noise due to heavy-haul trucks in this area would not be perceptible (DIRS 155825-Poston 2001, all).

6.3.3.2.3.9 Caliente/Las Vegas Route Aesthetics

The Caliente intermodal transfer station would be near the entrance to Kershaw-Ryan State Park. Park visitors would receive short-term visual impacts from construction activities. In addition, park visitors could be affected by noise from construction activities that could lessen their recreational experience. These short-term impacts would exist only during construction.

During operation of the intermodal transfer station, noise and lighting probably would be discernible from Kershaw-Ryan State Park, especially during night operations, and would probably detract from the recreational experience. The use of shielded and directional lighting would limit the amount of viewable light from outside the facility operational area.

6.3.3.2.3.10 Caliente/Las Vegas Route Utilities, Energy, and Materials

Section 6.3.3.1 discusses utilities, energy, and materials impacts that would be common to the heavy-haul truck implementing alternatives. This section focuses on the utilities, energy, and materials impacts that would be unique to the Caliente/Las Vegas heavy-haul truck implementing alternative.

Highway Construction and Upgrades. The construction of the Caliente intermodal transfer station would produce the same utilities, energy, and materials impacts as those discussed in Section 6.3.3.1.

Table 6-108 lists the estimated quantities of primary materials for the upgrade of Nevada highways for the Caliente/Las Vegas route. These quantities would be unlikely to be large in relation to the southern Nevada regional supply capacity (see Section 6.3.3.1).

Table 6-108. Utilities, energy, and materials required for upgrades along the Caliente/Las Vegas route.

Route	Length (kilometers)[a]	Diesel fuel (million liters)[b]	Gasoline (thousand liters)	Asphalt (million metric tons)[c]	Concrete (thousand metric tons)	Steel[d] (metric tons)
Caliente-Las Vegas	377	5.5	110	0.55	0.80	21

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. To convert metric tons to tons, multiply by 1.1023.
d. Steel includes rebar only.

Operations. Section 6.3.3.1 discusses the utilities, energy, and materials needs for the operation of an intermodal transfer station.

Fossil fuel that would be consumed by heavy-haul trucks during operations is discussed in Chapter 10, which addresses irreversible commitments of resources.

6.3.3.2.4 *Sloan/Jean Route Implementing Alternative*

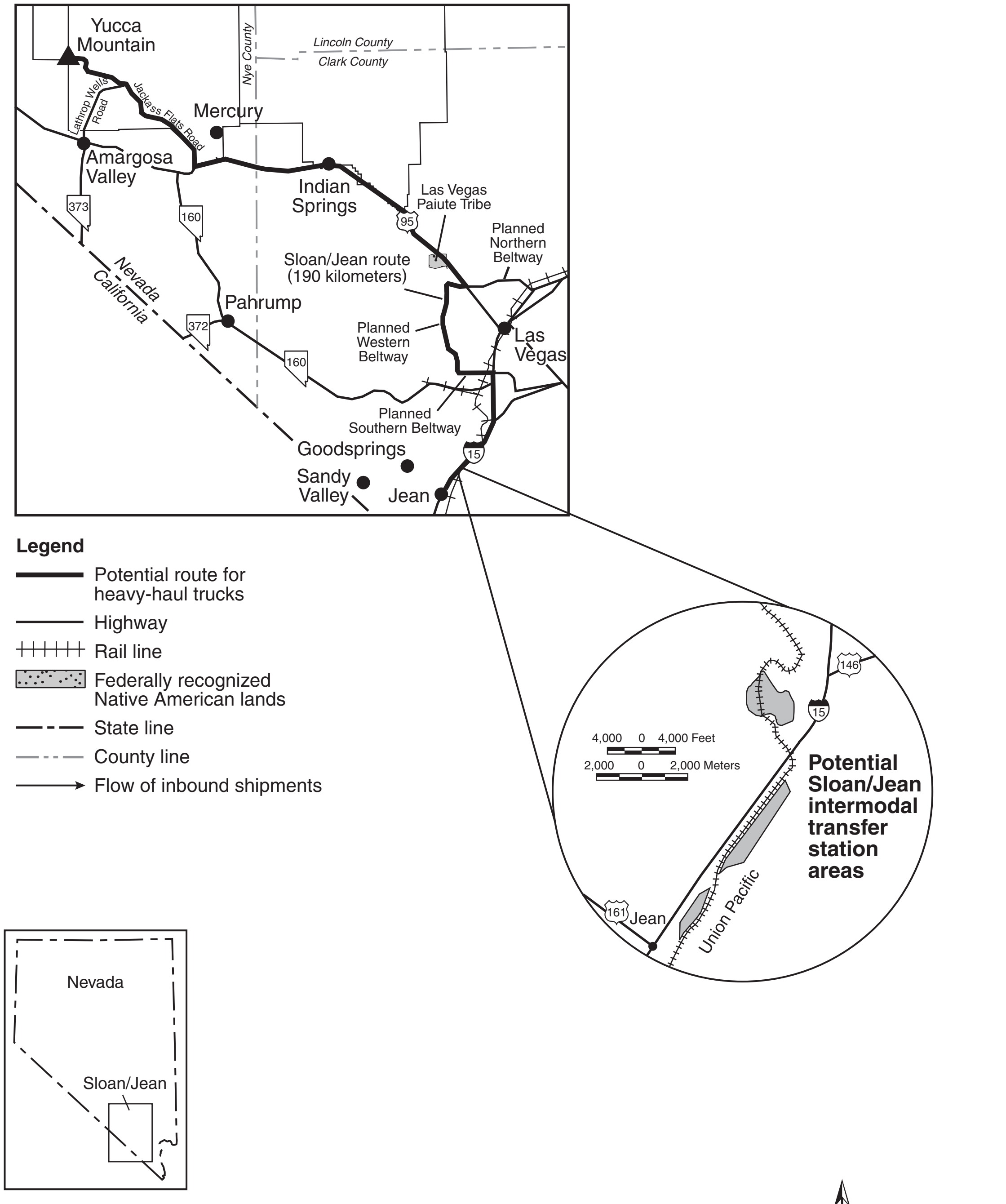
The Sloan/Jean route (Figure 6-25) is about 188 kilometers (117 miles) long. Heavy-haul trucks and escorts leaving a Sloan/Jean intermodal transfer station would enter I-15 at the Sloan interchange. The trucks would travel on I-15 to the exit to the southern portion of the proposed Las Vegas Beltway, and then travel northwest on the beltway. They would leave the beltway at U.S. 95, and travel north on U.S. 95 to the Mercury entrance to the Nevada Test Site. The trucks would travel on Jackass Flats Road on the Nevada Test Site to the Yucca Mountain site. The travel time (vehicle in motion plus periodic short stops for inspections) associated with a Sloan/Jean route would be as much as 4 hours.

The three potential areas for an intermodal transfer station southwest of Las Vegas are between the existing Union Pacific sidings at Sloan and Jean. One area is on the east side of I-15, south of the Union Pacific rail underpass at I-15, and has an area of 3.3 square kilometers (811 acres). The second, which has an area of 3.1 square kilometers (758 acres), is south of the Sloan rail siding along the east side of the rail line. A third area is south of the second, directly north of the Jean interchange on I-15, and has an area of 1.0 square kilometer (257 acres). The estimated life-cycle cost of constructing and operating an intermodal transfer station and of operating heavy-haul trucks along the Sloan/Jean route would be about $444 million in 2001 dollars.

The following sections address impacts that would occur to land use; air quality; biological resources and soils; hydrology including surface water and groundwater; cultural resources; occupational and public health and safety; socioeconomics; noise and vibration; and utilities, energy, and materials. Impacts that would occur to aesthetics and waste management would be the same as those discussed in Section 6.3.3.1 and are, therefore, not repeated here. Section 6.3.4 discusses the potential for transportation activities to cause environmental justice impacts in Nevada.

6.3.3.2.4.1 Sloan/Jean Route Land Use and Ownership

This section describes anticipated land-use impacts that could occur from the construction and operation of the Sloan/Jean intermodal transfer station, upgrades of highways, and heavy-haul truck operations over



Potential heavy-haul truck routes in Nevada are highways identified by the Nevada Department of Transportation for shipments of overweight and overdimensional loads. The Nevada Department of Transportation would issue permits that specified approved routing for heavy-haul truck shipments on Nevada highways. The State of Nevada could designate alternative and additional preferred routes as specified in 49 CFR 397.103, that could include routes other than ones through the Las Vegas metropolitan area.

To convert kilometers to miles, multiply by 0.62137.

Source: Modified from DIRS 104588-YMP (1998, all).

Figure 6-25. Sloan/Jean heavy-haul truck route.

the Sloan/Jean route. Chapter 3, Section 3.2.2.2.1, describes the Sloan/Jean intermodal transfer station site and the associated truck route.

Highway Construction and Upgrades. At the Sloan/Jean intermodal station area there could be potential impacts related to the current use of the land. All three Sloan/Jean candidate sites are on land administered by the Bureau of Land Management. The northernmost area is in the Spring Mountain grazing allotment and the Ivanpah Valley desert tortoise area of critical environmental concern. The Bureau of Land Management has designated land east of the railroad as a gravel pit (community pit), but that land has not been worked; the area is open to fluid mineral leasing but closed to mining claims. The two southern areas are in the Jean Lake grazing allotment, a special recreation management area, and an area designated as available for sale or transfer. Both southern areas are open to fluid mineral leasing and mining claims (DIRS 104993-CRWMS M&O 1999, p. 21).

This route would require the disturbance of approximately 0.63 square kilometer (160 acres) of land from road upgrades and additional construction activities. Table 6-109 summarizes these disturbances.

The land under consideration would require a change in ownership from the Bureau of Land Management to DOE. The amount of land transferred from grazing lands to DOE would result in a small loss to the allotment. Because of the relatively small size of the required parcels and their proximity to roads and railways, the removal of these lands would be unlikely to affect livestock management. A potential loss of desert tortoise habit is discussed below. The amount of land that would be removed from fluid mineral leases is small and would be unlikely to cause long-term impacts. If the areas under consideration were already under lease, DOE would negotiate a transfer with the lessee.

Table 6-109. Land disturbances along the Sloan-Jean heavy-haul truck route.

Disturbance	Area disturbed[a] (square kilometers)[b]
Haul road disturbed area	0.47
Aggregate plants	0.08
Road widening	<0.01
Passing lanes	None
Truck turnouts	None
Fortymile Wash new road	0.04
Overnight stops	None
Mercury turnoff road	0.03
Total disturbed area	0.63

a. Numbers approximate due to rounding.
b. To convert square kilometers to acres, multiply by 247.1.

The removal of land from a special recreational management area would be unlikely to cause long-term impacts to recreational activities. The Bureau of Land Management could make other lands available for the recreational activities. This would require agreement between the Bureau and DOE before the start of construction activities.

The potential loss of lands from the Bureau of Land Management land sale/transfer program could cause a loss of potential tax revenue.

The Sloan/Jean route would require considerable improvements at the interchange with I-15. A small amount of land would be converted for the improvements. Section 6.3.3.1 discusses other impacts on land use from upgrading Nevada highways for use by heavy-haul trucks.

Operations. There would be no direct land-use impacts associated with the operation of the Sloan/Jean intermodal transfer station or the Sloan/Jean route other than those described in Section 6.3.3.1.

6.3.3.2.4.2 Sloan/Jean Route Air Quality

This section describes anticipated nonradiological air quality impacts from construction activities and operations of an intermodal transfer station, highway construction and upgrades, and operation of heavy-haul trucks along the Sloan/Jean route. Such impacts would result from releases of criteria pollutants, including nitrogen dioxide, sulfur dioxide, carbon monoxide, and particulate matter (PM_{10}) (see Section 6.3.3.1).

Carbon monoxide and PM_{10} are of particular interest along the Sloan/Jean route because some construction activities as well as heavy-haul truck transport would occur through the Las Vegas Basin, which is classified as a serious nonattainment area for those pollutants, and because the intermodal transfer station locations would be in or near the nonattainment area. PM_{10} and carbon monoxide emissions from intermodal transfer station construction are presented in Section 6.3.3.1. Intermodal transfer station construction emissions would be 15 percent of the PM_{10} General Conformity threshold and would be 2.3 percent of the carbon monoxide General Conformity threshold level.

Highway Construction and Upgrades. Section 6.3.3.1 discusses the methods used to estimate the air quality impacts for the construction activities for the Sloan/Jean route. PM_{10} emissions would be an estimated 41 metric tons (45 tons) per year, including estimated emissions for the accelerated construction activities of the southern and western portions of the Las Vegas Beltway. These emissions would be 64 percent of the General Conformity threshold level. Carbon monoxide emissions for highway construction and upgrades would be an estimated 33 metric tons (36 tons) per year. These emissions are 36 percent of the carbon monoxide General Conformity threshold level.

Operations. Section 6.3.3.1 discusses the air quality impacts associated with the operation of a locomotive at the Sloan/Jean intermodal transfer station. In addition to these operations, the operation of heavy-haul trucks along the Sloan/Jean route would affect the Las Vegas Valley air basin. Air quality impacts from heavy-haul trucks to this air basin would be small [0.62 metric tons (0.68 ton) per year of carbon monoxide] with emissions at less than 1 percent of the General Conformity threshold level. These emissions would result from 11 round trip heavy-haul trucks traveling through the Las Vegas Valley each week.

6.3.3.2.4.3 Sloan/Jean Route Hydrology

DOE anticipates limited impacts to surface water and groundwater during upgrades to Nevada highways so they could accommodate daily use by heavy-haul trucks. This section discusses these impacts as well as those from the construction and operation of an intermodal transfer station and operation of trucks on the Sloan/Jean route. Section 6.3.3.1 discusses the hydrology impacts that would be common to all of the heavy-haul truck implementing alternatives. This section focuses on the hydrology impacts that would be unique to the Sloan/Jean heavy-haul truck implementing alternative.

Surface Water

Section 6.3.3.1 discusses the impacts to surface water from the construction and operation of an intermodal transfer station and upgrades to highways. The common impacts discussed in Section 6.3.3.1 apply to surface water along the Sloan/Jean route.

The assessment in Appendix L compares what is known about the floodplains, springs, and riparian areas at the three candidate intermodal transfer station sites (see Sections L.3.2.8 and L.4.2.2). The southernmost of the three locations for the Sloan/Jean station appears to be, at least in part, in a 100-year flood zone of a normally dry drainage channel (see Section L.3.2.8).

Groundwater

Highway Construction and Upgrades. Section 6.3.3.1 discusses the impacts to groundwater from the construction of an intermodal transfer station. Upgrades to the Sloan/Jean route would not require any water wells. The road upgrades would require an estimated total of about 9,200 cubic meters (8 acre-feet) of water (DIRS 104917-LeFever 1998, all). Options for obtaining this water would be to lease temporary water rights from individuals along the route, ship water from other permitted resources by truck (about 500 truckloads) to construction sites, or use a combination of these two actions.

Operations. Section 6.3.3.1 discusses impacts to groundwater from the operation of an intermodal transfer station, highway maintenance, and heavy-haul truck routes.

6.3.3.2.4.4 Sloan/Jean Route Biological Resources and Soils

Section 6.3.3.1 discusses impacts to biological resources from the construction and operation of an intermodal transfer station and upgrades to highways that would be common to all intermodal transfer stations and routes. This section discusses the construction- and operations-related impacts that would be unique to the Sloan/Jean intermodal station and route.

Highway Construction and Upgrades. Potential Sloan/Jean intermodal transfer station site locations are between the existing Union Pacific rail sidings at Sloan and Jean. The dominant land cover type in these areas is creosote-bursage (DIRS 104593-CRWMS M&O 1999, p. 3-36). The land cover type at the site is extensive in the region (DIRS 104593-CRWMS M&O, pp. C1 to C5).

The three sites that DOE is considering for a Sloan/Jean intermodal transfer station are in the range of the desert tortoise, but none of the areas are critical habitat for the tortoise (50 CFR 17.95). The construction site would disturb approximately 0.2 square kilometer (50 acres) of tortoise habitat. The likelihood of tortoise death or injury due to construction activities would be small if DOE moved tortoises in the immediate area to a safe habitat. The pinto beardtongue (classed as sensitive by the Bureau of Land Management) occurs in two of the proposed locations of the Sloan/Jean intermodal transfer station (DIRS 104593-CRWMS M&O 1999, p. 3-36). If one of these sites was selected, DOE would conduct pre-activity surveys for this plant species and would avoid disturbance of occupied areas if possible. The construction of an intermodal transfer station at a site southwest of Sloan could cause bighorn sheep to avoid the eastern edge of their winter range in that area. There are no springs or other areas that could be classified as wetlands at the location of the intermodal transfer station (DIRS 104593-CRWMS M&O 1999, p. 3-36).

Predominant land cover types in nonurban areas along the route are creosote-bursage and Mojave mixed scrub (DIRS 104593-CRWMS M&O 1999, p. 3-36). The regional area for each vegetation type is extensive. Because areas disturbed by upgrade activities would be in or adjacent to existing rights-of-way and the areas have been previously degraded by human activities, impacts would be small.

The only threatened or endangered species that occurs along the route is the desert tortoise. Desert tortoise habitat occurs throughout the length of the route (DIRS 103160-Bury and Germano 1994, pp. 57 to 72; 50 CFR 17.95). Construction activities could kill or injure desert tortoises; however, losses would be few because construction would occur only on the right-of-way and desert tortoises are uncommon along heavily traveled roads (DIRS 103160-Bury and Germano 1994, Appendix D, p. D12). Four other special status species occur along this route (DIRS 104593-CRWMS M&O 1999, p. 3-36), but construction activities would be limited to the road and adjacent areas; occupied habitat would not be destroyed and these species should not be affected.

This route would not cross any areas designated as game habitat and there are no springs or wetlands near the route. The corridor crosses a number of ephemeral streams that may be classified as waters of the United States. DOE would work with the State of Nevada and the U.S. Army Corps of Engineers to minimize impacts to these areas, and obtain individual or regional permits, as appropriate (DIRS 104593-CRWMS M&O 1999, p. 3-36). Impacts to soils would be transitory and small and would occur only along the shoulders of existing roads.

Operations. Impacts from operations would include periodic disturbances of wildlife from activities at the intermodal transfer station and additional truck traffic along this route. Trucks probably would kill individuals of some species but losses would be few and unlikely to affect regional populations of any species. No additional habitat loss would occur during operations. Impacts to soils would be small.

6.3.3.2.4.5 Sloan/Jean Route Cultural Resources

Highway Construction and Upgrades. A total of 59 archaeological and historic sites have been recorded along existing highway rights-of-way along the Sloan/Jean heavy-haul truck route (DIRS 155826-Nickens and Hartwell 2001, Appendix A). None of these occur in areas along roads that would require upgrades.

There are seven archaeological sites near the location of the Sloan/Jean intermodal transfer station, none of which has been evaluated for potential eligibility for the *National Register of Historic Places* (DIRS 155826-Nickens and Hartwell 2001, Appendix A). Possible unrecorded sites in the intermodal transfer station location include some associated with the original construction of the railroad in the early part of the 20th century, such as construction camps. The location of the "Last Spike," where the last two segments of the railroad were joined occurs in the vicinity of the site.

No areas or sites of cultural importance to Native Americans have been identified along the Sloan/Jean route or at the intermodal transfer station location, although field studies have not been completed. The route follows a portion of U.S. 95 that passes though approximately 1.6 kilometers (1 mile) of the Las Vegas Paiute Reservation.

Operations. Based on currently available information, operation of a Sloan/Jean intermodal transfer station and heavy-haul truck route would have no impacts on cultural resources.

6.3.3.2.4.6 Sloan/Jean Route Occupational and Public Health and Safety

This section addresses potential impacts to occupational and public health and safety from upgrading highways and heavy-haul truck operations on the Sloan/Jean route. Impacts from the associated intermodal transfer station in the Sloan/Jean area would be the same as those discussed in Section 6.3.3.1.

Highway Construction and Upgrades. Industrial safety impacts on workers from upgrading highways for the Sloan/Jean route would be small (Table 6-110). The analysis evaluated the potential for impacts in terms of total reportable cases of injury, lost workday cases, fatality risks for workers, and traffic fatalities related to commuting workers and the movement of construction materials and equipment. Table 6-111 lists the estimated fatalities from construction and commuter vehicle traffic.

Operations. The incident-free radiological impacts listed in Table 6-112 would occur during the routine transportation of spent nuclear fuel and high-level radioactive waste on the Sloan/Jean route. These impacts would include transportation along the Sloan/Jean route as well as transportation along railways in Nevada leading to the Sloan/Jean intermodal transfer station. The table includes the impacts of 1,079 legal-weight truck shipments from commercial sites that do not have the capability to load rail casks while operational.

Table 6-110. Health impacts to workers from industrial hazards from upgrading highways along the Sloan/Jean route.

Group and industrial impact category	Construction[a]	Operations[b]
nvolved workers		
Total recordable cases[c]	23	120
Lost workday cases	11	66
Fatalities	0.032	0.33
Noninvolved workers[d]		
Total recordable cases	1.4	6.8
Lost workday cases	0.5	2.5
Fatalities	0.001	0.007
otals[e]		
Total recordable cases	24	130
Lost workday cases	12	68
Fatalities	0.033	0.34

a. Impacts are totals over about 48 months.
b. Includes impacts for periodic maintenance and resurfacing. Impacts are totals over about 24 years.
c. Total recordable cases includes injury and illness.
d. The noninvolved worker impacts are based on 25 percent of the involved worker level of effort.
e. Totals might differ from sums due to rounding.

Table 6-111. Estimated number of fatalities from construction material delivery vehicles and construction and operations worker commuting traffic for the Sloan/Jean route for heavy-haul trucks.

Activity	Kilometers[a]	Traffic fatalities	Vehicle emissions fatalities
Construction[b]			
Material delivery vehicles	17,000,000	0.3	0.04
Commuting workers	21,000,000	0.2	0.03
Subtotals	*38,000,000*	*0.5*	*0.06*
Operations[c]			
Commuting workers	120,000,000	1.2	0.16
Totals	*170,000,000*	*1.7*	*0.23*

a. Includes impacts of construction and operation of an intermodal transfer station.
b. To convert kilometers to miles, multiply by 0.62137.
c. Impacts are totals over about 48 months.
d. Impacts are totals over 24 years.

Table 6-112. Health impacts from incident-free Nevada transportation for the Sloan/Jean heavy-haul truck implementing alternative.[a]

Category	Legal-weight truck shipments	Rail and heavy-haul truck shipments[b]	Totals[c]
Involved workers			
Collective dose (person-rem)	38	1,200	1,200
Estimated latent cancer fatalities	0.02	0.48	0.50
Public			
Collective dose (person-rem)	7	330	340
Estimated latent cancer fatalities	0.003	0.17	0.17
Estimated vehicle emission-related fatalities	0.002	0.19	0.19

a. Impacts are totals for 24 years.
b. Includes impacts to workers at an intermodal transfer station.
c. Totals might differ from sums of values due to rounding.

6.3.3.2.4.7 Sloan/Jean Route Socioeconomics

This section describes potential socioeconomic impacts that would occur from upgrading highways along the Sloan/Jean route, constructing and modifying a section of the planned Las Vegas Beltway, and building an intermodal transfer station for heavy-haul truck transportation. The discussion includes the impacts of operating an intermodal transfer station near Sloan/Jean in Clark County and of periodic resurfacing of the highways and Beltway.

This analysis of socioeconomic impacts assumed that Clark County would secure a loan to advance the construction schedule of the portion of the Las Vegas Beltway that would be part of this heavy-haul truck route. DOE estimates that modifications to the Beltway would cost between $98.1 million and $790 million in 2001 dollars. DOE believes the actual impacts would be between the two values. A loan to Clark County for $98.1 or $790 million, at a real rate of 3 percent, with repayment of the loan starting in 2010 and lasting for 30 years, is a part of the modeling to determine the impacts to employment, population, real disposable income, and expenditures by State and local governments. (A *real* percentage rate is the premium paid in addition to the rate of inflation; a real rate plus the rate of inflation equals the nominal or quoted rate.) Clark County would repay the load from tax revenues. DOE assumes most repayment funds would be from sources the county has already identified for completion of the Beltway.

Highway Construction and Upgrades. Socioeconomic impacts from upgrading existing highways for a Sloan/Jean route, advancing the construction schedule for modifying a portion of the planned Las Vegas Beltway, and building an intermodal transfer station would be temporary, occurring over a short period and spread among the counties along the route. Upgrading the existing highways for the route, excluding the Beltway, would cost about $20.8 million and would require 48 months to complete. The upgrades to the highways would occur during the 48-month construction period for the planned portion of the Beltway. Building an intermodal transfer station would cost $25 million and would require 18 months. If DOE selected this route, the Beltway construction schedule would be advanced to accommodate use by heavy-haul trucks. (Dollar values reported in this section are in 2001 dollars unless otherwise stated.)

Employment

The dynamics of specific construction projects include a period of brief, intense elevation in project-related employment, followed by an abrupt decrease in associated employment opportunities as construction workers move to other projects. Composite employment would peak in the region of influence in 2008, would be approximately 631 workers under the $98.1 million beltway assumption, and would peak in 2006 at 3,047 workers under the estimated $790 million assumption. Under the entire range of estimated costs, Clark County would provide more than 96 percent of the workers. Clark County would gain 620 to 2,996 workers, Nye County would gain 9 to 42 workers, and Lincoln County would gain 2 to 9 workers. The change in employment for Clark, Nye, and Lincoln Counties would be less than 1 percent of their employment bases.

Population

Population increases in the region of influence due to a Sloan/Jean route and intermodal transfer station construction would peak in 2009. During that year, the incremental increase in population for Clark County would be between 532 and 2,951 people, for Lincoln County between 1 and 8 people, and for Nye County between 11 and 63 people. The impacts due to an increase in population as a result of increased employment opportunities would be less than 1 percent of each county's population baseline. Because the increases in population in each county would be small and transient, impacts to schools or housing would be unlikely.

Economic Measures

Economic measures would rise during the construction of an intermodal transfer station, upgrading of highways, and construction of the Las Vegas Beltway. The increase in real disposable income of people in the three-county region of influence would peak in 2008 at between $20.7 million and $97.3 million. The region-wide increase in Gross Regional Product would peak in 2008 at between $36.0 million and $153.2 million. Increased State and local government expenditures would peak in 2009 at between $1.8 million and $9.9 million. The Gross Regional Product, real disposal personal income, and expenditures by State and local governments would rise by less than 1 percent of the baselines in Clark, Nye, and Lincoln Counties. (Dollar values reported in this section are in 2001 dollars unless otherwise stated.)

Transition to Operations. In the region of influence, employment of Sloan/Jean heavy-haul route workers and indirect (support) workers would decrease by 588 to 3,240 when construction of the intermodal transfer station and highway upgrades (including the Beltway portion) ended in 2009. Clark County would lose between 579 and 3,185 of these jobs, Nye County would lose between 8 and 45 of these jobs, and Lincoln County would lose between 1 and 10 jobs. DOE anticipates that some of the displaced workers would move into operational positions on the Sloan/Jean route while others would find other work in the State. While this project would lose jobs, employment projections for the State estimate approximately 1.4 million jobs in 2010, or about 999,500 in the region of influence.

Operations. Operations at an intermodal transfer station near Sloan/Jean and the use of heavy-haul trucks would begin in 2010 and last until 2033. A workforce of about 26 would be required for the intermodal transfer station. Direct employment for heavy-haul truck operations over a Sloan/Jean route, including shipment escorts, would be about 66 workers. The analysis assumed that operations workers would reside in Clark County.

To analyze the impacts of using a Sloan/Jean route for heavy-haul trucks, DOE considered three activities: the operation of the intermodal transfer station, the operation of heavy-haul trucks, and the maintenance of the highways and the Las Vegas Beltway.

Employment and Population

Employment associated with the operations of an intermodal transfer station and heavy-haul trucks would remain relatively level throughout operations. Total employment in the region of influence attributable to a Sloan/Jean route would average about 107 workers. The analysis determined that about 99 workers would come from Clark County and that the other 8 would come from outside the three-county region of influence. The impact on the population from operating heavy-haul trucks and the intermodal transfer station would be about 129 additional residents in the region. About 127 persons would live in Clark County, and 2 people would live in Nye County. Lincoln County would be unlikely to gain population as a result of this project. Impacts to the employment and population baselines in Nye and Clark Counties would be less than 1 percent. Because the incremental increase in population would be so small, impacts to housing and the school system would be unlikely.

Because of the periodic need to resurface highways used by heavy-haul trucks, construction maintenance employment would increase in the years during which these projects occurred. Resurfacing would occur from 2016 to 2017, 2024 to 2025, and 2032 to 2033. During these years, total employment in the region of influence would increase by about 42 jobs and decline as maintenance activities ended. DOE assumed that virtually all of the resurfacing construction employees would come from Clark County employers. Employment changes from periodic (every 8 years) highway-resurfacing projects would be less than 1 percent of the employment baseline in Clark County. The employees who would resurface the roads and their families are included in the employment and population averages discussed above for the operations phase.

Net changes to employment and population from all three portions of the Sloan/Jean heavy-haul truck route during the 24-year operations phase can be summarized. There would be an incremental average annual increase of 48 positions in the region of influence, 47 of them in Clark County if the cost of the beltway was approximately $98.1 million. The region of influence would experience a growth in population of 53 additional residents, 48 in Clark County and 5 in Nye County. These impacts would be less than 1 percent of the baselines. If the cost of the beltway reaches $790 million, the region of influence, while continuing to grow to an average of 1.1 million jobs, would have 501 fewer employment positions. Approximately 497 of these positions would have been in Clark County. Population, which is driven by employment opportunities, would be affected. The region of influence (with an average of 2.29 million residents) would have 1,016 fewer residents, all of whom would have lived in Clark County. Impacts to populations and employment at the upper range of the cost estimates would be less than 1 percent of the baselines.

Economic Measures

Changes in employment and population would drive changes in economic measures attributable to the project. If the final loan amount was $98.1 million, real disposable income in the region of influence would oscillate above and below the baseline throughout the operations period. The average would be $616,000 below the region of influence's $55.7 million average baseline. Gross Regional Product would rise during operations, with the average increase being $5.8 million. Annual State and local government expenditures would increase, with the average increase being $176,000. Increases to real disposable income, Gross Regional Product, and government expenditures would be less than 1 percent of the baselines for Clark, Nye, and Lincoln Counties.

If the final loan amount was $790 million, impacts would be more visible, but still less than 1 percent of the economic measure baselines for each county. Growth in real disposable income in the region of influence would slow throughout the operations period as the loan is repaid. Growth in real disposable income would decline by an average of $54.7 million, or 0.0981 percent of the region of influence's baseline during the operations phase. Decreases in Gross Regional Product would average $26.3 million in the three-county region of influence. The decline in the growth rate would be less than 1 percent of each county's baseline. A slowing in expenditures by State and local governments attributable to the project would average $3.7 million annually region-wide. As population growth slowed, there would be slowing in the rate of tax revenue collected and a slowing in the rate of population growth that would require a given level of public services.

6.3.3.2.4.8 Sloan/Jean Route Noise and Vibration

Section 6.3.3.1 discusses noise impacts common to all the heavy-haul truck implementing alternatives. This section focuses on the noise impacts that would be unique to the Sloan/Jean heavy-haul truck implementing alternative.

Highway Construction and Upgrades. There are residences and commercial businesses near the three potential sites for an intermodal transfer station in the Sloan/Jean area. Construction noise would occur during daylight hours and would be a temporary source of elevated noise in the area. Nighttime noise impacts would be unlikely because construction activities would not occur at night.

For the Sloan/Jean route, southern and western Las Vegas, the Town of Indian Springs, and the small rural community of Jean would be within the 2,000-meter (6,600-foot) region of influence for construction noise. Construction activities would occur on all sections of the route with the exception of I-15 between its interchange at Sloan and the planned Southern Las Vegas Beltway. Because the number of inhabitants of the region of influence would be high because the route passes around the greater Las Vegas area and includes other small rural communities and towns, there is a potential for construction noise impacts.

Operations. The presence of residences and commercial businesses near the Sloan/Jean location would make an intermodal transfer station a potential source of more noise complaints than the more remote locations. However, because operational noise in the vicinity of Sloan/Jean would not be much higher than the levels associated with most other light industrial areas, noise impacts would be unlikely. Railcar switching would be the greatest source of noise.

The Sloan/Jean route would use established highway systems with wide shoulders. The incremental noise increase due to the infrequent heavy-haul truck shipments would not alter the existing noise environment. Estimated noise levels (1-hour average sound levels) at Indian Springs and Cactus Springs would increase by about 0.4 dBA [at 15 meters (50 feet) from the road] due to heavy-haul truck traffic. Background traffic noise levels would be greatest along the western Beltway, reducing the potential for heavy-haul truck noise to cause adverse effects to public receptors during daylight hours. A potential receptor is the public school in Indian Springs which also serves students from Cactus Springs. The Indian Springs school is about 300 meters (980 feet) south of U.S. 95. The incremental contribution of heavy-haul trucks at this distance from the highway would not be perceptible. No historic buildings would be affected by ground vibration. No sensitive ruins of cultural significance have been identified along this route.

The Sloan/Jean heavy-haul truck route on U.S. 95 passes through about 1.6 kilometer (1 mile) of the Las Vegas Paiute Reservation. Because of the relatively large traffic volume on U.S. 95, the increase in traffic noise due to heavy-haul trucks in this area would not be perceptible (DIRS 155825-Poston 2001, all).

6.3.3.2.4.9 Sloan/Jean Route Utilities, Energy, and Materials

Section 6.3.3.1 discusses utilities, energy, and materials impacts that would be common to all the heavy-haul truck implementing alternatives. This section focuses on the utilities, energy, and materials impacts that would be unique to the Sloan/Jean heavy-haul truck implementing alternative.

Highway Construction and Upgrades. The construction of the Sloan/Jean intermodal transfer station would have the same utilities, energy and materials impacts as those discussed in Section 6.3.3.1.

Table 6-113 lists the estimated quantities of primary materials for the upgrade of Nevada highways for the Sloan/Jean route. These quantities are not likely to be very large in relation to the southern Nevada regional supply capacity (see Section 6.3.3.1).

Table 6-113. Utilities, energy, and materials required for upgrades along the Sloan/Jean route.

Route	Length (kilometers)[a]	Diesel fuel (million liters)[b]	Gasoline (thousand liters)	Asphalt (million metric tons)[c]	Concrete (thousand metric tons)	Steel[d] (metric tons)
Sloan/Jean	188	1.7	27	0.24	0.1	2.3

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. To convert metric tons to tons, multiply by 1.1023.
d. Steel includes rebar only.

Operations. Section 6.3.3.1 discusses utilities, energy, and materials needs for operation of an intermodal transfer station.

Fossil fuel that would be consumed by heavy-haul trucks during operations is discussed in Chapter 10, which addresses irreversible commitments of resources.

6.3.3.2.5 *Apex/Dry Lake Route Implementing Alternative*

The Apex/Dry Lake route (Figure 6-26) is about 183 kilometers (114 miles) long. Heavy-haul trucks and escorts would leave the intermodal transfer station at the Apex/Dry Lake location and enter I-15 at the Apex interchange. The trucks would travel south on I-15 to the exit to the proposed northern Las Vegas Beltway and travel west on the Beltway. They would leave the Beltway at U.S. 95, and travel north on U.S. 95 to the Mercury entrance to the Nevada Test Site. The trucks would travel on Jackass Flats Road on the Nevada Test Site to the Yucca Mountain site. The travel time (vehicle in motion plus periodic short stops for inspections) associated with an Apex/Dry Lake route would be as much as 4 hours.

The potential sites for the Apex/Dry Lake intermodal transfer station are in areas northeast of Las Vegas between the Union Pacific rail sidings at Dry Lake and at Apex. Three areas are available for station siting (see Figure 6-26). The first area is directly adjacent to the Dry Lake siding. This area is large [3.5 square kilometers (880 acres)] and has flat topography; it is adjacent to and west of the Union Pacific line. The second is a smaller area [0.18 square kilometer (45 acres)] on the same side of the Union Pacific mainline, a short distance northeast of the 3.5-square-kilometer area, and also has flat topography. This area would be used in combination with a portion of the first area. These two areas are bounded by hills to the north and by a wash and private land to the south. The third area, which is east of I-15, is adjacent to and west of the Union Pacific line and south of where the line crosses I-15. This location has an area of 0.96 square kilometer (240 acres). Because this area is between the Dry Lake and Apex sidings, the construction of an additional rail siding would be necessary. The estimated life-cycle cost to build and operate an intermodal transfer station and to operate heavy-haul trucks along the Apex/Dry Lake route would be about $387 million in 2001 dollars.

The following sections address impacts that would occur to land use; air quality; hydrology; biological resources and soils; cultural resources; occupational and public health and safety; socioeconomics; noise and vibration; and utilities, energy, and materials. Impacts to hydrology from the construction and operation of an intermodal transfer station, upgrading of highways, and operation of heavy-haul trucks on an Apex/Dry Lake route would be the same as those discussed in Section 6.3.3.2.4 for a Sloan/Jean route.

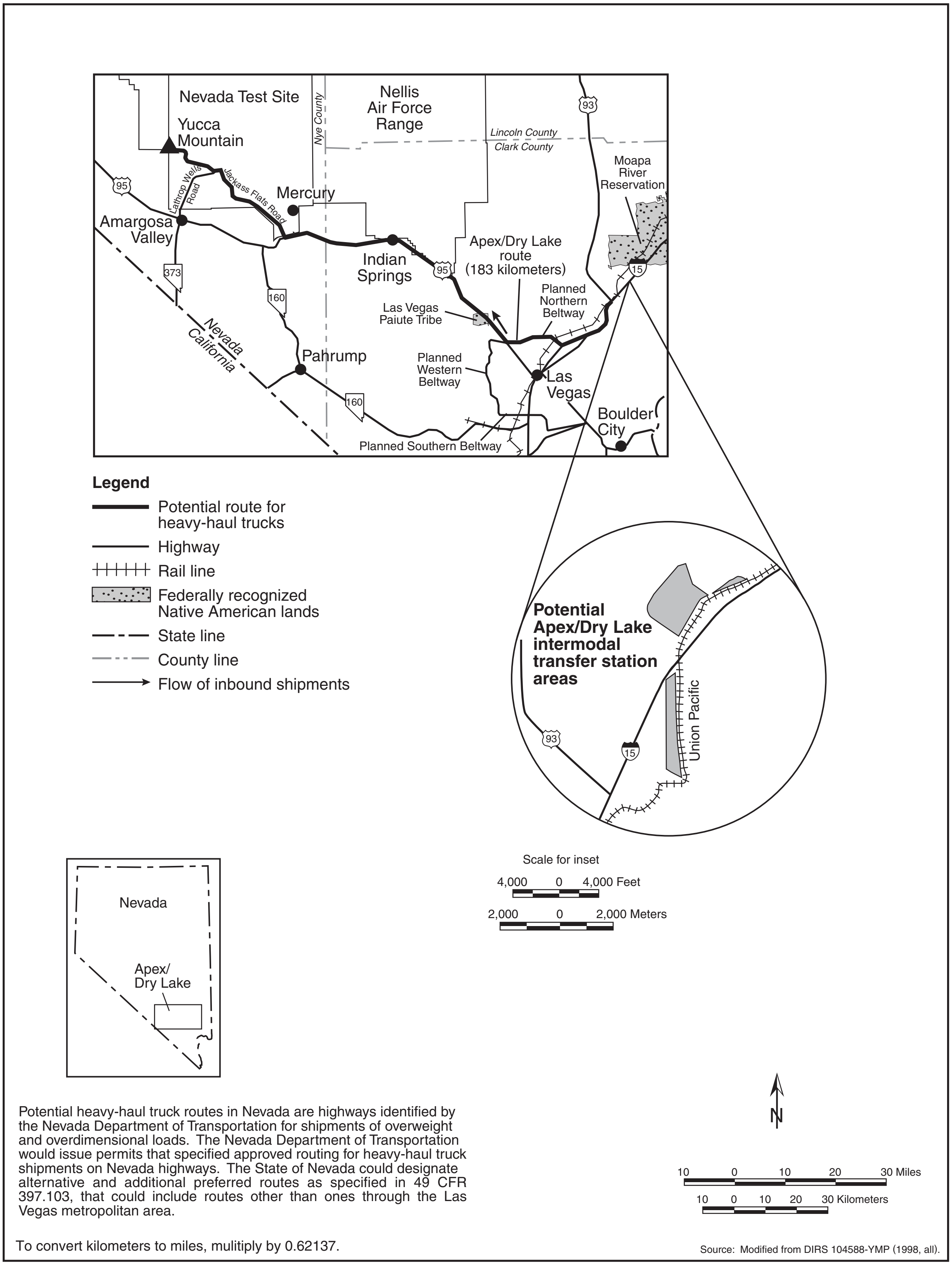


Figure 6-26. Apex/Dry Lake heavy-haul truck route.

Impacts to aesthetics and waste management would be the same as those discussed in Section 6.3.3.1 and are, therefore, not repeated here. Section 6.3.4 discusses the potential for transportation activities to cause environmental justice impacts in Nevada.

6.3.3.2.5.1 Apex/Dry Lake Route Land Use and Ownership

This section describes estimated land-use impacts that could occur from the construction and operation of the Apex/Dry Lake intermodal transfer station, upgrades of highways, and heavy-haul truck operations on the Apex/Dry Lake route. Chapter 3, Section 3.2.2.2.1, describes the Apex/Dry Lake intermodal transfer station site and associated truck route.

Highway Construction and Upgrades. The Apex/Dry Lake intermodal transfer station site could have potential impacts related to the current use of the land. The southern intermodal transfer station parcel east of I-15 at the Apex/Dry Lake site is on land administered by the Bureau of Land Management. Transfer of the property to DOE would be necessary. The northern areas have several infrastructure corridors (power line, telephone, and road rights-of-way). Right-of-way access through these areas would have to be leased by, purchased by, or transferred to DOE. The northern parcels are in the Dry Lake grazing allotment and a planned utility corridor. It is also open to mineral leasing and mining claims. One area has been designated as available for sale or transfer. This site also is in the area of the Apex Industrial Park that began development in mid-1999.

The parcel in the grazing allotment would lose a small parcel of land, if chosen. However, due to the proximity of the parcel to existing roads and rail lines, the transfer of this land to DOE would not divide the grazing allotment and would cause no livestock movement or watering problems.

The relatively small area of an intermodal transfer station location would not create long-term impacts to mineral exploration or mining claims unless the lands are already leased. If there were leases, DOE would negotiate with the lease holders for use of the property.

Because the transfer station parcels are in an area designated for sale or transfer by the Bureau of Land Management, the Bureau would have to remove the lands from this program to transfer them to DOE. The removal of these lands from the sale/transfer program could affect private, municipal or county, or other stakeholders. Tax revenue could be lost through the loss of economic development. This impact could be mitigated by the replacement of removed land with other parcels with similar characteristics. This route would require the disturbance of 0.63 square kilometer (155 acres) of land for road upgrades and additional construction activities. Table 6-114 summarizes these disturbances.

The Apex/Dry Lake route would require considerable improvements at the interchange at I-15. A small amount of land would be converted for the improvements. Section 6.3.3.1 discusses impacts on land use from upgrading Nevada highways for use by heavy-haul trucks.

Operations. There would be no direct land-use impacts associated with the operation of the Apex/Dry Lake intermodal transfer station or the Apex/Dry Lake route other than those described in Section 6.3.3.1.

Table 6-114. Land disturbances along the Apex/Dry Lake heavy-haul truck route.

Disturbances	Area disturbed[a] (square kilometers)[b]
Haul road disturbed area	0.47
Aggregate plants	0.08
Road widening	None
Passing lanes	None
Truck turnouts	None
Fortymile Wash new road	0.04
Overnight stops	None
Mercury turnoff road	0.03
Total disturbed area	0.63

a. Numbers approximate due to rounding.
b. To convert square kilometers to acres, multiply by 247.1.

6.3.3.2.5.2 Apex/Dry Lake Route Air Quality

This section describes anticipated nonradiological air quality impacts from the construction and operation of an intermodal transfer station, highway construction and upgrades, and operation of heavy-haul trucks along the Apex/Dry Lake route. Such impacts would result from releases of criteria pollutants, nitrogen dioxide, sulfur dioxide, carbon monoxide, and particulate matter (PM_{10}) (see Section 6.3.3.1). Carbon monoxide and PM_{10} are of particular interest along the Apex/Dry Lake Route because heavy-haul truck transport would occur through the Las Vegas Basin, which is classified as a nonattainment area for these pollutants. PM_{10} and carbon monoxide emissions from intermodal transfer station construction are presented in Section 6.3.3.1. Intermodal transfer station construction emissions would be 15 percent of the PM_{10} General Conformity threshold level and would be 2.3 percent of the carbon monoxide General Conformity threshold level.

Highway Construction and Upgrades. Section 6.3.3.1 discusses the methods used to estimate air quality impacts from the construction activities for the Apex/Dry Lake route. PM_{10} emissions would be an estimated 45 metric tons (50 tons) per year, including estimated emissions for the accelerated construction activities of the northern portion of the Las Vegas Beltway. These emissions would be 71 percent of the General Conformity threshold level. Carbon monoxide emissions for highway construction and upgrades would be an estimated 35 metric tons (39 tons) per year. These emissions are 39 percent of the carbon monoxide General Conformity threshold level.

Operations. The air quality impacts for the operations of an intermodal transfer station locomotive at the Apex/Dry Lake intermodal transfer station would be identical to those described for the Sloan/Jean station (see Section 6.3.3.2.4). In addition, heavy-haul trucks would pass through the Las Vegas Valley air basin. The air quality impacts from the heavy-haul trucks to this air basin would be small [0.46 metric tons (0.51 ton] per year carbon monoxide) with emissions at less than 1 percent of the General Conformity threshold level. These emissions would result from 11 roundtrip heavy-haul trucks traveling through the Las Vegas Valley each week.

6.3.3.2.5.3 Apex/Dry Lake Route Hydrology

DOE anticipates limited impacts to surface water and groundwater during upgrades to Nevada highways so they could accommodate daily use by heavy-haul trucks. This section discusses these impacts as well as those from the construction and operation of an intermodal transfer station and operation of trucks on the Apex/Dry Lake route. Section 6.3.3.1 discusses the hydrology impacts that would be common to all of the heavy-haul truck implementing alternatives. This section focuses on the hydrology impacts that would be unique to the Apex/Dry Lake heavy-haul truck implementing alternative.

Surface Water

Section 6.3.3.1 discusses the impacts to surface water from the construction and operation of an intermodal transfer station and upgrades to highways. The common impacts discussed in that section apply to surface water along the Sloan/Jean route.

The assessment in Appendix L presents a comparison of what is known about the floodplains, springs, and riparian areas at the three candidate intermodal transfer sites (see Sections L.3.2.7 and L.4.2.2) The southern most of the three locations considered for the Apex/Dry Lake intermodal transfer site appears to be, at least in part, within a 100-year flood zone of a normally dry drainage channel (see Section L.3.2.7).

Groundwater

Highway Construction and Upgrades. Section 6.3.3.1 discusses the impacts to groundwater from the construction of an intermodal transfer station. Upgrades to the Apex/Dry Lake route would not require any water wells. The road upgrades would require an estimate total of about 9,200 cubic meters (8 acre-feet) of water (DIRS 104917-LeFever 1998, all). Options for obtaining this water would be to lease temporary water rights from individuals along the route, ship water from other permitted resources by truck (about 500 truckloads) to construction sites, or use a combination of these two actions.

Operations. Section 6.3.3.1 discusses impacts to groundwater from the operation of an intermodal transfer station, highway maintenance, and heavy-haul routes.

6.3.3.2.5.4 Apex/Dry Lake Route Biological Resources and Soils

Section 6.3.3.1 discusses impacts to biological resources from the construction and operation of an intermodal transfer station and upgrades to highways that would be common to all intermodal transfer stations and routes. This section discusses the construction- and operations-related impacts that would be unique to the Apex/Dry Lake intermodal station and route.

Highway Construction and Upgrades. DOE has identified three areas for the construction of an Apex/Dry Lake intermodal transfer station. The predominant land cover type at these sites (creosote-bursage) and it is extensively distributed in the region (DIRS 104593-CRWMS M&O 1999, pp. 3-36 and C1 to C5). Considerable industrial development has occurred near the potential sites. The three sites are in the range of the threatened desert tortoise, although none is in an area considered to be critical habitat for the tortoise (50 CFR 17.95). The construction site would disturb approximately 0.2 square kilometer (50 acres) of desert tortoise habitat. The likelihood of death or injury to tortoises due to construction activities would be small if DOE conducted surveys for tortoises in areas to be disturbed and moved tortoises in the immediate area out of harm's way. Geyer's milk vetch (BLM sensitive) occurs on the southern edge of one of the proposed locations of the Apex/Dry Lake intermodal transfer station (DIRS 104593-CRWMS M&O 1999, p. 3-37). If this location for an intermodal transfer station was selected, DOE would conduct pre-activity surveys for this plant's species and would avoid occupied habitat if possible. There are no designated game habitats at the proposed locations for the intermodal transfer station, or any springs or other areas that could be classified as wetlands (DIRS 104593-CRWMS M&O 1999, p. 3-37).

The predominant land cover types along the Apex/Dry Lake heavy-haul truck route are creosote-bursage and Mojave mixed scrub, which are common throughout this region (DIRS 104593-CRWMS M&O 1999, pp. 3-34, and C1 to C5). Because areas disturbed by upgrade activities would be in or adjacent to the existing rights-of-way and the areas have been previously degraded by human activities, impacts would be small.

The only resident threatened or endangered species that occurs along the Apex/Dry Lake route is the desert tortoise. Desert tortoise habitat occurs along the entire length of the route (DIRS 103160-Bury and Germano 1994, pp. 57 to 72; 50 CFR 17.95). Construction activities could kill or injure desert tortoises; however, losses would be few because construction would occur only on the right-of-way and desert tortoises are uncommon adjacent to heavily traveled roads (DIRS 103160-Bury and Germano 1994, Appendix D, p. D12). Three other special status species occur along this route (DIRS 104593-CRWMS M&O 1999, p. 3-35) but because construction activities would be limited to the road and adjacent areas, occupied habitat would not be destroyed and these species should not be affected.

This route would not cross any areas designated as game habitat or springs or possible wetlands (DIRS 104593-CRWMS M&O 1999, p. 3-35). The corridor crosses a number of ephemeral streams that may be classified as waters of the United States. DOE would work with the State of Nevada and the U.S. Army Corps of Engineers to minimize impacts to these areas, and obtain individual, regional, or nationwide permits, as appropriate. Impacts to soils would be transitory and small and would occur only along the shoulders of existing roads.

Operations. Impacts from operations would include periodic disturbances of wildlife from activities at the intermodal transfer station and additional truck traffic along this route. Trucks probably would kill individuals of some species but losses would be few and unlikely to affect regional populations of any species. No additional habitat loss would occur during operations. Impact to soils would be small.

6.3.3.2.5.5 Apex/Dry Lake Route Cultural Resources

Highway Construction and Upgrades. A total of 51 archaeological and historic sites have been recorded along the highway rights-of-way that comprise the Apex/Dry Lake intermodal transfer station site and heavy-haul truck route (DIRS 155826-Nickens and Hartwell 2001, all). None of these previously recorded cultural sites are in locations proposed for upgrades.

There are no recorded cultural resources that would be affected by the construction of an Apex/Dry Lake intermodal transfer station. However, an original segment of the historic Arrowhead Trail Highway passes through the northern intermodal transfer station site location, and includes the archaeological remains of a motel and gas station. Based on previous archaeological studies in the larger area, there is a probability that there are one or more construction camps from the initial railroad construction era in the proposed intermodal transfer station locations as well.

The route follows a portion of U.S. 95 that passes though approximately 1.6 kilometers (1 mile) of the Las Vegas Paiute Reservation. The intermodal transfer station would be along I-15, about 3 kilometers (2 miles) south of the Moapa Paiute Reservation. Construction of the intermodal transfer station and use of U.S. 95 for this route would not have adverse impacts on Native American sites or values.

Operations. Use of an Apex/Dry Lake intermodal transfer station and heavy-haul truck route would not involve impacts (such as disturbing the sites or crushing artifacts) to known cultural resource sites.

6.3.3.2.5.6 Apex/Dry Lake Route Occupational and Public Health and Safety

This section addresses potential impacts to occupational and public health and safety from upgrading highways and heavy-haul truck operations on the Apex/Dry Lake route. The impacts of the Apex/Dry Lake intermodal transfer station would be the same as those discussed in Section 6.3.3.1.

Table 6-115. Impacts to workers from industrial hazards from upgrading highways along the Apex/Dry Lake route.

Group and trauma category	Construction[a]	Operations[b]
Involved workers		
Total recordable cases[c]	22	120
Lost workday cases	11	66
Fatalities	0.03	0.33
Noninvolved workers[d]		
Total recordable cases	1.3	6.8
Lost workday cases	0.5	2.5
Fatalities	0.001	0.007
Totals[e]		
Total recordable cases	23	130
Lost workday cases	11	68
Fatalities	0.032	0.34

a. Impacts are totals over about 28 months.
b. Includes periodic maintenance and resurfacing. Impacts are totals over about 24 years.
c. Total recordable cases includes injury and illness.
d. The noninvolved worker impacts are based on 25 percent of the involved worker level of effort.
e. Totals might differ from sums due to rounding.

Highway Construction and Upgrades. Industrial safety impacts on workers from upgrading highways for the Apex/Dry Lake route would be small (see Table 6-115). The analysis evaluated the potential for impacts in terms of total reportable cases of injury, lost workday cases, fatalities for workers, and traffic fatalities related to commuting workers and the movement of construction materials and equipment. Table 6-116 lists the estimated fatalities from construction and commuter vehicle traffic.

Operations. Incident-free radiological impacts listed in Table 6-117 would occur during the routine transportation of spent nuclear fuel and high-level radioactive waste on the route. These impacts would include transportation along the route as well as transportation along railways in Nevada leading to an Apex/Dry Lake intermodal transfer station. The table includes the impacts of 1,079 legal-weight truck shipments from commercial sites that do not have the capability to load rail casks while operational.

Table 6-116. Estimated number of fatalities from construction material delivery vehicles and construction and operations worker commuting traffic for the Apex/Dry Lake route for heavy-haul trucks.[a]

Activity	Kilometers[b]	Traffic fatalities	Vehicle emissions fatalities
Construction[c]			
Material delivery vehicles	15,000,000	0.3	0.03
Commuting workers	20,000,000	0.2	0.03
Subtotals	*35,000,000*	*0.5*	*0.06*
Operations[d]			
Commuting workers	120,000,000	1.2	0.16
Totals	***160,000,000***	***1.7***	***0.22***

a. Includes impacts of construction and operation of an intermodal transfer station.
b. To convert kilometers to miles, multiply by 0.62137.
c. Impacts are totals over about 28 months.
d. Impacts are totals over 24 years.

Table 6-117. Health impacts[a] from incident-free Nevada transportation for the Apex/Dry Lake heavy-haul truck implementing alternative.

Category	Legal-weight truck shipments	Rail and heavy-haul truck shipments[b]	Totals[c]
Involved workers			
Collective dose (person-rem)	38	1,100	1,100
Estimated latent cancer fatalities	0.02	0.44	0.46
Public			
Collective dose (person-rem)	7	150	160
Estimated latent cancer fatalities	0.003	0.08	0.08
Estimated vehicle emission-related fatalities	0.002	0.064	0.066

a. Impacts are totals for 24 years.
b. Includes impacts to workers at an intermodal transfer station.
c. Totals might differ from sums of values due to rounding.

6.3.3.2.5.7 Apex/Dry Lake Route Socioeconomics

This section describes potential socioeconomic impacts that would occur from upgrading highways along an Apex/Dry Lake route, advancing the construction schedule for a section of the planned Las Vegas Beltway to accommodate heavy-haul trucks, and building an intermodal transfer station. The section also describes socioeconomic impacts from the operation of an intermodal transfer station in Clark County and the periodic resurfacing of highways.

This analysis of economic measures assumed that Clark County would secure a loan to advance the construction schedule of the section of the Las Vegas Beltway that would be part of this heavy-haul truck route. The analysis based the estimates for a range of impacts on two sources of information from Clark County about the cost of building a section of the Beltway. Modifications to the Beltway would cost between $40 million (DIRS 103710-Clark County 1997, p. 2-7) and $425 million in 1998 dollars (DIRS 155112-Berger Group 2000, p. 29) (about $43.6 million to $463 million in 2001 dollars). DOE believes the actual cost would be between these values. A loan to Clark County for $43.6 million or $463 million, at an annual rate of 3 percent, with the repayment of the loan starting in 2010 and lasting for 30 years, is a part of the modeling to determine the impacts to employment, population, real disposable income, and expenditures by State and local governments. (A *real* percentage rate is the premium paid in addition to the rate of inflation; a real rate plus the rate of inflation equals the nominal or quoted rate.) Clark County would repay the loan from tax revenues. DOE assumes most repayment funds would be from sources the county has already identified for completion of the Beltway.

Highway Construction and Upgrades. Socioeconomic impacts from upgrading highways for an Apex/Dry Lake route, advancing the schedule for construction of a portion of the Las Vegas Beltway, and building an intermodal transfer station would be temporary, occurring over a short period and spread among the counties along the route. The highway upgrades, excluding the Beltway, would cost $20.8 million, require about 28 months to complete, and occur during the 48-month construction period for the Beltway. Building an intermodal transfer station would cost about $25.0 million and take 18 months to complete. If this route was selected, the construction schedule of the planned Las Vegas Beltway would be advanced. (Dollar values reported in this section are 2001 dollars unless otherwise stated.)

This discussion expresses values for socioeconomic measures (employment, population, real disposable income, Gross Regional Product, and State and local government expenditures) and for potential impacts that would change in those measures as a range of values. The first value refers to the outcome if the Beltway cost is $43.6 million; the second refers to the outcome if the Beltway cost is $463 million. DOE anticipates that the actual change would be between the two values.

Employment

Employment in the region of influence of construction workers involved with upgrading the highways (including the Beltway) or with building an intermodal transfer station (direct workers) and other workers who would be employed as a result of the economic activity generated by the project (indirect workers) would peak in 2008. Employment increases would be between 490 and 1,882 jobs. The increase in employment in Clark County would be between 482 and 1,848 workers, Nye County would gain between 6 and 27 workers, and Lincoln County would gain between 1 and 5 workers. The increases in Clark, Nye, and Lincoln Counties would be less than 1 percent of the employment baseline for each county.

Population

The increase in employment would also bring population increases in the region of influence that would peak in 2009. During that year, the incremental increase in population would be between 356 and 1,857 individuals. Clark County would experience about 97 percent of this impact. The increase in population for Clark County would be between 347 and 1,812, for Lincoln County between 0 and 5, and for Nye County between 7 and 39. The impact from an increase in population as a result of increased employment opportunities would be less than 1 percent of each county's population baseline. Because the increases in population in each county would be small and transient, impacts to schools or housing would be unlikely.

Economic Measures

Economic measures would rise during the construction of an intermodal transfer station and the upgrading of highways and Las Vegas Beltway. The increase in real disposable income of people in the three-county region of influence would peak in 2008 at between $15.7 million and $62.0 million. The region-wide increase in Gross Regional Product would peak in 2008 at between $28.9 million and $99.8 million. Increased State and local government expenditures would peak in 2009 at between $1.2 million and $6.1 million. More than 97 percent of this economic activity would be concentrated in Clark County. The Gross Regional Product, real disposable income, and expenditures by State and local governments would rise by less than 1 percent in Clark, Nye, and Lincoln Counties. (All dollar values reported in this section are in 2001 dollars unless otherwise stated.)

Transition to Operations. In the region of influence, employment of Apex/Dry Lake heavy-haul truck route workers and indirect (support) workers would decrease by 419 to 2,026 when construction of the intermodal transfer station and highway upgrades (including the Beltway portion) ended in 2009. Clark County would lose between 412 and 1,993 of these jobs, Nye County would lose between 6 and 28 of these jobs, and Lincoln County would lose between 1 and 5 jobs. DOE anticipates that some of the displaced workers would move into operational positions on the Apex/Dry Lake route while others would find other work in the State. While this project would lose jobs, employment projections for the State estimate approximately 1.4 million jobs in 2010, or about 999,500 in the region of influence.

Operations. Operations at an intermodal transfer station and the use of heavy-haul trucks would begin in 2010 and continue until 2033. A direct workforce of about 26 would be required for the intermodal transfer station. Direct employment for heavy-haul truck operations over an Apex/Dry Lake route, including Clark County-based shipment escorts, would be about 66 workers. DOE assumed that operations workers would reside in Clark County.

To analyze the socioeconomic impacts of operations for an Apex/Dry Lake route, DOE considered three activities: operation of the intermodal transfer station, operation of the heavy-haul trucks, and maintenance of the highways and the Las Vegas Beltway.

Employment and Population

Employment in the region of influence associated with the operations of an intermodal transfer station and heavy-haul trucks would average about 99 workers, all of whom would work in Clark County. The impact on population from these two activities would be an average of 129 workers of whom 127 would live in Clark County. These impacts to employment and population would be less than 1 percent of the baseline in Clark County. During periodic road resurfacing, employment (direct and indirect) in the region would increase by about 107 workers for 2 years. DOE assumed that all of these workers would come from Clark County-based firms. Overall, employment increases from periodic highway resurfacing projects (every 8 years starting in 2016) would be less than 1 percent of the baseline for Clark County. Given the short duration of each resurfacing project, there would be no perceptible change in the region's population.

Net changes to employment and population from all three portions of the Apex/Dry Lake heavy-haul truck route during the 24-year operations phase can be summarized. There would be an incremental increase of 90 positions in the region of influence, with 89 of the additional positions in Clark County if the cost of the beltway was approximately $43.6 million. The region of influence would experience a growth in population of an additional 137 residents, 132 of them in Clark County. This impact would be less than 1 percent of the baseline. If the cost of the beltway reaches $463 million, the region of influence (while continuing to grow to an average of 1.1 million jobs), would have 242 fewer employment positions, with 241 of these in Clark County. Population, which is driven by employment, would be affected. The region of influence would have 511 fewer residents and Clark County would have 519 fewer residents. The impacts at the upper range of the cost estimates would be less than 1 percent of the baselines. Because the impacts would be so small, impacts to housing or schools would be unlikely.

Economic Measures

Impacts from changes to the economic measures of real disposable income, Gross Regional Product, and expenditures by State and local governments from operating an intermodal transfer station at Apex/Dry Lake, operating heavy-haul trucks, and maintaining the highways would fluctuate throughout the operations period and would depend partially on changes in population and employment. If the beltway cost was at the lower end of the cost estimate, real disposable income and Gross Regional Product in the region of influence would rise during the operations period. The increase in real disposable income would average $3.6 million and in Gross Regional Product would average $8.2 million. Expenditures by governments would increase over the 24-year period by an average of $479,000. Virtually all of the activity would be concentrated in Clark County and would be less than 1 percent of the various baselines. If the final cost of the beltway was $463 million, the impacts would be more visible but still less than 1 percent of the applicable baselines. Real disposable income would decline from $4.0 million above the baseline in 2010 to $35.6 million below the baseline by 2033, an average of slowing growth in this area of $29.2 million. The region of influence would have an average real disposable income of $55,797,000 during this period. Gross Regional Product would remain below the baseline, averaging $11.2 million annually. Expenditures by government would decline from $5.4 million above the baseline in 2010 to $4.5 million below the baseline in 2033. The average would be a slowing of spending by $1.9 million. As population growth slows, there would be a slowing in the rate of tax revenues collected and a slowing in the rate of population growth that would require a given level of services.

6.3.3.2.5.8 Apex/Dry Lake Route Noise and Vibration

Section 6.3.3.1 discusses noise impacts common to all the heavy-haul truck implementing alternatives. This section focuses on noise impacts that would be unique to the Apex/Dry Lake heavy-haul truck implementing alternative.

Highway Construction and Upgrades. There is one residence near the Dry Lake site of the three tracts of land identified for an intermodal transfer station. Construction noise would occur during daylight hours and would be a temporary source of elevated noise in the area. Nighttime noise impacts would be unlikely because construction activities would not occur at night.

For the Apex/Dry Lake route, northern Las Vegas, the Town of Indian Springs, and the rural community of Cactus Springs are within the 2,000-meter (6,600-foot) region of influence for construction noise. Construction activities would occur at the I-15 interchange at Apex and along sections of U.S. 95. The route, which passes north of Las Vegas, is not heavily populated and the potential for noise-related construction impacts would be low.

Operations. An Apex/Dry Lake intermodal transfer station would be isolated, with one residence (DIRS 155825-Poston 2001, all) in the vicinity, adjacent to an existing rail line. The potential for noise impacts is unlikely unless operations were close to this residence.

The Apex/Dry Lake route would be confined to established highways with wide shoulders. Background traffic noise levels would be greatest along the planned northern Beltway, reducing the potential for heavy-haul truck noise to affect public receptors adversely during daylight hours. The incremental noise increase due to the infrequent heavy-haul truck shipments would not alter the existing noise environment. Estimated noise levels (1-hour average sound levels) at Indian Springs and Cactus Springs would increase by about 0.4 dBA [at 15 meters (44 feet) from the road] due to heavy-haul truck traffic. A potential receptor is the public school in Indian Springs, which also serves students from Cactus Springs. The Indian Springs school is about 300 meters (980 feet) south of U.S. 95. The incremental contribution of heavy-haul trucks at this distance from the highway would not be perceptible. No historic buildings would be affected by ground vibration. No sensitive ruins of cultural significance have been identified along this route.

The Apex/Dry Lake intermodal transfer station is about 3 kilometers (2 miles) from the Moapa Reservation. Assuming that the greatest source of noise would be locomotives, estimated noise levels at 520 meters (1,700 feet) would be 45 dBA. Noise generated at the intermodal transfer station would not be perceptible 910 meters (3,000 feet) away at the border of the Moapa Reservation. The Apex/Dry Lake heavy-haul truck route on U.S. 95 also passes through about 1.6 kilometers (1 mile) of the Las Vegas Paiute Reservation. Because of the relatively large traffic volume on U.S. 95, the increase in traffic noise due to heavy-haul trucks in this area would not be perceptible (DIRS 155825-Poston 2001, all).

6.3.3.2.5.9 Apex/Dry Lake Route Utilities, Energy, and Materials

Section 6.3.3.1 discusses the utilities, energy, and materials impacts that would be common to all the heavy-haul truck implementing alternatives. This section focuses on the utilities, energy and materials impacts that would be unique to the Apex/Dry Lake heavy-haul truck implementing alternative.

Highway Construction and Upgrades. The construction of the Apex/Dry Lake intermodal transfer station would have the same utilities, energy, and materials impacts as those discussed in Section 6.3.3.1.

Table 6-118 lists the estimated quantities of primary materials for the upgrade of Nevada highways for the Apex/Dry Lake route. These quantities are not likely to be very large in relation to the southern Nevada regional supply capacity (see Section 6.3.3.1).

Table 6-118. Utilities, energy, and materials required for upgrades along the Apex/Dry Lake route.

Route	Length (kilometers)[a]	Diesel fuel (million liters)[b]	Gasoline (thousand liters)	Asphalt (million metric tons)[c]	Concrete (thousand metric tons)	Steel[d] (metric tons)
Apex/Dry Lake	182	1.6	29	0.23	0.1	2.3

a. To convert kilometers to miles, multiply by 0.62137.
b. To convert liters to gallons, multiply by 0.26418.
c. To convert metric tons to tons, multiply by 1.1023.
d. Steel includes rebar only.

Operations. Section 6.3.3.1 discusses the utilities, energy, and materials needs for the operation of an intermodal transfer station.

Fossil fuel that would be consumed by heavy-haul trucks during operations is discussed in Chapter 10, which addresses irreversible commitments of resources.

6.3.4 ENVIRONMENTAL JUSTICE IMPACTS IN NEVADA

The analysis considered existing highways and railroads that DOE would use in Nevada—I-15, the proposed Las Vegas Beltway; U.S. 95; five possible highway routes for heavy-haul trucks; the Union Pacific Railroad's mainlines in northern and southern Nevada; and five corridors with variations for a possible branch rail line in the State. If DOE constructed and operated the repository, it would use combinations of these routes for shipments of spent nuclear fuel and high-level radioactive waste. DOE would use alternative preferred routes designated by the State of Nevada for highway shipments to the repository.

In general, the consequences of using a transportation route would occur close to the route. Thus, for transportation on a highway or railroad to affect a census block group for which environmental justice concerns could exist, the route would have to cross or be adjacent to the block group. Chapter 3, Section 3.1.13 discusses and depicts the minority and low-income populations in Nevada.

Portions of some routes would cross or be adjacent to Native American tribal lands. Existing or proposed highway routes avoid census block groups with high fractions of minority, low-income, or Native American populations with the exceptions of:

- Sections of I-15 that pass through the center of the Moapa Reservation northeast of Las Vegas, Nevada
- A 1.6-kilometer (1-mile) section of U.S. 95 across the southwest corner of the Las Vegas Paiute Indian Reservation that could be used by legal-weight trucks as well as either the Caliente/Las Vegas or Apex/Dry Lake heavy-haul truck route
- The Caliente/Las Vegas and Apex/Dry Lake routes for heavy-haul trucks, which would pass near the Moapa Reservation
- Sparsely populated areas of census block groups in the northern parts of Clark County

Existing or proposed rail routes could cross census block groups with high populations of minority, low-income, or populations of Native Americans only at the following points:

- The Union Pacific Railroad's mainline tracks pass through the center of the Moapa Reservation and through the center of Las Vegas, Nevada, crossing census block groups with high fractions of minority and low-income populations.

- The Bonnie Claire Alternate of the Caliente and Carlin Corridors would pass through 4.5 kilometers (2.8 miles) covering 1.8 square kilometers (450 acres) of the Scottys Junction portion of the newly designated Timbisha Shoshone Trust Lands parcel planned for residential use and tourist-related business.

Also, a branch rail line in the Valley Modified Corridor would pass near the Las Vegas Paiute Reservation. None of the potential intermodal transfer station sites that DOE could use would be near a census block group with high minority or low-income populations, but an intermodal transfer station in the Apex/Dry Lake area could be as close as about 3 kilometers (2 miles) to the Moapa Reservation.

Impacts to resource areas other than environmental justice along Nevada highways and railroads from the transportation of spent nuclear fuel and high-level radioactive waste would be small. The number of shipments in the mostly legal-weight truck and mostly rail scenarios would be small in comparison to the number of all other commercial shipments in southern Nevada. For comparison, under the mostly legal-weight truck scenario as many as five trucks carrying spent nuclear fuel would pass through the Moapa Indian Reservation on I-15 each day compared to daily traffic of more than 3,000 commercial trucks that use this section of highway (DIRS 156930-NDOT 2001, p. 6; DIRS 104727-Cerocke 1998, all). Under the mostly rail scenario as many as 11 railcars per week carrying spent nuclear fuel could travel into southern Nevada compared to about 1,000 railcars each day for other commodities. Thus, impacts from truck and rail traffic and emissions would be small for these shipments. The potential for accidents that could result in injuries or fatalities involving the shipments would also be small in comparison to the overall risk of accidents that would occur from other commercial traffic.

As much as 10 percent of travel in southern Nevada by legal-weight trucks or railcars carrying spent nuclear fuel would be through populations of Native Americans and census block groups with high fractions of minorities or low-income populations, depending on the selected route and transportation mode. Public health and safety impacts to all populations in Nevada would be small (about 1 fatality from cancer and other causes for incident-free transportation and 0.00006 latent cancer fatality for accidents over 24 years).

The public health and safety impacts to minority and low-income populations along the routes of travel would also be small. Because the probability would be small at any single location, the risk of an accident at a specific location would also be small. Thus, impacts to minority or low-income populations or to populations of Native Americans in small communities along the routes would also be small and, therefore, unlikely to be disproportionately high and adverse.

Unique practices and activities could create opportunities for increased impacts from transportation of spent nuclear fuel and high-level radioactive waste associated with the Proposed Action. One such practice could be the use of subsistence diets (that is, consumption of homegrown or naturally available plant and animal food). Because no radioactive materials would be released to the environment during incident-free transportation, the implementation of new or existing transportation routes in Nevada would not affect food sources likely to be involved in subsistence diets. If an accident resulted in the release of radioactive materials, food sources, both agricultural and subsistence, could be affected and mitigative actions would have to be taken to prevent contamination or consumption of contaminated food.

The American Indian Writers Subgroup identified noise from transportation as a concern because of its effects on ceremonies and the solitude necessary for healing and praying (DIRS 102043-AIWS 1998, p. 2-19). DOE is not aware of traditional cultural properties or other areas along the candidate rail corridors or routes for heavy-haul trucks, including variations, where noise from trains, construction of a branch rail line or intermodal transfer station, or conduct of heavy-haul or other trucking operations could interfere with conditions necessary for meditation by, or religious ceremonies of, Native Americans, with the exception of the Caliente Intermodal Transfer Station, as noted below. Similarly, no known ruins or other culturally sensitive structures have been identified that could be affected by ground vibration.

The analysis of transportation-related construction or upgrades identified potentially adverse impacts pertaining to certain routes or transportation modes. DOE could lessen some of these impacts through mitigation, as discussed in Chapter 9. Adverse impacts could include the following:

- The Valley Modified Corridor and some of its variations would involve construction in the Las Vegas Valley air basin, which is in serious nonattainment for particulate matter (PM_{10}) and carbon monoxide (DIRS 155557-Clark County 2001, Tables 3-8 and 5-3). Emission rates would exceed the General Conformity threshold (established by Environmental Protection Agency regulations that implement the Clean Air Act) for PM_{10} for a serious nonattainment area and would qualify the construction as a major source of emissions when evaluated under the Prevention of Significant Deterioration threshold. Comparison of this corridor with known locations of minority and low-income populations indicates that effects on such populations would not be disproportionately high and adverse in comparison with effects on the rest of the population. No unique practices or pathways have been identified that would increase impacts to minority or low-income populations. PM_{10} and carbon monoxide emissions are susceptible to mitigation.

- The northernmost site for a Sloan/Jean intermodal transfer station is in a PM_{10} nonattainment area. Emission rates would exceed the PM_{10} General Conformity threshold for a serious nonattainment area. Comparison of the Sloan/Jean route with known locations of minority and low-income populations indicates that effects on such populations would not be disproportionately high and adverse in comparison with effects on the rest of the population. No unique practices or pathways have been identified that would increase impacts to minority or low-income populations. PM_{10} and carbon monoxide emissions are susceptible to mitigation.

- Most of the road upgrades for a Sloan/Jean heavy-haul truck route would occur in areas that are in attainment for criteria pollutants. However, portions of the upgrades would occur in the Las Vegas Valley air basin, which is in nonattainment for carbon monoxide and PM_{10}. Comparison of the route with known locations of minority and low-income populations indicates that effects from road upgrades on such populations would not be disproportionately high and adverse in comparison with effects on the rest of the population. No unique practices or pathways have been identified that would increase impacts to minority or low-income populations. PM_{10} and carbon monoxide emissions are susceptible to mitigation.

- Construction and operation of a Caliente intermodal transfer station could cause aesthetic impacts to users of Kershaw-Ryan State Park. Impacts could result from construction activities and from noise, traffic, and lighting during operations. Impacts would be similar for all park users and, therefore, would not be disproportionately high and adverse for members of minority or low-income populations. Some of these impacts would be susceptible to mitigation.

- Biology and soils impacts from construction and from corridor and route occupancy and use would include long-term vegetation disturbance in corridors or at an intermodal transfer station and stopover sites. Short-term or individual impacts to threatened and endangered and special-status species could occur. The Valley Modified Corridor crosses two wilderness study areas and a national wildlife refuge. DOE has found no location-related or unique practices and pathways information to indicate that effects on minority or low-income populations would be disproportionately high and adverse in comparison with effects on the rest of the population.

- The construction and operation of a branch rail line in the Caliente or Carlin Corridor along the Bonnie Claire Alternate would cross the Scottys Junction parcel of the Timbisha Shoshone Trust Lands. Sections 6.3.2.2.1 and 6.3.2.2.2 discuss land-use and noise consequences for potential residents. Information available to DOE indicates that the Timbisha Shoshone have not developed residential areas on the parcel. Because residential development of the parcel has not occurred, there is no population present, no way to measure the likelihood of disproportionately high and adverse impacts on a possible minority or low-income population, and no present data indicating a potential for environmental justice concerns from the Bonnie Claire Alternate.

- The construction and operation of a branch rail line in any of the candidate rail corridors could present the potential for direct and indirect impacts to archaeological and historic resources related to Native American culture. Additional archaeological surveys and ethnographic studies are needed for the placement of an alignment within any of the rail corridors, including variations, to determine specific potential impacts and mitigation needs. Records searches indicate that only a small percentage of potentially affected lands in designated rights-of-way have been inspected.

- The operation of a heavy-haul truck route along any of the candidate routes could present the potential for direct and indirect impacts to archaeological and historic resources related to Native American culture. The determination of the potential for impacts to Native American cultural values from the upgrading and use of Nevada highways for heavy-haul truck shipments would require more study. The American Indian Writers Subgroup has commented that ethnographic field studies would be necessary to determine specific potential impacts to Native American cultural properties and values (DIRS 102043-AIWS 1998, p. 4-6) for candidate rail corridors and the use of existing highways as routes for heavy-haul trucks to Yucca Mountain.

- Construction of a Carlin branch rail line could affect two known historic-period Native American cemeteries, one in Crescent Valley and the other in Grass Valley (DIRS 155826-Nickens and Hartwell 2001, p. 27).

- Several rail corridors and routes for heavy-haul trucks pass through or are proximate to significant places for Native Americans. For example, in the Pahranagat National Wildlife Refuge, the Black Canyon area, the Storied Rocks site farther south, and the Maynard Lake vicinity have been identified. The entire Pahranagat Valley is an important cultural landscape (DIRS 155826 Nickens and Hartwell 2001, Appendix A). The Coyote Springs area and the Arrow Canyon Range valley south of the Pahranagat Valley are places of cultural importance. The operation of a Caliente intermodal transfer station could have a lasting impact on the cultural integrity of the location, which Native Americans have identified as an important place. The overall significance of such places and the potential for impacts from the transportation of spent nuclear fuel and high-level radioactive waste cannot be fully understood until a rail alignment or heavy-haul truck route is identified and ethnographic field studies and consultation have been completed.

In the viewpoint of Native Americans, the construction and operation of a branch rail line would constitute an intrusion on the holy lands of the Southern Paiute and Western Shoshone. In addition, some corridors pass through or near several significant places (see Chapter 3, Section 3.2.2.1.5). The American Indian Writers Subgroup has commented that the overall significance of these places and potential impacts from operation of a rail line on them cannot be fully understood until DOE has identified the rail alignment and completed ethnographic field studies and consultations (DIRS 102043-AIWS 1998, p. 4-6). If DOE selected a rail corridor, it would initiate additional engineering and environmental studies (including cultural resource surveys), conduct consultations with Federal agencies, the State of Nevada, and tribal governments, and perform additional National Environmental Policy Act reviews as a basis for final alignment selection and construction. DOE would address the mitigation of potential impacts to archaeological and historic sites during the identification, evaluation, and treatment planning phases of the cultural resource surveys.

For existing highways and mainline railroads, the added traffic would be minimal and shipments of spent nuclear fuel and high-level radioactive waste would be unlikely to affect land use, air quality, hydrology, biological resources and soils, cultural resources, socioeconomics, noise and vibration, or aesthetics, except as noted above. The analyses discussed in the preceding sections also determined that impacts to these resource areas from construction and operation of a branch rail line in any of the five potential rail corridors or construction of an intermodal transfer station and upgrading of highways in Nevada would be low.

Because the analyses did not identify large impacts for railroad and highway transportation of spent nuclear fuel and high-level radioactive waste in Nevada that would constitute credible adverse impacts on populations, workers, or individuals, adverse effects would be unlikely for any specific segment of the population, including minorities, low-income groups, and Native American tribes, except as noted above. Chapter 4, Section 4.1.13.4, contains an environmental justice discussion of a Native American perspective on the Proposed Action.

REFERENCES

Note: In an effort to ensure consistency among Yucca Mountain Project documents, DOE has altered the format of the references and some of the citations in the text in this Final EIS from those in the Draft EIS. The following list contains notes where applicable for references cited differently in the Draft EIS.

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