4.0 Environmental Consequences

This chapter describes the short- and long-term impacts that would result from implementing the alternatives discussed in Chapter 2.0. It addresses the impacts of the on-site disposal alternative and three off-site disposal alternatives for contaminated materials at the Moab site, remediation of vicinity properties, and ground water compliance at the Moab site. The alternatives and sections in which they are fully discussed are

- On-site disposal at the Moab site (Section 4.1)
- Off-site disposal at the Klondike Flats site (Section 4.2)
- Off-site disposal at the Crescent Junction site (Section 4.3)
- Off-site disposal at the White Mesa Mill site (Section 4.4)
- Borrow area impacts (Section 4.5)
- No Action alternative (Section 4.6)

As characterized in Chapter 2.0, each alternative except the No Action alternative would include both on-site and off-site activities. In the following sections, impacts of the alternatives are broken down by activity under each environmental resource area:

- *Construction and operations at the Moab site*—these activities would include those needed for surface remediation, ground water compliance, and reduction of the influence of ground water on the Colorado River. These activities would also include construction and operation of any transportation facilities needed at the site to either dispose of the contaminated material on the site or remove the materials from the site for off-site disposal.

- *Characterization and remediation of vicinity properties*—these activities would include surveying, sampling soil, removing contaminated materials, and restoring landscaping. Contaminated materials from vicinity properties would first be transported to the Moab site under all remediation alternatives. These activities would be the same under all the alternatives and thus are addressed only once, under the on-site disposal alternative.

- *Construction and operations at one of the three off-site disposal sites*—these activities are addressed only for the off-site alternatives and would include construction and operation of any transportation facilities needed at the off-site disposal sites for the handling and disposal of contaminated materials.

- *Construction and operations relating to transportation*—these activities would include (1) transportation of contaminated materials from vicinity properties to the Moab site (the estimated volume of contaminated materials from vicinity properties is included as part of the total volume of contaminated materials to be disposed of under all alternatives), (2) transportation of materials from borrow sites to the Moab site and to one of the three off-site disposal sites, and (3) transportation of contaminated materials from the Moab site to one of the three off-site disposal sites (where applicable). For the off-site alternatives, this section addresses impacts of truck, rail, and slurry pipeline transportation of contaminated materials from the Moab site to the off-site locations.

- *Monitoring and maintenance*—these activities would include inspections and sampling conducted in accordance with the site's Long-Term Surveillance and Maintenance Plan, which would be approved by NRC.

As applicable, the impacts from these activities are summarized for each resource. Impacts at the 10 borrow areas analyzed are addressed in Section 4.5. The No Action alternative is discussed in Section 4.6.

Consistent with DOE and Council on Environmental Quality NEPA guidance, the analysis of impacts in this chapter focuses on those areas in which impacts may occur from any action proposed by the alternatives assessed in this EIS. For this reason, the level of detail and analysis varies among the resource areas according to the duration and degree of the expected impact.

4.1 On-Site Disposal (Moab Site)

This section discusses the short-term and long-term impacts associated with the on-site disposal alternative. The impacts are based on the proposed actions described in Section 2.1 and the affected environment described in Section 3.1. This alternative would result in impacts at the Moab site, vicinity properties, and borrow areas, and transportation impacts associated with commuting workers and the transport of vicinity property material and borrow material. The combined impacts that may result from these activities are summarized for each assessment area (e.g., Geology and Soils) at the end of each subsection.

4.1.1 Geology and Soils

4.1.1.1 Construction and Operations Impacts at the Moab Site

Geology

Proposed surface or ground water remediation at the Moab site would not be affected by seismic factors. The Moab site is located in an area where evidence indicates that significant earthquakes are rare. The Moab Fault lies deep beneath the site, but it does not pose a significant earthquake or surface-rupture threat to the tailings pile and is not a capable fault under NRC siting criteria. The site lies within Uniform Building Code 1, indicating the lowest potential for earthquake damage.

Two geologic processes, subsidence (basin settling) and incision (cutting into bedrock by the Colorado River), would affect the tailings pile very slowly over very long periods of time. These processes are discussed in Section 3.1.1.4. Incision and subsidence rates indicate that the impact to a disposal cell at the Moab site over the 1,000-year regulatory design period would be to lower the elevation of the cell by approximately 1.4 ft in relation to the Colorado River. This would place the 100-year floodplain of the Colorado River about 1.4 ft higher on the east toe of the cell, creating a higher probability for flooding over time. This potential impact would be very long term, and the potential hazard would be reduced by the proposed buried riprap diversion wall (see Figure 2−3). The proposed ground water remediation would not be affected by these long-term geologic processes. Subsidence would result in the tailings coming into permanent contact with the ground water in approximately 7,000 to 10,000 years.

Several geologic resources exist beneath the disposal cell, including sand and gravel, saline minerals, and brine. The sand and gravel resource would be adversely affected by the proposed on-site disposal alternative because it provides a foundation for the disposal cell and would have to remain undisturbed in perpetuity; therefore, this resource would be unavailable for commercial exploitation. Saline minerals and brine resources would not be affected because they could be physically accessed and recovered by slant drilling from areas adjacent to the site. However, past mill operations have likely introduced sufficient quantities of contaminants to these resources to prohibit future use under any alternative.

Soils

The major impact on soils at the Moab site under the on-site disposal alternative would be the excavation and relocation onto the tailings pile of approximately 234,000 tons (173,000 yd^3) of off-pile contaminated site soil and the backfilling (replacement) of these soils with approximately 320,000 yd^3 of clean reclamation borrow soil to a depth of approximately 6 inches. These would be short-term impacts that would result in some potential for soil erosion due to the site soil characteristics discussed in Section 3.1.2. The potential for erosion would continue until the cover was installed, the reclamation soil emplaced, and vegetation established. The potential for erosion would be reduced through implementation of the *Fugitive Dust Plan for the Moab, Utah, UMTRA Project Site* (DOE 2002a) and Utah Pollutant Discharge Elimination System storm water discharge requirements. Soil subsidence, a form of subsidence associated with surface flow and erosion processes, could occur at the site through the development of soil pipes, or voids in the soil. However, no soil pipes have been discovered to date, and the engineered cell would control surface flow to prevent the development of soil pipes and subsequent soil subsidence adjacent to the cell. Ground water remediation would not affect soils. Reclamation and revegetation, the final proposed construction phase (Section 2.1.1.4), would leave the soils on and surrounding the tailings impoundment less vulnerable to erosion than they are today.

4.1.1.2 Impacts from Characterization and Remediation of Vicinity Properties

Soil impacts at the vicinity properties would be qualitatively similar to those for the Moab site, but on a much smaller scale. The average area of disturbance at a vicinity property is expected to be 2,500 ft^2, less than 6 percent of an acre, and the total area of soil disturbance to all vicinity properties is expected to be approximately 6 acres. As necessary and appropriate, erosion control measures would be implemented as described for the Moab site. Remediation of vicinity properties would not be affected by geologic features or processes. It is highly unlikely that any geologic resources exist at any vicinity properties in quantities or locations that would justify commercial interest.

4.1.1.3 Impacts from All Sources

The loss of potential commercial availability of sand and gravel resources underlying the tailings pile could be a negative long-term impact to geologic resources. However, it is likely that these resources are contaminated from previous mill operations and are therefore unusable under any alternative. There would be a negative long-term impact on the disposal cell due to a very slow subsidence of the cell (1.4 ft over 1,000 years) into the 100-year floodplain of the Colorado River on the east toe of the cell, but this impact would not result in collapse of the pile. Negative, short-term impacts on soils would result from excavating contaminated soils, conducting construction

activities, depositing contaminated materials in the tailings pile, recontouring, and capping the tailings pile. These activities would affect approximately 439 acres of the Moab site and 6 acres of vicinity properties. There would be no geologic or soils-related impacts associated with transportation, ground water remediation, or monitoring and maintenance activities under the on-site disposal alternative.

4.1.2 Air Quality

4.1.2.1 Construction and Operations Impacts at the Moab Site

During surface and ground water remediation (described in Sections 2.1.1 and 2.3.2), heavy-duty diesel equipment such as excavators, scrapers, and dozers would emit pollutants. Fugitive dust emissions would also occur. However, emission of fugitive dust would be minimized by using control measures, such as applying water or chemicals and covering truck beds. As shown in Table 4–1, the concentrations of criteria pollutants from the Moab site emissions are below the primary and secondary NAAQS in 40 CFR 50. The estimated concentrations of criteria air pollutants from emissions shown in Table 4–1 were derived by applying tailpipe emission factors provided in *Compilation of Air Pollutant Emission Factors* (EPA 2000) to the estimated construction fleet composition and duration of construction operations. With respect to PSD, and as noted in Section 3.1.4, the Moab site is in a Class II area but shares a common boundary with Arches National Park, a Class I area where maximum allowable increases in PM_{10} are limited to 4 $\mu g/m^3$ (annual arithmetic mean) and 8 $\mu g/m^3$ (24-hour maximum). However, Utah PSD regulations provide that concentrations of PM_{10} attributable to the increases in emissions from construction or other temporary emission-related activities shall be excluded in determining compliance with the maximum allowable increase (UAC 2000).

Table 4–1. Criteria Pollutant Concentrations from Emissions at the Moab Site

Pollutant	Averaging Period	Standard ($\mu g/m^3$)	Concentration from Emissions ($\mu g/m^3$)
Carbon monoxide	1-hour	40,000	31
	8-hour	10,000	22
Nitrogen dioxide	Annual	100	7.0
Sulfur dioxide	Annual	80	0.71
	24-hour	365	3.6
	3-hour	1,300	8.0
PM_{10}[a]	Annual	50	3.0
	24-hour	150	15

[a]PM_{10} includes fugitive dust emissions from construction activities.
$\mu g/m^3$ = micrograms per cubic meter.

In addition to the short-term criteria air pollutant emissions shown in Table 4–1, some long-term air emissions would be associated with ground water extraction and treatment activities. Emissions from ground water extraction would be expected to be minor because the system would probably use electric pumps. Emissions from treatment activities would depend on the treatment technology used. As noted in Section 2.3.2, operation of an evaporation pond, particularly spray evaporation, or ammonia-stripping treatment technology would probably be the alternatives with the highest potential for air emissions. Potential impacts from these emissions are discussed in Section 4.1.15, “Human Health,” subsection 4.1.15.1, “Construction and Operations Impacts at the Moab Site.”

4.1.2.2 Impacts from Characterization and Remediation of Vicinity Properties

During the remediation of vicinity properties, heavy-duty diesel trucks used to haul materials, automobiles used by workers, and backhoes or scrapers used to excavate, load, and unload materials would emit pollutants. Fugitive dust emissions would also occur, but they would be small because of the small acreage disturbed at each vicinity property (estimated to average 0.06 acre) and the relatively high moisture content of the material (DOE 1985). In addition, emission of fugitive dust at vicinity properties would be minimized by using control measures, such as applying water or chemicals and covering open truck beds.

During remediation of a typical vicinity property, an estimated 12.9 pounds of hydrocarbons, 23.6 pounds of nitrogen oxides, 0.7 pound of sulfur oxides, 157.6 pounds of carbon monoxide, and 0.5 pound of total suspended particulates would be emitted (DOE 1985). For remediation of 98 vicinity properties, a total of about 1,300 pounds of hydrocarbons, 2,300 pounds of nitrogen oxides, 70 pounds of sulfur oxides, 15,000 pounds of carbon monoxide, and 50 pounds of total suspended particulates would be emitted from vehicles. These emissions would be distributed geographically and temporally and would not cause any permanent air quality impacts (DOE 1985).

4.1.2.3 Construction and Operations Impacts Related to Transportation

The air quality impacts of transportation under the on-site disposal alternative are discussed in Section 4.1.15, “Human Health,” subsection 4.1.15.3.

4.1.2.4 Monitoring and Maintenance Impacts

During monitoring and maintenance activities, there would be minimal use of heavy equipment on the Moab site. Therefore, concentrations of criteria pollutants would be similar to the background concentrations shown in Table 3−5, “Air Quality in the Moab Region.”

4.1.2.5 Impacts from All Sources

Emissions of criteria air pollutants, including carbon monoxide, nitrogen dioxide, sulfur dioxide, and PM_{10}, would occur at the Moab site and at vicinity properties because of the operation of heavy construction equipment and ground water remediation equipment. No criteria air pollutant emission concentrations at the Moab site, where concentrations are expected to be highest, would exceed NAAQS.

4.1.3 Ground Water

This section describes the short-term and long-term impacts to ground water that would result from on-site disposal of contaminated site and vicinity property materials. Ground water impacts would directly affect surface water. Impacts are assessed assuming that the final disposal cell would be in the same location as the existing tailings pile. The impacts analysis is based on the proposed action and alternatives described in Sections 2.1 and 2.3 and the affected environment as described in Section 3.1.6. No impacts to ground water at the site would result from remediation of vicinity properties, transportation activities, or monitoring and maintenance. Therefore, no further discussion for these activities is included in this section.

According to the most recent site conceptual model, three discrete mechanisms for contaminant transport are affecting the site ground water system: (1) downward seepage of contaminated

fluids from the tailings pile to the ground water, (2) upward flux of contaminants from the brine interface to the freshwater layer, and (3) lateral movement of the legacy plume in the upper alluvial aquifer. All three are contributing ammonia to the Colorado River. Ground water potentially migrating beneath the Colorado River from the site is not anticipated to affect surface waters or aquatic communities on the east side of the river, in the vicinity of the Matheson Wetlands Preserve.

The naturally high salt content in the ground water prevents it from being a potential source of drinking water. Contaminated ground water would not be made available to the public and therefore would not pose a risk to public health. The impact analysis in this section addresses contaminants in ground water that influence surface water quality and subsequently aquatic receptors. Previous studies, recent DOE evaluations (DOE 2003a), and Chapter 3.0 indicate that ammonia is the primary contaminant of concern in ground water and could pose a risk to aquatic receptors in surface water. Active remediation of ground water would reduce the mass of ammonia discharging to the Colorado River and would prevent long-term adverse impacts to surface water and aquatic receptors. Active remediation would also ensure long-term protection of surface water and ecological receptors from risk that may be caused by other contaminants.

4.1.3.1 Construction and Operations Impacts at the Moab Site

For purposes of this EIS, short-term impacts to ground water would include the period from completion of the remedial action plan until concentrations in the surface water were protective of aquatic species, as described in Section 2.3. Therefore, short-term impacts would include those that would occur to ground water during surface remediation and during preparation of the site for active ground water remediation. Long-term impacts to ground water would be those that would occur during and after active remediation.

Although short-term impacts would not adversely affect human health, ground water impacts are discussed to provide an explanation of potential effects on surface water. In the short term, the potential exists for ammonia concentrations to increase slightly in the river as a result of tamarisk removal during surface remediation. If tamarisk were reestablished, phytoremediation would likely augment ground water and contaminant mass removal in ground water through root uptake. This, combined with active ground water remediation, would likely decrease ammonia concentrations affecting surface water. Tailings seepage and ammonia flux are all expected to decrease gradually both in the short and long term. Installation of extraction wells and trenches necessary for active remediation would not adversely affect ground water. Applications of clean water (discussed in Section 2.3.2.4) would not adversely affect ground water quality, as such applications are designed to enhance the quality of surface water.

In the long term, capping the tailings pile would reduce concentrations of ground water contaminants, including ammonia, to levels well below those currently existing, because decreased infiltration rates of precipitation through the tailings would reduce tailings pore fluid seepage. The seepage rate of tailings pore fluids would decline from the current rate of 20 gpm until consolidation of the tailings was complete and the steady-state condition of 0.8 gpm was reached in approximately 130 years. Ammonia flux from the brine and the legacy plume would decrease gradually through the action of natural processes (e.g., adsorption, geochemical degradation, dispersion) to background concentrations, as fresh ground water entered the site from recharge areas in the vicinity of Moab Wash and flowed beneath the tailings pile toward the Colorado River and as the contaminant mass in the brine was depleted.

Assumptions for tailings drainage and ammonia concentrations are presented in Table 4–2.

Table 4–2. Assumptions for Liquid Drainage and Ammonia Concentrations From the Tailings Pile for the On-Site Disposal Alternative

Parameter	Value
Infiltration rate	1×10^{-7} cm/s before construction and 1×10^{-8} cm/s after construction
Gravity drainage	Rate would decay from 8 gpm at present to 0.8 gpm at 130 years
Transient drainage	Rate would decay from 12 gpm at present to 0 gpm at 20 years
Initial ammonia concentration seepage from base of tailings pile	1,100 mg/L
Breakthrough ammonia concentration from upper salt layer	18,000 mg/L
Arrival time	1,100 years
Final concentration	1,100 mg/L
Exit time	1,540 years

cm/s = centimeters per second; gpm = gallons per minute; mg/L = milligrams per liter

Limited data suggest that there may be significantly higher ammonia concentrations in the upper 10 ft of tailings related to a 3- to 6-inch salt layer (DOE 2003a). In the future, as water infiltrates the upper portion of the tailings, it may dissolve the salt deposits, and pore fluid concentrations seeping from the base of the tailings could have up to 18,000 mg/L ammonia. These high concentrations would persist as long as salt deposits remain in the tailings. If the salt deposits become depleted by dissolution from infiltrating water, pore fluid concentrations would decrease. It is estimated that it would take approximately 1,100 years (longer than the disposal cell design life) for the relatively high ammonia concentrations to reach the ground water, and dissolution would continue for approximately 440 years until the salt layer was depleted. It is assumed that after the salt layer was depleted (in approximately 1,540 years), ammonia concentrations in the pore fluids would return to 1,100 mg/L (DOE 2003a).

If the on-site disposal alternative were selected, DOE would conduct more detailed field studies to confirm or refute the existence of the salt layer. Likewise, if the on-site alternative were selected, and if the existence of the salt layer were confirmed, additional field studies would then be conducted to characterize and map the salt layer. On the basis of these characterizations, DOE would conduct more reliable transport modeling and, based on the results, make a decision regarding the need for mitigation measures. If found to be necessary and appropriate, mitigation measures could include excavation and treatment of the salt layer, which could eliminate the concern over a secondary pulse of ammonia that might occur in the year 3100 time frame. However, given the still-unconfirmed presence of the salt layer and the nature of its possible future impacts, DOE has not conducted additional characterization of the potential impacts and associated mitigation measures or evaluated costs beyond the material presented here because DOE has determined that such information is not essential to a reasoned choice among the alternatives.

Available information is insufficient to reliably estimate the inventory of soluble mineral salts in the tailings, estimate the time for the salts to be completely depleted, or predict the future geochemical transformations that may occur. However, mineral depletion would trigger rapid decreases in pore water dissolved solids and ammonia concentrations. Because of the slow flow of water through the tailings, it is unlikely that mineral depletion would occur in any reasonable time period. In addition, the chemistry of the pore fluid would likely change as it percolated down through the tailings. Pore water pH would increase, and some minerals would form from reaction with minerals such as calcium carbonate. As acidic, high-concentration ammonia pore water moved down through high-pH, carbonate-bearing tailings, chemical precipitation would occur, and concentrations of some constituents would decrease. Thus, the ammonia concentration estimated at 18,000 mg/L (ammonia-N) could be significantly lower.

Ground water flow and transport modeling described in the SOWP (DOE 2003a) was performed to evaluate the impact of the on-site disposal alternative to the ground water system near the Colorado River from the three contaminant transport mechanisms (brine flux, legacy plume, and tailings seepage) over a period of 200 years. The modeling results, presented in Figure 4–1, indicate that most of the ammonia flux from the brine layer and the legacy plume in the alluvial aquifer would naturally flush to the river in approximately 80 years. At the end of the 80-year period, seepage of 1,100 mg/L ammonia from the base of the tailings pile would continue to decline until it reached a steady-state rate of 0.8 gpm; ground water concentrations near the river would decline below 0.7 mg/L ammonia after 200 years but remain above background. Predicted concentrations plotted in Figure 4–1 represent the maximum ammonia-N concentrations for a series of observations located along a transect parallel to the Colorado River downgradient from the toe of the tailings pile along a flow path near the center of the plume.

The target goal of 3 mg/L for ammonia in ground water, as discussed in Chapter 2.0, provides reasonable assurance of meeting the surface water remediation objective to provide protection of aquatic species. Modeling results indicate the ammonia concentrations in ground water near the bank of the Colorado River would be expected to decline from the current 500 to 1,000 mg/L to a maximum of approximately 3 mg/L in 80 years, and less than 0.7 mg/L at steady state in 200 years. Predicted concentrations in the ground water at 80 and 200 years in the future are summarized in Table 4–3. Predicted concentrations after 80 years and 200 years are illustrated in Figure 4–2 and Figure 4–3, respectively. As evident from the data presented in Table 4–3 and Figure 4–2, the on-site disposal alternative would meet the 3-mg/L target goal in ground water adjacent to the backwater habitat area.

Concentrations of treated ground water that would be reinjected into the aquifer would depend on the treatment options, as discussed in Section 2.3.2.1, but would not adversely affect ground water quality or human health. If reinjection were selected, contaminated ground water would be disposed of in accordance with state underground injection control regulations.

The potential exists in the long term (during and following active remediation) for ground water contaminant concentrations to be affected by a 100-year flood, similar to a flood that occurred in 1984, which was simulated to evaluate the impact of ammonia released to the Colorado River. A simplified analysis in the SOWP (Section 7.5.4) based on surveyed elevations of the tailings profile, river stage elevation measurements obtained during the 1984 flood, and physical properties of the tailings indicates that the drainage volume is approximately 591,250 ft^3 (4.4 million gallons). An average concentration of the tailings pore fluid of approximately 1,100 mg/L and an average drainage rate of the pore fluid of 307 gpm for 10 days would produce a source of approximately 1.8 million grams of ammonia per day. Model results suggest that near the bank of the Colorado River, the maximum ammonia concentration in ground water would increase ambient concentrations by just over 2 mg/L in approximately 10 years after a 100-year flood. However, effects of the tailings inundation would decline rapidly over a period of approximately 20 years after the flood event. After the estimated 80-year active remediation effort for the on-site disposal alternative, even during episodic flood events, water quality would remain protective of aquatic organisms at the point of exposure. Therefore, the on-site remedy could satisfy the requirements of 40 CFR 192.

This simplified analysis was performed as a screening step to evaluate the potential magnitude of a significant ground water rise caused by flooding in the Colorado River to determine if additional analysis would be warranted. Because the analysis was a worst-case scenario, and the ammonia concentrations were predicted to only slightly exceed 2 mg/L at the river, no additional analysis was deemed necessary.

Results of the simplified analysis probably overestimate the 2 mg/L ammonia concentration by one to two orders of magnitude for two reasons: (1) the actual drainage rate would be much less than the 307 gpm and (2) the ammonia concentrations in the seepage water would be much less than the assumed 1,100 mg/L. The actual drainage rate is overestimated because the analysis does not account for the low permeability of the sides of the pile that would be protected by a 1×10^{-8} centimeters per second (cm/s) clay layer and the low permeability of the dense basal layer of the tailings. These low permeabilities would limit the volume of water that enters into the pile. The analysis also conservatively assumes that the entire volume of water would equilibrate instantaneously to 1,100-mg/L ammonia while in contact with the tailings before draining. Therefore, it is very unlikely that the ammonia concentrations would approach 2 mg/L at the river.

4.1.3.2 Impacts from All Sources

Implementation of ground water remediation with application of supplemental standards would result in no adverse impacts to ground water and therefore would not adversely affect human health. In the long term, active remediation would reduce ammonia concentrations in ground water that are adversely affecting the Colorado River.

4.1.4 Surface Water

This section describes the short-term and long-term impacts to surface water that would result from on-site disposal of contaminated site and vicinity property materials. Impacts that could occur from remediation of surface materials and ground water are assessed assuming that the final disposal cell would be in the same location as the existing tailings pile. The impacts analysis is based on the proposed action and alternatives described in Sections 2.1 and 2.3 and

the affected environment as described in Section 3.1.7. Section 4.1.4.1 discusses the impacts that would result from construction and operations. Section 4.1.4.2 discusses impacts associated with remediating vicinity properties. No impacts to surface water at the Moab site are anticipated as a result of transporting vicinity property materials to the site, or as a result of maintenance and operations following surface remediation. Therefore, these aspects are not discussed further. Section 4.1.4.3 summarizes the impacts from all sources for later comparison of impacts between the alternatives. Section 4.1.17 discusses potential impacts as a result of a post-remediation catastrophic event.

4.1.4.1 Construction and Operations Impacts at the Moab Site

In the short term, surface-disturbing activities, including removing tamarisk, excavating contaminated soils, regrading the disposal cell, realigning Moab Wash, and placing vicinity property materials on the site, present the potential for increased contamination and sediment runoff to the Colorado River and Moab Wash. However, no significant adverse impacts to surface water are anticipated because site controls and a storm water management plan would be implemented as described in Chapter 2.0. Enforcement of the plan would be shared jointly by DOE, the State of Utah, and, when applicable, the Corps of Engineers. Likewise, fuel storage areas would be managed and controlled in accordance with state regulations to prevent the release of petroleum products to surface waters. Withdrawal of surface water for clean water applications, as described in Section 2.3.2.4, and for dust control would be within the water rights granted by the State. Any work within Moab Wash or the Colorado River high water mark would be completed in accordance with a Clean Water Act Section 404 permit.

Concentrations of ammonia in surface water can exceed federal and state ambient water quality criteria in some locations at certain times. Contaminated ground water could continue to adversely affect surface water for up to 5 years after implementation of active ground water remediation (see Figure 2–42). However, interim actions, including DOE's proposed clean water application (Section 2.3.2.4), are being implemented and could be implemented periodically to reduce ammonia concentrations and minimize adverse effects to surface water quality.

An analysis of ground water impacts (Section 4.1.3) shows that ammonia concentrations in ground water would decrease through natural processes (e.g., adsorption, geochemical degradation, dispersion) until a steady-state concentration was reached. Surface water concentrations should decrease as well. For the on-site disposal alternative, this steady-state concentration is predicted to be approximately 0.7 mg/L, which is approximately a factor of 1,000 less than current concentrations. The correlation between ground water and surface water concentrations is expected to result in a similar decrease in surface water concentrations as well.

Long-term impacts to surface water as a result of active ground water remediation would depend on the extraction, treatment, and disposal options selected. The proposed active remediation would control ground water discharge to the river while natural processes reduced ammonia concentrations in the ground water to levels protective of aquatic species. After completion of active remediation, the potential does exist for a flood to slightly increase ammonia concentrations in ground water (Section 4.1.3.1), but this should have minimal impact to surface water concentrations.

Any treatment of contaminated ground water and discharge to surface waters, as described in Section 2.3.2, would be in accordance with state permitting requirements and therefore would

not result in an adverse impact to Moab Wash or the Colorado River. Other treatment and disposal methods would also not adversely affect surface water.

Active remediation would be discontinued when ammonia concentrations in ground water reached acceptable levels that allow resumption of discharge to surface water (estimated at 80 years). At that time, discharge of ground water to the surface would have no discernible impact. However, concentrations of ammonia in surface water would probably remain above surface water background concentrations because of steady-state concentrations in ground water.

Storm water management during site reclamation would include berms between the site operational areas and the Colorado River and Moab Wash to ensure that the site is not inundated from flood events up to the magnitude associated with 100-year return intervals. Should a flood event of greater magnitude than this occur, there is a potential for tailings to be transported off the site and into the Colorado River and Moab Wash. Disposal alternatives that could involve on-site drying of tailings (i.e., off-site disposal via truck or rail haul) would have the potential for supplying a greater amount of tailings to floodwaters than alternatives that do not involve on-site drying (i.e., off-site disposal via slurry pipeline or on-site disposal) should a flood greater than a 100-year return interval occur. However, a substantial failure of the storm water pollution prevention system would reasonably occur only from a flood event greater than the 100-year return interval. As indicated by a recent USGS study (USGS 2005), the overbank flow velocities associated with an event of this magnitude would be less than 2 ft/s. There would be very limited ability to transport contaminants from the site due to the low velocity of the floodwaters, and the overbank flows would likely result in net deposition of sediment. The impact of these limited quantities of contaminants would be mitigated by mixing with the large volumes of floodwaters (72,000 cfs). The minimal amount of contaminants that may become suspended or dissolved into these floodwaters during the completion of on-site disposal would be dispersed and diluted in the floodwaters such that there would be no significantly measurable contamination in off-site sediment or river water.

4.1.4.2 Impacts from Characterization and Remediation of Vicinity Properties

Surface water located close to vicinity properties could be affected by sedimentation and possibly by contaminant runoff. DOE would implement a storm water control plan for those properties.

4.1.4.3 Impacts from All Sources

Short-term impacts to surface water as a result of construction and operation at the site and from characterization and remediation of vicinity properties would not be expected to be adverse. However, elevated contaminant levels in ground water would continue to adversely affect surface water in the short term until active remediation of ground water reduced concentrations. Once active remediation was implemented, contaminant concentrations in ground water discharging to surface water would decrease to levels that would be protective of aquatic species. Following completion of active remediation, levels would be expected to remain protective.

4.1.5 Floodplains and Wetlands

Impacts that could result from surface remediation are assessed with the assumption that the final disposal cell would be in the same location as the existing tailings pile. The impacts analysis is

based on the proposed alternative action described in Section 2.1 and the affected environment as described in Sections 3.1.8 and 3.1.9. Impacts for this alternative are more thoroughly discussed in the floodplain/wetlands assessment (Appendix F).

4.1.5.1 Construction and Operations Impacts at the Moab Site

Soil excavation and removal of contaminated materials during surface remediation of the former millsite would occur within the 100- and 500-year floodplains. Removal of soils may permanently lower the elevation of the floodplain, resulting in greater exposure of the base of the pile (currently underground) to floodwaters, increased capacity of the floodplain, and possible changes to flooding patterns at the Matheson Wetlands Preserve.

Rechanneling Moab Wash would affect the floodplain in the short term by changing drainage patterns and the river discharge point and by increasing runoff to the river. However, storm water management measures could also decrease the amount of water and sediment entering Moab Wash. In the long term, the realignment of Moab Wash would reduce the potential for storm water to affect the disposal cell. The wash would still enter the river upstream of endangered fish habitat, but its rechanneling could alter flow patterns and disrupt downstream wetlands. These effects would be long-term, and such action would require federal and state permits.

The proposed removal of the tamarisk and other vegetation adjacent to the river would be an adverse, short-term impact to the stability of the floodplain and wetlands until revegetation was complete.

The buried riprap wall would stabilize the soil in the floodplain. Therefore, an adverse impact would not be expected.

4.1.5.2 Impacts from Characterization and Remediation of Vicinity Properties

Vicinity properties may be located within the Colorado River, Pack Creek, or Mill Creek floodplains. If these sites are located within floodplains or wetlands, short-term impacts could result. Remediation would include excavating and transporting contaminated materials from vicinity properties to the Moab site. Because DOE would implement site controls (e.g., storm water management) and obtain necessary federal and state permits to control potential impacts during remediation, any short-term impacts to floodplains or wetlands would be expected to be minimal. Reconstruction and revegetation at vicinity properties would be consistent with the existing use of the property. Therefore, there would be no long-term impacts to floodplains or wetlands.

4.1.5.3 Construction and Operations Impacts Related to Transportation

Because existing roads would be used to transport contaminated materials from vicinity properties to the Moab site, no adverse impacts to floodplains and wetlands would be expected. New proposed routes from borrow areas would be investigated for wetlands prior to construction. Impacts would be avoided wherever possible by rerouting roads to bypass these areas. In the long term, disturbed areas would be restored to their previous condition, or as agreed to with the appropriate land management agency.

4.1.5.4 Impacts from All Sources

Long-term and short-term impacts would be associated with rechanneling Moab Wash and with remedial activities at the Moab site. Only short-term impacts would occur from characterization and remediation of vicinity properties and from constructing or updating transportation routes.

4.1.6 Aquatic Ecology

The aquatic resources within the vicinity of the Moab tailings pile are associated with the Colorado River. This assessment of environmental consequences focuses on the aquatic plants and animals in the river and on the shore between the site and the river. Potential impacts are discussed in terms of direct and indirect effects to individuals and populations, and the potential impacts to their habitat.

This section describes the short-term and long-term impacts to aquatic ecology, including receptors, which could result from on-site disposal of contaminated site and vicinity property materials. Section 4.1.17 discusses potential post-remediation impacts to aquatic species as a result of a catastrophic event. Adverse impacts could be a result of physical (e.g., mechanical disturbance, habitat alteration), chemical (e.g., ammonia contamination), and radiological influences. Of these, chemical influences from the adjacent ground water plume would be of greatest concern in the short term until active remediation reduced risk to aquatic species, especially endangered species. Federally listed species that could be potentially affected by both surface and ground water remedial actions include the endangered Colorado pikeminnow, razorback sucker, humpback chub, and bonytail.

Detailed discussion of impacts to endangered species is presented in Appendix A1, “Biological Assessment.”

Impacts in this section are assessed with the assumption that (1) the disposal cell would be located in the same place as the existing tailings pile, and (2) the location of the legacy plume would not be affected by surface remediation activities. The impacts are based on the proposed action and alternatives described in Sections 2.1 and 2.3 and the affected environment as described in Section 3.1.10. Adverse impacts to surface water would not be expected to occur from transportation activities or monitoring and maintenance. Therefore, these activities are not discussed further in this section. It is expected that active remediation would be protective of aquatic species at the individual, population, and community levels of the Colorado River ecosystem**.**

4.1.6.1 Construction and Operations Impacts at the Moab Site

Mechanical Disturbance. The impact to aquatic species due to construction and operations at the Moab site would be from mechanical disturbances and loss of vegetation along the shoreline of Moab Wash and the Colorado River. Activities at the Moab site would likely disturb about 8,100 ft of Colorado River shoreline. The vegetation along the shoreline, consisting primarily of tamarisk, would be removed in order to excavate and remove contaminated soils (RRM). The tamarisk along the banks of Moab Wash as it enters the Colorado River would likely be removed as well.

The effects of mechanical disturbance would include the loss of shade and cover over the shoreline and potentially a loss of surface stability that could lead to increased erosion and siltation into the wash and river. Impacts to aquatic species due to these changes would be minimal. The shade and cover provided by the tamarisk is only along the edge of the river during high and moderate flows of the river. At low river flows, the shoreline vegetation provides no shade, and the flow into the wash is cut off. The potential also exists for water intake structures in the river to result in mortality to eggs, larvae, young-of-the-year, and juvenile fish life stages. DOE would minimize this potential by using one-quarter to three-eighths inch screened mesh on water intake structures.

Effects from siltation and erosion into the river and wash could fill in backwater areas that may be important to macroinvertebrates and fish. Moab Wash has been documented as potential pikeminnow nursery habitat that could be affected by siltation and erosion (NPS 2003). Erosion along the river shoreline could create new backwater areas, but these would likely be temporary and depend on river stage.

Federally listed species that could be potentially affected by the changes to the shoreline include the endangered Colorado pikeminnow, razorback sucker, humpback chub, and bonytail. The Colorado River reach near the Moab site has been designated as critical habitat (50 CFR 17.95) for all four federal endangered fish species. Juvenile and adult Colorado pikeminnow, stocked adult razorback sucker and bonytail have been collected near the Moab site. Moab Wash and the riparian vegetation adjacent to the Colorado River potentially provide nursery habitat for young-of-the-year fish (NRC 1999, NPS 2003, UDWR 2003). Erosion and siltation events that change the depth and configuration of these backwater areas are likely to affect the extent of nursery habitat for endangered fish. Other fish, macroinvertebrates, and emergent plants associated with the backwater areas are also likely to be affected by erosion and siltation. The effects of erosion and siltation would be prevented or reduced by minimizing shoreline disruption, replacing vegetation, and installing erosion control devices.

Noise. Noise from site construction and operations is not expected to affect the aquatic environment. Activities along the shoreline are likely to be of short duration and are not likely to cause macroinvertebrate or fish communities to avoid the area.

Other Human Disturbances. Aspects of human presence such as personnel or vehicle movement and supplemental lighting are not expected to affect the aquatic environment.

Water depletion in the Colorado River as a result of remediation of the Moab site would be in accordance with the Cooperative Agreement to implement the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (USF&WS 1987). The Cooperative Agreement was signed by the Secretary of the Interior and by the governors of the states of Colorado, Utah, and Wyoming. The Recovery Program requires that all Section 7 consultations address depletion impacts. A key element of the program requires a one-time contribution of $10 per acre-foot (adjusted annually for inflation) based on the average annual depletion through activities at the site, to be paid to USF&WS. The balance of the payment would be due at the commencement of construction at the site. The impacts due to water depletion can be offset by the one-time contribution, appropriate legal protection of instream flows pursuant to state law, and accomplishments of activities necessary to recover the endangered fish as specified in the Recovery Plan (NRC 1999). Further consultation would be

necessary to determine any required permits and the financial contribution based on water depletion.

Effects of Flooding on Ground Water Remediation. Although effects of catastrophic flooding to the pile are considered in Section 4.1.17, there is also the possibility that flooding could affect the aquatic environment by interrupting ground water remediation. The interim action and proposed ground water remediation includes wells and pumps, or shallow trenches located between the foot of the pile and the river's edge (Section 2.3). Impacts to the aquatic environment could occur because of flooding of the remediation systems. As discussed in Section 3.1.8, the location for these systems is in the 100-year floodplain. If a flood were to inundate the remediation systems, contaminated ground water from the wells or trenches could be carried into the river. DOE expects that remediation systems would be quickly restored after the floodwaters receded. USF&WS would be notified if ground water remediation systems were shut down because of flooding, and monitoring of the river environment would take place to determine if the concentrations of contaminants of concern exceed aquatic benchmark values.

Temperature. Temperature can influence the development, metabolism, motility, and mobility of fish; affect the expression of other environmental factors; and destroy the integrity of a fish, causing its death (Beitinger et al. 2000). Impacts associated with activities related to remediation would not be expected to influence the temperature of the Colorado River. Leachate from the tailings pile travels through ground water into the river, and the temperature gradient is not expected to affect the aquatic environment.

Chemical Impacts to Aquatic Species. The tailings pile on the Moab site is the source of chemical contamination to ground water, which in turn is the source of contamination in the Colorado River.

The aquatic environment near the site has been characterized in Chapter 3.0. Characterization has included sampling sediment, fish tissue, and surface water near the Moab site and upstream background surface water. Sediment samples of the Colorado River were collected from 1995 through 1997; however, these samples were not considered in this analysis because of comments in the Final Biological Opinion in NRC's final EIS (NRC 1999) concerning the quality of the data for evaluation of impacts. Concerns for the quality of the sediment data include inappropriate procedures and protocols for sample collection and inadequate collection of samples for statistical evaluation. Fish were collected for tissue analyses from 1995 through 1997, and results of the fish tissue analyses also were not considered in this analysis because of comments similar to those made about the data quality of sediment samples (NRC 1999). An evaluation of the means and standard deviations for all the combined fish tissue data does not show a strong statistical difference in concentrations in the tissues collected upstream of the Moab site compared to those collected downstream.

The screening of contaminants is presented in Appendix A2 of the EIS and summarized here. The screening is based on surface water samples collected by Shepherd Miller, Inc. (SMI), DOE, and USGS. Samples were collected by SMI and DOE from 2000 through 2002. These data are presented in Appendix D of the *Site Observational Work Plan for the Moab, Utah, Site* (DOE 2003a). Water sample data were collected by USGS from 1998 through 2000 and are presented in *A Site-Specific Assessment of the Risk of Ammonia to Endangered Colorado Pikeminnow and Razorback Sucker Populations in the Upper Colorado River Adjacent to the Atlas Mill Tailings Pile, Moab, Utah* (USGS 2002). Many of the samples from other studies were

considered, but quality issues were discovered during the evaluation of data for surface water samples taken prior to 2000. These issues included insufficient information to determine the location of the analyzed sample and laboratory quality control and quality assurance questions. Contaminants of potential concern for the Moab site were identified from institutional knowledge about the uranium milling processes used during operation of the Atlas mill and from the NRC EIS (NRC 1999). Surface water monitoring data were evaluated to determine if maximum concentrations were above detection limits, background levels, and federal and state criteria (i.e., benchmarks) for surface water quality.

Impacts to aquatic organisms can result from either acute or chronic exposures to contaminants of potential concern (Appendix A2). An acute exposure is defined as "the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect" (EPA 2002). A chronic exposure is defined as "the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect" (EPA 2002). Currently, the State of Utah criteria include an acute, 1-hour exposure and a chronic, 4-day exposure. Suter and Tsao (1996) were used where state and federal standards were not available. However, they used a method, referred to as Tier II, to establish criteria for aquatic benchmarks using fewer data than required by EPA in the NWQC. Also, they developed estimated lowest chronic values for fish extrapolated from laboratory studies. The standards are discussed further in Appendix A2 of the EIS.

Based on the evaluation of contaminants of potential concern in Appendix A2, the contaminants that would require further assessment and continued monitoring during ground water remediation for the Moab site are ammonia, copper, manganese, sulfate, and uranium. If active ground water remediation near the Colorado River were conducted, the maximum concentrations of these contaminants of concern where the ground water enters the river (nearshore environment) would decrease to levels below acute and chronic benchmarks. It is DOE's position that if acute criteria can be met everywhere, then chronic criteria can be met outside the mixing zone (Section 2.3.2). In addition, available data regarding interaction of ground water and surface water indicate that concentrations of most constituents decrease significantly as ground water discharges to and mixes with surface water (a 10-fold decrease is observed on average).

Consequently, there is a reasonable assurance that protective surface water concentrations could be achieved by meeting less conservative goals than chronic standards in ground water. DOE believes that a target goal of 3 mg/L in ground water (the low end of the reasonable acute range) would provide adequate surface water protection. The 3-mg/L concentration represents a 2- to 3-order-of-magnitude decrease in the center of the ammonia plume and would be expected to result in a corresponding decrease in surface water. Coupled with the average 10-fold dilution and the tendency for ammonia to volatilize, this value should result in compliance with both acute and chronic ammonia standards in the river everywhere adjacent to the site. Therefore, DOE proposes to use the 3-mg/L concentration of ammonia as a target goal for evaluating ground water cleanup options. Potential synergistic effects between contaminants would be reduced through ground water remediation. Continued monitoring during ground water remediation would be necessary to verify that contaminant concentrations remained below both acute and chronic benchmarks for aquatic species.

Radiological Impacts to Aquatic Species. The primary source of radioactive contamination in the aquatic environment at the Moab site is ground water. The routes of exposure for the radioactive contaminants are the same as those for chemical contaminants. The contributors to radiological

dose to the aquatic organisms at the Moab site that have been monitored include lead-210, polonium-210, radon-222, radium-226, radium-228, thorium-230, uranium-234, and uranium-238, and the general indicators of radionuclides, gross alpha and gross beta.

The RESRAD Biota Code (Version 1.0 Beta 3, June 3, 2003) was used to screen the dose rate to aquatic organisms based on the maximum observed concentrations of uranium-238, uranium-234, and radium-226 (DOE 2002b). These isotopes represent the highest values analyzed for radionuclides from 2000 to 2002. The protocol for screening assessment includes multiple tiers. The first-tier screening assessment using the maximum observed concentrations had a sum of fractions that equaled 3.16, which exceeded the DOE guidance level of 1.0 for aquatic biota. A second-tier analysis based on mean concentrations of these three radionuclides of those values above detection resulted in a sum of fractions value of 0.29. The results of the second-tier analysis indicate that dose rates are below the 1.0-rad-per-day guidance level adopted by DOE for screening dose rates to aquatic organisms.

Results of the RESRAD assessment indicate that the actual dose rates to aquatic organisms are below a population effect level. There are no guidelines for radiological effects to individuals, which is important in evaluating impacts to threatened and endangered species. The studies that were completed for the 1.0-rad-per-day criterion were based on exposures to organisms for 1 year, and then normalized to a dose rate based on a day. One can interpret these results to mean that a dose rate of 1.0 rad per day, if sustained for a year, would have an effect on some individuals but not on the population as a whole. Based on monitoring results from 2000 to 2002 and on the life styles of the endangered fish around the Moab site, radiological effects currently are not expected to adversely affect the aquatic environment.

In another study, the USGS concluded that there would be “no significant biological impacts to fish populations caused by radionuclide concentrations sampled in the Colorado River and sediments.” It found that “radiochemical concentrations are elevated in ground water below the Moab pile; however, these waters do not result in a high radiation exposure to fish” (USGS 2002).

Ground water extraction near the Colorado River and the use of freshwater injection would further decrease the maximum concentrations of radionuclides in the shoreline of the Moab site. These activities would be necessary for reducing impacts from chemical contaminants. They would also reduce the potential for radiological effects to individuals, which is important to endangered species as well as populations.

4.1.6.2 Impacts from Characterization and Remediation of Vicinity Properties

Some vicinity properties may be close to surface water. In the short term, the potential exists for sedimentation, erosion, and alteration of habitat. However, the potential for adverse impacts would be minimal because of engineering and site controls for storm water runoff. As previously discussed, removal of vegetation in riparian areas could alter habitat and reduce stream cover and shade. However, few, if any, vicinity properties would likely be within surface waters or quality habitat for aquatic species. Consequently, any effects on aquatic biota from characterization and remediation of vicinity properties would likely be very small and of short duration (i.e., a few weeks) at each site.

4.1.7 Terrestrial Ecology

Appendix A1, "Biological Assessment," presents a detailed discussion of federally listed species that would be affected in the vicinity of the Moab site.

4.1.7.1 Construction and Operations Impact at the Moab Site

Habitat Loss. Under the on-site disposal alternative, the primary impact to terrestrial species and habitats due to construction and operations at the Moab site would be the mechanical disturbance and the resulting loss of vegetation and habitat. Activities at the Moab site would disturb approximately 439 acres within the site boundaries. Although most of the Moab site has very little to no vegetation, approximately 50 acres of habitat in the southern corner of the site is currently dominated by a relatively dense stand of tamarisk that would be lost in order to remove contaminated soil. The effects of this mechanical disturbance would include the loss of foraging and breeding habitat for various wildlife species, loss of shade and cover, including the areas near the Colorado River shoreline, and potentially a loss of surface stability that could lead to increased erosion and siltation.

Federally listed species that could be potentially affected by the habitat loss include the endangered southwestern willow flycatcher. The only federal candidate species that could be so affected is the western yellow-billed cuckoo. On May 12, June 24, and July 10, 2004, DOE and UDWR conducted field surveys of this tamarisk habitat and no flycatchers were detected. Further, UDWR concluded that this tamarisk constitutes only marginal nesting habitat at best (UDWR 2004b). Although flycatchers did not breed in this habitat in 2004, they could breed there in subsequent years. In addition, the southwestern willow flycatcher could potentially occur in the Matheson Wetlands Preserve across the Colorado River from the Moab site and several miles downstream from the Moab site (NRC 1999, USGS 2002). It could thus also use the Moab site for foraging or as stopover habitat during migration. Because the cuckoo has been known to nest across the river in the Matheson Wetlands Preserve (USGS 2001), it also could potentially use this tamarisk habitat for foraging. If this were the case, removal of this habitat still would only minimally affect cuckoos, if at all.

Other riparian birds also could be affected by the habitat loss as well as some species of mammals, reptiles, and amphibians. It is unlikely that removal of the 50 acres of tamarisk habitat would have a significant effect on the populations of any wildlife species in the Moab site vicinity, especially with the presence of hundreds of acres of similar habitat across the river in the Matheson Wetlands Preserve.

The effects of habitat loss would be of relatively short duration, especially if vegetation were replaced upon completion of surface cleanup. There could be a long-term benefit if the tamarisk were replaced with more desirable vegetation (such as willows) that would provide higher quality habitat for a greater number of species. Other measures that could be employed to reduce impacts include scheduling the removal of vegetation outside the nesting season and migration periods, minimizing the area of disturbance to the extent practical, and using best management practices for runoff and sediment control.

Noise. Noise from site construction and operations could have adverse impacts on terrestrial biota in the vicinity of the Moab site. Man-made noise can affect wildlife by inducing physiological changes, nest or habitat abandonment, or behavioral modifications, or it can

disrupt communications required for breeding or defense (Larkin 1996). In contrast, wildlife may also habituate to man-made noise (Larkin 1996). Much of the available effects data focus on noise sources more extreme than construction activities, such as aircraft overflights (Efroymson et al. 2000), and most of the existing data are species-specific. Consequently, only a general evaluation of potential noise impacts at the Moab site is possible without specific knowledge about the locations of species relative to the noise source and without specific data on the responses of the same species to construction noises.

As described in Section 4.1.10, the maximum noise level generated by construction equipment at the Moab site would be estimated to be approximately 95 dBA measured at 49 ft. This noise level would decrease with distance, until it reached a daytime background level of approximately 65 dBA at 1,476 ft from the source (65 dBA is the normal daytime background level in Moab). If additional vegetation were removed from the site as part of construction operations, the effects of elevated noise levels on wildlife should be minimal, because wildlife would already have been displaced by the habitat removal discussed above. Further, there could be detectable elevated sound levels in habitats downstream and across the river resulting from work near the periphery of the site.

The southwestern willow flycatcher and threatened bald eagle are the only federally listed species that could be present near the periphery of the site and therefore could be affected by noise from site operations. The western yellow-billed cuckoo is the only federal candidate species that could be present near the periphery of the site and could also be affected. The willow flycatcher does not appear to be overly sensitive to low-level human activity outside of its breeding territory (USF&WS 2002). Typical mitigation measures that have been employed to minimize impacts to breeding willow flycatchers include limiting equipment use within about 300 to 1,000 ft of occupied territories (CDFG 2002). Consequently, it is unlikely that off-site southwestern willow flycatchers would be significantly affected by construction activities at the Moab site. The bald eagle is often more sensitive to human presence and noise than other species. However, it is not known to nest or night roost at the Moab site and is not commonly seen in the vicinity of the site, and it is therefore is unlikely to be affected by noise from site operations. Information on the response of yellow-billed cuckoo to noise is insufficient to evaluate potential impacts on this species.

Other Human Disturbance. Other aspects of human presence, such as personnel or vehicle movement and supplemental lighting, could have an effect on local wildlife under the on-site disposal alternative. However, because essentially all usable habitat at the Moab site would be removed as part of construction operations, it is doubtful that these factors would cause significant adverse impacts to wildlife at the site. Impacts to off-site populations could be minimized by limiting activities near the site periphery, pointing lights downward, or installing canopies to limit the amount of light beyond the site boundary.

Erosion. Runoff and erosion could affect terrestrial systems by damaging surface vegetation and by siltation of wetlands, which could disrupt breeding habitat for amphibians and insects. During operations, erosion could result from movement of vehicles and materials. In general, these effects could be minimized using standard best management practices to control erosion and sedimentation. In the long term, a disposal cell could result in significant erosion and sedimentation and could disturb recovering vegetation at the site. The potential for this to occur would be minimized by design requirements and site storm water runoff controls. This would tend to have a greater impact on aquatic rather than terrestrial ecology.

Chemical/Radiological Impacts from Contaminants in Surface Water. Because of the complexity of the analysis of these impacts, only a brief conclusion is presented here. Appendixes A2 and A1 present more detailed discussions.

There is no potential risk of chemical or radiotoxic effects for riparian vertebrates, including federally listed species that could potentially occur at the Moab site (southwestern willow flycatcher, western yellow-billed cuckoo, and bald eagle), from chemical or radioactive constituents in surface water under the No Action alternative. Consequently, there would be no effects under the on-site disposal alternative, since chemical and radionuclide concentrations would likely be reduced.

There is a potential risk of toxic effects to riparian plants from chemical constituents in surface water under the No Action alternative, assuming plant roots are in contact with the freshwater aquifer or associated soil water above it. However, such effects would be unlikely under the on-site disposal alternative, since chemical concentrations would likely be reduced. There would be no phytotoxic effects to federally listed plant species (Jones' cycladenia, Navajo sedge, and clay phacelia), since these are not known to occur on or near the Moab site.

There is no potential risk of radiotoxic effects to riparian plants from radioactive constituents in surface water under the No Action alternative. Consequently, there would be no effects under the on-site disposal alternative, since radionuclide concentrations would likely be reduced. There would also be no radiotoxic effects to federally listed plant species (Jones' cycladenia, Navajo sedge, and clay phacelia), since these are not known to occur on or near the Moab site.

Wildlife Exposure at Evaporation Ponds. One of the effluent treatment technologies under consideration is solar evaporation. Solar evaporation consists of pumping extracted ground water into large membrane-lined ponds built into the floodplain, allowing the water to evaporate naturally, and disposing of accumulated solids. Pond(s) would need to be of sufficient size that evaporation rates could keep up with extraction rates and complete remediation in a reasonable time frame. Estimated pond areas range up to 40 acres, and a total of 60 acres of land would need to be disturbed. This would include some type of support facility, but the facility would be expected to be small and would probably be located in already disturbed areas.

Potential impacts that could result from construction and operation of an evaporation pond include floodplain habitat disturbance and wildlife displacement/destruction or contaminant impacts. Habitat disturbance and wildlife displacement/destruction could be minimized by selecting a site in an area that has been previously disturbed or otherwise has relatively little habitat value and by avoiding clearing land during the nesting season of migratory birds. Evaporation ponds could attract wildlife that may be exposed to contaminants through ingestion of contaminated prey and water, dermal uptake of contaminated water and airborne contaminants, and inhalation of airborne contaminants. In addition to impacts from exposure, wildlife could transport contamination off site.

The bald eagle, southwestern willow flycatcher, and western yellow-billed cuckoo are the only federally listed species considered to be potentially present at the Moab site and that could thus be affected by an evaporation pond. The evaporation pond would be located in an area that has been previously disturbed and is generally devoid of vegetation (e.g., that could be used by bald eagles to perch in and flycatchers and cuckoos to forage in). Vegetation around the evaporation pond, if any, would be maintained in such a state that it would remain unattractive to these

species. Further, the pond would also be located in an area where project activities and site maintenance operations would create continual disturbance. Consequently, the probability of visits from these three species to the pond would be expected to be low. Nevertheless, the pond would be qualitatively monitored for general wildlife use. If it were determined that one or more of these three species were frequenting the evaporation pond, techniques to minimize or eliminate use would be identified and implemented. Techniques may include deterrents such as noise (e.g., propane boom cannons), visual deterrents (e.g., reflectors, silhouettes, effigies, water color), or obstruction (e.g., netting).

Animal Intrusion into the Moab Tailings Pile. Because the barrier that would cover the Moab tailings pile would be designed to prevent animal intrusion, wildlife exposure to the tailings would not be expected.

4.1.7.2 Impacts from Characterization and Remediation of Vicinity Properties

Under the on-site disposal alternative, mechanical disturbance and a potential loss of vegetation and habitat would occur during remediation at the vicinity property sites. Each site would likely be small (average approximately 2,500 ft^2; see Section 2.1.2.2). Therefore, the magnitude of physical disturbance at each site would likely be small. This disturbance could result in minor habitat loss for some wildlife species and could potentially disturb populations of rare plant species. However, few if any of the vicinity properties would likely be in native condition or represent quality habitat for wildlife.

Activities at the vicinity property sites could affect wildlife in the surrounding area by introducing noise and increased human presence. However, most of the vicinity property sites are located close to human habitation or regular human activities, so most wildlife in the vicinity would likely be habituated to human presence. The quantity and scale of the equipment used (backhoes, graders, dump trucks) would be similar to that used in typical small-scale construction projects. There is a low probability for diesel or oil spills, and these would likely be quickly controlled and remediated. Consequently, the effects on terrestrial organisms from characterization and remediation of vicinity properties would likely be very small and of short duration (i.e., a few weeks) at each site.

4.1.7.3 Construction and Operations Impacts Related to Transportation

Under the on-site disposal alternative, the transportation of vicinity property and borrow materials to the Moab site could affect terrestrial organisms either through direct mortality (e.g., collisions) or indirectly through noise. The magnitude of impacts for both of these factors would be related to the number of trucks trips required to haul the materials and the total number of miles traveled by those trucks. As indicated in Table 3−15, over 2,800 vehicles per day travel on US-191 north of Moab, and at least 3,000 per day travel on US-191 south of Moab. The estimated increase in traffic associated with the on-site disposal alternative is discussed in Section 4.1.16. The increase in traffic could increase the number of animals killed or injured in collisions with vehicles, especially on US-191, the major artery that would carry commuters and on which borrow and vicinity property material would be transported. The likelihood of increased collisions with wildlife would be greatest during seasons when material transportation or commuting would occur before sunrise or after sunset.

Several types of animals are typically involved in vehicle collisions; most noticeable are large ungulates such as deer, pronghorn antelope, and bighorn sheep. Less noticeable but more prevalent are snakes, lizards, and small mammals. Bighorn sheep have been reintroduced into Arches National Park, and individuals are now occasionally seen near US-191 north of Moab. The increased truck traffic to haul borrow materials to the Moab site would probably slightly increase the number of bighorn sheep killed in that area.

The bald eagle is the only federally listed species that could incur an increase in traffic-related mortality. The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas. Indeed, bald eagles could be found temporarily and infrequently using such areas when there are opportunities to feed on carrion, such as in big-game wintering areas or in prairie dog colonies. Therefore, it is possible that if traffic-related wildlife mortality increased due to the project, an increased number of eagles could be hit on highways. However, without data on this relationship, it is reasonable to assume that the number of eagles hit on highways would be proportional to the number of carrion available. The increase in the number of traffic-related wildlife mortalities is expected to be small. Consequently, the potential increase in associated eagle deaths is also expected to be small.

Transportation of vicinity property and borrow materials would also increase noise on US-191 because of increased truck traffic. Average background noise levels along US-191 are approximately 70 dBA measured at 49 ft, which is likely detectible to humans up to approximately 6 miles from the road (Section 3.1.14). As described in Section 4.1.10, the increased truck traffic due to hauling borrow materials would likely increase the average noise level by approximately 2 dBA at 49 ft from the highway. This difference in noise level is essentially imperceptible to humans and would not be noticeable as different from baseline conditions within several hundred yards.

The primary federally listed species that could be affected by this increased traffic noise would be the threatened Mexican spotted owl. Data provided by UDWR (2003) indicated that there were no occurrences of the Mexican spotted owl in any of the project areas. However, habitat models (BLM 2003) indicate that potential habitat areas may exist in the canyons near US-191 over the first 7 miles north from the Moab tailings pile. Nonetheless, these models are primarily based on physical and topographic features and do not consider vegetation requirements. Mexican spotted owls nest, roost, and forage in an array of different community types, but mixed-conifer forests dominated by Douglas fir and/or white fir are most common (USF&WS 1995). However, they may also nest, but less frequently, in arid, rocky, mostly unvegetated canyons (Romin 2004). Although there are no forested areas in the vicinity of US-191 north of Moab, there are arid canyons that largely or altogether lack forest-type vegetation. Thus, it is unlikely but possible that spotted owls occur in the canyons near US-191 over the first 7 miles north of the Moab site. If present, the species could be disturbed by noise from increased truck traffic. The area in the vicinity of this section of transportation corridor constitutes a very popular recreation area, with heavy use by off-highway vehicles and mountain bikes. Although the increase in truck traffic noise could be detectable up to several miles from the highway, the existing off-highway vehicle noise and associated human presence would likely have a greater and more direct impact on the owls.

The likelihood of adverse impacts from either vehicle collisions or increased noise levels would be greater at night than during the day. For example, deer are typically more active at dawn and dusk than during the day and are therefore more likely to be hit at that time. Highway noise would likely be detectable from farther away at night because of reduced levels of background noise. The vehicle collision and noise impacts of transportation would return to previously existing conditions at the completion of activities at the Moab site, and no long-term effects would be expected.

4.1.7.4 Monitoring and Maintenance Impacts

Routine post-closure monitoring and maintenance of the Moab site would not be expected to have any impacts to terrestrial species or habitats. However, in the event that major corrective actions were needed, some of the recovering vegetation on and around the disposal site could be disturbed.

4.1.7.5 Impacts from All Sources

Overall impacts to terrestrial ecological resources under the on-site disposal alternative include approximately 50 acres of tamarisk habitat loss at the Moab site (the rest of the site is considered to have zero habitat quality) and a maximum of approximately 550 acres of desert habitat at the borrow sites (assuming use of Floy Wash for cover soils and Klondike Flats for radon barrier soils). Additional habitat would be lost at the commercial quarry sites for sand, gravel, and riprap. Habitat value would decrease slightly near US-191 because of the increased truck traffic required to haul borrow materials, and traffic-related wildlife mortalities would increase slightly because of increased traffic.

4.1.8 Land Use

Under the on-site disposal alternative, impacts to land use would include potential changes to existing land use at the site or to nearby properties.

4.1.8.1 Construction and Operations Impacts at the Moab Site

Construction and operations at the Moab site, which is currently under federal ownership and control, would not alter the existing land use at the site. Noise and vibrations that could occur as a result of these activities would be unlikely to travel off the site and thus would be unlikely to affect the use of adjacent property or nearby recreational areas (see also Section 4.1.10). Following surface remediation, ground water contamination would remain beneath the site, and DOE would operate a ground water treatment facility until ground water cleanup goals were met, estimated to be 80 years. The land occupied by the mill tailings pile would remain under federal ownership and control in perpetuity, creating a long-term loss of that acreage for beneficial land use by other government or private owners.

4.1.8.2 Impacts from Characterization and Remediation of Vicinity Properties

Under the on-site disposal alternative, remediation of vicinity properties could result in short-term displacement of some families or businesses if relocation were necessary during the removal of contaminated materials from properties. It is unlikely that contamination at any vicinity property would be extensive enough to cause it to be left in place, thereby requiring a change of land use or implementation of access or use restrictions.

4.1.8.3 Construction and Operations Impacts Related to Transportation

All vicinity property material and borrow material would be transported to the Moab site by trucks using existing roadways. No additional road construction or road improvement is expected to be necessary. Noise and traffic disruptions could occur as a result of the transport of these materials; such disruptions could temporarily disturb residents, businesses, and recreational users along the travel routes (see Sections 4.1.10 and 4.1.16) and temporarily affect current uses of the property. These impacts would last for the duration of remediation at the Moab site.

4.1.8.4 Monitoring and Maintenance Impacts

Monitoring and maintenance activities at the Moab site would not affect land use as long as the site remained under federal ownership and control. No monitoring or maintenance would be expected for any of the vicinity properties.

4.1.8.5 Impacts from All Sources

Short-term, temporary land use impacts would be expected as a result of remediation of vicinity properties. Under the on-site disposal alternative, the land required for the disposal cell would remain in federal ownership in perpetuity. Additional acreage may be required to support ground water remediation infrastructure. Therefore, there would be no changes in land use from the current status in the foreseeable future. However, DOE would defer its decisions on the release and future use of the Moab site pending an evaluation of the success of surface and ground water remediation.

The long-term commitment of the Moab site for disposal would conflict with Grand County land use planning that designates the site as a “Specially Planned Area” during remediation activities according to County Ordinance 346, but that envisions future land uses that would allow for low-density residential use upon completion of remediation.

4.1.9 Cultural Resources

This section addresses the potential for the disturbance of known cultural resources or the discovery of unknown resources under the on-site disposal alternative.

4.1.9.1 Construction and Operations Impacts at the Moab Site

Construction and operations at the Moab site would adversely affect some or all of the remaining structures and features associated with the historical uranium mill, which has been recommended for inclusion in the National Register of Historic Places, because they could be removed or dismantled during remediation. Most or all of the features associated with the historical mill are radioactively contaminated. At this time, it is not known which structures may be kept or dismantled. However, a collapsed log cabin is eligible for inclusion in the National Register and

would be left in place; a radiological survey of this site has shown that the materials and soils are not contaminated. None of the other eligible cultural resources at or near the Moab site (including the one recorded traditional cultural property) would be affected by construction and operations at the site. DOE plans to consult with the State Historic Preservation Officer and other interested parties to determine mitigation measures for those millsite features that would be demolished. Mitigation measures might include (1) documenting and photographing the features in accordance with the Utah State Historic Preservation Officer's standards, (2) providing historical information about the millsite and its operations to the Dan O'Laurie Canyon Country Museum in Moab, and (3) constructing a roadside turnout and erecting a kiosk containing historical information about the site.

Cultural resources located near areas of disturbance could be adversely affected indirectly through illicit collection, vandalism, or inadvertent destruction as a result of increased human activity in the area. DOE would require site workers to receive training on the need to protect cultural resources and the legal consequences of disturbing cultural resources.

4.1.9.2 Impacts from Characterization and Remediation of Vicinity Properties

Most of the vicinity properties are highly disturbed sites and would not likely contain significant cultural resources that could be affected by characterization and remediation of those properties. However, DOE would procure the services of a qualified and permitted professional archaeologist to assess the need to conduct Class III cultural resource surveys at Arches National Park, the Matheson Wetlands Preserve, and other properties as appropriate. If cultural resources eligible for inclusion in the National Register of Historic Places were located on a property and could be adversely affected, DOE would consult with the State Historic Preservation Officer and affected parties to determine mitigation measures.

4.1.9.3 Construction and Operations Impacts Related to Transportation

Impacts to cultural resources would not occur from construction and operations related to transportation because no new highway construction near the Moab site would take place.

4.1.9.4 Monitoring and Maintenance Impacts

Monitoring and maintenance activities under the on-site disposal alternative would not affect cultural resources.

4.1.9.5 Impacts from All Sources

Table 4–4 lists the total number of cultural sites eligible for inclusion in the National Register of Historic Places that could be adversely affected under the on-site disposal alternative.

Table 4–4. Number of Cultural Sites That Could Be Adversely Affected Under the On-Site Disposal Alternative

Location/Activity	No. of Cultural Sites Adversely Affected
Moab site (construction and operations)	0–2
Radon barrier material (Klondike Flats borrow area)	3–7
Cover soil material (Floy Wash borrow area)	1–2
Total	**4–11**

4.1.10 Noise and Vibration

This section addresses the impacts of noise and ground vibration, primarily to human receptors, under the on-site disposal alternative. Where appropriate, impacts to wildlife and cultural resources are also identified. Unless indicated otherwise, all noise and vibration impacts would be temporary and would last only as long as project construction and operations were ongoing.

4.1.10.1 Construction and Operations Impacts at the Moab Site

Noise associated with the on-site disposal alternative would come from construction activities, movement of contaminated soil from the site to the tailings pile, and movement of borrow materials on the site. The largest sources of noise on the site would be heavy earth-moving equipment. Typical noise emissions from construction equipment such as trucks, front-end loaders, bulldozers, excavators, and other heavy equipment range from 70 to 85 dBA at a 50-ft distance (Table 4–5) (Parsons 2003). A combination of the loudest pieces of equipment would have a cumulative noise source of 95 dBA at a 50-ft reference distance. This assumption is conservative, since general operation of equipment would not result in maximum noise levels, and all the equipment would never be at the same point at the same time.

Table 4–5. Noise Levels (dBA) Used for Noise Assessment

Source of Noise	Reference Distance (ft)	Range of Measured Noise Levels (dBA)	Maximum Noise Level Estimate Used (dBA)
Loader	50	82	85
Bulldozer	50	85	85
Backhoe	50	80−82	85
Blade	50	85	85
Roller	50	82	85
Dump Truck	50	79	85
Concrete Truck	50	82	85
Truck at 60 mph	25	81−87	95
Truck at 30 mph	25	77−80	85
Car at 70 mph	25	76−78	80
Car at 35 mph	25	61−65	67
Freight Train	30	72−82	97

A maximum noise level of 95 dBA at 50 ft would produce a 1,480-ft radius of influence where 1-hour L_{eq} noise levels would exceed the noise standard (65 dBA) for the city of Moab (Moab City Ordinance 17.74.080, "Noise Levels"). Moab city limits are approximately 9,840 ft from the tailings pile, well beyond the distance necessary for noise to attenuate to levels below applicable standards. There is one rural residence within 1,480 ft of the site boundary, located adjacent to the northeast portion of the site. This rural residence is on the opposite side of the site from the tailings pile and is more than 1,480 ft from where most of the earth-moving activity would occur.

Surface remediation would not be expected to generate noise levels that would exceed levels associated with earth-moving equipment, and there would be no off-site impact to people. Activities located between the tailings pile and the Colorado River could disrupt wildlife inhabiting the riparian zone along the western shoreline of the Colorado River and recreational users of the river.

Background levels of ground vibration range between 62 and 65 dBV. Ground vibration generated from construction equipment at the Moab site would be estimated to have a maximum level of 95 dBV (Hanson et al. 1991). Levels of ground vibration that approach 92 to 100 dBV could damage fragile buildings. Ground vibration is estimated to follow a logarithmic decrease as distance from the source increases. Vibrations from a 95-dBV source should decrease to levels below human detection within 820 ft. The entrance to Arches National Park is within 820 ft of the Moab site boundary, and visitors could experience small vibrations as a result of activities at the Moab site. Some cultural sites containing rock structures are within 300 to 400 ft of the Moab site boundary, but ground vibration levels are not expected to reach levels (estimated to be 92 to 100 dBV) that would damage these structures at that distance.

4.1.10.2 Impacts from Characterization and Remediation of Vicinity Properties

Remediation of vicinity properties would increase noise levels at the sites as a result of operating excavating equipment, loading trucks for removal, unloading borrow materials at the sites, and performing grading and finishing work. Activities would be limited to usually one piece of heavy equipment (shovel, bulldozer, or grader) and a truck transporting soil to or from the site during daylight hours. People residing on or near the vicinity properties could be disturbed by the noise associated with these activities. A region of influence would extend 820 ft from the remediation site, at which point the modeled noise levels would drop to 65 dBA. These activities would produce a temporary, adverse impact on the properties adjacent to the vicinity properties.

The activities required for remediation of vicinity properties could also produce ground vibration at levels that would disturb nearby residences, but the vibrations would not damage any buildings.

4.1.10.3 Construction and Operations Impacts Related to Transportation

Remediation of vicinity properties would generate noise from trucks used to transport material from the vicinity properties to the Moab site and transport borrow materials from borrow areas to the properties. Many of these trucks would travel through Moab. A total of 30 trips for removal and 30 trips for delivery of borrow material would occur for each of the estimated 98 sites. This would result in a total of 120 truck trips (coming and going) for each of the 98 sites. Remediation of the vicinity properties would last 1 to 3 years, and each site would take 4 to 6 weeks to complete. On average, there would be less than one truck trip per hour, and the contribution above background 1-hour L_{eq} noise levels would be minimal.

In order to haul borrow materials to the Moab site, an upgrade of the existing site entrance from US-191 would be necessary. This construction would employ equipment similar to that used for construction at the Moab site. An estimated maximum noise source of 95 dBA would attenuate to 65 dBA within 1,480 ft. The only receptors potentially located within 1,480 ft of any transportation infrastructure construction would be at Arches National Park. However, the topography and access to Arches National Park make it unlikely that any members of the public would be using the park within 1,480 ft of the construction.

For trucks hauling borrow material to the Moab site (estimated 43 round trips per day), the 1-hour L_{eq} at the construction site would be insignificant compared to the 95-dBA maximum noise level assumed for construction activities. Estimates of noise impacts to areas adjacent to transportation routes for the borrow material are listed in Table 4–6. For all the transportation

routes, the impact of additional noise generated by trucks hauling borrow material would be minimal. The distance from US-191 that is modeled to have 1-hour L_{eq} sound pressure level above 65 dBA would increase by 52 ft, from 164 to 216 ft (30 percent increase), by the additional truck traffic. This transportation route goes by Arches National Park and would increase the noise level on a small portion of the park. The National Park has a visitor's center approximately 490 ft from US-191. Noise levels would not be expected to exceed noise standards at the visitor's center or to increase the noise level at the visitor's center by a perceptible amount. The I-70 corridor between Floy Wash and Crescent Junction would be expected to see the largest region of influence, modeled at 243 ft from the roadway.

Table 4–6. Noise Impacts (1-hour L_{eq}) Around Transportation Routes for Borrow Material

Highway Section	Hourly Average Baseline Noise (dBA) at 25 ft From Source	Hourly Average Project Truck Traffic	Hourly Average Project Truck Traffic Noise (dBA) at 25 ft From Source	Total Noise (dBA) at 25 ft From Source	Increase at 25 ft (dBA) From Truck
Floy Wash to Crescent Junction Exit	74	5.6	66	75	0.7
Crescent Junction to Moab	73	8.3	68	74	1.2
Klondike Flats to Moab	73	8.3	68	74	1.2
Moab[a]	66	1.8	54	66	0.3
La Sal Junction through Moab	73	1.8	61	73	0.3
Spanish Valley through Moab	70	1	59	70	0.3
Lisbon Valley to La Sal Junction	57	1.8	61	63	5.8

Assumptions: Single project truck vehicle noise 95 dBA[b] at 60 mph[a], 25 ft from source.
Single project truck vehicle noise 85 dBA[b] at 60 mph[a], 25 ft from source.
[a]Project truck speed 30 mph within Moab city limits, 60 mph elsewhere.
[b]Conservative estimation based on values from multiple sources (Bowlby 1991, Sandberg 2001)

Transportation of borrow materials through the city of Moab would not be expected to result in a noticeable increase in traffic noise because of the reduced speeds through town and the higher background traffic noise. The route from Lisbon Valley to La Sal Junction would have the greatest impact from trucks hauling borrow material because of the low baseline noise levels. However, the noise levels (1-hour L_{eq}) would not exceed the 65 dBA residential noise standard (Moab City Ordinance 17.74.080, "Noise Levels").

Ground vibration generated by vehicles with rubber tires would be minimal, especially on smooth pavement. Potholes could increase the ground vibration generated by trucks, so vibration within the city of Moab could increase by a small amount. However, ground vibration generated by trucks hauling borrow material would be very near the threshold of human perception at the source.

4.1.10.4 Monitoring and Maintenance Impacts

Monitoring and maintenance of the Moab site would not be expected to result in significant generation of noise. Any noise generated by these activities would attenuate to levels near background before leaving the disposal site boundary.

4.1.10.5 Impacts from All Sources

Noise generated as a result of the on-site disposal alternative would not exceed the city of Moab residential noise standard of 65 dBA at any receptor locations. The receptors with the most potential to notice any increase in noise generated by this alternative would include the resident located on the eastern boundary of the site, residents along SR-46 between Lisbon Valley and La Sal Junction, and visitors at Arches National Park. Ground vibration generated by on-site activities and trucks would be expected to be at or below human perception in most instances.

4.1.11 Visual Resources

This section describes the impacts to physical features of the landscape from activities proposed under the on-site disposal alternative. The impacts would be imposed on viewers who live in, work in, or visit an area and can see ongoing human activities or the results of those activities.

4.1.11.1 Construction and Operations Impacts at the Moab Site

The primary viewers of construction and operations at the Moab site would be southbound and northbound travelers on US-191 and SR-279. Other viewers would include residents of the home immediately northeast of the site, residents of a home at The Portal RV and Park, and a limited number of visitors to Arches National Park. The darkened areas in Figure 4–4 indicate locations from which the disposal cell could potentially be viewed.

The visibility analysis used to create this map is based on elevation and topography and does not take into account the potential obstruction of views from cultural modifications (such as buildings) and vegetation. Consequently, activities at the site would not be viewed from the major portion of the darkened area south and east of the site because of shielding by buildings and tall vegetation (mainly cottonwood trees and tamarisk shrubs).

Travelers southbound on US-191 would be able to view construction activities and the completed disposal cell for approximately 2.5 minutes; viewing time for northbound travelers would be approximately 1.3 minutes. For both northbound and southbound travelers on SR-279, viewing times would be approximately 2.5 minutes. Residents of the home located at The Portal RV and Park generally would not have a clear view of the site or disposal cell when local vegetation is green. The site and cell would become more apparent in winter when the trees and shrubs lose their leaves. Residents at the home immediately northeast of the site would have a clear view of the site year-round. Travelers through Arches National Park would be able to view the site along a 1.2-mile section of the park's access road, from the park entrance to a hairpin turn at the top of the climb; after the turn, the site would not be visible. Construction activities at the site and the completed disposal cell would not dominate the view of the park's visitors, as vehicle drivers would most likely be focused on the park's narrow, winding road, and passengers would likely be viewing the more dramatic features of the park. The primary visual impact on the nearby residents and park visitors would be the dusk and dawn lighting during the construction period.

The views of southbound and northbound travelers on US-191 would be the most dramatically affected by this alternative. DOE evaluated visual impacts from three key observation points: (1) along southbound US-191 for a distance of approximately 2 miles, (2) along northbound US-191 for a distance of approximately 1 mile, and (3) along SR-279 for approximately 1.5 miles. At each observation point, DOE assessed the degree and types of changes that would occur in the landscape from the proposed activities (constructing the disposal cell with heavy equipment, covering the side slopes of the current tailings pile with light-gray riprap, filling the riprap interstices with reddish soil, and seeding the entire disposal cell with native or adapted plant species).

During the construction period, the primary visual impacts from the three key observation points would be associated with the dusk and dawn lighting and noticeable movement of heavy equipment on the site. Exhaust emissions and dust generated by the equipment also would be noticeable. In an otherwise natural and still landscape, the lighting, movement, and emissions of the heavy equipment would create moderate contrasts during the day and strong contrasts during dawn, dusk, and nighttime hours. Once the cell was completed, the heavy equipment and on-site lighting would be removed, thus eliminating these impacts in the long term. The short-term adverse visual impacts from construction activities could be minimized by planting a "hedgerow" of trees and shrubs between the disposal cell and US-191 and SR-279. Once the plants matured, they would shield much of the on-site construction activities from travelers during the spring, summer, and fall months.

The strongest contrasts would occur for an approximate 3- to 5-year period after the disposal cell was completed and before vegetation was well established, as shown in the photo simulation in Figure 4–5. In contrast with the natural, complex terrain created by rugged canyon walls, jagged rock formations, and distant mountain peaks, the disposal cell would be characterized by horizontal lines and a simple geometric form. In addition, the pink-stippled, light-gray color of the riprapped side slopes would contrast strongly with the predominant reds and beiges of the natural landscape. The riprap would impart a somewhat rugged texture to the side slopes when viewed close-up. However, from a distance, the side slopes would appear smooth and would create yet another contrast with the surroundings.

Visual Resource Contrast Rating

DOE used BLM's Visual Resource Contrast Rating system (BLM 2003b) to evaluate visual impacts that would occur as a result of the proposed alternatives. From **key observation points**, DOE's visual resource specialist observed the existing landscape at each site proposed to be disturbed under one or more of the alternatives. The basic elements of the landscape—**form, line, color, and texture**—were then compared to the basic elements that would occur as a result of the proposed activity. The degree of contrast that would occur was then rated as **none, weak, moderate, or strong**.

Definitions

Key observation point—one or a series of points on a travel route or at a use area where the view of a proposed activity would be most revealing.

Basic landscape elements—

Form: the mass or shape of an object or group of unified objects, such as the shape of a barren area, a cliff formation, or a pipeline.
Line: the path, real or imagined, that the eye follows when perceiving abrupt differences in form, color, or texture. Within landscapes, lines may be found as ridges, skylines, structures, or changes in vegetation types.
Color: the value, chroma, hue, and reflectivity of an object or area.
Texture: the visual manifestations of the interplay of light and shadow created by the variations in the surface of an object or landscape.

Degrees of contrast—

None: the contrast is not visible or perceived.
Weak: the contrast can be seen but does not attract attention.
Moderate: the contrast begins to attract attention and begins to dominate the landscape.
Strong: the contrast demands attention, will not be overlooked, and is dominant in the landscape.

Figure 4–5. Simulated View of the Moab Disposal Cell from the Southbound Lane of US-191 Immediately After Construction

[Before UDOT widened US-191]

After vegetation was well established, the strong contrasts in line, form, color, and texture would be lessened, as shown in the photo simulation in Figure 4–6. Desert shrubs such as rabbitbrush and fourwing saltbush would be expected to become established on the side slopes and would alter the overall appearance of the cell. Although the dominant form of the cell would remain simple and geometric, the vegetation would soften the harsh horizontal lines and add complexity to the cell's color and texture. Overall, a moderate contrast with the surrounding landscape would be expected.

Neither the strong contrasts anticipated to occur in the short term nor the moderate contrasts anticipated to occur in the long term would be compatible with the Class II objectives (see Section 3.1.15) that BLM has assigned to the nearby landscapes. To meet Class II objectives, the level of change to the existing landscape would have to be low, could not attract the attention of the casual observer, and should repeat the basic elements of line, form, color, and texture that are found in the predominant natural features (BLM 2003). The strong and moderate visual contrasts could be mitigated somewhat by placing beige- and red-colored riprap on the side slopes (instead of light gray); and recontouring the cell to a more complex, less geometric shape. Even then, Class II visual objectives may not be achievable from all viewing locations. DOE is not required to meet the objectives of BLM's visual resource management system on the DOE-owned Moab site; however, the system provides a useful way to measure the effects of a proposed action on visual resources.

Figure 4–6. Simulated View of the Moab Disposal Cell from the Southbound Lane of US-191 After Vegetation Is Established

[Before UDOT widened US-191]

4.1.11.2 Impacts from Characterization and Remediation of Vicinity Properties

Remediation of vicinity properties would result in short-term adverse impacts to visual resources. The removal of vegetation and consequent increase in barren ground would create strong, local contrasts in line, form, texture, and color. The primary viewers of these contrasts would be the residents of the home or facility undergoing remediation and nearby neighbors. Most of the contrasts would be eliminated in the short term, as DOE would replace barren lawn areas with green sod, replace shrubs and trees with nursery-grown plants, and resurface paved areas. No long-term impacts to visual resources would be expected to occur.

4.1.11.3 Construction and Operations Impacts Related to Transportation

Impacts to visual resources would not be expected to occur from transporting vicinity property material or borrow material to the Moab site. Moab residents would notice the presence of large dump trucks and heavy equipment in residential neighborhoods during remediation of vicinity properties, but this impact would be short term and minor.

4.1.11.4 Monitoring and Maintenance Impacts

Impacts to visual resources would not occur from monitoring and maintenance activities under the on-site disposal alternative.

4.1.11.5 Impacts from All Sources

Stabilizing the tailings pile at its current location on the Moab site would likely have adverse impacts on visual resources. Although the tailings pile would remain in its present location on the Moab site, riprap would be placed on the side slopes, and interstitial voids would be filled with soils and planted with vegetation. From the key observation points established for the site, the predominantly smooth, horizontal lines created by the pile would continue to create a strong contrast with the adjacent vertical sandstone cliffs. Due to its relatively large size, the pile could dominate the view of the casual observer from the US-191 and SR-279 key observation points. It would likely be recognized as an anomalous feature. If light gray riprap were used, it would contrast strongly with the reds of the surrounding cliffs. Unlike the pile in its current condition (covered in red soils), it would likely be noticed by visitors to the Moab area. The visual contrasts that would occur under this alternative would not be compatible with the Class II objectives that BLM has assigned to the nearby landscapes. Although DOE is not required to meet the objectives of BLM's visual resource management system on the DOE-owned Moab site, the system provides a useful way to measure the effects of a proposed action on visual resources. Table 4–7 summarizes the visual resource impacts expected to occur under the on-site disposal alternative. The primary negative impacts would occur in the short term and long term from disposal cell construction.

Table 4–7. Summary of Visual Resource Impacts Under the On-Site Disposal Alternative

Location/Activity	Visual Resource Impacts	
	Short Term	Long Term
Moab site	Strong adverse impacts primarily to travelers on US-191 and SR-279	Moderate adverse impacts primarily to travelers on US-191 and SR-279
Klondike Flats borrow area (radon barrier material)	Negligible to no adverse impacts; site not visible to most casual observers	No adverse impacts
Cover soil borrow area	Negligible to strong adverse impacts, depending upon borrow source	No adverse impacts
Vicinity properties	Strong adverse impacts to residents and neighbors	No adverse impacts
Truck haul	Minor adverse impact to residents and neighbors	No adverse impacts
Monitoring and maintenance	No adverse impacts	No adverse impacts

4.1.12 Infrastructure

This section addresses potential impacts on the availability of electric power, potable water, nonpotable water, sewage treatment, rail service, and highways. Unless indicated otherwise, all infrastructure impacts would be temporary and would last only as long as project construction and operations were ongoing.

4.1.12.1 Construction and Operations Impacts at the Moab Site

The primary electrical demands would be associated with the use of the existing mill building as an equipment/vehicle maintenance shop, field office trailer power, security lighting, nighttime operations lighting (if work activities continued into nighttime), river pump stations, and decontamination spray pumps. The electrical service at the Moab site would be required to support an estimated basic demand of 600 kVA. Electric Systems Consultants (ESC) of Fort Collins, Colorado, developed and reviewed this projected demand with Mathew Yates, Pacific Corporation (Utah Power and Light), Moab, Utah. Pacific Corporation indicated that this

demand would present no capacity problems to the existing electrical supply system at the site, nor would system upgrades be required (ESC 2003).

Implementation of this alternative would require an estimated 4,200 gallons of potable water per day to be purchased from the city of Moab. The city potable water system, which is spring-based, currently delivers about 3 million gallons of water per day during the high-demand summer season and about 1 million gallons per day in winter. The City has indicated that the projected 4,200-gallon-per-day demand would not represent a significant impact and could be met without adversely affecting the city's water supply or requiring system upgrades (Swenson 2003).

This alternative would also consume 70 acre-feet of nonpotable water annually (or a project total of approximately 490 acre-feet, assuming a 7-year project duration). All of this water would be drawn from the Colorado River under DOE's existing Moab site water rights, which authorizes DOE to withdraw approximately 3 cfs consumptive use and approximately 3 cfs nonconsumptive use. The authorized total of 6 cfs allows for withdrawal of approximately 4,560 acre-feet per year.

The projected 70 acre-feet per year of total usage is approximately 3 percent of DOE's annual authorized consumptive use withdrawal volume, and less than the 100 acre-feet per year deemed by USF&WS to be protective of endangered fish species. This level of protection complies with the cooperative agreement to implement the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (USF&WS 1987). Therefore, there would be only a minor impact to designated critical habitat.

Activities at the Moab site would generate approximately 10,000 gallons of sanitary waste per week. The waste would be stored in portable toilets or in septic tanks connected to trailers at the on-site support area. The waste would be disposed of in the city of Moab's sewage treatment plant, which can treat up to 1.5 million gallons of sewage per day and currently treats less than 1 million gallons per day (see Section 3.1.16.1). Consequently, the 10,000-gallons-per-week estimate would represent about 2 percent of the city's current excess treatment volumetric capacity and would not be a significant impact. However, the City restricts the amount of waste it will accept from septic tanks and portable toilets (all sources) to 9,000 gallons per day, and it will only receive such wastes 3 days per week. These restrictions could constrain the amount of waste the City would accept from the Moab site, depending on amounts the city was receiving from other sources. This potential impact could be alleviated by coordinating shipments of the site's sanitary waste so that the restrictions would not be exceeded, or by diluting the waste to a density similar to that of sanitary waste in sewer lines, thereby making disposal acceptable. The City has indicated that it would work with contractors to accommodate disposal schedules and evaluate the applicability of the 9,000-gallon-per-day limit if the waste were diluted. If dilution were necessary, it would represent a relatively small increase in the total nonpotable water use.

4.1.12.2 Impacts from Characterization and Remediation of Vicinity Properties

Under the on-site disposal alternative, activities at the vicinity properties would have no impacts on the local power or rail infrastructure. There would be no impacts on potable or nonpotable water requirements beyond those discussed for activities at the Moab site, which include consumption due to activities at vicinity properties. Not more than one portable toilet should be required for the remediation of any of the vicinity properties. One portable toilet would generate

less than 100 gallons of concentrated sanitary waste per week, which should not negatively affect the 9,000-gallon-per-day capacity of the Moab sewage treatment plant for this type of waste.

4.1.12.3 Construction and Operations Impacts Related to Transportation

Transportation of contaminated materials from vicinity properties to the Moab site and transportation of borrow materials from borrow areas to the Moab site would have no impact on the local or regional power, water, or rail infrastructures. Truck traffic transporting vicinity property or borrow area material to the Moab site would result in increased wear and tear on local roads and on US-191. The cost to the state for these impacts would be offset through vehicle registration and special permit fees, both of which provide revenue to the state general highway fund for road maintenance and repair. Transportation plans would include provisions for enforcing speed limits, road load limits, and any other applicable traffic laws.

4.1.12.4 Monitoring and Maintenance Impacts

Monitoring and maintenance activities would be generally limited to periodic inspections and activities to remedy incipient erosion. DOE anticipates that these activities would not impact any element of the local or regional infrastructures.

4.1.12.5 Impacts from All Sources

Power demand of 600 kVA could be met with no impact to Utah Power's existing electric supply infrastructure servicing the site. Potable water demand of 4,200 gallons per day could be met with no adverse impact to the city of Moab's existing potable water supply infrastructure. Nonpotable water demand of 70 acre-feet per year would represent about 3 percent of DOE's existing Colorado River water usage rights at the Moab site. The estimated 10,000 gallons of sanitary waste per week could be treated by the city of Moab's existing sanitary waste treatment infrastructure, but the city's limit of 9,000 gallons per day of concentrated sanitary waste from septic tanks and portable toilets could be exceeded. Mitigation measures to address this potential exceedance would entail coordinating shipment schedules or diluting the waste prior to shipment. Shipments of vicinity property material and borrow materials to the Moab site would result in accelerated wear and tear on neighborhood, county, and state roads. Truck permit and registration fees would compensate the State and Grand County for this unavoidable adverse impact to the road infrastructure.

4.1.13 Solid Waste Management

This section discusses impacts from the generation of solid waste under the on-site disposal alternative. These wastes would be generated for the duration of the remedial action and would cease once remedial action was completed.

4.1.13.1 Construction and Operations Impacts at the Moab Site

Activities at the Moab site would generate approximately 1,040 yd^3 of uncontaminated solid waste per year for 7 to 10 years. This waste would be disposed of at the Grand County landfill, which has a projected life span of 64 years at a disposal rate of 30,000 to 35,000 yd^3 per year. The Grand County landfill received approximately 36,000 yd^3 of solid waste in 2002; therefore, the volumes of solid waste generated at the Moab site and disposed of at the landfill would not negatively affect the Grand County landfill's life span.

Because the ground water contamination beneath the Moab site includes uranium and radium as well as ammonia and other contaminants (See Section 3.1.6.3), any of the screened ground water treatment technologies discussed in Sections 2.3.2.1 would generate RRM during the estimated 80-year duration of ground water remediation under the on-site alternative. Section 2.3.2.1 discusses possible treatment technologies for the extracted ground water. As noted in Section 2.3.2.1, discharge of ground water to the Colorado River would require extensive treatment and appropriate permits. Either deep well or shallow injection technologies would also require appropriate State and NRC permits. An evaporation treatment technology would require provisions for disposal of the RRM solids that would accumulate in the evaporation ponds. On the basis of dissolved solids content of the ground water, DOE estimates that an evaporation treatment technology would generate approximately 6,600 tons of RRM annually for the 80 years that ground water treatment was ongoing. This waste stream would be disposed of in a properly licensed facility such as a DOE-controlled disposal cell or a commercial disposal facility.

4.1.13.2 Impacts from Characterization and Remediation of Vicinity Properties

Almost all wastes generated at vicinity properties (an average of 300 yd^3 for each vicinity property) would be contaminated material that would be transported to the Moab site for disposal. A very small volume of uncontaminated solid waste could be generated during the remediation of the vicinity properties and would be disposed of directly in the Grand County landfill or in trash receptacles near the vicinity properties. The volume of solid waste generated during the remediation of each vicinity property would be variable but would not negatively affect the Grand County landfill's life span.

4.1.13.3 Construction and Operations Impacts Related to Transportation

Small volumes of uncontaminated solid waste could be generated during transportation of contaminated materials from vicinity properties to the Moab site and during transportation of borrow materials to the Moab site. These wastes would be disposed of in the Grand County landfill.

4.1.13.4 Monitoring and Maintenance Impacts

Very small volumes of waste would be generated as a result of ongoing inspections and monitoring. All wastes would be managed in accordance with applicable laws and regulations.

4.1.13.5 Impacts from All Sources

Management of an estimated 1,040 yd^3 of uncontaminated solid wastes generated as a result of activities at the site for 7 to 10 years would not result in adverse environmental or waste disposal capacity impacts. About 6,600 tons of RRM would be generated annually for 80 years if an evaporation-based ground water remediation treatment were implemented. These wastes would be handled, recycled, or disposed of according to approved waste management plans and applicable state and federal regulations.

4.1.14 Socioeconomics

This section discusses the potential socioeconomic impacts under the on-site disposal alternative. Project activities would be executed over three phases: a pre-remediation phase, a remediation phase, and a post-remediation phase. The potential impacts are examined using geographically

and industrially detailed information on expected direct and indirect changes in output, earnings, and employment over the construction and transportation phases of the project. The analysis also considers potential impacts from increased demand for temporary housing, and the short-term and long-term influence of surface remediation on the regional tax base and future economic development opportunities.

The affected socioeconomic region of influence covers Grand County and San Juan County in southwestern Utah. The impact analysis uses annualized project cost information specific to actions undertaken for the on-site disposal alternative developed from DOE's cost estimates for each alternative. This information is summarized for all on-site and off-site disposal alternatives in Table 4–8.

Data sources used for these estimates include:

- Actual vendor quotes
- RS Means 2003 Cost Estimating Guides (RS Means 2003)
  —Environmental Remediation Cost Data—Unit Pricing, 9th Edition
  —Environmental Remediation Cost Data—Assemblies, 9th Edition
  —Site Work & Landscape Cost Data, 22nd Edition
  —Building Construction Cost Data, 61st Edition
  —Heavy Construction Cost Data, 17th Edition
- Similar project experience

The cost information provided in Table 4–8 itemizes the total project costs by alternative that were summarized in Table 2–35 and includes cost for:

A. The pre-remediation phase during which design, procurement, and site preparation would occur.
B. The remediation phase of the project during which surface and ground water remediation would occur.
C. A 10-percent cost-contingency on these two phases.
D. Total surface remediation costs assuming an 8-year duration.
E. Annual ground water remediation costs that would be incurred for 80 years under on-site disposal and 75 years for the off-site disposal alternatives and annual post-surface remediation costs.
F. Total annual costs for each alternative during active surface and ground water remediation assuming an 8-year duration.

On the basis of the above cost information, economic impacts for the Moab remediation project were estimated using the Regional Input-Output Modeling System II (RIMS II) method of the Bureau of Economic Analysis, U.S. Department of Commerce (BEA 1997). This methodology is widely used in systematic analysis of economic impacts from large-scale public sector projects. The RIMS II method takes account of interindustry relationships within the two-county socioeconomic region of influence, which largely determine how the regional economy would respond to the infusion of new spending resulting from construction-transportation activities undertaken in the Moab site remediation.

The RIMS II multipliers used in the analysis were estimated by the Bureau of Economic Analysis specifically for Utah's Grand and San Juan counties. Final-demand and direct-effect multipliers for the construction sector are used in estimating the impact of the Moab surface remediation project on regional output, earnings, and employment. The impact on annual output of goods and services and labor earnings is calculated as the products of the final-demand multipliers (1.3178 and 0.3250) and annualized project cost. The impact on annual labor employment is calculated as the product of the direct-effect multiplier (1.4262) and estimated direct employment for each action alternative. Table 4–9 reports the associated economic impacts along with annual project costs.

Table 4–9. Economic Impacts in the Two-County Socioeconomic Region of Influence

On-Site Disposal[a]	Annual Cost	Annual Output of Goods and Services	Annual Labor Earnings	Jobs
Moab Site	$20,739,125	$27,330,019	$6,740,216	171

[a]Economic impacts for regional output of goods and services and labor earnings are calculated based on final-demand multipliers provided by the Bureau of Economic Analysis. The respective multiplier values (1.3178 and 0.3250) are multiplied by annualized cost to generate the impact values shown. Employment impacts are calculated as the product of the direct-effects multiplier (1.4262) and 120 total direct jobs (see Table 2–4).

The industries expected to be initially affected by the project include the regional construction and transportation industries, along with supporting service industries (especially hotels and restaurants). The project workforce is assumed to come from outside the socioeconomic region of influence and to spend a portion of their earnings on housing, food, and other goods and services within the two-county socioeconomic region of influence.

These impacts are based on estimated annual project costs of $20,739,125 over an 8-year disposal period, followed by estimated annual costs of $942,000 over an additional 80-year period of ground water remediation/site monitoring. These annual expenditures would cover the various activities described above, including construction and operations at the Moab site; ground water remediation; characterization and remediation of vicinity properties; transportation of vicinity property materials and borrow materials to the Moab site; and monitoring and maintenance impacts. Over the 8-year disposal period, the annual expenditures reflect increased annual output of goods and services of $27,330,019; increased annual labor earnings of $6,740,216; and increased direct and indirect employment of 171. Annual ground water remediation and site monitoring expenditures over the 80-year period following completion of surface remediation would not have significant impacts on the output of goods and services, labor earnings, or employment levels in the two-county region.

The potential shorter-term impacts from the on-site disposal alternative include effects on the demand for temporary housing. Project workers would take up temporary housing in the two-county socioeconomic region of influence, and their spending on goods and services would result in the collection of tax revenues by the state. As noted in Section 3.1.18.2, the availability of temporary housing is heavily dependent on tourist-recreation activity. The remediation project would tend to cause some crowding-out impacts during the peak tourism season due to increased competition for temporary accommodations. However, lower vacancy rates would be expected during the off-season, as workers took up temporary accommodation in the two counties. The increase in the workforce would tend to last over the duration of the surface remediation project. Consequently, any potential impacts on public safety (police, fire, medical) or on local school systems would be restricted to the duration of the project.

Longer-term beneficial impacts from the on-site disposal alternative relate to greater opportunities for economic development in the Moab area and greater diversification of the tax base. Currently, the local tax base depends heavily on the seasonally driven tourist-recreation sector. New spending and tax collections during and after the remediation process would help diversify the current tourist-driven tax base. These longer-term impacts would depend upon continued growth in the recreational demand for land and water resources in the socioeconomic region of influence, particularly in the vicinity of the Moab site and vicinity properties. The remediation process would improve both land and water quality in these areas and would safeguard surface and ground water quality for future beneficial uses along the Colorado River, such as rafting and camping.

4.1.15 Human Health

This section addresses potential impacts to human health under the on-site disposal alternative. These impacts include the potential for worker deaths that could occur as a result of industrial accidents, worker or public latent cancer fatalities that could occur as a result of exposure to radiation from activities at the Moab site, at vicinity properties, or during transportation of materials to the Moab site. In addition, residents would be exposed to radon gas and radioactive particulates released from the Moab site.

4.1.15.1 Construction and Operations Impacts at the Moab Site

Under the on-site disposal alternative, construction activities at the Moab site would be estimated to result in less than one fatality (0.16) as a result of industrial accidents.

During operations, workers at the site would be exposed to radon gas (an inhalation hazard) and external radiation from the mill tailings at the site. According to environmental monitoring data collected on the tailings pile, the average radon concentration over the period 2002 and 2003 was 5.9 pCi/L. This is equivalent to 0.041 working level, using an equilibrium factor of 0.7 (Wasiolek and Schery 1993). A worker exposed to this level of radon for 2,000 hours per year has a latent cancer fatality risk of 2.6×10^{-4} per year of exposure. Based on an external gamma radiation survey conducted on top of the tailings pile, the average external gamma exposure rate was about 0.35 milliroentgen per hour (mR/h). A worker exposed to this level of radiation for 2,000 hours per year would have a latent cancer fatality risk of 3.5×10^{-4} per year of exposure. The total latent cancer fatality risk to the worker on the tailings pile would be 6.1×10^{-3} per year of exposure (Table 4–10), or 1.5×10^{-3} over the 5-year duration of activities at the Moab site.

Table 4–10. Worker Impacts for the On-Site Disposal Alternative (Moab Site)

Category of Worker	Radon-Related LCFs[a]	External Radiation-Related LCFs[a]	Total LCFs[a]
Annual			
Individual	2.6×10^{-4}	3.5×10^{-4}	6.1×10^{-4}
Population	0.012	0.016	0.028
5-Year Duration of Activities			
Individual	6.5×10^{-4}	8.8×10^{-4}	1.5×10^{-3}
Population	0.030	0.041	0.071

[a]LCF = latent cancer fatality based on 47 workers at the Moab site.

Remediation at the Moab site would employ about 47 workers. If they were all exposed to radon and external radiation at the levels discussed for individual workers, the latent cancer fatality risk for this population of workers would be 0.028 per year of exposure, or 0.071 over the 5-year duration of surface remediation activities at the Moab site.

For non-workers (i.e., local residents), monitoring data collected during 2002 and 2003 around the Moab site indicate that the radon concentration at the location of the maximally exposed individual is about 1.9 pCi/L. Assuming that this individual was exposed for 8,760 hours per year, this would be equivalent to a latent cancer fatality risk of 1.2×10^{-3} over the 5-year duration of activities for the on-site disposal alternative.

Monitoring data collected during 2002 and 2003 indicate that the latent cancer fatality risk to the maximally exposed individual from radioactive particulates would be about 4×10^{-6} over the 5-year duration of activities for the on-site disposal alternative.

For the population, over the 5 years of activity at the Moab site, the latent cancer fatality risk from radon releases to the population surrounding Moab would be 0.080.

As described under the proposed action for ground water remediation (Section 2.3.2), a 40-acre evaporation pond could be constructed to treat extracted ground water. The water pumped to this pond would be contaminated with ammonia at concentrations of about 1,000 mg/L. The atmospheric concentration of this ammonia for a nearby resident was estimated to be about 2.1 mg/m^3. This concentration is less than the Temporary Emergency Exposure Limit-0 (TEEL-0) value of 15 mg/m^3 for ammonia, which is the threshold concentration below which most people experience no adverse health effects.

4.1.15.2 Impacts from Characterization and Remediation of Vicinity Properties

Remediation at vicinity properties would be estimated to result in less than one fatality (0.031) as a result of industrial accidents.

Radiation exposure at the vicinity properties has not been extensively characterized. However, on the basis of data from other vicinity properties (DOE 1985), the indoor radon level at vicinity properties was estimated to be about 0.046 working levels (7 pCi/L), and the external gamma exposure rate at vicinity properties was estimated to be 0.12 mR/h. A worker exposed for 2,000 hours per year would have a latent cancer fatality risk of 2.9×10^{-4} for radon and 1.2×10^{-4} for external radiation. The total latent cancer fatality risk for a worker at vicinity properties would be 4.1×10^{-4} per year of exposure (Table 4–11), or 1.2×10^{-3} over the 3-year duration of activities at the vicinity properties.

Table 4–11. Worker Impacts for the On-Site Disposal Alternative (Vicinity Properties)

Category of Worker	Radon-Related LCFs[a]	External Radiation-Related LCFs[a]	Total LCFs[a]
Annual			
Individual	2.9×10^{-4}	1.2×10^{-4}	4.1×10^{-4}
Population	6.7×10^{-3}	2.9×10^{-3}	9.6×10^{-3}
Duration of Activities			
Individual	8.7×10^{-4}	3.7×10^{-4}	1.2×10^{-3}
Population	0.020	8.6×10^{-3}	0.029

[a]Based on 23 workers at vicinity property sites.

About 23 workers would be employed at the vicinity properties. If they were all exposed to radon and external radiation at the levels discussed for individual workers, the latent cancer fatality risk for this population of workers would be 9.6×10^{-3} per year of exposure, or 0.029 over the 3-year duration of activities at the vicinity properties.

Prior to remediation activities, people living at the vicinity properties would be exposed to radon and external gamma radiation levels similar to those mentioned previously—indoor radon levels of about 0.046 working levels (7 pCi/L) and external gamma exposure rate of about 120 microroentgens per hour (μR/h). A person exposed for 8,760 hours per year would have a latent cancer fatality risk of 1.3×10^{-3} for radon and 6.5×10^{-4} for external gamma radiation. The total latent cancer fatality risk for a person at vicinity properties prior to remediation would be 1.9×10^{-3} per year of exposure, or 9.6×10^{-3} if this individual lived at a vicinity property for 5 years prior to remediation. If four people lived at each of the 98 vicinity properties, the latent cancer fatality risk for these 392 people would be 0.76 per year of exposure. If these people lived in the vicinity properties for 5 years, about 4 (3.8) of them would die from cancer caused by the mill tailings contamination.

Remediation of the vicinity properties would reduce the radon and external radiation levels at those properties to levels specified by EPA standards, 0.02 working levels (about 3 pCi/L) for radon and 20 μR/h for external gamma exposure rate. A person exposed for 8,760 hours per year would have a latent cancer fatality risk of 5.5×10^{-4} for radon and 1.1×10^{-4} for external gamma radiation. The total latent cancer fatality risk for a person at vicinity properties would be 6.6×10^{-4} per year of exposure. If four people lived at each of the 98 vicinity properties, the annual latent cancer fatality risk for all of these people combined would be 0.26. Over the 30-year post-remediation time period, about 8 (7.8) of these people would die from cancer. Over the entire 35-year pre- and post-remediation time period, about 12 of these people would die from cancer.

4.1.15.3 Construction and Operations Impacts Related to Transportation

The on-site disposal alternative would require about 2,940 shipments of contaminated materials from vicinity properties to the Moab site and 56,463 shipments of borrow material to the Moab site. The borrow material would consist of cover soils, radon and infiltration barrier soils, sand and gravel, riprap, and Moab site reclamation soils.

The transportation impacts of shipping contaminated materials from vicinity properties and borrow material would be from two sources: radiological impacts and nonradiological impacts. Radiological impacts would be from incident-free transportation and from transportation

accidents that released contaminated material. There would be no radiological impacts from moving borrow material because it is not contaminated. Nonradiological impacts would be from engine pollution (emissions from the trucks moving the contaminated material and the borrow material) and from traffic fatalities. The total transportation impacts would be the sum of the radiological and nonradiological impacts. Additional details on these analyses are provided in Appendix H.

Table 4–12 lists the transportation impacts for the on-site disposal alternative. For this alternative, DOE estimates there would be less than one fatality. In comparison, about 40,000 traffic fatalities occur annually in the United States (U.S. Census Bureau 2000) and about 335 occur annually in Utah (DOT 2004).

Table 4–12. Transportation Impacts for the On-Site Disposal Alternative

Alternative	Radiological			Nonradiological		Total Fatalities
	Incident-Free		Accident Risk LCFs	Pollution Health Effects Fatalities	Traffic Fatalities	
	Public LCFs	Worker LCFs				
Vicinity properties	2.7×10^{-5}	3.9×10^{-5}	6.9×10^{-9}	3.7×10^{-4}	1.1×10^{-3}	1.5×10^{-3}
Borrow material	0	0	0	1.1×10^{-3}	0.081	0.082
Mill tailings	0	0	0	0	0	0
Total	**2.7×10^{-5}**	**3.9×10^{-5}**	**6.9×10^{-9}**	**1.5×10^{-3}**	**0.082**	**0.084**

LCF = latent cancer fatality.

Workers. For truck shipments of mill tailings from vicinity properties to the Moab site, the maximally exposed transportation worker would be the truck driver. This person would receive a radiation dose of 26 mrem/yr, which is equivalent to a probability of a latent cancer fatality of about 1.3×10^{-5}.

Public. For truck shipments of mill tailings from vicinity properties to the Moab site, the maximally exposed member of the public would be a person who happened to be in a traffic jam next to a truck containing mill tailings. This person would receive a radiation dose of 0.084 mrem, which is equivalent to a probability of a latent cancer fatality of about 5.0×10^{-8}.

Accidents. The maximally exposed individual member of the public would receive a radiation dose of 0.048 mrem or 4.8×10^{-5} rem from the maximum dose reasonably foreseeable in a transportation accident involving a shipment of mill tailings from a vicinity property to the Moab site. This is equivalent to a probability of a latent cancer fatality of about 2.9×10^{-8}. The probability of this accident is about 4×10^{-4} per year. The population would receive a collective radiation dose of 5.6×10^{-4} person-rem from this accident. This is equivalent to a probability of a latent cancer fatality of about 3.3×10^{-7}.

4.1.15.4 Monitoring and Maintenance Impacts

Monitoring and maintenance activities would include checking water quality, installing a long-term ground water monitoring system, and conducting periodic maintenance and inspections of the site (checking for erosion, damaged fencing, etc.). None of these activities would be expected to breach the cap over the tailings; the installation of the ground water system would be done in clean areas after remediation was complete. Data from another UMTRCA site indicate that the

on-site disposal alternative would be effective in isolating contaminants in the tailings from individuals conducting activities on the site. DOE (2001) concluded that both radon and gamma levels associated with the capped-in-place tailings pile at the Shiprock site in New Mexico were indistinguishable from naturally occurring radiation levels. Therefore, the risk to workers conducting monitoring and maintenance would be comparable to the latent cancer fatality risk from background levels of radioactivity in Utah, about 3×10^{-4} per year of exposure.

4.1.15.5 Impacts from All Sources

Under the on-site disposal alternative, construction activities would occur at vicinity properties, borrow areas, and at the Moab site. Table 4–13 lists the construction-related impacts (fatalities) from these activities. For this alternative, less than one fatality would be estimated to occur from all construction activities.

Table 4–13. Construction-Related Fatalities for the On-Site Disposal Alternative

Alternative	Construction Fatalities
Truck option	
Vicinity properties	0.031
Borrow areas	0.014
Moab site activities	0.11
Total	**0.16**

Table 4–14 shows the total impacts that could occur to workers as a result of exposure to radiation during activities at the Moab site and at vicinity properties.

Table 4–14. Worker Impacts for the On-Site Disposal Alternative (Moab Site and Vicinity Properties)

Category of Worker	Site	Radon-Related LCFs	External Radiation-Related LCFs	Total LCFs[a,b]
Annual				
Individual	Moab	2.6×10^{-4}	3.5×10^{-4}	6.1×10^{-4}
	Vicinity properties	2.9×10^{-4}	1.2×10^{-4}	4.1×10^{-4}
Population	Moab	0.012	0.016	0.028
	Vicinity properties	6.7×10^{-3}	2.9×10^{-3}	9.6×10^{-3}
	Total	**0.019**	**0.019**	**0.038**
5-Year Duration of Activities				
Individual	Moab	6.5×10^{-4}	8.8×10^{-4}	1.5×10^{-3}
	Vicinity properties	8.7×10^{-4}	3.7×10^{-4}	1.2×10^{-3}
Population	Moab	0.030	0.041	0.071
	Vicinity properties	0.020	8.6×10^{-3}	0.029
	Total	**0.052**	**0.051**	**.103**

[a]Based on 47 workers at the Moab site.
[b]Based on 23 workers at vicinity property sites.

Based on as-built radon flux measurements from completed uranium mill tailings disposal cells constructed under both Title I (federal UMTRA Project sites) and Title II (private licensees) of UMTRCA, it is anticipated that actual radon flux would be two orders of magnitude less than the 20-pCi/m^2-s EPA protective standard promulgated in 40 CFR 192. Consequently, it is not expected that radon release from the capped pile would be a contributing source to future exposures. Table 4–15 presents the risks that would occur from residual on-site contamination (ground water) to a future resident, rafter, and camper on the Moab site. In all cases, added cancer risk would be less than a one-in-one-million probability of developing cancer. The potential for noncarcinogenic impacts would be less than the benchmark (a hazard index of 1). The detailed assumptions and calculation methods used to estimate these risk are presented in Appendix D.

Even though DOE's experience supports a conclusion that radon release rates from the capped pile would be negligible and that DOE's long-term monitoring and maintenance of the site would ensure cap integrity, for the purpose of supporting analyses of long-term performance and impacts, DOE has also assessed impacts assuming the maximum allowable release rate of radon, 20 pCi/m^2-s, under EPA's regulations (40 CFR 192). On the basis of this emission rate and the dimensions of the tailings pile, the latent cancer fatality risk for a nearby resident of Moab would be 8.9×10^{-5} per year of exposure, or 2.7×10^{-3} over the 30-year period following the end of construction and operations. This latent cancer fatality risk is less than the risk from background levels of radioactivity in Utah, about 3×10^{-4} per year of exposure or 0.9×10^{-2} over 30 years. Stated differently, the incremental additional latent cancer fatality risk from the maximum permissible disposal cell radon flux to the nearest individual, which is likely orders of magnitude greater than realistic future emission rates, is roughly one-third of the risk from natural background conditions to an individual in the state of Utah. The calculation methods used to estimate these risk are also presented in Appendix D.

Similarly, the annual latent cancer fatality risk for the population within a 50-mile radius of the site was estimated to be 6×10^{-3}. For this same population, the latent cancer fatality risk from the maximum permissible disposal cell radon flux would be 0.18 over the 30-year period following the end of construction and operations. These calculations are based on a distributed population size of 11,028.

The design life of the disposal cell for the uranium mill tailings is 200 to 1,000 years. Over this period of time, the amount of radioactivity in the disposal cell will decrease slightly, less than 1 percent, due to the half lives of the radionuclides contained in the uranium mill tailings. In the time frame of 200 to 1,000 years, the major route of exposure of people would be through the inhalation of radon progeny from the disposal cell. The ground water at the Moab site is naturally high in salts and would not be used for human consumption. Releases of radionuclides to surface water would be diluted by the flow of the Colorado River. Consequently, it is unlikely that ground water and surface water would contribute large latent cancer fatality risks relative to inhalation of radon progeny. With the disposal cell cover in place and the Moab site being under perpetual care, it is likely that the latent cancer fatality risk for an inadvertent intruder would also be low.

As with the radioactivity in the disposal cell, the annual risk would also not decrease appreciably over the 200- to 1,000-year time. Therefore, the annual latent cancer fatality risk for a nearby Moab resident would be about the same immediately after the cover is installed as it would be 1,000 years after the cover is installed, about 8.9×10^{-5} per year of exposure. Based on the 20-pCi/m^2-s radon release rate, for the population within a 50-mile radius of the site, the estimated annual latent cancer fatality risk would be 6×10^{-3}. As with the radioactivity in the disposal cell, the annual population risk would also not decrease appreciably over the 200- to 1,000-year time frame. If it is assumed that the population around the Moab site remains constant over 1,000 years, then an estimated 6 latent cancer fatalities over the 1,000-year time period would occur.

4.1.16 Traffic

This section summarizes potential impacts to traffic in the area affected by the on-site disposal alternative. In the following discussions, estimated percent increases in traffic are based on increases over the 2001 AADT for all vehicles or for trucks on segments of US-191 or I-70 (see Table 3–15). Implementation of this alternative would increase area traffic due to construction and operations at the Moab site, remediation of vicinity properties, and transport of borrow materials from borrow areas to the Moab site and vicinity properties. There would be initial unknown but minor short-term (period of several months) increases in area traffic on US-191 while various site preparations took place. These activities would include bringing heavy construction equipment to the site, such as backhoes, graders, front-end loaders, bulldozers, and trucks; constructing secure stockpile areas for various materials to be used during the remedial action (e.g., diesel fuel, water for dust control); and bringing a variety of construction trades to the site to set up temporary field offices and prepare road access areas. These activities would add to area traffic and could result in minor congestion and inconveniences near the site entrance on US-191.

Workers would commute to the Moab site for jobs at the site, at vicinity properties, and at borrow areas. DOE estimates that the average annual vehicle trips associated with these workers could increase daily traffic in central Moab by an estimated 240 vehicle trips per day on US-191. Although the addition of 240 vehicle trips per day would result in only a 1-percent increase in daily traffic (the reported 2001 AADT in central Moab was 16,045 vehicles of all types), UDOT reports the current traffic situation in Moab as highly congested. Thus, these additional vehicle trips would exacerbate the current congestion problem. Miscellaneous trips for supplies and meals would also add to traffic congestion. However, the above estimate is based on a worst-case analysis that assumes that all 120 workers (see Table 2−4) would need to traverse central Moab to access the Moab site. It is more likely that some workers, possibly one-half of the work force, would come from cities north of Moab, such as Green River, Utah, or Grand Junction, Colorado, and that some workers would car-pool. Also, these trips would occur before 7:00 a.m. and after 7:30 p.m., which are times of the day when traffic volumes would be lower.

Trucks carrying borrow material would travel from borrow sources north (cover, radon barrier, and reclamation soils) and south (sand, gravel, and riprap) of the Moab site, and all of these trips would occur on segments of US-191. North of the Moab site, average annual daily truck traffic on US-191 would increase by 70 daily trips (calculated from Table 2–2). Average annual daily truck trips would increase from 857 to 927, or approximately an 8 percent increase over 2001 levels. Because the destination of these trucks would be the Moab site, they would not pass through the city of Moab. An estimated 16 truck trips per day would be required to provide sand,

gravel, and riprap from sources south of the Moab site. This increase would not be expected to affect traffic on US-191 south of Moab, but because these trucks would have to pass through Moab they would add to the traffic congestion on US-191 in central Moab.

Trucks carrying vicinity property material to the Moab site (and transporting backfill to the properties) would use US-191 both north and south of Moab (Figure 2–7) and also local roads or streets. The estimated maximum of 48 daily one-way trips hauling this material would increase the average annual truck traffic on US-191 by 6 percent. Many of these trips would traverse all or part of Moab.

Monitoring and maintenance activities at the site would result in fewer than five vehicles per day and would be inconsequential compared to existing traffic volumes.

4.1.17 Disposal Cell Failure from Natural Phenomena

This section addresses the potential natural processes that could cause a failure of the disposal cell at the Moab site and the expected consequences and potential risks. The focus of this analysis is to evaluate the potential consequences of contaminants in the water and sediments of the Colorado River based on a significant (catastrophic) release of tailings. The probability of a significant release would be very small over the design life of the on-site disposal cell. Because the initiating event is highly unlikely, failure of mitigation measures and long-term management must be assumed. However, a catastrophic failure was assumed to occur in order to evaluate the potential consequences (risks) and provide decision-makers with impacts that would be unique to on-site disposal.

Several processes could affect the integrity of the disposal cell at the Moab site:

- *Flooding*—Over the design life of the disposal cell (200 to 1,000 years) and beyond, severe flooding of the Colorado River and of the Moab Wash drainage could occur from a large precipitation event in the Moab area and upstream of the Moab area. Flooding as an initiating event for catastrophic failure would be mitigated with side slope armament of sufficient size to prevent erosion from floodwaters, as described in Section 2.1.3.1. The expected consequences from a flood event are discussed further in Section 4.1.3.1.
- *River Migration*—The Colorado River could migrate into the disposal cell over an extended period of time. Catastrophic failure of the disposal cell due to sudden river migration from a single event is considered extremely unlikely. Therefore, river migration would be assumed to occur over many years, and a failure of long-term management of the pile would also have to occur for tailings releases to be significant. The likelihood of river migration as an initiating event would be reduced by the construction of a barrier wall, as described in Section 2.1.4, between the river and the disposal cell to deflect river encroachment.
- *Seismic Activity/Basin Settling*—Although seismic activity is unlikely (see Section 3.1.1.4), the Moab site sits on salt beds that are prone to dissolution over an extended period of time. Dissolution of the salt beds could cause differential settling and disrupt the integrity of the disposal cell. Assuming failure of long-term management, settling of the entire cell would tend to increase the possibility of impacts from radon emissions, floods, or river migration and would tend to increase the potential for ground water contamination.

- *Cap Erosion/Failure*—During major storms or basin settling, it is possible that some failure or breach of the tailings pile cap or cover could occur. Assuming failure of long-term management, this would result in a slow release of contamination to the river and would include the possibility of increased radon releases.

For purposes of this analysis, two types of failures were evaluated even though highly unlikely: catastrophic and long-term. A catastrophic failure could occur during a major flood or a seismic event. A long-term, slow release would be possible for events such as river migration, basin settling, or intermittent erosion of the cell cover. Long-term failures assume smaller-quantity releases over an extended period (many years); a continuation of this type of release would also require a failure of long-term management (this assumes that no repairs to the damaged cell would be done). This type of release, which is possible at all UMTRCA Title I sites, can be mitigated. DOE's newly created (2003) Office of Legacy Management is responsible for monitoring and mitigating this type of release. The hypothetical catastrophic failure could release a large quantity of tailings into a relatively small volume of water compared to long-term releases, which would release a small quantity of tailings into a large volume of water (river flow over many years). Consequently, the assumptions associated with the hypothetical catastrophic event would yield the worst-case situation (more tailings released and higher contaminant concentrations in water).

Risks to humans would be based on some type of activity that would bring people in contact with contamination. In this case, the contamination currently in the tailings pile was assumed to be dispersed downstream during an event such as a flood, and it was assumed that people would come in contact with this contamination in the water or sediments. Exposure of humans to the contamination would depend on what people were doing in the contaminated area. Examples could include building a house and living in this area, camping, or river rafting. These events result in differing time periods that people could spend in contaminated areas and differing activities that could cause someone to be exposed to the contamination (e.g., drinking contaminated water, breathing contaminated air). Risks increase with increasing time and exposure to contamination. Situations where people were exposed to contaminated media (soil, sediments, water, air) for a long period (many hours per day for many years) would yield the highest risks for the same level of contamination in the contaminated media. Other activities such as camping in a contaminated area would yield lower risks because exposure to contamination would occur for a limited number of days per year.

Two types of scenarios were analyzed. First, it was assumed that someone would build a house on contaminated sediments released from the tailings pile at a location downstream of the pile (residential scenario). This scenario assumes a home would be built in a contaminated area and the contaminated water (in this case, contaminated surface water) would be used as the primary drinking water source for many years (in reality, the contaminant concentrations in water would only last on the order of days; therefore, the exposures to contaminated water under a residential scenario are unrealistically high but provide an upper bound to the potential risks). The most significant risks would occur from ingestion of contaminated drinking water and exposure to the radon in air originating from radium-226. This assumes that a flood deposited contaminated sediments in an area where it was feasible to construct a house (e.g., outside the 100-year floodplain).

Second, it was assumed someone would camp in a contaminated area downstream of the pile (camping scenario). The camping scenario assumes two overnight camping events per year in contaminated areas and the accidental ingestion of contaminated surface water and sediments. This scenario was assumed because it yields more worst-case risks than those estimated using assumptions for rafting (the other likely recreational use of the area downstream of the Moab site).

Table 4–16 presents the estimated maximum level of contaminants in water and sediment that would still be protective of human (and ecological) health. The basis for these levels is provided in Appendix D.

Table 4–16. Maximum Exposure Level of Contaminants Protective of Human Health and Ecological Resources

Medium/ Contaminant	Maximum Exposure Level Protective of Human Health (Residential Scenario)[a]	Maximum Exposure Level Protective of Human Health (Camping Scenario)[a]	Maximum Exposure Level Protective of Ecological Resources (Aquatic)[a]	Maximum Exposure Level Protective of Ecological Resources (Terrestrial) [a,b]
Water/uranium	0.11 mg/L	19−36 mg/L	0.0026−0.455 mg/L 1.3 mg/L (chronic) 2.1 mg/L (acute)	7.00−68.8 mg/L
Water/ammonia-N	0.21 mg/L	NA	Approx. 0.6 to 1.2 mg/L (chronic) 3−6 mg/L (acute)	NA
Sediment/uranium	0.23 mg/kg	30,000–120,000 mg/kg	NA	NA
Sediment/radium-226	5 pCi/g[c]	1,700 to 6,900 pCi/g	NA	NA

[a]Concentrations in water and sediments that are greater than the listed exposure levels may indicate a potential unacceptable risk.

[b]Range values are the lowest wildlife no-observed-adverse-effects-level (NOAEL) drinking water standards, 7.00 for mammals (white-tailed deer) and 68.8 for birds (rough-winged swallow) (see Appendix A2).

[c]pCi/g = picocuries per gram.

For the purpose of analysis, a large disposal cell failure (20 to 80 percent of the tailings eroded) was assumed to occur over a short duration (10 hours). Although such a large event would be unlikely, the analysis is useful in projecting potential environmental consequences of a worst-case scenario. The Colorado River was assumed to be at high flood stage during the tailings release. Concentrations of uranium, ammonia as nitrogen, and radium-226, the most prevalent contaminants, were estimated for the failure scenarios.

The following assumptions were made to estimate the concentrations of uranium and ammonia as nitrogen in Colorado River water following a catastrophic tailings release (DOE 2003b):

- The total volume of tailings is 10.5 million tons; 25 percent of the volume is pore water (NRC 1999).
- Volumes of 20 and 80 percent of the tailings eroded into the river at a constant rate over a period of 10 hours (NRC 1999).
- Disposal cell failure occurs during a PMF, and the average river flux over the 10-hour period is 150,000 cfs, or half the 300,000 cfs maximum flux (NRC 1999).

- Concentrations of uranium and ammonia in tailings pore fluids and solid phases are the geometric means of all tailings samples.
- Uranium partitions between solid-phase tailings and river water according to a linear relationship with a distribution ratio of 3.0 mL/g.
- All ammonia is dissolved into the river water (based on its common occurrence in soluble salts at the Moab site).
- Colorado River water mixes with Green River water at a ratio of 1.2:1.0, a 30-year average value determined from river gage stations at Cisco, Utah (Colorado River), and Green River, Utah (Green River) (USGS 2004).
- There is no dispersion of the dissolved phase.
- Colorado River water mixes uniformly with 50 percent of the water in Lake Powell; Lake Powell contains 6.85 trillion gallons (USBR 2004).
- There is no sorption of dissolved contaminants to clean suspended load in the river.

The concentration of uranium in the river water at the Moab site is calculated by assuming the total released uranium (derived from both the solid-phases and the pore water) is distributed linearly between the tailings solids phases and the dissolved aqueous phase:

$$C_{rw} = M_{tot}/(M_s \times R_d + V_{rw})$$

where

C_{rw} = concentration of uranium in river water (mg/L)
M_{tot} = total mass of uranium derived from tailings solids and pore water (kg)
M_s = mass of solid tailings phases (kg)
R_d = distribution coefficient (3 L/kg)
V_{rw} = volume of river water based on 150,000 cfs for 10 hours

The calculation indicates that the river has 1.0 to 4.0 mg/L uranium and 21 to 84 mg/L ammonia (as N) at the Moab site immediately following the release (Table 4-17). The Green River enters the Colorado River about 50 miles downstream. Water transport time to the Green River confluence is about 15 hours. Mixing with water from the Green River dilutes the uranium concentration to 0.55 to 2.2 mg/L (Table 4−17). Mixing with water in Lake Powell further dilutes the uranium concentration to 0.006 to 0.012 mg/L. The ammonia (as N) concentrations decrease to 12 to 48 mg/L and 0.12 to 0.48 mg/L following dilution by the Green River and Lake Powell, respectively (Table 4−17). Further chemical degradation of ammonia would be expected as it is transported from the Moab site through Lake Powell, although ammonia degradation was not evaluated as part of this analysis. In addition, it is likely that concentrations of uranium would be similar to natural background values by the time the water exits Lake Powell. Further dilution would be expected by Lake Mead, and dilution by dispersion, although not included in the analysis, can be expected to be significant.

Table 4–17. Calculated Concentrations of Dissolved Uranium and Ammonia (as N) in Colorado River Water Following a Catastrophic Failure at the Moab Site

Constituent	Tailings Pore Fluid (mg/L)	Tailings Solid Phase (mg/kg)	Concentration at Moab Site (20% release (mg/L)	Concentration at Moab Site (80% release (mg/L)	Concentration after Green River (20% release) (mg/L)	Concentration after Green River (80% release) (mg/L)	Concentration after Lake Powell (20% release) (mg/L)	Concentration after Lake Powell (80 % release) (mg/L)
Uranium	6.63	81.0	1.0	4.0	0.55	2.2	0.006	0.012
Ammonia-N	1,607	1,654	21	84	12	48	0.12	0.48

Source: DOE 2003b.
mg/L = milligrams per liter.

Sediment released during a catastrophic event would deposit in the river bottom or along banks or become part of the suspended load. Fine-grained portions of the sediment would remain in suspension and rapidly transport downstream. Where the river overflowed its banks, fine-grained sediment would be deposited by settling in standing water. The concentrations of contamination in backwater areas would depend on (1) the proportion of fine-grained tailings to clean suspended load, (2) concentration in the suspended tailings, and (3) the mass deposited over a given area. During periods of low flow, fine-grained sediment would be deposited; during high flow, these deposits would be remobilized and transported farther downstream. The sediment would be dispersed and mixed with clean sediment during transport, causing a continual decrease in contaminant load. Based on detailed studies of deposition of radioactive sediment in the Colorado River Basin, it would be expected that very small amounts of contamination would accumulate in the main river channel (HEW 1963).

The most significant mill-related contaminant in the sediment would be radium-226 because of its low tendency to partition (dissolve) in water and its abundance in the tailings (HEW 1963). The calculated radium concentration is based on the assumption that all the radium-226 is partitioned to (held in) the solid phases. Concentration of uranium in the suspended load was calculated by assuming chemical equilibrium with the dissolved phase. Fifty percent of the tailings sediment is assumed to become suspended load, and the other 50 percent is bedload. Uranium concentration in the suspended load of clean sediment is assumed to be 2,000 mg/L and is based on USGS suspended load data from the Cisco, Utah, gaging and sampling station (DOE 2003b).

Table 4–18 presents the calculated concentrations of uranium and radium-226 in the suspended sediment load. These concentrations represent the maximum values that could result in areas where suspended sediment settles out, such as an overbank area. The uranium concentrations in the Colorado River based on the 20-percent failure scenario (2.2 mg/kg near the Moab site and 1.2 mg/kg below the confluence with the Green River) are relatively low and are near the crustal average of 1.8 mg/kg (Mason and Moore 1982). Radium-226 concentrations are well above the 40 CFR 192 cleanup standards of 5 and 15 pCi/g in all cases. Radium-226 deposited from suspended sediment after a catastrophic failure could be of concern.

Table 4–18. Calculated Concentrations of Uranium and Radium-226 in Suspended Load in the Colorado River Following a Catastrophic Failure at the Moab Site

Constituent	Concentration at the Moab Site (20% release)	Concentration at the Moab Site (80% release)	Concentration Below Green River Confluence (20% release)	Concentration Below Green River Confluence (80% release)
Uranium (mg/kg)	2.2	8.8	1.2	4.8
Radium-226 (pCi/g)	944	1,173	515	640

Source: DOE 2003b.
mg/kg = milligrams per kilogram; pCi/g = picocuries per gram.

Table 4–19 compares the maximum exposure levels that would be protective of human and ecological health to the estimated range of concentrations after a catastrophic disposal cell failure.

Table 4–19. Comparison of Risk-Based Maximum Exposure Levels to Estimated Concentrations Following a Disposal Cell Failure

Medium/ Contaminant	Concentration Range (Lake Powell to Moab)	Maximum Exposure Level Protective of Human Health (Residential Scenario)[a]	Maximum Exposure Level Protective of Human Health (Camping Scenario)[a]	Maximum Exposure Level Protective of Ecological Resources (Aquatic)[a] (mg/L)
Water/uranium (mg/L)	0.006−4.0	0.11	19−36	0.0026−0.455 1.3 (chronic) 2.1 (acute)
Water/ammonia-N (mg/L)	0.12−84	0.21	NA	Approx. 0.6 to 1.2 (chronic) 3−6 (acute)
Sediment/uranium (mg/kg)	1.2−8.8	0.23	30,000–120,000	N/A
Sediment/ radium-226 (pCi/g)	515−1,173	5	1,700−6,900	N/A

[a]Concentrations in water and sediments that are greater than the listed exposure levels may indicate a potential risk.
mg/kg = milligrams per kilogram; mg/L = milligrams per liter; pCi/g = picocuries per gram; N/A = not available.

As shown in the tables, if a house were constructed in a contaminated area and contaminated water was used as the primary source of drinking water, risk above the protective levels would occur under the residential scenario. This impact would be more pronounced near the Moab site and would decrease after the influx of the Green River and mixing occurred in Lake Powell. The highest risks would likely occur from constructing a house in an area contaminated with radium-226. Potential concentrations would be much higher than the protective levels for surface soils.

Concentrations under the camping scenario would not appear to present risk above protection levels.

The degree of contaminant impact to aquatic receptors would depend upon (1) the type, duration, and areal extent of the failure event, and (2) the mass and concentrations of contaminants released into the Colorado River. Because of uncertainties associated with a contaminant release,

and cumulative effects that are not contaminant-related, specific impacts to endangered species are difficult to assess.

Assuming catastrophic failure, short-term adverse impacts to aquatic receptors from contaminants would be likely in surface waters and sediments adjacent to the site. These negative impacts would likely decrease as the contaminant concentrations were reduced through dilution and dispersion downstream. Impacts from elevated ammonia at the Moab site downstream to Lake Powell would likely be short term, although fish kills would be possible where concentrations exceeded the acute standards. Ammonia degrades and volatilizes and is not expected to persist in the environment. Although the uranium surface water benchmarks would be exceeded, impacts would more likely occur from elevated concentrations in the sediment. Uranium accumulates in sediments and enters the food chain by adsorption on surfaces of plants and animals and by ingestion of sediments and contaminated food (Driver 1994; Cooley and Klaverkamp 2000; Swanson 1983). Thus, impacts from uranium in the sediments may be longer term because it complexes with sediments where it is likely to be more persistent.

Catastrophic disposal cell failure as a result of an unexpected event could also cause negative impacts to aquatic habitat within areas that are relatively close to the site. Habitat loss could include degradation of backwater nursery areas as a result of elevated concentrations of contaminants and sediment loading. This loss could be extensive in the short term. Once the river dynamics normalized, newly created fish habitat, including backwater areas, could be adversely affected depending upon the duration and concentrations of the contaminant release from the material deposited from the pile.

Catastrophic disposal cell failure would also result in increased turbidity and sediment, which could affect the aquatic and benthic producers. With the loss of primary producers, there would be an effect to the entire food chain.

If mitigated, long-term failure would not likely result in negative impacts to aquatic biota. This type of release can be mitigated with current engineering and technology. DOE's newly created (2003) Office of Legacy Management is responsible for monitoring and mitigating this type of release. In addition, all currently available evaluations of the site's geologic and hydrologic conditions suggest that future lateral migration of the river will tend toward the east, away from the site (See Table 2–33, No. 10 in the EIS). Further, DOE has incorporated a buried riprap diversion wall into the on-site disposal design to mitigate potential impacts should lateral river migration occur. It has been estimated that this engineering control could easily be enhanced or modified in the future should river migration cause encroachment on the site and the disposal cell.

Assuming catastrophic failure, uranium concentrations in Colorado River water would not likely cause negative impacts to terrestrial receptors from the Moab site downstream to Lake Powell. The potential for negative impacts from elevated uranium concentrations in sediment and shoreline soils is unknown. The variable nature of these substrates influences uranium bioavailability and uptake; thus, no single value or benchmark can be applied (Driver 1994). However, riparian communities would be expected to be lost and dependent species displaced. Habitat loss would be extensive and short term. Recolonization of riparian communities and dependent biota would be expected.

Long-term disposal cell failure would not result in negative impacts to terrestrial biota either through increased contaminant concentrations or habitat loss. Estimated concentrations of uranium after a catastrophic failure would approach the background concentrations currently found in Lake Powell. Ammonia levels might still be elevated in Lake Powell, but considerable volatilization and degradation would be expected as the contamination traveled downstream (this was not considered in the calculations). Much of the radium-226 would be expected to settle out in Lake Powell. Therefore, a major tailings release is not anticipated to significantly increase risks to the human populations located downstream of Lake Powell.

4.1.18 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629), directs federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. Minority and low-income populations in the area within 50 miles of the Moab site are described in Section 3.1.20.

The Council on Environmental Quality has issued guidance (CEQ 1997) to federal agencies to assist them with their NEPA procedures so that environmental justice concerns are effectively identified and addressed. In this guidance, the Council encouraged federal agencies to supplement the guidance with their own specific procedures tailored to particular programs or activities of an agency. DOE has prepared guidance, *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements, Second Edition* (DOE 2004), based on Executive Order 12898 and the Council on Environmental Quality environmental justice guidance.

Among other things, the DOE guidance states that even for actions that are at the low end of the scale with respect to the significance of environmental impacts, some consideration (which could be qualitative) is needed to show that DOE considered environmental justice concerns. DOE needs to demonstrate that it considered apparent pathways or uses of resources that are unique to a minority or low-income community before determining that, even in light of these special pathways or practices, there are no disproportionately high and adverse impacts on the minority or low-income population. The DOE guidance also defines “minority population” as a populace where either (1) the minority population of the affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population.

In the EIS, DOE applied the environmental justice guidance to determine whether there could be any disproportionately high and adverse human health or environmental impacts on minority or low-income populations surrounding the Moab site as a result of the implementation of the on-site disposal alternative. Environmental justice concerns were analyzed through an assessment of the impacts reported for on-site disposal. Although no high and adverse impacts were identified, DOE considered whether minority or low-income populations would be disproportionately affected by the alternatives.

An assessment of the census data found that, within the 50-mile area around the Moab site, less than 1 percent of the population had a household income below $18,244, the poverty level for a family of four.

DOE has identified no high and adverse impacts, and there are no minority or low-income populations who would be disproportionately affected by implementation of the on-site disposal alternative.

4.2 Off-Site Disposal (Klondike Flats Site)

The Klondike Flats site is the closest of the alternative disposal sites to the Moab site (approximately 18 miles to the north). This section discusses the short-term and long-term impacts associated with the first of three off-site disposal alternatives. The impacts are based on the proposed actions described in Section 2.2 and the affected environment described in Section 3.2 of this EIS. This alternative may result in the following impacts:

- Impacts at the Moab site
- Impacts at the Klondike Flats site
- Transportation impacts associated with moving tailings from the Moab site to the Klondike Flats site
- Monitoring and maintenance impacts at the Klondike Flats site

The combined impacts that may result from these activities are then summarized for each assessment area (e.g., Geology and Soils) at the end of each subsection. For many activities, impacts at the Moab site would not differ significantly from those described in Section 4.1. Impacts of characterization and remediation of vicinity properties would be the same as those described in Section 4.1. Transportation impacts would vary, depending upon the transportation mode (truck, rail, or slurry pipeline). Vicinity property materials would be co-transported from the Moab site to the Klondike Flats site. Therefore, impacts associated with transporting vicinity property materials are not addressed separately. Impacts associated with borrow areas are addressed collectively in Section 4.5 and are therefore not addressed in this section.

4.2.1. Geology and Soils

Monitoring and maintenance activities would not adversely affect geology and soils. Therefore, these activities are not addressed further in this section.

4.2.1.1 Construction and Operations Impacts at the Moab Site

The geology and impacts at the Moab site due to surface and ground water remediation would be the same as those described for the on-site disposal alternative in Section 4.1.1.1. The soil impacts at the Moab site would be similar to those described in Section 4.1.1.1; however, the approximately 234,000 tons (173, 000 yd^3) of excavated off-pile contaminated site soil would be shipped off-site rather than relocated to the tailings pile. Excavation and backfilling of the tailings pile and the estimated 420,000 yd^3 (2 ft) of contaminated subpile soil that would occur under the off-site disposal alternative would increase the potential for short-term soil erosion at the Moab site.

4.2.1.2 Construction and Operations Impacts at the Klondike Flats Site

Geology

Earthquake risks and seismic activity at the site are low. No hazards to disposal cell stability, such as landslides, slumping, or rock falls, are known to exist. Identified geological resources underlying Klondike Flats are too deep for economical exploitation and therefore would not be affected by the Klondike Flats disposal alternative.

Soils

The primary impact to soils would be the excavation to construct the new disposal cell; this impact would be short term. In addition, approximately 2.2 million yd^3 of borrow soil and other borrow material would be excavated for use at the disposal cell site and Moab site. The maximum area of disturbance to the cell construction area would be 435 acres. The short-term erosion potential and erosion mitigation measures would be identical to those described for the on-site disposal alternative. In addition, UMTRA Project experience has shown that after construction of low-permeability layers within a disposal cell, soils adjacent to the cell are subject to increased long-term erosion due to runoff from the cell. The potential for this long-term erosion to occur would be reduced through the proposed design enhancements along the edges of the cell. Construction of the disposal cell would not result in soil subsidence impacts because construction of the cell would involve removing soils to bedrock.

4.2.1.3 Construction and Operations Impacts Associated With Transportation

Table 4–20 summarizes the areal extent of disturbed soils at the Moab and Klondike Flats sites, including the extent of on-site soils disturbance for each transportation mode (see Section 2.2.7.3). The table also shows the additional disturbance between the Moab site and the Klondike Flats site for each mode. Off-site disturbances would range from 40 to 85 acres; the slurry pipeline would involve the greatest disturbance.

Table 4–20. Summary of Short-Term Soil Impacts—Klondike Flats Off-Site Disposal Alternative

Soil Disturbance Location or Source	Area of Soil Disturbance (acres)
Moab Site (on site)	439
Klondike Flats (on-site; including transportation disturbances)	
Truck transportation	435
Rail transportation	420
Slurry pipeline transportation	435
Moab to Klondike Flats (off site; exclusive of on site)	
Truck transportation	40
Rail transportation	69
Slurry pipeline transportation	85

4.2.1.4 Impacts from All Sources

Under the Klondike Flats disposal alternative, impacts to soils would be short term and would occur from excavation and other disturbances to soils associated with surface remediation activities at the Moab site; construction of the disposal cell, cell access roads and staging areas; and from construction of infrastructure to support the selected transportation method. Table 4–20 summarizes the areal extent of disturbed soils at all locations under the Klondike Flats off-site

disposal alternative. The potential for long-term erosion of soils adjacent to the disposal cell exists but would be controlled by construction design enhancements.

4.2.2 Air Quality

Monitoring and maintenance activities would not adversely affect air quality. Therefore, these activities are not addressed further in this section.

4.2.2.1 Construction and Operations Impacts at the Moab Site

During remediation activities at the Moab site, heavy-duty diesel equipment such as graders, scrapers, and dozers would emit pollutants and fugitive dust. Emission of fugitive dust would be minimized by use of control measures, such as applying water or chemicals and covering open-bodied trucks. As shown in Table 4–21, concentrations of criteria pollutants from the Moab site emissions would be below the primary and secondary NAAQS in 40 CFR 50; concentrations estimated for the truck, rail, or slurry pipeline options would all be about the same. The estimated concentrations shown in Table 4–21 and Table 4–22 were derived by applying tailpipe emission factors provided in *Compilation of Air Pollutant Emission Factors* (EPA 2000) to the estimated construction fleet composition and duration of construction operations.

Table 4–21. Criteria Pollutant Concentrations at the Moab Site

Pollutant	Averaging Period	Standard ($\mu g/m^3$)	Concentration from Emissions ($\mu g/m^3$)
Carbon monoxide	1-hour	40,000	40
	8-hour	10,000	28
Nitrogen dioxide	Annual	100	9.1
Sulfur dioxide	Annual	80	0.90
	24-hour	365	4.5
	3-hour	1,300	10
PM_{10} [a]	Annual	50	3.2
	24-hour	150	16

[a]PM_{10} includes fugitive dust emissions from construction activities.
$\mu g/m^3$ = micrograms per cubic meter.

Table 4–22. Criteria Pollutant Concentrations at the Klondike Flats Site

Pollutant	Averaging Period	Standard ($\mu g/m^3$)	Concentration from Emissions ($\mu g/m^3$)
Carbon monoxide	1-hour	40,000	53
	8-hour	10,000	37
Nitrogen dioxide	Annual	100	12
Sulfur dioxide	Annual	80	1.3
	24-hour	365	6.3
	3-hour	1,300	14
PM_{10} [a]	Annual	50	3.6
	24-hour	150	18

[a]PM_{10} includes fugitive dust emissions from construction activities.
$\mu g/m^3$ = micrograms per cubic meter.

4.2.2.2 Construction and Operations Impacts at the Klondike Flats Site

During construction activities at the Klondike Flats site, heavy-duty diesel equipment such as graders, scrapers, and dozers would emit pollutants and fugitive dust. Emission of fugitive dust would be minimized by use of control measures, such as applying water or chemicals and

covering open truck beds. As shown in Table 4–22, concentrations of criteria pollutants from the Klondike Flats site emissions would be below the primary and secondary NAAQS in 40 CFR 50; concentrations estimated for the truck, rail, or slurry pipeline options would all be about the same. As noted in Section 4.1.2.1, Utah PSD regulations provide that concentrations of PM_{10} attributable to the increases in emissions from construction or other temporary emission-related activities shall be excluded in determining compliance with the maximum allowable increase.

4.2.2.3 Construction and Operations Impacts Related to Transportation

The air quality impacts of transportation under the Klondike Flats disposal alternative are included in Section 4.2.15, "Human Health."

4.2.2.4 Impacts from All Sources

Emissions of criteria air pollutants, including carbon monoxide, nitrogen dioxide, sulfur dioxide, and PM_{10}, would occur at the Moab site, Klondike Flats site, and vicinity properties due to the operation of heavy construction equipment and ground water remediation equipment. No criteria air pollutant emission concentrations at the Klondike Flats site, where concentrations would be expected to be highest, would exceed NAAQS.

4.2.3 Ground Water

Monitoring and maintenance activities would not result in adverse impacts to ground water. Therefore, these activities are not assessed further in this section.

4.2.3.1 Construction and Operations Impacts at the Moab Site

Short-term impacts to ground water would be similar to those described under the on-site disposal alternative. Until construction was completed and the tailings pile was removed from the site, seepage contributed by pore fluids from the base of tailings pile would be expected to contribute a continuous source of 1,100 mg/L ammonia to the ground water system. However, if the pile were removed, no long-term potential for natural subsidence or for seepage of tailings fluids and the salt layer, as described in Section 4.1.3, from the tailings pile to the ground water would exist. The seepage rate from the tailings as a function of time and ammonia concentration is summarized in Table 4–23. In addition, the potential for increasing ammonia concentrations in surface water as a result of a flood would be eliminated.

Table 4–23. Assumptions for Liquid Drainage and Ammonia Concentrations From the Tailings Pile Under the Off-Site Disposal Alternative

Parameter	Value
Infiltration rate	1×10^{-7} cm/s
Gravity drainage	Constant rate: 8 gpm
Transient drainage	Rate would decay from 12 gpm at present to 0 gpm when construction ended
Initial ammonia concentration seepage from base of tailings pile	1,100 mg/L during construction
Breakthrough ammonia concentration from upper salt layer	Not applicable once tailings were removed
Arrival time	Not applicable once tailings were removed
Final concentration	0 mg/L once tailings were removed
Exit time	Not applicable once tailings were removed

gpm = gallons per minute; mg/L = milligrams per liter; cm/s = centimeters per second

Modeling results, presented in Figure 4–7, indicate that most of the ammonia flux from the brine layer and the legacy plume in the alluvial aquifer would flush naturally to the river in approximately 60 to 80 years. At the end of this period, concentrations would decline more rapidly under the off-site disposal alternative than under the No Action alternative or the on-site disposal alternative, because the continuing source of ammonia seeping from the base of the tailings pile would no longer be present. Ground water concentrations would continue to decline until background levels were reached. Predicted concentrations plotted in Figure 4–7 represent the maximum ammonia-N concentrations from a series of observations located along a transect parallel to the Colorado River downgradient from the toe of the tailings pile along a flow path near the center of the plume.

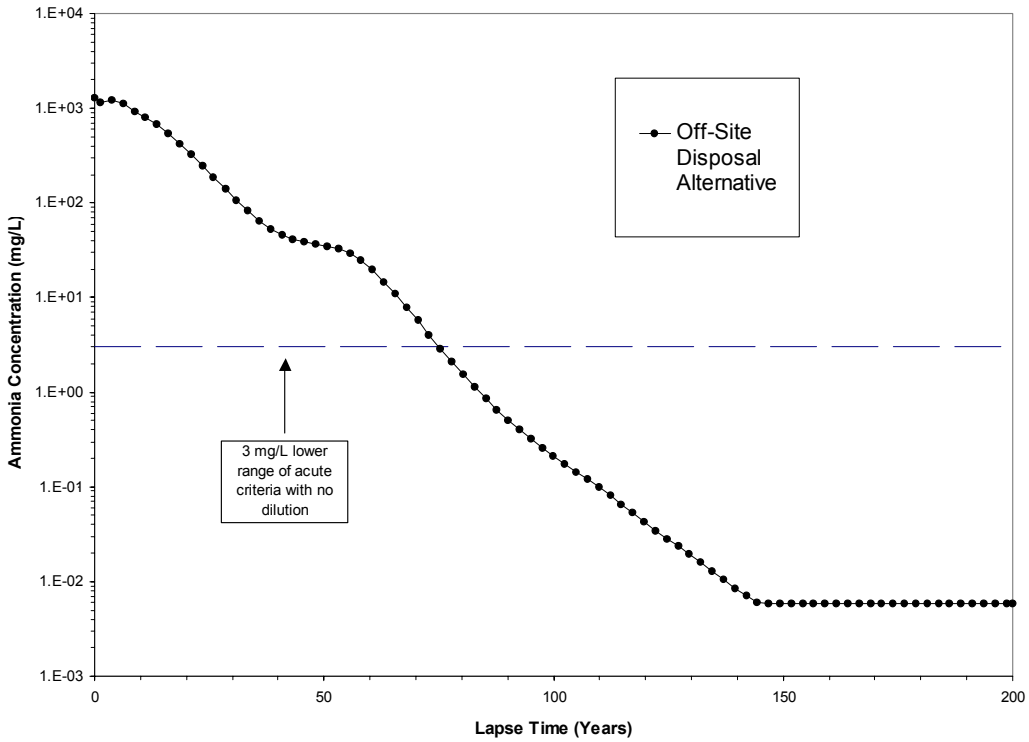

Figure 4–7. Predicted Ammonia Concentrations in Ground Water Adjacent to the Colorado River Under the Off-Site Disposal Alternative

Modeling results indicate that ammonia concentrations in ground water near the bank of the Colorado River would be expected to decline from the current 500 to 1,000 mg/L to a maximum of approximately 3 mg/L in 75 years and reach background concentrations in approximately 150 years. Concentrations at 75 years are illustrated in Figure 4–8.

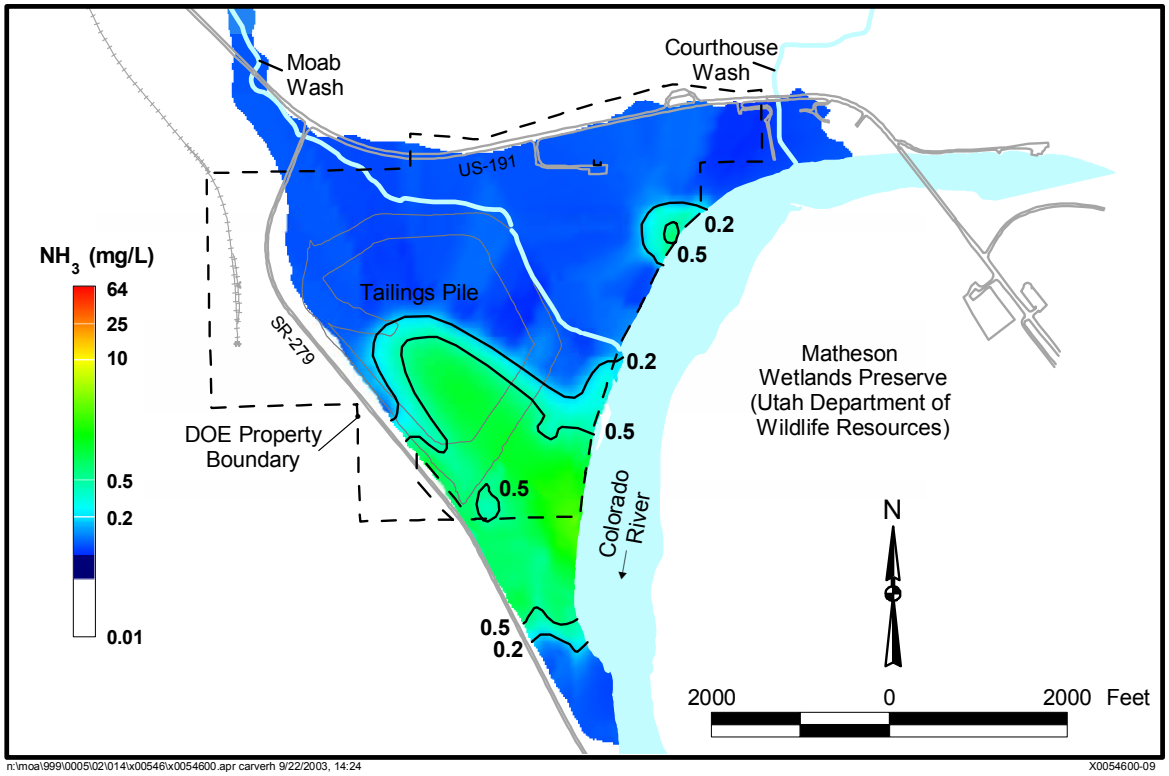

Figure 4–8. Predicted Ammonia Concentrations in Alluvial Ground Water After 75 Years Under the Off-Site Disposal Alternative

4.2.3.2 Construction and Operations Impacts at the Klondike Flats Site

There would be no anticipated effects on regional or local ground water quality resulting from a proposed disposal cell in the Klondike Flats area; the uppermost aquifer (Dakota Sandstone or Cedar Mountain Formation) is approximately 400 to 500 ft below land surface. The Dakota Sandstone is separated from the surface by a thick section of relatively impermeable Mancos Shale that acts as an aquitard to inhibit ground water flow to deeper stratigraphic units. A first-order estimate of travel time for any water seeping from the cell to migrate through the Mancos Shale and reach the uppermost aquifer is over 25,000 years. This estimate is based on a typical hydraulic conductivity value of 1.0×10^{-9} cm/s for marine shale (Freeze and Cherry 1979) and a porosity of 0.06 (Morris and Johnson 1967). This travel time estimate would be verified by site characterization if this site were selected as the off-site alternative. The Ferron Sandstone Member is approximately 200 to 300 ft above the base of the Mancos Shale but is not considered a water-bearing unit. The first significant regional ground water resource is in the Navajo Sandstone, approximately 1,500 to 2,000 ft below land surface. This ground water resource would not be affected by a proposed disposal facility in this area. The areal extent and duration of potential impacts would be limited or nonexistent. There would be no beneficial or adverse effects on ground water if the proposed disposal cell were located at this site. There are no sole-source aquifers in the area within reasonable range of potential impact from the proposed disposal cell.

There would be no anticipated present or future effects on ground water use in the area because there is very little current use and none in the immediate area of the proposed disposal cell.

The compliance strategy for ground water protection would be to meet maximum concentration limits or background levels in the uppermost aquifer, which would be ground water in the Dakota Sandstone or Cedar Mountain Formation. Implementation of this strategy would be enhanced by hydrogeologic isolation (from the 400 to 500 ft of Mancos Shale) and disposal cell design.

4.2.3.3 Construction and Operations Impacts Related to Transportation

In areas that may be affected by the transportation corridors, depth to ground water in the uppermost aquifer varies from less than 100 ft near the Moab site to more than 700 ft near the Klondike Flats site. Therefore, no adverse impacts to ground water as a result of transportation modes are expected.

4.2.3.4 Impacts from All Sources

Ground water at the Moab site would not be adversely affected. Active remediation of ground water influencing surface water would result in reducing the adverse impact to surface water. No adverse impacts would occur to ground water at the Klondike Flats site or to ground water in the transportation corridors.

4.2.4 Surface Water

Because no perennial surface waters are present at the Klondike Flats site, there would be no short-term or long-term impacts to surface water as a result of construction or operations. Likewise, no perennial surface waters are present in the transportation corridors, resulting in no adverse impacts. Monitoring and maintenance activities would not result in adverse impacts at the Klondike Flats site. Therefore, these activities are not assessed further in this section.

4.2.4.1 Construction and Operations Impacts at the Moab Site

Impacts to surface water would be similar to those described under the on-site disposal alternative (Section 4.1.4.1). In the short term, sediment runoff would be controlled during construction and operations activities. Also in the short term, site-related contaminant concentrations affecting the Colorado River would be reduced through implementation of interim actions. Within 5 years of implementing active ground water remediation, contaminant concentrations in surface water would meet applicable surface water criteria. Surface water monitoring would continue after completion of active remediation to verify that contaminant concentrations in surface water were below surface water criteria.

Storm water management during site reclamation would include berms between the site operational areas and the Colorado River and Moab Wash to ensure that the site was not inundated from a flood up to the magnitude associated with a 100-year return interval. If a flood of greater magnitude than this occurred, there would be a potential for tailings to be transported off the site and into the Colorado River and Moab Wash. During a flood greater than the 100-year return interval, alternatives that include on-site drying of tailings materials (i.e., off-site disposal using truck or rail haul) would have the potential for supplying a greater amount of tailings to floodwaters than alternatives that do not include on-site drying (i.e., off-site disposal using slurry pipeline or on-site disposal).

Qualitatively, a substantial failure of the storm water pollution prevention system would reasonably occur only from a flood event greater than the 100-year return interval. As indicated by a recent USGS study (USGS 2005), the overbank flow velocities associated with an event of this magnitude would be less than 2 ft/s. These velocities would have very limited ability to transport contaminants from the site and would likely result in net deposition of sediment. However, the greater flow velocities associated with a flood event through Moab Wash would have a greater ability to transport contaminants from the site to the Colorado River. In either case, the minimal amount of contaminants that may become suspended or dissolved into Colorado River or Moab Wash floodwaters during the completion of either on-site or off-site disposal would be dispersed and diluted in the floodwaters such that there would be no significantly measurable contamination in off-site sediment or river water. A detailed failure analysis was not deemed necessary because (1) the storm water pollution prevention system would be designed for a 100-year event, a level typically applied for permanent civil structures, (2) the duration of activities within the floodplain would be limited to a few years, and (3) the velocities of floodwaters are projected to be low.

4.2.5 Floodplains/Wetlands

Because the Klondike Flats site has no known floodplains or wetlands, no adverse impacts would be expected as a result of monitoring and maintenance or construction and operations activities. A more detailed discussion of impacts to floodplains and wetlands is included in Appendix F.

4.2.5.1 Construction and Operations Impacts at the Moab Site

Impacts at the Moab site under this alternative would be similar to those described under the on-site disposal alternative (Section 4.1.5.1). Impacts due to rechanneling Moab Wash would not occur, but the meanders that would be added to Moab Wash in its current location would result in its carrying less sediment to the river than it does now. The buried riprap wall would not be installed, so no impacts would result. Short-term impacts to the floodplain would result from construction of tailings processing areas; these areas would be removed after remediation.

4.2.5.2 Construction and Operations Impacts Related to Transportation

Because ephemeral and intermittent washes with riparian resources are located near Klondike Flats, the potential for short-term impacts due to construction of transportation routes exists. Impacts would be minimized by avoiding these areas wherever possible and implementing measures to restrict sediment or water runoff from the roads. No long-term impacts would be expected.

4.2.5.3 Impacts from All Sources

At the Moab site, there would be short-term adverse impacts to wetlands and floodplains, and long-term impacts to floodplains associated with remediation and construction activities. Long-term effects associated with adding meanders to Moab Wash would be expected, but they would be beneficial.

4.2.6 Aquatic Ecology

Because no perennial surface waters are present, no adverse impacts to aquatic communities or receptors would occur as a result of construction and operations or monitoring and maintenance at the Klondike Flats site. Therefore, these activities are not discussed further in this section.

4.2.6.1 Construction and Operations Impacts at the Moab Site

Impacts to aquatic biota and habitats at the Moab site would be very similar to those described under the on-site disposal alternative. As described in Chapter 2.0, it is assumed that the same amount of physical disturbance would occur at the Moab site regardless of the disposal option. Chemical and radiological impacts to aquatic resources would be similar to those under the on-site disposal alternative in the short term. The annual use of 235 to 730 acre-feet (depending on transportation mode) of nonpotable Colorado River water would be within DOE's authorized river water use rights but would exceed the 100-acre-foot annual limit set by USF&WS as protective. This unavoidable impact would be mitigated through negotiated water depletion payments. In the long term, removal of the tailings pile combined with active ground water remediation would decrease the time that the contaminants from the disposal cell would affect aquatic resources.

4.2.6.2 Construction and Operations Impacts Related to Transportation

Because no perennial surface waters are present along the transportation corridor between the Moab site and the Klondike Flats site, no adverse effects to aquatic receptors would occur as a result of transportation at the Klondike Flats site. Therefore, transportation-related impacts are not discussed further.

4.2.6.3 Impacts from All Sources

Overall impacts to aquatic ecological resources under the Klondike Flats off-site disposal alternative would include short-term impacts (1) from construction activities along the edge of the Colorado River at the Moab site, (2) from construction of transportation infrastructure across ephemeral surface water channels, and (3) potentially from any transportation spills. These short-term impacts would not occur once the disposal cell construction and the transportation of tailings were complete. No long-term adverse impacts to aquatic resources are expected.

4.2.7 Terrestrial Ecology

Under the off-site disposal alternative, the physical, chemical, and radiological impacts to terrestrial species and habitats associated with construction and operations at the Moab site would be similar to those described for on-site disposal (Section 4.1.7). Appendix A1, "Biological Assessment," presents a detailed discussion of federally listed species that would be affected in the Klondike Flats area.

4.2.7.1 Construction and Operations Impacts at the Klondike Flats Site

Construction of a disposal cell and ancillary support facilities would disturb up to 435 acres at the Klondike Flats site in the disposal cell area. The impacts of physical disturbance would include the short-term loss of cover, foraging, and breeding habitat in construction areas. In the

long term, the area occupied by the proposed disposal cell would result in a permanent loss of habitat. Species with small home ranges would be displaced. However, species with larger home ranges are not anticipated to be adversely affected.

The endangered black-footed ferret (*Mustela nigripes*) is the only federally listed species that could potentially be affected by habitat disturbance resulting from construction of a disposal cell. The white-tailed prairie dog (*Cynomys leucurus*), upon which the black-footed ferret depends, is the only species currently in review for federal listing that could be so affected. All black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne counties in 1999 or their offspring could occur on or in the vicinity of the Klondike Flats disposal site, although the UDWR (2003) reported an unconfirmed sighting in the area in 1989. Consequently, impacts from construction to the black-footed ferret would not be anticipated.

Surveys for white-tailed prairie dogs have been conducted at the Klondike Flats site (BLM 1995). At that time, it was determined that all of the colonies were relatively small and isolated, such that they would not support black-footed ferrets. Prior to development of the Klondike Flats disposal site, the area would be surveyed and the potential effects to white-tailed prairie dogs evaluated. In addition, the potential of such colonies to support black-footed ferrets would also be evaluated simultaneously.

Noise due to construction and operations could have an adverse effect on terrestrial wildlife. At the Klondike Flats site, noise would be generated by construction equipment and material transfer operations. It is estimated that the maximum noise levels that would be generated when all equipment was operating would be approximately 95 dBA measured at 49 ft. This noise level would attenuate over a distance of approximately 6 miles until it reached the quiet desert background level of approximately 30 dBA.

Noise can affect terrestrial organisms by causing physiological changes or behavioral modifications, including nest abandonment. It can also disrupt communication and defense systems. Any of the species that may be present at the Klondike Flats site could be affected by the noise associated with construction and operations. Some of these, such as burrowing owls and prairie dogs, are frequently found close to human activities and may thus be more likely to habituate to noise above background levels.

The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas. The bald eagle is the only federally listed species in the vicinity of the Klondike Flats site that could be affected by noise from site operations. However, it is not known to nest or night roost in the area, nor is it commonly seen in the area, and it would therefore be unlikely to be affected.

Other effects of human presence, including night lighting, also would reduce the overall habitat value of the area. As with noise, some species become habituated to human presence, but others, such as deer or pronghorn antelope, could avoid the site during human activities. The Klondike Flats site is surrounded by many square miles of similar habitat. Therefore, individuals that avoided the vicinity of construction activities would not be forced into less desirable habitat.

Because the effects of noise, supplemental lighting, and human presence could be greater at night than during the day, double-shift operations would likely have greater impact than single-shift

operations. The effects of noise, supplemental lighting, and human presence could be mitigated by limiting the amount of light off the site, minimizing activities at the periphery of the site, and limiting especially loud activities to daylight hours and to seasons when the effects on biota would be reduced. There would not likely be chemical impacts at the Klondike Flats site. Accidental spills of diesel, oil, or other materials would be quickly controlled and mitigated.

Other species of interest, if present, that could be affected by construction of a disposal cell and the associated types of disturbance discussed above, include the burrowing owl, Swainson's hawk, ferruginous hawk, and peregrine falcon.

Impacts of physical disturbance could be avoided or minimized in several ways. The most important action would be to conduct site-specific investigations prior to any development activities at the site to determine the presence of any species of concern. Additional actions would include minimizing site disturbance to the extent practical, revegetating disturbed lands and the cover cap after cleanup was completed, and scheduling ground-clearing activities during periods that would not disturb nesting migratory birds.

4.2.7.2 Impacts of Transportation

The effects to terrestrial species and habitats of transporting the tailings to the Klondike Flats site would depend on the transportation option selected. Truck transport would increase collision mortality and noise, rail transport would increase noise and require greater land development at the Klondike Flats site, and a slurry pipeline would likely disrupt more habitat along the pipeline corridor.

At the Klondike Flats site, much of the cover and radon barrier borrow materials could be obtained from borrow sites relatively near the disposal site, and much of the transport of borrow materials would occur on lower-speed access roads than US-191. This could translate into a lower rate of wildlife-vehicle collisions and less noise due to truck transport of borrow materials compared to transporting the materials from more distant borrow sites on higher-speed access roads.

<u>Truck Transportation Option</u>

Truck transportation of tailings materials from the Moab site to the Klondike Flats site would increase the amount of truck traffic on US-191 north of Moab (Section 4.2.16). This increase in traffic would likely lead to an increase in traffic-related wildlife mortalities and an increase in the average noise levels in the vicinity of the highway.

Bighorn sheep are occasionally observed in the vicinity of US-191, and there have been traffic-related mortalities in the area. Other species potentially affected include mule deer and pronghorn antelope. Small mammals, reptiles, and possibly birds would also suffer increased highway mortality rates. However, it is unlikely that the regional population of any wildlife species would be significantly affected by this increased traffic mortality rate.

The bald eagle is the only federally listed species that could incur an increase in traffic-related mortality. The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas. Bald eagles could be found temporarily and infrequently using such areas when there are opportunities to feed on carrion,

such as in big-game wintering areas or in prairie dog colonies. Therefore, it is possible that if traffic-related wildlife mortality increased due to the project, an increased number of eagles could be hit on highways. However, without data on this relationship, it is reasonable to assume that the number of eagles hit on highways would be proportional to the number of carrion available. The increase in the number of traffic-related wildlife mortalities is expected to be small. Consequently, the potential increase in associated eagle deaths is also expected to be small.

The increased truck traffic along US-191 resulting from transport of tailings from the Moab site to the Klondike Flats site would likely increase ambient noise levels by approximately 5 dB (measured at 49 ft). However, no adverse effect to terrestrial wildlife is anticipated.

The primary federally listed species that could be affected by this increased traffic noise would be the Mexican spotted owl. Data provided by the UDWR (2003) indicated that there were no occurrences of the Mexican spotted owl in any of the project areas. However, habitat models (BLM 2003) indicate that potential habitat areas may exist in the canyons near US-191 over the first 7 miles north from the Moab tailings pile. Nonetheless, these models are primarily based on physical and topographic features and do not consider vegetation requirements. Mexican spotted owls nest, roost, and forage in an array of different community types, but mixed-conifer forests dominated by Douglas fir and/or white fir are most common (USF&WS 1995). However, they may also nest, but less frequently so, in arid, rocky, mostly unvegetated canyons (Romin 2004).

Although there are no forested areas in the vicinity of US-191 north of Moab, there are arid canyons that largely or altogether lack forest-type vegetation. Thus, it is unlikely but possible that spotted owls occur in the canyons near US-191 over the first 7 miles north of the Moab site. If present, the species could be disturbed by noise from increased truck traffic. The area around this section of transportation corridor is a popular recreation area, with heavy use by off-highway vehicles and mountain bikes. Although the increase in truck traffic noise could be detectable up to several miles from the highway, the existing off-road vehicle noise and associated human presence would likely have a greater and more direct impact on the owls.

The potential for impacts to terrestrial wildlife from truck transportation of tailings would be greater in the evening or at night than during the day. Therefore, the impacts of double-shift operations would probably be greater than those of single-shift operations. In either case, such impacts would be of relatively short duration and would cease once the transfer of materials to the disposal cell was completed.

Rail Transportation Option

Rail transportation of tailings from the Moab site to the Klondike Flats site would result in less frequent but potentially higher intermittent noise and ground vibration levels (Section 4.2.10) compared to the truck transportation option. As with truck traffic, this would probably not adversely affect Mexican spotted owls in the vicinity of the rail corridor. Other wildlife species could be sensitive to noise from the rail system, but because of the degree of off-road recreational activity in the area, most wildlife is probably somewhat habituated to human presence and noise. The potential collision-mortality rate would be lower using rail transport compared to the truck transportation option.

Development of the rail infrastructure would disturb slightly more land than either of the other two transportation options. Most of this would occur very near or within the Klondike Flats site boundaries and would not result in increased habitat fragmentation.

The effects of noise on wildlife would be of relatively short duration and would cease at the completion of tailings transport. Because of the poor soils and arid climate, reclamation of the rail infrastructure areas, if pursued, would be slow, resulting in longer-term effects.

Slurry Pipeline Option

Use of a slurry pipeline system to transport tailings from the Moab site to the Klondike Flats site would disturb less habitat at the Klondike Flats site than either of the other transport options. However, this option would increase the amount of potential habitat disturbance away from the disposal site along the transportation corridor.

Construction of the pipeline would disturb some habitat along the route; however, much of this habitat occurs in previously disturbed corridors.

Installation of the pipeline system could disturb species along the transportation corridor such as the Mexican spotted owl, white-tailed prairie dog, black-footed ferret, and species of ground-nesting migratory birds, if present. Site-specific investigations would be conducted prior to pipeline construction to identify any populations of these species. If present, potential impacts could be mitigated by adjusting the location of the pipeline route, or constructing the pipeline during periods of the year that would not disrupt nesting of spotted owls or migratory birds. Operation of the pipeline would not be expected to have any adverse effects on wildlife species or habitats.

4.2.7.3 Monitoring and Maintenance Impacts

Routine post-closure monitoring and maintenance of a disposal cell at the Klondike Flats site would not be expected to have any impacts to terrestrial species or habitats. In the event that major corrective actions were needed, some vegetation recovering on and around the disposal site could be disturbed.

4.2.7.4 Impacts from All Sources

Overall impacts to terrestrial ecological resources from the Klondike Flats off-site disposal alternative would include approximately 50 acres of tamarisk habitat lost at the Moab site (the rest of the site is considered to have zero habitat quality), a maximum of approximately 690 acres of desert habitat at the borrow sites, 420 to 435 acres for development of the disposal cell, and varying additional acreage depending on the mode of transportation.

Total maximum habitat disturbance for the truck or rail transport options from all activities (Moab site, borrow areas, transportation, and Klondike Flats site) would be approximately 1,200–1,245 acres. If the slurry pipeline option were selected, 85 acres would be disturbed for the pipeline corridor and 24 for support roads, bringing the total maximum disturbance from all activities to approximately 1,385 acres.

An additional amount of habitat would be lost at the commercial quarry sites for sand, gravel, and riprap. There would be a slight decrease in habitat value near US-191 if the truck transport option were selected because of increased truck traffic required to haul tailings materials, and there would be a slight increase in traffic-related wildlife mortalities. The rail transport option would result in slightly higher average noise levels near the rail corridor. Impacts of borrow material haulage would be less than for the on-site disposal alternative because the radon barrier and cover materials would be available near the disposal cell site, and haulage of these materials at highway speeds on US-191 would not be required.

4.2.8 Land Use

4.2.8.1 Construction and Operations Impacts at the Moab Site

Impacts to land use would include potential changes to existing land use at the Moab site or at nearby properties. Land use impacts of construction and operations at the Moab site with final disposal at Klondike Flats would be primarily short-term impacts. Construction and operations at the Moab site, which is currently under federal ownership and control, would not alter existing land use at the site. Noise and vibrations that could occur as a result of these activities would be unlikely to travel off the site and thus would be unlikely to affect the use of adjacent or nearby recreational areas (see Section 4.2.10).

Some long-term land use impacts would occur at the Moab site. Following removal of the tailings, ground water contamination would remain beneath the site, and DOE would retain some land for a water treatment facility that would operate until surface water goals were met. Property designated for this facility would likely be in federal ownership for 75 years, creating a loss of that acreage for beneficial land use during this period by other government or private owners and potential interference with other uses of the site.

As discussed in Section 1.4.5, release of portions of the site for future uses would depend on the success of site remediation. DOE's ultimate goal would be to remediate to unrestricted surface use standards. However, DOE would defer its decisions on the release and future use of the Moab site pending an evaluation of the success of surface and ground water remediation.

The long-term commitment of the Moab site for ground water remediation would conflict with Grand County land use planning that designates the site as a Specially Planned Area during remediation activities according to County Ordinance 346, but that envisions future land uses that would allow for low-density residential uses upon completion of remediation.

4.2.8.2 Construction and Operations Impacts at the Klondike Flats Site

Impacts to land use would include potential changes to existing land use at the affected site or at nearby properties. The land selected for the Klondike Flats site is currently administered by BLM. The approximately 435 acres needed for the cell construction area would be withdrawn from BLM administration and transferred to DOE in perpetuity. All surface and subsurface land uses would be vested with DOE.

The Klondike Flats site is currently part of the Big Flat grazing allotment, which is under permit until 2013. This permit would be vacated, and there would be a loss of 0.4 percent of the allotment's grazing rights for the current permittee. The Klondike Flats site is also available for

oil and gas and mineral leasing. A disposal cell in this location would create a long-term loss of all grazing rights and oil and gas and mineral extraction in perpetuity. This would create a long-term loss of revenue for any surface or subsurface permits or leases on the site.

All three options for transportation to the Klondike Flats site would require a permanent access road and land for other transportation modes and the associated infrastructure. About 40 acres of land would be required for the truck haul option transportation infrastructure, including a new overpass to exit US-191. For a rail haul option, approximately 69 additional acres would be needed to construct new rail spurs, a transfer station, and haul roads. Wherever possible, a slurry pipeline would be constructed in the existing pipeline right-of-way or along the US-191 right-of-way. However, approximately 24 acres would be disturbed for a transfer station. For a slurry pipeline, some truck haul roads would still be needed, and the associated impacts would still exist because not all materials could be transported by slurry pipeline to the site for final disposal and must be transported by other means. Land disturbance for the slurry pipeline would be short term because the property allocated for such use would be reclaimed once remediation of the Moab site was complete and the disposal cell was capped.

Regardless of the mode of transportation, a new public access road would be constructed parallel to CR-138 (Blue Hills Road) to facilitate public and recreational traffic south of the site, which has seen increasing motorized and nonmotorized recreational use. It is likely that the new access road would be constructed in the existing county right-of-way, and no new land use impacts would occur. The location and length of the permanent access road would vary depending on the transportation mode and would require approximately 7,000 ft of right-of-way across a southern section of the site, which is currently administered by the State of Utah.

4.2.8.3 Construction and Operations Impacts Related to Transportation

Under the truck haul option, trucks would use the existing highway between the Moab site and the Klondike Flats site. As noted, a new public access road would be constructed to the site. There is an existing rail line between Moab and a location near Klondike Flats. Other than the construction and operation of a rail spur from this line to the Klondike Flats site, there would be no additional land use impacts as a result of the rail haul option.

Noise and vibration would occur above background levels as a result of transporting the tailings by truck or rail and could temporarily disturb residents, businesses, and recreational users along the travel routes (see Section 4.2.10) and temporarily affect current uses of those properties. Traffic disruptions could occur as a result of increased truck traffic and adversely affect residents, businesses, and recreational users along the travel routes (see Section 4.2.16).

The slurry pipeline route from the Moab site to the Klondike Flats site would be 18.8 miles, all within lands administered by BLM. The pipeline would be located in an existing right-of-way to the extent possible, or in a right-of-way parallel to the existing right-of-way. Use of an existing right-of-way would not adversely affect existing land use; use of a corridor parallel to the existing right-of-way would cause minor, short-term land use impacts. When the project was completed, if DOE decided that the pipeline could not be used for other purposes, the pipeline would be removed and the land returned to its original condition.

4.2.8.4 Monitoring and Maintenance Impacts

Monitoring and maintenance of a disposal cell at the Klondike Flats site would not impose any land use impacts as long as the site remained under federal ownership and control. Monitoring locations such as wells that were required outside of DOE's property would impose minor land use impacts.

4.2.8.5 Impacts from All Sources

Short-term land use impacts would occur at the Moab site during construction and reclamation. Long-term impacts would result from ongoing ground water cleanup. Residual contamination at the site or on surrounding properties could create a need for short- to long-term access and restrictions in the form of institutional controls.

Long-term land use impacts would occur at the Klondike Flats site and for the permanent access road. The land use impacts created by the rail and slurry pipeline transportation options would be short term because the land needed for these transportation modes would be reclaimed and returned to BLM for prior designated land use. Of the total potential land use disturbance at Klondike Flats, approximately 420–435 acres for cell construction and up to 24 acres for dedicated access roads would remain under DOE ownership in perpetuity. DOE is deferring decisions regarding future uses and ownership of the 439-acre Moab site pending a determination of the success of remediation activities.

4.2.9 Cultural Resources

This section addresses the potential for disturbance of known cultural resources or the discovery of unknown resources associated with the Klondike Flats off-site disposal alternative.

4.2.9.1 Construction and Operations Impacts at the Moab Site

Under the Klondike Flats off-site disposal alternative, impacts to cultural resources from construction and operations at the Moab site would be the same as those described in Section 4.1.9.1.

4.2.9.2 Construction and Operations Impacts at the Klondike Flats Site

On the basis of current estimates (see Section 3.2.10), 15 to 19 cultural sites eligible for inclusion in the National Register of Historic Places could be adversely affected by construction and operations at the Klondike Flats disposal site. The Class III cultural resource survey that DOE would conduct at the Klondike Flats site would indicate the precise number and types of cultural sites present. Along with the Class III survey, DOE would conduct a site-specific study to identify potential traditional cultural properties that may exist on the site (there is a low to medium likelihood that they would occur). DOE, BLM, the State Historic Preservation Officer, affected Native American tribes, and the Advisory Council on Historic Preservation would determine appropriate mitigation measures through the Section 106 consultation process (see Section 3.1.13.3). Mitigation measures might include (1) avoiding the cultural resource sites, (2) monitoring the cultural resource during surface-disturbing activities, (3) excavating and recording cultural resource data before construction activities began, or (4) moving cultural resource objects from areas of disturbance to nearby undisturbed areas.

Cultural resources located near areas of disturbance could be adversely affected indirectly (through illicit collection, vandalism, or inadvertent destruction) as a result of increased human activity in the area. DOE would require site workers to receive training on the need to protect cultural resources and the legal consequences of disturbing cultural resources.

4.2.9.3 Construction and Operations Impacts Related to Transportation

Under the truck transportation mode, one to four cultural sites (one site near the Moab site; up to three sites near the Klondike Flats site) eligible for inclusion in the National Register of Historic Places could be adversely affected by the construction of transportation infrastructure. Up to three cultural sites near the Klondike Flats site could be adversely affected under the rail alternative.

A total of 25 eligible cultural sites are known to exist within 0.5 mile of the proposed slurry pipeline to the Klondike Flats site. Of these, 6 to 20 could be adversely affected during pipeline construction. The potential for traditional cultural properties to occur along the pipeline route is medium to high. If these properties were located along the route, they most likely would be adversely affected as well. DOE, BLM, UDOT, the State Historic Preservation Officer, affected Native American tribes, and the Advisory Council on Historic Preservation would determine appropriate mitigation measures for these sites through the Section 106 consultation process.

In addition to these direct impacts, cultural resources located near the pipeline could be adversely affected indirectly through illicit collection, vandalism, or inadvertent destruction as a result of increased human activity in the area.

4.2.9.4 Monitoring and Maintenance Impacts

Impacts to cultural resources would not occur from monitoring and maintenance activities under the Klondike Flats disposal alternative.

4.2.9.5 Impacts from All Sources

Table 4–24 lists the total number of cultural sites eligible for inclusion in the National Register of Historic Places that could be adversely affected under each of the Klondike Flats site transportation options.

Table 4–24. Number of Cultural Sites That Could Be Adversely Affected Under the Three Transportation Options

Location/Activity	Transportation Mode		
	Truck	**Rail**	**Slurry Pipeline**
Moab site (construction and operations)	0–2	0–2	0–2
Moab site (highway improvements)	1	0	0
Klondike Flats site (including radon barrier borrow area and site access road)	15–19	15–19	15–19
Cover soil borrow area	0–11	0–11	0–11
Overpass and haul road for truck transport to Klondike Flats site	0–3	NA	0–1
Rail infrastructure at Klondike Flats site	NA	0–3	NA
Pipeline construction	NA	NA	6–20[a]
Total	**16–36**	**15–35**	**21–53[a]**

[a]Numbers do not include potential traditional cultural properties that have not yet been identified along the pipeline route; the likelihood of their occurrence is medium to high.

4.2.10 Noise and Vibration

This section addresses the impacts of noise and ground vibration primarily to human receptors. Where appropriate, impacts to wildlife and cultural resources are also identified. Unless indicated otherwise, all noise and vibration impacts would be temporary and would last only as long as project construction and operations were ongoing.

4.2.10.1 Construction and Operations Impacts at the Moab Site

Under this alternative, noise at the Moab site would come from construction activities and removal of the tailings pile. The largest sources of noise on the site would be heavy earth-moving equipment. The noise generated from these activities would not differ significantly from the noise generated at the Moab site under the on-site disposal alternative. See Section 4.1.10 for a description of the noise associated with construction and earth-moving activities.

For the rail transportation alternative, a conveyor system would be constructed to move the tailings uphill to the rail cars. This would represent an additional noise source. Estimates of noise from conveyor systems vary, but in general, the motor would be the most significant source of noise for a conveyor system. Diesel generators produce less than 80 dBA at a 23-ft reference distance (according to manufacturer specifications) when outfitted with mufflers and enclosures. The maximum level for a conveyor system of 90 dBA at 23 ft would attenuate to 65 dBA within 820 ft. The conveyor system would be located more than 980 ft from Arches National Park, and 1.1 miles from the nearest residence. The additional noise generated by a conveyor system would be indistinguishable relative to the noise generated by other construction equipment such as trucks and bulldozers.

Ground vibration generated by heavy equipment at the Moab site is discussed in Section 4.1.10. No appreciable differences would be expected in ground-level vibration between the on-site disposal alternative and the Klondike Flats off-site disposal alternative.

4.2.10.2 Construction and Operations Impacts at the Klondike Flats Site

Noise at the Klondike Flats site would come from construction activities and movement of the tailings. Regardless of the transportation method used, tailings disposal would require excavating soil and moving the tailings. Borrow materials brought in to cover the disposal cell would also be unloaded and moved. The most significant source of noise from these activities would be heavy equipment such as bulldozers and trucks. Similar to the analysis of the Moab site, a maximum noise level of 95 dBA (1-hour L_{eq}) was assumed to constitute a conservative estimate. This maximum noise level would attenuate to a level below the Moab 65-dBA residential noise standard within 1,480 ft. The only residence near the Klondike Flats site is the Canyonlands Field Airport, where four to seven people reside. This airport is located approximately 2,950 ft from the boundary of the Klondike Flats site and is outside the region of influence for noise.

Background levels of ground vibration range between 62 and 65 dBV. Ground vibration generated from equipment operations at the Klondike Flats site is estimated to have a maximum noise level of up to 95 dBV (Hanson et al. 1991). Ground vibration is estimated to follow a logarithmic decrease as distance from the source increases. Vibrations from a 95-dBV source should decrease to levels below human detection within 820 ft.

4.2.10.3 Construction and Operations Impacts Related to Transportation

Noise from transportation of material from the Moab site to the Klondike Flats site would originate from truck traffic, rail traffic, construction of temporary overpasses, or construction of a slurry pipeline. Truck traffic would occur along US-191 and access roads. Rail traffic would occur along existing rail lines and a new rail spur. Noise from construction of the slurry pipeline would occur along the pipeline corridor, which would run essentially parallel to US-191.

For truck transportation, the maximum hourly average of tailings haul truck traffic passing any point on US-191 between the Moab site and Klondike Flats site would be approximately 40 trucks. Current traffic along this stretch of highway produces a 1-hour L_{eq} of 73 dBA at 25 ft. Assuming attenuation from a line source and molecular absorption, there is a region of influence of 164 ft where noise levels exceed the 65-dBA Moab residential standard (Moab City Ordinance 17.74.080, "Noise Levels"). Assuming the project trucks were going 60 mph and generated 95 dBA at 25 ft from the source, the region of influence would increase by 260 ft to 426 ft. No permanent residences are within this region of influence along the transportation route. Noise generated along access roads should be less than along the highway because of the lower driving speed. No residences are within 0.6 mile of the proposed truck access roads.

For train transportation, the noise would be less than with truck transportation. The region of influence around the rail line that would exceed 65 dBA is estimated to be less than 330 ft. There are no residents within 330 ft of the existing rail line or the spur that would be added.

For slurry pipeline construction, a maximum noise level of 95 dBA is a conservative estimate. The region of influence around the construction site would be 1,480 ft. The location of the noise would move as construction progressed and would end once construction was complete.

There would also be short-term noise associated with the construction of access roads, temporary overpasses, the slurry pipeline, or a new rail spur. These sources of noise would be temporary and would occur more than 0.6 mile from the nearest residents at Canyonlands Field Airport. Noise associated with these activities would attenuate to levels below 65 dBA before reaching the airport.

Ground vibration was considered only for the train and slurry pipeline alternatives, since rubber-wheeled vehicles such as trucks produce minimal amounts of ground vibration. Vibration from rail traffic could reach 90 dBV but would likely be less because of the slow travel speeds expected (10 to 30 mph, depending on grade and crossings). This level of ground vibration would attenuate to background levels within 660 ft of the source. No residents or sensitive receptors were identified within 660 ft of the existing rail line or the spur that would be added. Construction of a slurry pipeline would likely result in ground vibration above background levels within Arches National Park. The estimated maximum level for ground vibration produced during construction of a slurry pipeline would be 95 dBV. This level would result in ground vibration above background levels 820 ft from the source and levels above human perception within 330 ft of the source. Some cultural sites containing rock structures and the historic rock bridge at Arches National Park would be within 2,620 ft of the pipeline, but ground vibration levels would not reach levels (estimated to be 92 to 100 dBV) that would damage these structures.

4.2.10.4 Monitoring and Maintenance Impacts

Monitoring and maintenance of the Klondike Flats site would not be expected to result in significant generation of noise. Any noise generated by these activities would attenuate to near background levels before leaving the boundary of the disposal site.

4.2.10.5 Impacts from All Sources

Noise generated under the Klondike Flats off-site disposal alternative would not exceed the Moab residential noise standard of 65 dBA at any receptor locations. The receptors with the most potential to notice any increase in noise generated by this alternative would include the residences located on the eastern boundary of the Moab site and visitors at Arches National Park. If two 10-hour shifts were used instead of a single 12-hour shift, the noise generated would not change substantially, but there could be a higher potential for annoyance from late-night and early-morning activities.

4.2.11 Visual Resources

This section describes the impacts to the physical features of the landscape that impart scenic value in the region affected by the Klondike Flats off-site disposal alternative. The impacts would be imposed on viewers who live in, work in, or visit an area and can see ongoing human activities or the results of those activities.

4.2.11.1 Construction and Operations Impacts at the Moab Site

Construction and operations at the Moab site would have adverse impacts on visual resources during the construction period. During this period, the primary visual impacts would be associated with the noticeable movement of heavy equipment on the site as well as exhaust emissions and dust generated by the equipment. In an otherwise natural and still landscape, the movement and emissions of the heavy equipment would create a moderate contrast. Removal of the tailings pile, section by section, would increase the contrast between the pile and surrounding landscape until the pile was completely removed. These moderate to strong contrasts would result from the increase in smooth horizontal and vertical lines associated with cuts into the pile. Dusk and dawn lighting (and nighttime lighting under a double-shift work scenario) would be noticeable from all the key observation points as well. The primary viewers of construction activities, the length of time the activities might be viewed, and potential mitigation measures are described in Section 4.1.11.1.

After the tailings were removed, the entire Moab site would be regraded and revegetated with native or adapted plant species. Until vegetation was established on the site (3 to 5 years), the 439 acres of smooth-textured, barren, red soil would contrast strongly with the more rugged, vegetated surroundings. In the long term, these contrasts would become negligible as the site developed a more natural, vegetated look. Scenic views of the Colorado River corridor, with its spectacular canyons and green riverbanks, would expand and become more prominent for travelers on US-191 and SR-279. Figure 4–9 shows a photo simulation of the Moab site after tailings removal and revegetation. Although the future use of the site is not known, removal of the pile and revegetation of the site would have strong positive visual impacts.

Figure 4–9. Simulated View of the Moab Site from Southbound Lane of US-191 After Tailings Pile Removal

[Before UDOT widened US-191]

4.2.11.2 Construction and Operations Impacts at the Klondike Flats Site

Construction and operations at the Klondike Flats site would have minor adverse effects on visual resources, primarily because construction activities and the completed disposal cell would not be seen by most people. DOE selected four key observation points from which to assess visual impacts: (1) US-191 southbound, (2) US-191 northbound, (3) Blue Hills Road, and (4) Arches National Park. Figure 4–10 and Figure 4–11 show DOE's visibility analysis results for two potential locations for the Klondike Flats disposal cell—one in Section 35 of T. 23 S, R. 19 E (Figure 4–10) and one in Section 25 of the same township (Figure 4–11). The darkened areas indicate locations from which a disposal cell could potentially be viewed. The visibility analysis used to create this map is based on elevation and topography. It does not take into account the potential obstruction of views from cultural modifications or vegetation, or the effects of distance on visibility. Without visual aids, such as binoculars, most people would not be able to recognize a disposal cell at distances greater than 5 to 10 miles.

The visibility analysis results for both cell-location scenarios indicate that travelers on US-191, Blue Hills Road, and most areas within Arches National Park would not be able to view the Klondike Flats disposal cell. The one potential adverse impact from cell construction at these key observation points would be from the lighting used during dawn and dusk hours (and at nighttime under the double-shift work scenario) during the construction period. This impact would be expected to be minor, as shielded night lighting would be used to minimize glare. No lighting would remain at the site once the cell was completed.

Figure 4–10 indicates that the disposal cell would be in a viewer's line of sight from the I-70 scenic overlook and the Windows View area in Arches National Park. DOE staff visited both locations and determined that both were too distant from the Klondike Flats site for a cell to be discernible. In both figures, the darkened areas within a 10-mile radius of the Klondike Flats site are in remote locations that generally would not be accessible by vehicle. The only group that would likely view construction activities and the completed disposal cell from these remote locations would be persons recreating in the area.

DOE's proposed action at the Klondike Flats site would be compatible with BLM's Class III visual resource objectives for this area, as the Class III designation allows an activity to attract, but not dominate, the attention of casual observers (BLM 2003). Construction activities and the completed disposal cell would not be seen by the general public.

4.2.11.3 Construction and Operations Impacts Related to Transportation

Truck Haul

Under the truck haul option, the newly constructed US-191 overpass and access road to the Klondike Flats site would be visible to travelers on US-191 and Blue Hills Road, respectively. These features, however, would not draw the attention of most travelers; they are common features in the modern, culturally modified landscape, and travelers would expect to see these kinds of features. Once the disposal cell was completed, the overpass and a portion (about a 2-mile section) of the access road would be removed and reclaimed. After 3 to 5 years of vegetation growth, the former locations of these features would not be apparent.

The number of trucks per hour that would use US-191 and the haul road adjacent to Blue Hills Road on any given day to transport materials (tailings, borrow material, and vicinity property material) would vary, probably significantly, depending on the phase of operation and other factors during the approximately 3 to 5 years (depending on work shift scenario) during which construction and transportation activities would be ongoing (Figure 2–1). Table H–7 reports a total of approximately 331,000 material shipments, which would represent approximately 662,000 one-way trips, conservatively assuming that all shipments consisted of two legs.

A single 12-hour work shift ongoing for 5 years (350 days/year) and a double 10-hour work shift ongoing for 3 years both represent 21,000 work hours. Thus, on average, regardless of the work shift scenario, DOE estimates that it would require approximately 32 trucks per hour using US-191 and the haul road adjacent to Blue Hills Road to transport all materials. This increase in truck traffic may or may not be noticed by travelers on US-191, which already is a primary trucking route. Because truck traffic is currently pervasive on US-191, the visual impacts of the potential additional traffic would be negligible for US-191 travelers. For travelers on Blue Hills Road, between US-191 and the turn-off to the disposal cell site, the addition of 32 trucks per hour would have adverse visual impacts. In an isolated, somewhat desolate, desert setting, the additional truck traffic would create moderate to strong contrasts (depending upon the amount of motorized recreational traffic present) in movement and would draw attention to the project. These impacts would be short term (3 to 5 years) only.

For the general public, this transportation option would be compatible with BLM's Class III visual resource objectives. For a relatively small number of recreationists who travel Blue Hills

Road, this transportation option would not be compatible with Class III objectives during the 3- to 5-year period of disposal cell construction.

Rail Haul

Under the rail haul option, the newly constructed railroad spur would be visible to travelers on US-191 and Blue Hills Road. As under the truck haul option, this feature would not draw the attention of most travelers, as it is a feature commonly found along highways. The train/truck transfer station that would be constructed under this option would draw the attention of recreationists traveling Blue Hills Road. The station would not be visible to travelers on US-191. The station's buildings and rotary dump—characterized by bold, angular, smooth surfaces—would create a strong contrast with the surrounding natural landscape, which is characterized by smooth, flat desert plains, horizontal mesa tops, and sparsely scattered vegetation The movement of haul trucks between the rotary dump and disposal cell site would also create moderate to strong contrast, depending upon the amount of motorized recreational traffic present. These adverse impacts would occur throughout the construction period. Once the disposal cell was completed, haul truck traffic would cease, the station would be dismantled, and the station area would be reclaimed with native vegetation. After 3 to 5 years of vegetation growth, the visual impact would be eliminated. Because of the strong visual contrast the station and truck traffic would create for travelers on Blue Hills Road, this transportation option would not be compatible with BLM's Class III visual resource objectives during the construction period. However, Class III objectives would be met once the station was dismantled.

Slurry Pipeline

Under the slurry pipeline option, adverse visual resource impacts would occur during pipeline construction and for approximately 3 to 5 years afterward, during revegetation of the corridor. After construction of the disposal cell was completed, the pipeline would be removed, again disturbing the land and creating adverse visual impacts. The primary viewers of the pipeline corridor would be travelers on US-191, as the corridor would be visible from the highway along most of its length (with the exception of a 4-mile stretch that parallels historic US-160). In Moab Canyon, the smooth, linear, unvegetated swath created by pipeline construction would contrast moderately with the surrounding features, some of which are linear and barren of vegetation (US-191, historic US-160, railroad grade) and some of which are complex, rugged, or vegetated (canyon walls, sagebrush-covered hills). After vegetation was established along the corridor, the contrast would be weak or nonexistent. The visual impacts associated with construction of the pipeline would not be compatible with BLM's Class II objectives in Moab Canyon. To meet Class II objectives, the level of change to the existing landscape would have to be low, could not attract the attention of a casual observer, and should repeat the basic elements of line, form, color, and texture that are found in the predominant natural features. Class II objectives would be met once the corridor became revegetated, after approximately 3 to 5 years.

North of Moab Canyon, the pipeline route would cross terrain that is designated Class III and Class IV by BLM. In these areas, the smooth, linear, unvegetated swath created by pipeline construction would contrast moderately with the surrounding features, characterized primarily by light-beige and light-gray, rolling desert plains and smooth, rounded, buff-colored bluffs.

Figure 4–12. View of 5-Year-Old Pipeline Corridor from US-191, Approximately 2 Miles South of Blue Hills Road Turnoff

After vegetation was established along the corridor, the contrast between the corridor and surrounding landscape would be moderate to nonexistent, depending upon the success of revegetation. Figure 4–12 shows a view from US-191 of an existing pipeline corridor 5 years after construction. DOE's proposed pipeline would parallel this corridor. The visual impacts associated with construction and revegetation of the pipeline would be compatible with BLM's Class III and IV objectives.

4.2.11.4 Monitoring and Maintenance Impacts

Impacts to visual resources would not occur from monitoring and maintenance activities under the Klondike Flats disposal alternative.

4.2.11.5 Impacts from All Sources

Moving the tailings pile from the Moab site to the Klondike Flats site under any transportation option would have short-term, adverse visual impacts and negligible to no long-term adverse visual impacts, primarily because the short-term construction activities and the completed disposal cell would not be seen by most people. At the Moab site, removal of the pile would have strong beneficial impacts to visual resources. Table 4–25 summarizes visual resource impacts that would be expected under this alternative.

Table 4–25. Summary of Visual Resource Impacts Under the Klondike Flats Off-Site Disposal Alternative

Location/Activity	Visual Resource Impacts	
	Short Term	Long Term
Moab site	Strong adverse impacts primarily to travelers on US-191 and SR-279	Strong positive impacts from removal of tailings pile
Klondike Flats disposal cell site	Negligible to no adverse impacts; site not visible to most casual observers	Negligible to no adverse impacts; site not visible to most casual observers
Cover soil borrow area	Negligible to strong adverse impacts, depending upon borrow source	No adverse impacts
Truck haul[a]	Negligible adverse impacts to US-191 travelers; moderate to strong adverse impacts to Blue Hills Road travelers	No adverse impacts
Rail haul[a]	Negligible adverse impacts to US-191 travelers; strong adverse impacts to Blue Hills Road travelers	No adverse impacts
Slurry pipeline[a]	Moderate adverse impacts to travelers on US-191	Moderate to no adverse impacts to travelers on US-191
Monitoring and maintenance	No adverse impacts	No adverse impacts

[a]Only one transportation option would be selected.

4.2.12 Infrastructure

This section addresses potential impacts on the availability of electric power, potable water, nonpotable water, sewage treatment, rail service, and highways. Unless indicated otherwise, all infrastructure impacts would be temporary and would last only as long as project construction and operations were ongoing.

4.2.12.1 Construction and Operations Impacts at the Moab Site

The basic 600-kVA power demand at the Moab site discussed for the on-site disposal alternative would also apply at the Moab site under all three off-site disposal alternatives. In addition, the rail and slurry pipeline options would result in additional power demands. For truck transportation, the total power demand would be 600 kVA, the same as for the on-site disposal alternative. Rail transportation would require an additional 100 kVA of demand, for a total demand of 700 kVA. Slurry pipeline transportation would require an additional 2,800 kVA, for a total demand of 3,400 kVA. ESC Inc. developed and reviewed this projected demand with Mathew Yates, Pacific Corporation, Moab. Pacific Corporation indicated that this demand would present no capacity problems to the existing electric supply system at the site, nor would system upgrades be required (ESC 2003).

The estimated average daily potable water consumption would differ for the three possible modes of transportation. Assuming the more aggressive double 10-hour work schedule, these demands would be approximately 11,000 gallons per day for slurry pipeline transportation, 12,500 gallons per day for rail transportation, and 15,000 gallons per day for truck transportation.[1] The city of Moab has indicated that these demands could be met without adversely affecting the city's water supply or requiring system upgrades (Swenson 2003).

[1]In Table 2−25, the data shown assume the less aggressive single 12-hour work schedule; the estimates above assume the more aggressive double 10-hour schedule. Further, data in the table show collective consumption at the Moab site, an off-site cell location, and transportation-related usages. For estimating usage at different locations, DOE assumed that half the usage shown in the table would be at the Moab site and half at the off-site disposal site.

The estimated average annual nonpotable water demand impact would differ for the three possible modes of transportation. Assuming the more aggressive double 10-hour schedule for rail and truck transportation, these demands would be approximately 120 acre-feet per year for both rail and truck transportation.[2] For the slurry pipeline mode of transportation, DOE assumes that all 730 acre-feet per year shown in Table 2−24 would come from the Colorado River at the Moab site, although DOE recognizes that some nonpotable makeup water from the off-site disposal sites would be used if necessary. As noted in Section 4.1.12.1, DOE is authorized to withdraw approximately 3 cfs (2,366 acre-feet per year) from the Colorado River for consumptive use and an equal amount for nonconsumptive use. The highest potential demand of 730 acre-feet per year (pipeline transportation) converts to approximately 1.0 cfs, or one-third of DOE's annual authorized consumptive withdrawal volume.

The proposed new rail sidings and rail infrastructure would neither enhance nor detract from the rail infrastructure currently servicing the area and would be removed upon completion of the project. The proposed new acceleration and deceleration lanes and overpasses would neither enhance nor detract from the road infrastructure currently servicing the area; they, too, would be removed upon completion of the project.

Sanitary waste impacts would be the same as those described for the Moab site in Section 4.1.12.1.

4.2.12.2 Construction and Operations Impacts at the Klondike Flats Site

Power demands for construction and operations at the Klondike Flats site would be qualitatively similar to but quantitatively less than those for the Moab site. The impact on the existing electrical infrastructure servicing the Klondike Flats site area would differ for the three alternative modes of transportation. For truck transportation, the total power demand would be 300 kVA; for rail transportation, the total power demand would be 600 kVA; and for slurry pipeline transportation, the total power demand would be 2,500 kVA. ESC of Fort Collins, Colorado, developed and reviewed this projected demand with Mathew Yates, Pacific Corporation (Utah Power and Light), Moab. The capacity of the existing electrical distribution system circuit would support the additional demands for the truck or rail haul options. However, the electrical demands of the slurry pipeline option would require a distribution circuit upgrade from Utah Power's Seven Mile substation, which is located about 6 miles south at the intersection of SR 191 and SR 313, or an upgrade of the Bookcliffs substation, which is located about 12 miles north in Crescent Junction. If the slurry pipeline option were implemented, the selection of the substation for upgrading would be based on a full utility engineering evaluation at the time of construction (ESC 2003).

The potable water demand at the Klondike Flats site would be the same as the demand at the Moab site (Section 4.1.12.1). That is, assuming the more aggressive double 10-hour work schedule, potable water demands would be approximately 5,500 gallons per day for slurry pipeline transportation, 6,250 gallons per day for rail transportation, and 7,500 gallons per day for truck transportation. These demands would not adversely affect the city water supply system.

[2]In Table 2−24 (Nonpotable Water Consumption), the data show collective consumption at the Moab site, the off-site cell location, and transportation-related usages. For estimating usage at the Moab site only, DOE assumed 50 percent of the collective 235 to 240 acre-feet/year usage for rail or truck transport shown in the table, or approximately 120 acre-feet per year.

The nonpotable water demands for Klondike Flats site would be the same as the demand at the Moab site (Section 4.1.12.1). All of the nonpotable water would come from the Colorado River. For the truck and rail transportation modes, DOE assumes that approximately half of the total demand for nonpotable water would be consumed at the off-site disposal site.

Activities at the Klondike Flats site would generate 5,000 to 11,000 gallons of sanitary waste per week, depending on the transportation mode. This would be in addition to the 10,000 gallons per week generated at the Moab site. The waste would be stored in portable toilets and septic tanks and transported for treatment at the city of Moab sewage treatment plant. The total 15,000 to 21,000 gallons of sanitary waste per week would not exceed the city's current excess capacity (see Section 4.1.12.1); however, the same 9,000-gallon-per-day restrictions for wastes from septic tanks and portable toilets described in Section 4.1.12.1 would also apply.

4.2.12.3 Construction and Operations Impacts Related to Transportation

The proposed new rail sidings and rail infrastructure and the proposed acceleration and deceleration lanes and overpasses would neither enhance nor detract from the rail and road infrastructure currently servicing the area and would be removed upon project completion. Truck traffic transporting contaminated materials or borrow area material to the Klondike Flats site or the Moab site would result in increased wear and tear on local roads and on US-191. However, UDOT has indicated that the additional trucks resulting from the truck haul option could be accommodated with current highway design and planned improvements (UDOT 2002). The cost to the State from wear and tear on roads would be offset through vehicle registration and special permit fees, both of which provide revenue to the state general highway fund for road maintenance and repair. Transportation plans would include provisions for enforcing speed limits, road load limits, and any other applicable traffic laws.

The proposed 100 tons of cargo per railcar is currently the National Association of Railroads average cargo weight per car, and neither this load weight nor the proposed 30 cars per train would pose any track use restrictions. However, the proposed increase in train frequency (four to eight round trips per day compared to the current one round trip per week) would require increased track inspections and maintenance and possible speed restrictions in specific areas due to increased wear and tear on the track and crossings. The required increased maintenance costs would be built into the rate quotes for the shipments. The increased volume of traffic may require crossing gates at specific crossings. A decision regarding crossing gates would be made jointly by UDOT, Grand County, and the railroad, based on final determinations of train frequency and schedules (Legg 2003).

Overall site power requirements under the Klondike Flats off-site disposal alternative, including those for transportation-related operations, are presented in Chapter 2.0. The truck transportation mode would not entail additional power demands over the 300 kVA required for site construction and operations. However, the rail transportation mode would draw an additional 300 kVA (600 kVA total demand), and the slurry pump would draw an additional 2,200 kVA (2,500 kVA total demand).

4.2.12.4 Monitoring and Maintenance Impacts

Monitoring and maintenance activities would be generally limited to periodic inspections and activities to remedy incipient erosion. DOE expects that these activities would not affect the local or regional infrastructures.

4.2.12.5 Impacts from All Sources

At the Moab site, the maximum power demand of 3,400 kVA (slurry pipeline transportation option) could be met with no impact to Utah Power's existing electric supply infrastructure servicing the site. At the Klondike Flats site, the power demands of the rail and truck transportation options could be met with no impact to Utah Power's existing electric supply infrastructure servicing the area, but the 2,500-kVA demand of the slurry pipeline option would require a distribution circuit upgrade at Utah Power's Bookcliff or Seven Mile substation. At the Moab site and the Klondike Flats site, the maximum potable water demand of 7,500 gallons per day for both locations (truck transport option) could be met with no adverse impact to the city of Moab's existing potable water supply infrastructure. At the Moab site and the Klondike Flats site, the combined maximum nonpotable water demand of 730 acre-feet per year (slurry pipeline transportation option) would be approximately one-third of DOE's existing Colorado River water usage rights at the Moab site. Sanitary waste impacts at the Moab site and Klondike Flats site would be the same as those described for the Moab site in Section 4.1.12.5. Shipments of vicinity property material and borrow material to the Moab and Klondike Flats sites would result in wear and tear on state and county roads. In addition, implementation of the truck transportation option would result in further road wear and tear. Truck permit and registration fees would compensate Utah and Grand County for this unavoidable adverse impact to the road infrastructure. If the rail transportation option were implemented, there would be increased wear and tear on the Cane Creek Branch rail line and the need to schedule more frequent track and rail bed inspections, maintenance, and repair. Shipping fees paid to Union Pacific Railroad would compensate the railroad for this unavoidable adverse impact to the rail infrastructure.

4.2.13 Solid Waste Management

This section discusses impacts from generation of solid waste under this alternative. These wastes would be generated for the duration of remedial action. Contaminated solid wastes generated at the site would be disposed of in the tailings pile. The impacts of construction and operations at the Moab site under the Klondike Flats disposal alternative would be the same as those described in Section 4.1.13.1 with the exception that RRM from ground water treatment would be generated for an estimated 75 rather than 80 years.

4.2.13.1 Construction and Operations Impacts at the Klondike Flats Site

Activities at the Klondike Flats site would generate approximately 1,040 yd^3 of uncontaminated solid waste, which would be disposed of at the Grand County landfill, with the same impacts as the on-site disposal alternative (see Section 4.1.13.1).

4.2.13.2 Construction and Operations Impacts Related to Transportation

Small volumes of uncontaminated solid waste would be generated during transportation of contaminated materials. These wastes would be disposed of in the Grand County landfill.

4.2.13.3 Monitoring and Maintenance Impacts

Very small volumes of waste would be generated as a result of ongoing inspections and monitoring. All wastes would be managed in accordance with applicable laws and regulations.

4.2.13.4 Impacts from All Sources

Management of an estimated 1,040 yd^3 of solid wastes generated as a result of the Klondike Flats off-site disposal alternative would not result in adverse environmental or waste disposal capacity impacts. Sixty-six hundred tons of RMM would be generated annually for 75 years if an evaporation-based ground water remediation treatment were implemented. These wastes would be handled, recycled, or disposed of according to approved waste management plans and applicable state and federal regulations.

4.2.14 Socioeconomics

This section discusses potential socioeconomic impacts for the off-site disposal alternative at the Klondike Flats site. The aggregate impacts would depend on the mode of transportation used: truck, rail, or slurry pipeline. These impacts are examined using geographically and industrially detailed information on expected direct and indirect changes in output, earnings, and employment over the construction and transportation phases of the project. The analysis also considers potential impacts from increased demand for temporary housing, and the short-term and long-term influence of the surface remediation on the regional tax base and future economic development opportunities.

As discussed in Section 4.1.14, for purposes of analysis, the principal affected socioeconomic region of influence is assumed to be Grand and San Juan Counties in southeastern Utah. For the Klondike Flats alternative, some socioeconomic impacts may carry over to the adjacent Utah Counties of Emory and Carbon and into Mesa County, Colorado. The impact analysis uses project cost and workforce information specific to actions undertaken for the off-site disposal alternative (summarized in Section 4.1.14, Table 4–8). On the basis of this information, economic impacts in the principal two-county socioeconomic region of influence are evaluated using RIMS II regional multipliers obtained from the U.S. Department of Commerce Bureau of Economic Analysis (BEA 1997) (described in Section 4.1.14). The industries expected to be initially affected by the project include the regional construction and transportation industries, along with supporting service industries (especially hotels and restaurants). The project workforce is assumed to come from outside the socioeconomic region of influence and to spend a portion of their earnings on housing, food, and other goods and services within the principal two-county socioeconomic region of influence.

The economic impacts for the off-site disposal alternative at the Klondike Flats site are summarized in Table 4–26. The annual project cost under the truck transport option is estimated to be $41,287,950 over an 8-year disposal period, followed by estimated annual costs of $933,000 during the 75-year period of active ground water remediation/site monitoring. Annual costs under the rail transport option are estimated to be $48,978,463 over the 8-year disposal period, followed by $933,000 over the ground water remediation/site monitoring period. The slurry pipeline transport option is expected to have annual costs of $49,401,688 over the disposal period, and $933,000 over the ground water/site remediation period. Project expenditures over the 8-year disposal period would result in changes in the output of goods and services, labor

Table 4–26. Economic Impacts in the Principal Two-County Socioeconomic Region of Influence Under the Klondike Flats Off-Site Disposal Alternative

Transport Method	Annual Cost	Annual Output of Goods and Services	Annual Labor Earnings	Jobs
Truck	$41,287,950	$54,563,048	$13,418,584	391
Rail	$48,978,463	$64,697,605	$15,918,000	315
Pipeline	$49,401,688	$65,255,331	Year 1 $16,055,548 Years 2–8 15,097,007	335 315

Note: Economic impacts for regional output of goods and services and labor earnings are calculated based on final-demand multipliers provided by the Bureau of Economic Analysis. The respective multiplier values (1.3178 and 0.3250) are multiplied by annualized cost to generate the impact values shown. Employment impacts are calculated as the product of the direct-effects multiplier (1.4262) and total direct jobs for each action alternative (see Tables 2–16, 2–17, and 2–18).

earnings, and employment levels, particularly in the regional construction/transportation industries. Under the truck transport option, the regional output of goods and services would increase by $54,563,048 a year over the 8-year disposal period. Under the rail transport or slurry pipeline options, annual output of goods and services would increase by $64,697,605 and $65,255,331, respectively. The new spending would also increase labor earnings and employment. Under the truck option, earnings and employment would rise by $13,418,584 and 391 direct and indirect jobs. The increase in labor earnings and employment would be $15,918,000 and 315 direct and indirect jobs under the rail transport option. Increased regional earnings under the slurry pipeline option would initially rise to $16,055,548 and 335 jobs during the first-year construction phase of the pipeline. Thereafter, earnings and employment would scale down to $15,097,007 and 315 jobs. The annual expenditures during ground water remediation and site monitoring of $933,000 would not produce significant impacts on the output of goods and services, labor earnings, or employment levels in the two-county socioeconomic region of influence.

The potential shorter-term impacts under the Klondike Flats off-site disposal alternative would include increased demand for temporary housing (discussed in Section 4.1.14) and transportation-related inconveniences to motorists (discussed in Section 4.2.16). The extent of these shorter-term impacts would depend on levels of tourism-recreation activities and the mode of transportation used in the remediation process. Longer-term beneficial impacts from remediation at the Moab site would relate to greater opportunities for economic development in the Moab area and greater diversification of the tax base (discussed in Section 4.1.14).

4.2.15 Human Health

This section addresses potential impacts to human health. These impacts are worker deaths that could occur as a result of industrial accidents and worker or public latent cancer fatalities that could occur as a result of exposure to radiation from activities at the Moab and Klondike Flats sites, at vicinity properties, or during transportation of materials.

4.2.15.1 Construction and Operations Impacts at the Moab Site and Klondike Flats Site

Under the Klondike Flats off-site disposal alternative, construction activities would occur at the Moab site, vicinity properties, borrow areas, and the Klondike Flats site. Table 4–27 lists the impacts from these activities. For each transportation option under this alternative, less than one fatality would be estimated to occur from construction activities.

Table 4–27. Construction-Related Fatalities Under the Klondike Flats Off-Site Disposal Alternative

Alternative	Construction Fatalities
Truck Option	
Vicinity properties	0.031
Borrow areas	0.042
Moab and Klondike Flats activities	0.31
Total	**0.38**
Rail Option	
Vicinity properties	0.031
Borrow areas	0.037
Moab and Klondike Flats activities	0.32
Total	**0.39**
Slurry Pipeline Option	
Vicinity properties	0.031
Borrow areas	0.042
Moab and Klondike Flats activities	0.36
Total	**0.43**

Workers. Under the Klondike Flats disposal alternative, workers would be exposed to radon gas (an inhalation hazard) and external radiation from the mill tailings at the Moab site, vicinity properties, and the Klondike Flats site. According to results of monitoring data collected during construction of an evaporation pond on the tailings pile, the highest radon level measured on the pile was 0.096 working levels (21 pCi/L). A worker exposed to this level of radon for 2,000 hours per year would have a latent cancer fatality risk of 6.1×10^{-4} per year of exposure. The highest external gamma exposure rate measured on the tailings pile was about 0.60 mR/h. A worker exposed to this level of radiation for 2,000 hours per year would have a latent cancer fatality risk of 6.0×10^{-4} per year of exposure. The total latent cancer fatality risk to the worker on the tailings pile would be 1.2×10^{-3} per year of exposure (Table 4–28), or 6.0×10^{-3} over the 5-year duration of activities at the Moab site. Assuming that the radon and external gamma radiation levels were comparable at Klondike Flats, this would also be the latent fatality risk at Klondike Flats.

At the Moab site, there would be 67 workers. Assuming that they were all exposed to radon and external radiation at the levels discussed for individual workers, the latent cancer fatality risk for this population of workers would be 0.081 per year of exposure or 0.40 over the 5-year duration of activities at the Moab site. At the Klondike Flats site, there would be 70 workers. Assuming that they were all exposed to radon and external radiation at the levels discussed for individual workers, the latent cancer fatality risk for this population of workers would be 0.085 per year of exposure or 0.42 over the 5-year duration of activities at Klondike Flats.

Impacts to workers as a result of activities at the vicinity properties would be the same as those under the on-site disposal alternative, as would be the lack of impacts from ground water treatment; these impacts are described in Section 4.1.15.2.

Table 4–28. Worker Impacts Under the Klondike Flats Off-Site Disposal Alternative

Worker	Site	Radon Related LCFs[a,b]	External Radiation-Related LCFs[a,b]	Total LCFs[a,b]
Annual				
Individual	Moab	6.1×10^{-4}	6.0×10^{-4}	1.2×10^{-3}
	Klondike Flats	6.1×10^{-4}	6.0×10^{-4}	1.2×10^{-3}
	Vicinity properties	2.9×10^{-4}	1.2×10^{-4}	4.1×10^{-4}
Population	Moab	0.041	0.040	0.081
	Klondike Flats	0.043	0.042	0.085
	Vicinity properties	6.7×10^{-3}	2.9×10^{-3}	9.6×10^{-3}
	Total	**0.091**	**0.085**	**0.18**
5-Year Duration of Activities				
Individual	Moab	3.0×10^{-3}	3.0×10^{-3}	6.0×10^{-3}
	Klondike Flats	3.0×10^{-3}	3.0×10^{-3}	6.0×10^{-3}
	Vicinity properties	8.7×10^{-4}	3.7×10^{-4}	1.2×10^{-3}
Population	Moab	0.20	0.20	0.40
	Klondike Flats	0.21	0.21	0.42
	Vicinity properties	0.020	8.6×10^{-3}	0.029
	Total	**0.43**	**0.42**	**0.85**

[a]Based on 67 workers at the Moab site, 70 workers at the Klondike Flats site, and 23 workers at vicinity property sites.
[b]LCF = latent cancer fatality

Public. Under the Klondike Flats off-site disposal alternative, nearby residents would be exposed to radon gas released at the Moab site and at Klondike Flats. The average radium-226 content of the tailings, 516 pCi/g, would produce a latent cancer fatality risk for a maximally exposed individual (nearby resident) in Moab of 8.8×10^{-3} over the 5-year duration of activities at the Moab site and 1.8×10^{-5} over the 5-year duration of activities at Klondike Flats. These estimates include radon released from the drying areas at the Moab site. If a slurry pipeline were used to move the tailings to Klondike Flats, the drying areas would not be necessary, and the resulting latent cancer fatality risk for a nearby resident at Moab would be reduced to 6.9×10^{-3} over the 5-year duration of activities at the Moab site.

For the population, over the 5 years of activities at Klondike Flats, the latent cancer fatality risk to the population surrounding Klondike Flats would be 0.011. Over the 5 years of activities at the Moab site, the latent cancer fatality risk to the population surrounding the Moab site would be 1.0. If a slurry pipeline were used to move the tailings to the Klondike Flats site, the drying areas would not be necessary, and the resulting latent cancer fatality risk for the population surrounding the Moab site would be reduced to 0.74 over the 5-year duration of activities at the Moab site.

Nearby residents would also be exposed to radioactive particulates (e.g., radium-226, polonium-210, thorium-230, and uranium) blown off the site from the Moab site and at Klondike Flats. Estimates based on monitoring data collected during 1998 and 1999 from the Monticello, Utah, mill tailings site when uranium mill tailings were being excavated indicate that the latent cancer fatality risk from radioactive particulates would be about 0.1 percent of the risk from radon emissions from the Moab site and Klondike Flats. This is due to the aggressive dust suppression practices that would be used to minimize emissions of radioactive particulates.

4.2.15.2 Construction and Operations Impacts Related to Transportation

Under the Klondike Flats disposal alternative, there would be a total of 330,926 shipments if trucks were used to move the tailings from the Moab site to Klondike Flats (Table 4–29). If rail were used, there would be a total of 68,154 shipments. If a slurry pipeline were used to move the tailings, there would be 64,314 shipments. These shipments would include contaminated material from vicinity properties, uranium mill tailings, and borrow material, which would consist of cover soils, radon and infiltration barrier soils, sand and gravel, riprap, and Moab site reclamation soils.

Table 4–29. Shipments Under the Klondike Flats Off-Site Disposal Alternative

Material	Truck Option		Rail Option		Slurry Pipeline Option	
	Shipments	Mode	Shipments	Mode	Shipments	Mode
Vicinity property material	2,940	Truck	2,940	Truck	2,940	Truck
Borrow material	59,186	Truck	59,186	Truck	59,186	Truck
Uranium mill tailings	268,800	Truck	3,840 2,188	Rail[a] Truck	2,188	Truck
Total	**330,926**		**68,154**		**64,314**	

[a]Each rail shipment would consist of 30 railcars of uranium mill tailings.

The transportation impacts of shipping contaminated materials from vicinity properties, mill tailings, and borrow material would be from two sources: radiological impacts and nonradiological impacts. Radiological impacts would be from incident-free transportation and from transportation accidents that released contaminated material. There would be no radiological impacts from moving borrow material because it is not contaminated. Nonradiological impacts would be from engine pollutants (emissions from the truck or train moving the contaminated materials from vicinity properties, mill tailings, and the borrow material) and from traffic fatalities. The total transportation impacts would be the sum of the radiological and nonradiological impacts. Additional details on these analyses are provided in Appendix H.

Table 4–30 lists the transportation impacts under the Klondike Flats off-site disposal alternative. For this alternative, there would less than one fatality. In comparison, about 40,000 traffic fatalities occur annually in the United States (U.S. Census Bureau 2000) and about 335 occur annually in Utah (DOT 2004).

Workers. For truck shipments of mill tailings from the Moab site to Klondike Flats, the maximally exposed transportation worker would be the truck driver. This person was assumed to drive the truck containing mill tailings for 1,000 hours per year. For the other 1,000 hours per year, the truck would be empty. This driver would receive a radiation dose of 220 mrem/yr, which is equivalent to a probability of a latent cancer fatality of about 1.1×10^{-4}.

Table 4–30. Transportation Impacts Under the Klondike Flats Off-Site Disposal Alternative

Alternative	Radiological			Nonradiological		Total Fatalities
	Incident-Free		Accident Risk LCFs	Pollution Health Effects Fatalities	Traffic Fatalities	
	Public LCFs	Worker LCFs				
Truck Option						
Vicinity properties	2.7×10^{-5}	3.9×10^{-5}	6.9×10^{-9}	3.7×10^{-4}	1.1×10^{-3}	1.5×10^{-3}
Borrow material	0	0	0	9.3×10^{-4}	0.081	0.082
Mill tailings	1.6×10^{-3}	0.010	2.0×10^{-9}	9.6×10^{-5}	0.26	0.27
Total	$\mathbf{1.6 \times 10^{-3}}$	**0.010**	$\mathbf{8.9 \times 10^{-9}}$	$\mathbf{1.4 \times 10^{-3}}$	**0.34**	**0.35**
Rail Option						
Vicinity properties	2.7×10^{-5}	3.9×10^{-5}	6.9×10^{-9}	3.7×10^{-4}	1.1×10^{-3}	1.5×10^{-3}
Borrow material	0	0	0	9.3×10^{-4}	0.081	0.082
Mill tailings	1.6×10^{-5}	1.6×10^{-3}	3.5×10^{-9}	6.1×10^{-5}	0.15	0.15
Total	$\mathbf{4.3 \times 10^{-5}}$	$\mathbf{1.6 \times 10^{-3}}$	$\mathbf{1.0 \times 10^{-8}}$	$\mathbf{1.4 \times 10^{-3}}$	**0.23**	**0.23**
Slurry Option						
Vicinity properties	2.7×10^{-5}	3.9×10^{-5}	6.9×10^{-9}	3.7×10^{-4}	1.1×10^{-3}	1.5×10^{-3}
Borrow material	0	0	0	9.3×10^{-4}	0.081	0.082
Mill tailings	1.3×10^{-5}	8.4×10^{-5}	1.6×10^{-11}	7.8×10^{-7}	2.1×10^{-3}	2.2×10^{-3}
Total	$\mathbf{4.0 \times 10^{-5}}$	$\mathbf{1.2 \times 10^{-4}}$	$\mathbf{6.9 \times 10^{-9}}$	$\mathbf{1.3 \times 10^{-3}}$	**0.084**	**0.086**

For rail shipments of mill tailings from the Moab site to Klondike Flats, the maximally exposed transportation worker would be an individual who inspects the loading of the rail cars. This person would receive a radiation dose of 440 mrem/yr, which is equivalent to a probability of a latent cancer fatality of about 2.2×10^{-4}.

Public. For truck shipments of mill tailings from the Moab site to Klondike Flats, the maximally exposed member of the public would be a resident who lived along the road on which the tailings were shipped. This person would receive a radiation dose of 1.0 mrem/yr, which is equivalent to a probability of a latent cancer fatality of about 6.3×10^{-7}.

For rail shipments of mill tailings from the Moab site to Klondike Flats, the maximally exposed member of the public would be a resident who lived along the rail line on which the tailings were shipped. This person would receive a radiation dose of 0.53 mrem/yr, which is equivalent to a probability of a latent cancer fatality of about 3.2×10^{-7}.

Accidents. If trucks were used to transport the mill tailings from the Moab site to Klondike Flats, the maximally exposed individual would receive a radiation dose of 0.16 mrem or 1.6×10^{-4} rem from the maximum dose reasonably foreseeable for a transportation accident involving a shipment of mill tailings. This is equivalent to a probability of a latent cancer fatality of about 9.6×10^{-8}. The probability of this accident is about 0.06 per year.

If this accident occurred near Moab, the population would receive a collective radiation dose of 1.8×10^{-3} person-rem, which is equivalent to a probability of a latent cancer fatality of about 1.1×10^{-6}. If this accident occurred in a rural area, the population would receive a collective radiation dose of 2.9×10^{-6} person-rem, which is equivalent to a probability of a latent cancer fatality of about 1.7×10^{-9}.

If rail were used to transport the mill tailings from the Moab site to Klondike Flats, the maximally exposed individual would receive a radiation dose of 1.4 mrem or 1.4×10^{-3} rem from the maximum dose reasonably foreseeable for a transportation accident involving a shipment of mill tailings. This is equivalent to a probability of a latent cancer fatality of about 8.5×10^{-7}. The probability of this accident is about 0.3 per year.

If this accident occurred near Moab, the population would receive a collective radiation dose of 0.017 person-rem, which is equivalent to a probability of a latent cancer fatality of about 1.0×10^{-5}. If this accident occurred in a rural area, the population would receive a collective radiation dose of 2.7×10^{-5} person-rem, which is equivalent to a probability of a latent cancer fatality of about 1.6×10^{-8}.

4.2.15.3 Monitoring and Maintenance Impacts

Monitoring and maintenance activities would include checking water quality and installing a long-term ground water remediation system at the Moab site, and conducting periodic maintenance and inspections of the Klondike Flats site (checking for erosion, damaged fencing, etc.). None of these activities would be expected to breach the cap over the tailings; installation of the Moab site ground water system would be done in clean areas after remediation was complete. Data from another UMTRCA site indicate that the Klondike Flats off-site disposal alternative would be effective in isolating the contaminants in the tailings from individuals conducting activities on the site. DOE (2001) concluded that both radon and gamma levels associated with the capped-in-place tailings pile at the Shiprock site in New Mexico were indistinguishable from naturally occurring radiation levels. Therefore, the latent cancer fatality risk to workers conducting monitoring and maintenance would be comparable to the risk from background levels of radioactivity in Utah, about 3×10^{-4} per year of exposure.

4.2.15.4 Impacts from All Sources

Under the Klondike Flats off-site disposal alternative, less than one fatality would be estimated to occur from construction activities under any of the transportation options. Transportation of contaminated materials from the Moab site to the Klondike Flats site would result in the exposure of workers and the public to very small amounts of radiation; these exposures would not be expected to result in any latent cancer fatalities to any population. Ammonia releases from ground water remediation would be well below threshold concentrations for human health effects.

Based on as-built radon flux measurements from completed uranium mill tailings disposal cells constructed under both Title I (federal UMTRA Project sites) and Title II (private licensees) of UMTRCA, it is anticipated that actual radon flux would be two orders of magnitude less than the 20-pCi/m^2-s EPA protective standard promulgated in 40 CFR 192. However, even though DOE's experience supports a conclusion that radon release rates from the capped pile would be negligible and that DOE's long-term monitoring and maintenance of the site would ensure cap integrity, for the purpose of supporting analyses of long-term performance and impacts, DOE has also assessed impacts assuming the maximum allowable release rate of radon, 20 pCi/m^2-s, under EPA's regulations (40 CFR 192).

Based on this emission rate and the dimensions of the disposal cell, the latent cancer fatality risk for a nearby resident would be 1.5×10^{-7} per year of exposure, or 4.4×10^{-6} over the 30-year period following the end of construction and operations. This latent cancer fatality risk is less than the risk from background levels of radioactivity in Utah, about 3×10^{-4} per year of exposure.

For the population near the Klondike Flats site, the latent cancer fatality risk would be 2.8×10^{-3} over the 30-year period following the end of construction and operations.

At the Moab site, radon emissions would fall to background levels because the mill tailings pile would have been relocated. The latent cancer fatality risk would be comparable to the risk from background levels of radioactivity in Utah, about 3×10^{-3} per year of exposure.

The design life of the disposal cell for the uranium mill tailings is 200 to 1,000 years. Over this period of time, the amount of radioactivity in the disposal cell will decrease slightly, less than 1 percent, due to the half lives of the radionuclides contained in the uranium mill tailings. In the time frame of 200 to 1,000 years, the major route of exposure of people would be through the inhalation of radon progeny from the disposal cell. There is no surface water pathway at the Klondike Flats site. The uppermost aquifer at the Klondike Flats site is 400 to 500 ft below the surface, and the travel time to the uppermost aquifer is over 25,000 years, so it is unlikely that ground water would contribute large latent cancer fatality risks relative to inhalation of radon progeny. With the disposal cell cover in place and the Klondike Flats site being under perpetual care, it is likely that the latent cancer fatality risk for an inadvertent intruder would also be low.

After the disposal cell cover was installed, the estimated annual latent cancer fatality risk from radon for a nearby Klondike Flats resident would be 1.5×10^{-7}. As with the radioactivity in the disposal cell, the annual risk would also not decrease appreciably over the 200- to 1,000-year time frame. Therefore, the annual latent cancer fatality risk for a nearby Klondike Flats resident would be about the same immediately after the cover was installed as it would be 1,000 years after the cover was installed. This assumes that the nearby resident remains at his or her present location. If the resident were to move closer to the disposal cell, the annual latent cancer fatality risk would be similar to the risk at the Moab site, 8.9×10^{-5} per year of exposure.

Based on the 20-pCi/m^2-s radon release rate, for the population within a 50-mile radius of the Klondike Flats site, the annual latent cancer fatality risk was estimated to be 9.3×10^{-5}. As with the radioactivity in the disposal cell, the annual risk would also not decrease appreciably over the 200- to 1,000-year time frame. If it is assumed that the population around the Klondike Flats site remains constant over 1,000 years, then the estimated latent cancer fatality risk over the 1,000-year time period would be 0.09.

4.2.16 Traffic

This section summarizes potential impacts to traffic in the area affected by the Klondike Flats disposal alternative. In the following discussions, estimated percent increases in traffic are based on increases over the 2001 AADT for all vehicles or for trucks on segments of US-191 or I-70 published by UDOT (see Table 3–15).

Implementation of this alternative would increase area traffic as a result of construction and operations at the Moab site, remediation of vicinity properties, transport of tailings from the Moab site to the Klondike Flats site, and transport of borrow materials from borrow areas to the Moab site, vicinity properties, and the Klondike Flats site.

There would be initial minor short-term (period of several months) increases in area traffic on US-191 while preparations took place at the Moab site and at the Klondike Flats site. These activities would include bringing heavy equipment such as backhoes, graders, front-end loaders, bulldozers, and trucks to the sites; and constructing secure stockpile areas for various materials to be used during the remedial action (e.g., diesel fuel, water for dust control). In addition, a variety of construction trades would need to access the sites to set up temporary field offices and prepare road access areas. These activities would add to area traffic and could result in minor congestion and inconveniences near the site entrances on US-191.

Construction workers would commute to the Moab site for jobs at the site, at vicinity properties, and at borrow areas. DOE estimates that the average annual number of vehicle trips associated with these workers could increase daily traffic in central Moab by an estimated 380 vehicle trips per day on US-191 (calculated from Table 2–16). Transportation-related workers would also commute to jobs. DOE estimates that the vehicle trips associated with these workers could increase daily traffic on US-191 by 168 vehicle trips per day (truck transportation option) (calculated from Table 2–16). If all workers traveled through central Moab to access their work location, an estimated 548 new vehicle trips per day would result in an estimated 3-percent increase in traffic in central Moab. (The rail and pipeline transportation modes would also result in a 3-percent increase in traffic in downtown Moab from commuters.) The current traffic situation in Moab is reported by UDOT as highly congested, and these additional vehicle trips would exacerbate the current congestion problem. Miscellaneous trips for supplies and meals would also add to traffic congestion. However, this estimate is based on a worst-case analysis that assumes the maximum number of transportation workers (truck option) and that all workers would need to traverse central Moab to access the Moab and Klondike Flats sites. It is more likely that some workers, possibly one-half of the work force, would come from cities north of Moab, such as Green River, Utah, or Grand Junction, Colorado, and that some workers would car-pool. In addition, assuming a double work shift, approximately half of these trips would occur before 7:00 a.m. and just after 4:00 a.m., times of the day when traffic volumes are typically lower. The short-term (estimated 6 months) impact that would be associated with the 250 pipeline construction workers under the pipeline option was not considered a worst-case scenario.

Transporting contaminated vicinity property material and associated backfill material to the Moab site would require up to 48 daily truck trips on local roads and US-191, some or most of which would transit central Moab (Section 2.1.2.2). Assuming the worst-case traffic scenario of a double work shift, transporting all contaminated material from the Moab site to the Klondike Flats site would require an estimated 768 daily tandem truck trips (Table 2–9) on US-191, none of which would transit central Moab. This would increase existing levels of all traffic on US-191 between the Moab site and Klondike Flats by 29 percent, or an estimated 95-percent increase in truck traffic on US-191. Using truck transportation under this alternative would almost double truck use of US-191 from the existing use; however, this increase would be distributed evenly over the 20 hours per day that work would be ongoing under a double-shift work schedule.

Trucks carrying borrow material would originate from borrow sources north and south of the Klondike Flats site. All of these trips would occur on segments of US-191. North of Moab, truck traffic would increase by 116 trucks per day, or a 14-percent increase in truck traffic on US-191 north of the disposal site. A portion of these materials would continue to the Moab site to be used for site restoration. Because the destination of these trucks would be the Klondike Flats site or the Moab site, traffic in central Moab would not be affected. However, an estimated nine truck trips carrying borrow materials from south of Moab would also occur. These trips are not considered further, as their impact would be minor compared to existing traffic levels of 16,045 in central Moab.

In addition to use of US-191, borrow material shipments coming from the Floy Wash borrow area would also need to use I-70. As shown in Table 3−15, the existing AADT on I-70 west of Crescent Junction is 7,040 vehicles of all types. Assuming all cover and Moab site reclamation soils came from Floy Wash, the addition of 116 trips per day would result in a 2-percent increase over current AADT volumes on 1-70. Truck volume on I-70 would increase from 1,126 trucks to 1,246 heavy trucks per day, a 10-percent increase. I-70 in this area is not considered congested by UDOT and does not currently carry large volumes of traffic.

Although there would be sustained increases in the AADT on US-191, project components would include an overpass to access the upgraded disposal site road (Blue Hills Road) and acceleration and deceleration lanes that would alleviate safety concerns related to use of US-191 by recreational and commercial truck traffic. It is anticipated that upgrading US-191 from two to four lanes between SR-313 and the Moab site would be completed prior to the start of this project.

Rail transport would also require the transport of borrow materials as described above (116 truck trips per day related to transport of borrow materials from borrow areas north of Moab, and 9 trips per day related to transport of borrow sources south of Moab). It would also require 2–5 truck trips per day to haul contaminated debris that could not be carried by rail. This additional truck traffic on US-191 would not be noticeable.

Rail transport would require between 8 and 16 daily train trips to carry contaminated materials between the Moab site and Klondike Flats site, which would occur 6 days a week. One to two trains per hour would travel past intersecting county or state roads, which would result in vehicle delays of 2 to 3 minutes at the various railroad crossings. These delays would affect primarily SR-313, Gemini Bridges, Blue Hills Road, and other county roads used for backcountry access. There would be potential safety concerns over motorists waiting at the intersection of Blue Hills Road and US-191 for the railroad crossing to clear. Blue Hills Road provides access to heavily used backcountry areas.

A slurry pipeline would also require limited transport of materials by truck. Transport of oversized materials that could not be transported by pipeline would result in additional minor use of trucks on US-191 (about six trucks per day). In addition, borrow materials would be transported as described under the truck transportation option.

Annual monitoring and maintenance activities at the site would result in no increases in traffic volumes.

4.2.17 Disposal Cell Failure from Natural Phenomena

It is possible that a disposal cell failure could occur at the Klondike Flats site. The possibility of failure at this site would be much lower than at the Moab site because it was selected for analysis, in part, to avoid the more dynamic characteristics of the Moab site (see Chapter 3.0). The Klondike Flats site is not located near a river, does not have historical seismic activity, and is not prone to settling. In addition, this site is located farther away from populated areas or sensitive habitats than the Moab site, which would reduce the potential risks if a disposal cell failure occurred. Therefore, the possibility of a failure occurring and resulting in potential risks at the Klondike Flats site would be much lower than the potential risks of a disposal cell failure at the Moab site. For this reason, a potential failure at this site was not evaluated.

4.2.18 Environmental Justice

The basis for DOE's analysis of environmental justice impacts is described in Section 4.1.18. One census block area with a reported annual household income of less than $18,244 (poverty level for a family of four) is found about 30 miles north of the site. Although this population could be exposed to small doses of radiation as a result of activities under this alternative, there is no evidence that it would be exposed at a level any higher than the general population. Although traffic in central Moab would be an adverse impact, it does not appear that minority or low-income populations would suffer disproportionately.

DOE has identified no high and adverse impacts, and no minority or low-income populations that would be disproportionately affected by the implementation of the Klondike Flats disposal alternative.

4.3 Off-Site Disposal (Crescent Junction Site)

This section discusses the short-term and long-term impacts associated with the second of three off-site disposal alternatives. The Crescent Junction site is located approximately 31 miles north of the Moab site and approximately 13 miles north of the Klondike Flats site. The impacts are based on the proposed actions described in Section 2.2, and the affected environment described in Section 3.3, of this EIS. This alternative may result in the following impacts:

- Impacts at the Moab site
- Impacts at the Crescent Junction site
- Transportation impacts associated with moving tailings from the Moab site to the Crescent Junction site
- Monitoring and maintenance impacts at the Crescent Junction site

The combined impacts that may result from these activities are summarized for each assessment area (e.g., Geology and Soils) at the end of each subsection. For many activities, impacts at the Moab site would not differ significantly from those described in Section 4.2 for Klondike Flats. Likewise, construction and operation impacts at the Crescent Junction site, as well as monitoring and maintenance impacts, would be similar to those addressed for the Klondike Flats site.

Contaminated vicinity property materials would be transported from the Moab site to the Crescent Junction site. Therefore, impacts associated with transporting vicinity property

materials are not addressed separately. Impacts associated with borrow areas are addressed collectively in Section 4.5 and are therefore not addressed in this section.

4.3.1 Geology and Soils

Construction and operations impacts to geology and soils at the Moab and Crescent Junction sites, as well as monitoring and maintenance impacts, would be very similar to or the same as those described in Section 4.2.1 for the Klondike Flats off-site disposal alternative. Impacts from all sources would also be qualitatively identical and quantitatively very similar to those described for the Klondike Flats site in Section 4.2.1. The only differences would be the degree of off-site disturbances associated with transportation modes, as seen by comparing Table 4–31 and Table 4–20. The potential for long-term erosion of soils adjacent to the disposal cell exists but would be controlled by construction design enhancements.

Table 4–31. Summary of Short-Term Soil Impacts—Crescent Junction Off-Site Disposal Alternative

Soil Disturbance Location or Source	Area of Soil Disturbance (acres)
Moab site (on site)	439
Crescent Junction (on-site; including transportation disturbances)	
Truck transportation	435
Rail transportation	420
Slurry pipeline transportation	435
Moab to Crescent Junction (off-site; exclusive of on-site)	
Truck transportation	13
Rail transportation	57
Slurry pipeline transportation	164

4.3.2 Air Quality

Construction and operations impacts to air quality at the Moab and Crescent Junction sites, as well as monitoring and maintenance impacts, would be very similar to or the same as those described in Section 4.2.2 for the Klondike Flats off-site disposal alternative. Emissions of criteria air pollutants, including carbon monoxide, nitrogen dioxide, sulfur dioxide, and PM_{10}, would occur at the Moab site, Crescent Junction site, vicinity properties, and borrow areas because of the operation of heavy construction equipment and ground water remediation equipment. No criteria air pollutant emission concentrations would exceed NAAQS as a result of construction and operations at the Crescent Junction site. Consequently, the analysis of air quality impacts is not repeated in this section.

4.3.3 Ground Water

Ground water impacts as a result of construction and operations at the Moab site and of monitoring and maintenance at the Crescent Junction site would be comparable to those described in Section 4.2.3.1. Therefore, these concerns are not addressed further in this section.

4.3.3.1 Construction and Operations Impacts at the Crescent Junction Site

No anticipated adverse impacts on regional or local ground water quality would result from a proposed disposal cell in the Crescent Junction area because of the depth (3,000 ft) to the

uppermost aquifer. In addition, the Dakota Sandstone Formation is separated from the surface by a very thick section of relatively impermeable Mancos Shale, which forms an aquitard that inhibits ground water migration to deeper ground water. Estimated travel time for any water seeping from the cell to migrate through the Mancos Shale and reach the uppermost aquifer is estimated at over 170,000 years. This estimate is based on a typical hydraulic conductivity value of 1.0×10^{-9} cm/s for marine shale (Freeze and Cherry 1979) and a porosity of 0.06 (Morris and Johnson 1967). This travel time estimate would be verified by site characterization if this site were selected as the off-site alternative. Because there are no sole-source aquifers in the area within reasonable range of impact of the proposed disposal cell, the potential for adverse impacts to ground water would be further limited.

4.3.3.2 Construction and Operations Impacts Related to Transportation

Potential impacts to ground water associated with transportation would be limited to the slurry pipeline. There is a possibility that a line could break or leak. However, because of engineering controls for the pipeline (see Section 2.2.4.3), little potential exists for a spill to reach ground water at depths ranging from 100 to 300 ft (the closest depths to ground water along the entire route).

4.3.3.3 Impacts from All Sources

No impacts to ground water are expected at the Crescent Junction site. Ground water impacts that would occur at the Moab site from off-site disposal are discussed in Section 4.2.3.

4.3.4 Surface Water

Impacts to surface water from construction and operations at the Moab site would be similar to those described in Section 4.2.4. At the Crescent Junction site, there would be no impacts to surface water as a result of construction and operations or monitoring and maintenance. Approximately 100 ft of buried pipeline would be placed within ephemeral stream crossings under this alternative. Transportation-related impacts would be limited to the potential for short-term surface disturbance as a result of construction through ephemeral washes and to spills that could occur. However, the potential for short-term adverse effects would be limited with well-planned routing and site control measures as described in Chapter 2.0.

4.3.5 Floodplains/Wetlands

Construction and operations impacts that would occur to floodplains and wetlands at the Moab site from off-site disposal would be very similar to those described in Section 4.2.5.

4.3.5.1 Construction and Operations Impacts at the Crescent Junction Site

Because the Crescent Junction site would be located outside of the flood-prone areas of Crescent Wash and Crooked Wash, the likelihood of the proposed disposal cell location being affected by floodwaters is very low. The potential exists for construction of the disposal cell to increase sedimentation during a storm in the Crescent Wash drainage. However, site storm water controls would minimize the potential for any short-term impacts to Crescent Wash. No long-term impacts would be expected because no modifications would remain in the drainage following completion of remediation. There would be no impacts to wetlands because none are known to exist in the area.

4.3.5.2 Construction and Operations Impacts Related to Transportation

No wetland areas are known to exist along the proposed transportation routes, but the area would be investigated prior to construction. Potential impacts to ephemeral washes and any associated wetlands would be short term as a result of construction or upgrading roads, rail spurs, or the pipeline. Affected areas would be restored, avoiding any adverse long-term impact.

4.3.5.3 Impacts from All Sources

No long-term effects would be expected under the Crescent Junction off-site disposal alternative. Short-term impacts to Crescent Wash and wetlands, if they exist, would occur along proposed transportation routes.

4.3.6 Aquatic Ecology

Under this alternative, the short-term physical impacts to aquatic biota and habitats, including federally listed species, at the Moab site associated with construction and operations from off-site disposal would be very similar to those described in Section 4.2.6. Chemical and radiological impacts to aquatic resources would also be similar to those described in Section 4.2.6. Because there are no perennial surface waters at the Crescent Junction site, no adverse impacts to aquatic ecology would occur as a result of construction and operations, monitoring and maintenance activities, or transportation at that site. Therefore, these issues are not discussed further.

4.3.7 Terrestrial Ecology

Under this alternative, the physical, chemical, and radiological impacts to terrestrial species and habitats associated with construction and operations at the Moab site would be very similar to those described for on-site disposal (Section 4.1). Appendix A1, "Biological Assessment," presents a detailed discussion of potential effects on federally listed species at the Crescent Junction site.

4.3.7.1 Construction and Operations Impacts at the Crescent Junction Site

Construction of a disposal cell and ancillary support facilities would disturb up to 435 acres at the Crescent Junction site. The impacts of physical disturbance would include the short-term loss of cover, foraging, and breeding habitat in construction areas. In the long term, the area occupied by the disposal cell would result in a permanent loss of habitat. Species with small home ranges would be displaced. However, species with larger home ranges would not be expected to be adversely affected.

The black-footed ferret is the only federally listed species that could potentially be affected by habitat disturbance resulting from construction of a disposal cell. The white-tailed prairie dog, upon which the black-footed ferret depends, is the only species currently in review for federal listing that could be so affected. All black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne counties in 1999 or their offspring could occur on or near the Crescent Junction disposal site, although UDWR (2003) reported an unconfirmed sighting in the area in 1989. Consequently, no impacts from construction to the black-footed ferret would be anticipated.

Numerous white-tailed prairie dog colonies ranging in size from 10 acres to 2,445 acres occur around the Crescent Junction area (Seglund 2004). It is unknown to what extent individual colonies or a combination of colonies could support black-footed ferrets. Prior to development of the Crescent Junction disposal site, the area would be surveyed and the potential effects to white-tailed prairie dogs evaluated. In addition, the potential of such colonies to support black-footed ferrets would also be evaluated simultaneously.

Noise due to construction and operations could have an adverse effect on terrestrial wildlife. At the Crescent Junction site, noise would be generated by construction equipment and material transfer operations. It is estimated that the maximum noise levels that would be generated when all equipment was operating would be approximately 95 dBA measured at 49 ft. This noise level would attenuate over a distance of approximately 6 miles until it reached the quiet desert background level of approximately 30 dBA.

Noise can affect terrestrial organisms by causing physiological changes or behavioral modifications, including nest abandonment. It can also disrupt communication and defense systems. Any of the species that may be present at the site could be affected by the noise associated with construction and operations. Some of these, such as burrowing owls and prairie dogs, are frequently found near human activities and may thus be more likely to habituate to noise above background levels.

The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas. The bald eagle is the only federally listed species in the vicinity of the Crescent Junction site that could be affected by noise from site operations. However, it is not known to nest or night roost in the area, nor is it commonly seen in the area, and it would therefore be unlikely to be affected.

Other effects of human presence, including night lighting, also would reduce the overall habitat value of the area. As with noise, some species become habituated to human presence, but others, such as deer or pronghorn antelope, could avoid the site during human activities. The site is surrounded by many square miles of similar habitat. Therefore, individuals that avoided the vicinity of construction activities would not be forced into less desirable habitat.

The effects of noise, supplemental lighting, and human presence could be greater at night than during the day. Therefore, double-shift operations would likely have a greater impact than single-shift operations. The effects of noise, supplemental lighting, and human presence could be mitigated by limiting the amount of light off the site, minimizing activities at the periphery of the site, and limiting especially loud activities to daylight hours and to seasons when the effects on biota would be reduced. There would not likely be chemical impacts at the site. Accidental spills of diesel, oil, or other materials would be quickly controlled and mitigated.

Other species of interest, if present, that could be affected by construction of a disposal cell and the associated types of disturbance discussed above, include the burrowing owl, Swainson's hawk, ferruginous hawk, and peregrine falcon. Mexican spotted owls were historically reported to occupy the Book Cliffs to the north of the site but have not been observed in the vicinity recently (USF&WS 1995).

Development of the site for a disposal cell would reduce the amount of habitat available for white-tailed prairie dogs but likely would not affect the overall local population. In the short

term, avian species (e.g., raptors) could be affected by loss of foraging habitat. Birds that may nest in the area (e.g., burrowing owl and ferruginous hawk) could be displaced during construction activities. However, it is unlikely that population abundance and distribution of these species would be adversely affected in the long term.

Short-term impacts of physical disturbance could be avoided or minimized in several ways. The most important action would be to conduct site-specific investigations prior to site development activities to determine the presence of any species of concern. Additional actions would include minimizing site disturbance to the extent practical, revegetating disturbed lands and the cover cap once it was completed, and scheduling ground-clearing activities during periods that would not disturb nesting migratory birds.

There would not likely be chemical or radiological impacts at the Crescent Junction site. Accidental spills of diesel, oil, or other materials could be quickly controlled and mitigated.

4.3.7.2 Impacts of Transportation

The effects to terrestrial species and habitats of transporting the tailings to the Crescent Junction site would depend on the transportation option selected. In the short term, truck transport could increase collision mortality and noise, rail transport could increase noise, and a slurry pipeline would disturb more habitat in the pipeline corridor.

Much of the transport of borrow materials would occur on lower-speed access roads rather than US-191. This could result in a lower rate of wildlife-vehicle collisions and less noise due to truck transport of borrow materials compared to transporting the materials from more distant borrow sites.

<u>Truck Transportation Option</u>

There is the potential for greater mortality for species, including the bighorn sheep, that frequent the US-191 corridor. Other species potentially affected include mule deer and pronghorn antelope. Small mammals, reptiles, and possibly birds would also suffer increased highway mortality rates. However, it is unlikely that the regional populations of any wildlife species, with the possible exception of the bighorn sheep, would be affected by this increased traffic mortality rate.

The bald eagle is the only federally listed species that could incur an increase in traffic-related mortality. The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas. Bald eagles could be found temporarily and infrequently using such areas when there are opportunities to feed on carrion, such as in big-game wintering areas or in prairie dog colonies. Therefore, it is possible that if traffic-related wildlife mortality increased because of the project, an increased number of eagles could be hit on highways. However, without data on this relationship, it is reasonable to assume that the number of eagles hit on highways would be proportional to the number of carrion available. The increase in the number of traffic-related wildlife mortalities is expected to be small. Consequently, the potential increase in associated eagle deaths is also expected to be small.

The increased truck traffic along US-191 resulting from transport of tailings from the Moab site to the Crescent Junction site would likely increase ambient noise levels by approximately 5 dB (measured at 49 ft). However, no adverse effect to terrestrial wildlife is anticipated.

The primary federally listed species that could be affected by this increased traffic noise would be the Mexican spotted owl. Data provided by UDWR (2003) indicated that there were no occurrences of the Mexican spotted owl in any of the project areas. However, habitat models (BLM 2003) indicate that potential habitat areas may exist in the canyons near US-191 over the first 7 miles north from the Moab tailings pile. Nonetheless, these models are primarily based on physical and topographic features and do not consider vegetation requirements. Mexican spotted owls nest, roost, and forage in an array of different community types, but mixed-conifer forests dominated by Douglas fir and/or white fir are most common (USF&WS 1995). However, they may also nest, but less frequently, in arid, rocky, mostly unvegetated canyons (Romin 2004). Although there are no forested areas in the vicinity of US-191 north of Moab, there are arid canyons that largely or altogether lack forest-type vegetation. Thus, it is unlikely but possible that spotted owls occur in the canyons near US-191 over the first 7 miles north of the Moab site. If present, the species could be disturbed by noise from increased truck traffic. The area around this section of transportation corridor is a popular recreation area, with heavy use by off-highway vehicles and mountain bikes. Although the increase in truck traffic noise could be detectable up to several miles from the highway, the existing off-road vehicle noise and associated human presence would likely have a greater and more direct impact on the owls.

The potential for impacts to terrestrial wildlife from truck transportation of tailings would be greater in the evening or at night than during the day. Therefore, double-shift operations would probably have a greater potential for adverse impacts than single-shift operations. In either case, the impacts would be of relatively short duration and would cease once the transfer of materials to the disposal cell was completed.

Rail Transportation Option

Rail transportation of tailings from the Moab site to the Crescent Junction site would result in less frequent but potentially higher intermittent noise and ground vibration levels compared to the truck transportation option. Some wildlife species could be sensitive to noise from the rail system. However, because of the degree of off-road recreational activity in the area, as well as nearly 3,000 cars and trucks per day on US-191, most of the wildlife in the area would likely be somewhat habituated to human presence and noise. The potential collision-mortality rate would be lower using rail transport than truck transport.

Slurry Pipeline Option

Use of a slurry pipeline system to transport tailings material from the Moab site to the Crescent Junction site would result in a greater amount of short-term surface disturbance compared to the other two transportation modes.

Because much of the proposed pipeline route would be within, parallel to, or adjacent to either US-191 or the Williams Gas pipeline rights-of-way, construction impacts would be expected to be minimal. However, some previously undisturbed habitat would be removed in the short term. Installation of the pipeline system could disturb species such as the Mexican spotted owl, white-tailed prairie dog, black-footed ferret, and species of ground-nesting migratory birds. Such

impacts could be managed by performing site-specific investigations prior to pipeline construction to identify populations of these species of concern, adjusting the pipeline location if needed, and constructing the pipeline during periods of the year that would not disrupt nesting. Operation of the pipeline would not be expected to have any adverse effects on wildlife or habitat under the Crescent Junction off-site disposal alternative.

4.3.7.3 Monitoring and Maintenance Impacts

Routine post-closure monitoring and maintenance of a disposal cell at the Crescent Junction site would not be expected to affect terrestrial species or habitats. If major corrective actions were needed, some of the recovering vegetation on and around the disposal site could be disturbed.

4.3.7.4 Impacts from All Sources

Overall impacts to terrestrial ecological resources under the Crescent Junction off-site disposal alternative would include approximately 50 acres of tamarisk habitat lost at the Moab site (the rest of the site has a habitat value of zero), a maximum of approximately 690 acres of desert habitat at the borrow sites, 420 to 435 acres for construction of the disposal cell, and varying additional acreage depending on the mode of transportation.

Total maximum habitat disturbance for truck or rail transportation options from all activities (Moab site, borrow areas, transportation, and Crescent Junction site) would be approximately 1,175–1,235 acres. If the slurry pipeline option were selected, 164 acres of habitat could be disturbed for the pipeline corridor and 11 for support roads, bringing the total maximum habitat disturbance from all activities to approximately 1,345 acres.

Additional habitat would be lost at the commercial quarry sites for sand, gravel, and riprap. There would be a slight decrease in habitat value near US-191 if the truck transport option were selected because of the increased truck traffic required to haul tailings materials, and there would be a slight increase in traffic-related wildlife mortalities. Rail transport of tailings materials would slightly increase average noise levels along the rail route. Impacts of borrow material haulage would be less than under the on-site disposal alternative because the cover materials would be available near the disposal cell site (all other materials would require longer-distance transport), and haulage of these materials at highway speeds on US-191 would not be required.

4.3.8 Land Use

The land use impacts at the Moab site under the Crescent Junction off-site disposal alternative would be the same as those described in Section 4.2.8.

4.3.8.1 Construction and Operations Impacts at the Crescent Junction Site

Approximately 420 to 435 acres needed in the long term for the cell construction area would be withdrawn from BLM administration and transferred to DOE in perpetuity. All surface and subsurface land uses would be vested with DOE. These lands would be removed from the Crescent Canyon grazing allotment (1.9-percent reduction). Oil and gas leases would be terminated. Affected permittees and lessees would be compensated for lost grazing and oil and gas rights. The disposal cell would also result in long-term loss of all surface uses and leasing

and mineral extraction in perpetuity on the withdrawn acreage and would result in a long-term loss of revenue for BLM for any surface or subsurface permits or leases on the site.

4.3.8.2 Construction and Operations Impacts Related to Transportation

The three options for transportation to the Crescent Junction site would likely result in restricted use of lands occupied by transportation infrastructure in the short term. For the rail haul option, approximately 57 acres would be temporarily dedicated to a new rail spur and a transfer station, which would be removed and reclaimed once tailings transport was completed. The slurry pipeline would be constructed predominantly in existing rights-of-way. Impacts to lands required for the transfer station, the slurry pipeline receiving facility, and the slurry pipeline would also be short term; these lands would be returned to their previous use once transportation of tailings was completed. Long-term land use (up to 13 acres) would be required for a permanent access road constructed from CR-223 to the disposal site under the truck transportation option.

4.3.8.3 Monitoring and Maintenance Impacts

The Crescent Junction site would be transferred to DOE, so there would be no additional impacts from monitoring and maintenance at the site. If monitoring locations were required outside DOE's property, lands required for wells or other monitoring equipment and the associated access would be negotiated and maintained.

4.3.8.4 Impacts from All Sources

Land use impacts at the Moab site would be similar to those described in Section 4.2.8. In addition, long-term land use impacts would occur at the Crescent Junction site for the cell and for the permanent access road to the site. The land use impacts associated with the rail spur, the transfer station required for the rail haul, the slurry receiving facility, and the slurry pipeline itself would be short term because these transportation modes and associated infrastructure would be reclaimed and returned to BLM for prior designated land use. There would be no impacts for borrow materials procured from commercial facilities. Of the total potential land use disturbance at the Crescent Junction site, approximately 420–435 acres for cell construction and up to 13 acres for dedicated access roads would remain under DOE ownership in perpetuity. DOE is deferring decisions regarding future uses and ownership of the 439-acre Moab site pending a determination of the success of remediation activities.

4.3.9 Cultural Resources

This section addresses the potential for the disturbance of known cultural resources or the discovery of unknown resources under the Crescent Junction off-site disposal alternative.

4.3.9.1 Construction and Operations at the Moab Site

Construction and operations impacts at the Moab site would be the same as those described in Section 4.1.9.1.

4.3.9.2 Construction and Operations Impacts at the Crescent Junction Site

On the basis of current estimates in Chapter 3.0, one to two cultural sites eligible for inclusion in the National Register of Historic Places could be adversely affected by construction and

operations at the Crescent Junction site. The Class III cultural resource survey that DOE would conduct at the Crescent Junction site would indicate the precise number and types of cultural sites present. Along with the Class III survey, DOE would conduct a site-specific study to identify potential traditional cultural properties that may exist on the site (there is a low to medium likelihood that they would occur). DOE, BLM, the State Historic Preservation Officer, affected Native American tribes, and the Advisory Council on Historic Preservation would determine appropriate mitigation measures through the Section 106 consultation process (see Section 3.1.13.3). Mitigation measures might include (1) avoiding the cultural resource sites, (2) monitoring the cultural resource during surface-disturbing activities, (3) excavating and recording cultural resource data before construction activities began, or (4) moving the cultural resource objects from areas of disturbance to nearby undisturbed areas.

Cultural resources located near areas of disturbance could be adversely affected indirectly (through illicit collection, vandalism, or inadvertent destruction) as a result of increased human activity in the area. DOE would require site workers to receive training on the need for cultural resource protection and the legal consequences of disturbing cultural resources.

4.3.9.3 Construction and Operations Impacts Related to Transportation

Because of the expected low density of cultural sites, construction of the infrastructure needed for the truck and rail alternatives would not be expected to adversely affect cultural resources at or near the Crescent Junction site. One cultural site—the historic US-160 that parallels US-191—could be adversely affected by construction of a highway overpass and acceleration lane at the Moab site under the truck option.

A total of 45 cultural sites eligible for inclusion in the National Register of Historic Places are known to exist within 0.5 mile of the proposed slurry pipeline route to the Crescent Junction site. Of these, 11 to 25 could be adversely affected during pipeline construction. The potential for traditional cultural properties to occur along the pipeline route is low to high. If these properties were located along the route, they most likely would be adversely affected as well. DOE, BLM, UDOT, the State Historic Preservation Officer, affected Native American tribes, and the Advisory Council on Historic Preservation would determine appropriate mitigation measures for these sites through the Section 106 consultation process.

In addition to these direct impacts, cultural resources located near the pipeline could be adversely affected indirectly (through illicit collection, vandalism, or inadvertent destruction) as a result of increased human activity in the area.

4.3.9.4 Monitoring and Maintenance Impacts

Monitoring and maintenance at the Crescent Junction site would have no effect on cultural resources.

4.3.9.5 Impacts from All Sources

Table 4–32 lists the total number of cultural sites eligible for inclusion in the National Register of Historic Places that could be adversely affected under each of the Crescent Junction transportation options.

Table 4–32. Number of Cultural Sites That Could Be Adversely Affected Under the Three Transportation Options

Location/Activity	Transportation Mode		
	Truck	Rail	Slurry Pipeline
Moab site (construction and operations)	0–2	0–2	0–2
Moab site (highway improvements)	1	0	0
Crescent Junction disposal cell area (including cover soil borrow area)	1–2	1–2	1–2
Radon barrier borrow area	3–7	3–7	3–7
Haul road for truck transport at Crescent Junction site	0	N/A	0
Rail infrastructure at Crescent Junction site	N/A	0	N/A
Pipeline construction	N/A	N/A	11–25[a]
Total	**5–12**	**4–11**	**15–36[a]**

[a]Numbers do not include potential traditional cultural properties that have not yet been identified along the pipeline route; the likelihood of their occurrence is low to high.

4.3.10 Noise and Vibration

This section addresses the impacts of noise and ground vibration primarily to human receptors. Where appropriate, impacts to wildlife and cultural resources are also identified. Unless otherwise indicated, all noise and vibration impacts would be temporary and would last only as long as project construction and operations were ongoing.

4.3.10.1 Construction and Operations Impacts at the Moab Site

Noise from the Moab site under the Crescent Junction off-site disposal alternative would come from construction activities and removal of the tailings pile. The largest sources of noise on the site would be heavy earth-moving equipment. The noise generated from these activities would not differ significantly from the noise generated at the Moab site under the on-site disposal alternative. Section 4.1.10 describes the noise associated with construction and earth-moving activities. A description of the noise generated by a conveyor system for the train transportation option is presented in Section 4.2.10.1.

Ground vibration generated by heavy equipment at the Moab site is discussed in Section 4.1.10. No appreciable differences would be expected in ground-level vibration between the on-site disposal alternative and the Crescent Junction off-site disposal alternative.

4.3.10.2 Construction and Operations Impacts at the Crescent Junction Site

Noise at the Crescent Junction site from the disposal of tailings would come from construction activities and movement of the tailings. The type of noise generated from these activities and the region of influence around the site are described in Section 4.2.10.2 for the Klondike Flats site. No appreciable differences would be expected in the source or levels of noise. However, the receptors around Crescent Junction would be different from those around the Klondike Flats site. A gas station and several (one to five) residents are located approximately 2,620 ft south of the Crescent Junction site. These receptors are beyond the estimated 1,480-ft region of influence that would exceed the 65-dBA residential standard for the city of Moab (Moab City Ordinance 17.74.080, “Noise Levels”).

Ground vibration generated from construction and operations at the Crescent Junction site would be the same as those discussed in Section 4.2.10.2. There are no receptors at the Crescent Junction site within the 820 ft estimated for ground vibration to attenuate to background levels.

4.3.10.3 Construction and Operations Impacts Related to Transportation

Noise from transportation of material from the Moab site to the Crescent Junction site would originate from truck traffic, rail traffic, or construction of a slurry pipeline. A description of the noise generated from these activities and the region of influence around the transportation routes is included in Section 4.2.10.3. No appreciable differences would be expected in the source or levels of noise. However, the receptors around Crescent Junction would be different from those around the Klondike Flats site. For the truck haul alternative, noise levels at the gas station and residences could exceed the 65-dBA residential standard for the city of Moab (Moab City Ordinance 17.74.080, "Noise Levels"). The exact location of these buildings relative to the transportation route is not known. The region of influence around the transportation route expected to exceed 65 dBA is 430 ft. The increase in noise caused by truck-hauling activity would be estimated to be 4 dBA (1-hour L_{eq}). The actual increase could be less, depending on truck speed on the highway overpass.

Construction of a slurry pipeline would likely result in ground vibration above background levels within Arches National Park. The estimated maximum level for ground vibration produced during construction of a slurry pipeline would be 95 dBV. This level would result in ground vibration above background levels 820 ft from the source and levels above human perception within 330 ft of the source. Some cultural sites containing rock structures and the historic rock bridge at Arches National Park would be within 2,620 ft of the pipeline, but ground vibration levels would not reach levels (estimated at 92 to 100 dBV) that would damage these structures.

4.3.10.4 Monitoring and Maintenance Impacts

Monitoring and maintenance of the Crescent Junction site would not be expected to result in significant generation of noise. Any noise generated by these activities would attenuate to near background levels before leaving the site boundary.

4.3.10.5 Impacts from All Sources

Noise generated under the Crescent Junction off-site disposal alternative would not exceed the Moab residential noise standard of 65 dBA at any receptor locations. The receptors with the most potential to notice any increase in noise generated by this alternative include the resident located on the eastern boundary of the site, visitors at Arches National Park, and residents near the gas station at Crescent Junction. If two 10-hour shifts were used instead of a single 12-hour shift, the noise generated would not change substantially, but there could be a higher potential for annoyance from late-night and early-morning activities.

4.3.11 Visual Resources

This section describes the impacts to those physical features of the landscape that impart scenic value in the region affected by this alternative. The impacts would be imposed on viewers who live in, work in, or visit an area and can see ongoing human activities or the results of those activities. Construction and operations impacts to visual resources at the Moab site would be the same as those described in Section 4.2.11.1. No impacts to visual resources would occur from

monitoring and maintenance activities under this alternative. Therefore, these activities are not addressed further.

4.3.11.1 Construction and Operations at the Crescent Junction Site

Construction and operations at the Crescent Junction site would have moderate adverse effects on visual resources, primarily because construction activities and the completed disposal cell would be viewed by a large number of travelers on I-70. DOE selected five key observation points from which to assess visual impacts: (1) western Thompson Springs residences, (2) Crescent Junction residences, (3) I-70 westbound, (4) I-70 eastbound, and (5) I-70 scenic overlook. Figure 4–13 shows DOE's visibility analysis results for a proposed disposal cell at the Crescent Junction site. The darkened areas indicate locations from which a disposal cell could potentially be viewed. The visibility analysis used to create this map is based on elevation and topography. It does not take into account the potential obstruction of views from cultural modifications or vegetation or the effects of distance on visibility. Without visual aids, such as binoculars, most people would not be able to recognize a disposal cell at distances greater than 5 to 10 miles.

The visibility analysis results indicate that residents of Thompson Springs and Crescent Junction, travelers on I-70, and visitors to the I-70 scenic overlook would be able to view the Crescent Junction disposal cell. Given the distance from the disposal cell and viewing angle, residents in western Thompson Springs would not likely be able to view construction activities during the construction period. They would, however, likely notice dust during daylight hours and light during dawn and dusk (and at nighttime under a double-shift work scenario). Neither dust nor light would be visible after construction was completed, as no dust-producing activities would occur, and no lighting would remain at the site. Residents would not be able to see much of the completed disposal cell. The cell would appear as a thin, grayish-beige sliver of earth for 3 to 5 years after completion; contrasts with the surrounding buff-colored landscape would be weak. After the cell was revegetated, it would not be noticeable.

Views of construction activities and the completed disposal cell from residences (four mobile homes, two of which are unoccupied, and one house) in Crescent Junction would be obstructed primarily by the railroad grade located between the homes and the cell and secondarily by the foliage of cottonwood and Siberian elm trees. Like the residents in Thompson Springs, residents of the Crescent Junction homes would likely see dust during daylight hours and light during dawn and dusk (and at nighttime under a double-shift work scenario). These visual impacts would not occur after disposal cell construction was completed.

Travelers would have a clear view of the completed disposal cell from both the westbound and eastbound lanes of I-70. Viewing times from both lanes would be approximately 3 minutes for the driver and 3.5 minutes for passengers. Because of the 1-mile distance to the disposal cell and the viewing angle from the freeway, travelers may or may not notice construction activities. The disposal cell itself would create a weak to moderate contrast with the surrounding landscape. Relative to the steep, dissected cliffs of the 1,000-ft-high Book Cliffs, the 30-ft-high disposal cell would appear as a light-gray, slender, linear form (see Figure 4–14). The cell could be camouflaged somewhat by the linear railroad grade located between the observers and the cell. After 3 to 5 years, shrubby vegetation on the light-gray side slopes would camouflage the color and linearity of the cell even more, lessening the potential visual contrast (Figure 4–15).

For visitors at the I-70 scenic overlook, the completed disposal cell would create a moderate to strong contrast with the surrounding landscape. The higher viewing angle from this location would allow observers to view the top and side slopes of the cell. Viewing time would be approximately 5 to 10 minutes. Before the cell was revegetated, its simple, barren, geometric form and relatively bright surface would contrast moderately to strongly with the more complex, vertical form of the Book Cliffs and the adjacent, vegetated desert plain (Figure 4–16). After vegetation was established, the simple, rectangular form would be camouflaged somewhat by shrubs and would create a weak to moderate contrast with the adjacent desert plain (Figure 4–17).

From all but the I-70 scenic overlook key observation point, DOE's proposed action at the Crescent Junction site would be compatible with BLM's Class III visual resource objectives for this area, as the Class III designation allows an activity to attract, but not dominate, the attention of casual observers (BLM 2003). Class III objectives would be met from the I-70 scenic overlook after vegetation was established on the cell.

4.3.11.2 Construction and Operations Impacts Related to Transportation

Truck Haul

Construction of a 2.5-mile access road from Crescent Junction to the proposed disposal cell site under the truck haul option would have negligible impacts to visual resources. From all key observation points, the linear feature would contrast weakly with the natural surroundings and existing linear features (US-191, CR-175, railroad grade, I-70) in the area. Most travelers would not notice the road. Travelers at the I-70 scenic overlook and local residents would likely notice the haul truck traffic on the access road. DOE estimates that, on average, approximately 28 trucks per hour would use US-191 and the access road to transport tailings, vicinity property, and borrow materials during the 3 to 5 years of operations. Given the proximity to I-70 traffic and traffic associated with the Crescent Junction store and gas station, the adverse visual impact from the additional movement and dust would be negligible to moderate. Overall, this transportation option would be compatible with BLM's Class III visual resource objectives.

Rail Haul

The newly constructed railroad spur would not be visible from any of the key observation points, with the exception of the I-70 scenic overlook. This feature by itself would not draw the attention of most observers, as it is a feature commonly found along highways. Because of distance and viewing angles, the train/truck transfer station constructed on the Crescent Junction site might be noticed but would not dominate the views from any of the key observation points. Travelers at the I-70 scenic overlook and local residents would likely notice the haul truck traffic between the transfer station and disposal cell. Potentially, approximately 29 trucks per hour could be transporting tailings and borrow materials on the access road during the 3 to 5 years of disposal cell construction at the Crescent Junction site. Given the proximity to I-70 traffic and traffic associated with the Crescent Junction store and gas station, the adverse visual impact from the additional movement and dust would be negligible to moderate. Once the disposal cell was completed, haul truck traffic would cease, the transfer station would be dismantled, and the station area would be reclaimed with native species. After 3 to 5 years of vegetation growth, the visual impact would be eliminated. This transportation option would be compatible with BLM's Class III visual resource objectives.

Slurry Pipeline

Visual impacts from construction of a slurry pipeline between Moab and the Klondike Flats portion of the pipeline are described in Section 4.2.11.3. Between the Klondike Flats and Crescent Junction portion of the pipeline, approximately 3 miles of the corridor immediately north of the Klondike Flats site would be visible to travelers on US-191. In this 3-mile section, the smooth, linear, unvegetated swath created by pipeline construction would contrast moderately with the surrounding features, characterized primarily by light-beige and light-gray, rolling desert plains and smooth, rounded, buff-colored bluffs. After the pipeline was removed and the corridor revegetated, the contrast between the corridor and surrounding landscape would be moderate to nonexistent, depending upon the success of revegetation.

North of the 3-mile section visible to travelers, the corridor would veer off to the northeast along an existing pipeline route and would not be visible to the general public until it crossed I-70 near the town of Crescent Junction. Most travelers would not notice either a barren or vegetated pipeline corridor that crossed beneath the freeway because of their travel speed and the presence of a number of other linear features (I-70, US-191, CR-175, railroad grade) in the area. The visual impacts associated with construction and revegetation of the pipeline would be compatible with BLM's Class III and IV objectives for this area.

4.3.11.3 Impacts from All Sources

Moving the tailings pile from the Moab site to the Crescent Junction site would have some moderate, short-term, adverse visual impacts and moderate to no long-term adverse visual impacts, primarily because the short-term construction activities and the completed disposal cell would not be seen by many people. At the Moab site, removal of the pile would have strong beneficial impacts to visual resources. Table 4–33 summarizes visual resource impacts expected to occur under this alternative.

Table 4–33. Summary of Visual Resource Impacts Under the Crescent Junction Off-Site Disposal Alternative

Location/Activity	Visual Resource Impacts	
	Short-Term	Long-Term
Moab site	Strong adverse impacts primarily to travelers on US-191 and SR-279	Strong positive impacts from removal of tailings pile
Crescent Junction disposal site	Weak to strong adverse impacts, depending upon viewing location	Moderate to no adverse impacts, depending upon viewing location
Cover soil borrow area	Negligible to strong adverse impacts, depending upon borrow source	No adverse impacts
Truck haul[a]	Negligible to moderate adverse impacts	No adverse impacts
Rail haul[a]	Negligible to moderate adverse impacts	No adverse impacts
Slurry pipeline[a]	Moderate adverse impacts to travelers on US-191	Moderate to no adverse impacts to travelers on US-191
Monitoring and maintenance	No adverse impacts	No adverse impacts

[a]Only one transportation option would be selected.

4.3.12 Infrastructure

This section addresses potential impacts on the availability of electric power, potable water, nonpotable water, sewage treatment, rail service, and highways. Unless otherwise indicated, all

infrastructure impacts would be temporary and would last only as long as project construction and operations were ongoing.

4.3.12.1 Construction and Operations Impacts at the Moab Site

The infrastructure impacts associated with construction and operations at the Moab site would be the same as those described for the truck and rail options in Section 4.2.12.1. For the slurry pipeline option, electric power demand would be 4,800 kVA, 1,400 kVA more than under the Klondike Flats off-site disposal alternative.

4.3.12.2 Construction and Operations Impacts at the Crescent Junction Site

The infrastructure impacts associated with construction and operations at the Crescent Junction site would be the same as those described in Section 4.2.12.2 for construction and operations at the Klondike Flats site, with the exception of electric power demands. The impact on the existing electrical infrastructure servicing the Crescent Junction disposal cell area would differ for the three alternative modes of transportation. For truck transportation, the total power demand would be 300 kVA; for rail transportation, the total power demand would be 600 kVA. Both of these options would require the same demand as for the Klondike Flats site. For slurry pipeline transportation, however, the demand would be 2,800 kVA, 300 kVA more than for the Klondike Flats site. ESC of Fort Collins, Colorado, developed and reviewed this projected demand with Mathew Yates, Pacific Corporation, Moab. Pacific Corporation indicated that this demand would present no capacity problems to the existing electric supply system at the site, nor would system upgrades be required (ESC 2003).

4.3.12.3 Construction and Operations Impacts Related to Transportation

Infrastructure impacts associated with transportation would be qualitatively similar to those described in Section 4.2.12.3 for the Klondike Flats site. Quantitatively, there would be an increased incremental electric power demand. Overall site power requirements for Crescent Junction, including those for transportation-related operations, are presented in Chapter 2.0. The truck transportation mode would not entail additional power demands over the 300 kVA required for site construction and operations. However, the rail transportation mode would draw an additional 300 kVA (600 kVA total demand), and the slurry pump would draw an additional 2,500 kVA (2,800 kVA total demand).

4.3.12.4 Monitoring and Maintenance Impacts

Monitoring and maintenance activities would be generally limited to periodic inspections and activities to remedy incipient erosion as necessary. DOE does not expect these activities to affect the local or regional infrastructures.

4.3.12.5 Impacts from All Sources

Regional and local supplies of power, water, and sewage treatment capacity would be adequate to meet the requirements of the Crescent Junction off-site disposal alternative. Transportation would cause increased wear and tear on roads, which would be paid for through vehicle registration and special permit fees.

4.3.13 Solid Waste Management

The impacts of solid waste management under the Crescent Junction off-site disposal alternative would be identical to those described in Section 4.2.13 for the Klondike Flats off-site disposal alternative.

4.3.14 Socioeconomics

The socioeconomic impacts from off-site disposal at the Crescent Junction site would be similar in scope to those described in Section 4.2.14. As was assumed for the Klondike Flats alternative (Section 4.2.14), for purposes of analysis, the principal affected socioeconomic region of influence is assumed to be Grand and San Juan Counties in southeastern Utah. For the Crescent Junction alternative, some socioeconomic impacts may carry over to the adjacent Utah Counties of Emory and Carbon and into Mesa County, Colorado. Aggregate expenditures under this alternative would include construction and surface remediation at the Moab and Crescent Junction sites, ground water remediation, remediation of vicinity properties, and transportation of materials from the Moab site and vicinity properties to the Crescent Junction site. As described in Section 4.2.14, the aggregate impacts would depend on the mode of transportation used. The project cost data and economic impact estimation methodology are described in Section 4.1.14.

The economic impacts of off-site disposal at the Crescent Junction site are summarized in Table 4–34. The annual project costs over the 8-year disposal period are estimated to be $41,741,425 under the truck transport option. Under the rail transport option, the annual spending over the disposal period is estimated to be $49,423,275. The slurry pipeline transport option is expected to increase annual spending over the 8-year period by $50,258,588. Over the remaining 75-year ground water remediation/site monitoring period, the annual project costs are estimated to be $933,000 under each transportation option. The project spending would increase the final demand for the construction and transportation industries. Under the truck transport option, regional output of goods and services would increase by $55,006,850 a year. Under the rail transport and slurry pipeline options, the demand for goods and services would increase by $65,129,992 and $66,230,767, respectively. Project spending over the disposal period would also increase labor earnings and employment. Under the truck option, earnings and employment would rise by $13,565,963 and 431 direct and indirect jobs. The increase in labor earnings and employment would be $16,062,564 and 335 direct and indirect jobs under the rail option. Increased regional earnings under the slurry pipeline option would initially rise to $16,334,041 and 458 jobs during the first-year construction phase of the pipeline. Thereafter, earnings and employment would scale down to $15,097,007 and 315 jobs.

Table 4–34. Economic Impacts in the Principal Two-County Socioeconomic Region of Influence Under the Crescent Junction Off-Site Disposal Alternative

Transport Method	Annual Cost	Annual Output of Goods and Services	Annual Labor Earnings	Jobs
Truck	$41,741,425	$55,006,850	$13,565,963	431
Rail	$49,423,275	$65,129,992	$16,062,564	335
Pipeline	$50,258,588	$66,230,767	Year 1 $16,334,041 Years 2–8 15,097,007	458 315

Note: Economic impacts for regional output of goods and services and labor earnings are calculated based on final-demand multipliers provided by the Bureau of Economic Analysis. The respective multiplier values (1.3178 and 0.3250) are multiplied by annualized cost to generate the impact values shown. Employment impacts are calculated as the product of the direct-effects multiplier (1.4262) and total direct jobs for each action alternative (see Tables 2−16, 2−17, and 2−18).

The potential shorter-term impacts under the Crescent Junction off-site disposal alternative would include increased demand for temporary housing (discussed in Section 4.1.14) and transportation-related inconveniences to motorists (discussed in Section 4.3.16). The extent of these shorter-term impacts would depend on levels of tourism-recreation activities and the mode of transportation used in the remediation process. Longer-term beneficial impacts from the off-site disposal alternative would relate to greater opportunities for economic development in the Moab area and greater diversification of the tax base (discussed in Section 4.1.14).

4.3.15 Human Health

This section addresses potential impacts to human health. These impacts are worker deaths that could occur as a result of industrial accidents and worker or public latent cancer fatalities that could occur as a result of exposure to radiation from activities at the Moab and Crescent Junction sites, at vicinity properties, or during transportation of materials.

4.3.15.1 Construction and Operations at the Moab Site and the Crescent Junction Site

Under the Crescent Junction off-site disposal alternative, construction activities would occur at vicinity properties, borrow areas, Crescent Junction, and at the Moab site. Table 4–35 lists the impacts from these activities. For each option under this alternative, less than one fatality would be estimated to occur from construction activities.

Table 4–35. Construction-Related Fatalities Under the Crescent Junction Off-Site Disposal Alternative

Alternative	Construction Fatalities
Truck Option	
Vicinity properties	0.031
Borrow areas	0.042
Moab and Crescent Junction activities	0.31
Total	**0.38**
Rail Option	
Vicinity properties	0.031
Borrow areas	0.037
Moab and Crescent Junction activities	0.32
Total	**0.39**
Slurry Option	
Vicinity Properties	0.031
Borrow areas	0.042
Moab and Crescent Junction activities	0.39
Total	**0.47**

Workers. Under the Crescent Junction off-site disposal alternative, workers would be exposed to radon gas (an inhalation hazard) and external radiation from the mill tailings at the Moab site, vicinity properties, and Crescent Junction. According to monitoring data collected during construction of an evaporation pond on the mill tailings pile, the highest radon level measured on the mill tailings pile was 0.096 working levels (21 pCi/L). A worker exposed to this level of radon for 2,000 hours per year would have a latent cancer fatality risk of 6.1×10^{-4} per year of exposure. The highest external gamma exposure rate measured on the mill tailings pile was about 0.60 mR/h. A worker exposed to this level of radiation for 2,000 hours per year would have a

latent cancer fatality risk of 6.0×10^{-4} per year of exposure. The total latent cancer fatality risk to the worker on the mill tailings pile would be 1.2×10^{-3} per year of exposure (Table 4–36) or 6.0×10^{-3} over the 5-year duration of activities at the Moab site. Assuming that the radon and external radiation levels were comparable at the Crescent Junction site, this would also be the latent cancer fatality risk at the Crescent Junction site.

The Moab site would employ about 67 workers. If they were all exposed to radon and external radiation at the levels discussed for individual workers, the latent cancer fatality risk for this population of workers would be 0.081 per year of exposure, or 0.40 over the 5-year duration of activities at the Moab site. The Crescent Junction site would employ about 70 workers. If they were all exposed to radon and external radiation at the levels discussed for individual workers, the latent cancer fatality risk for this population of workers would be 0.085 per year of exposure, or 0.42 over the 5-year duration of activities at the Crescent Junction site.

Table 4–36. Worker Impacts Under the Crescent Junction Off-Site Disposal Alternative

Worker	Site	Radon-Related LCFs[a,b]	External Radiation-Related LCFs[a,b]	Total LCFs[a,b]
Annual				
Individual	Moab	6.1×10^{-4}	6.0×10^{-4}	1.2×10^{-3}
	Crescent Junction	6.1×10^{-4}	6.0×10^{-4}	1.2×10^{-3}
	Vicinity Properties	2.9×10^{-4}	1.2×10^{-4}	4.1×10^{-4}
Population	Moab	0.041	0.040	0.081
	Crescent Junction	0.043	0.042	0.085
	Vicinity Properties	6.7×10^{-3}	2.9×10^{-3}	9.6×10^{-3}
	Total	**0.091**	**0.085**	**0.18**
5-Year Duration of Activities				
Individual	Moab	3.0×10^{-3}	3.0×10^{-3}	6.0×10^{-3}
	Crescent Junction	3.0×10^{-3}	3.0×10^{-3}	6.0×10^{-3}
	Vicinity Properties	8.7×10^{-4}	3.7×10^{-4}	1.2×10^{-3}
Population	Moab	0.20	0.20	0.40
	Crescent Junction	0.21	0.21	0.42
	Vicinity Properties	0.020	8.6×10^{-3}	0.029
	Total	**0.43**	**0.42**	**0.85**

[a]Based on 67 workers at the Moab site, 70 workers at the Crescent Junction site, and 23 workers at vicinity property sites.
[b]LCF = latent cancer fatality.

Impacts to workers as a result of activities at the vicinity properties would be the same as under the on-site disposal alternative, as would be the lack of impacts from ground water treatment; these impacts are described in Section 4.1.15.2.

Under the Crescent Junction off-site disposal alternative, nearby residents would be exposed to radon gas released from the Moab site and at Crescent Junction. The average radium-226 content of the tailings, 516 pCi/g, would produce a latent cancer fatality risk for a nearby resident in Moab of 8.8×10^{-3} over the 5-year duration of activities at the Moab site and 7.5×10^{-5} over the 5-year duration of activities at the Crescent Junction site. These estimates include radon released from the drying areas at the Moab site. If a slurry pipeline were used to move the tailings to Crescent Junction, the drying areas would not be necessary, and the resulting latent cancer

fatality risk for a nearby resident at Moab would be reduced to 6.9×10^{-3} over the 5-year duration of activities at Moab.

For the population, over the 5 years of activities at the Crescent Junction site, the latent cancer fatality risk to the population surrounding Crescent Junction would be 8.3×10^{-3}. Over the 5 years of activities at the Moab site, the latent cancer fatality risk to the population surrounding the Moab site would be 1.0. If a slurry pipeline were used to move the tailings to Crescent Junction, the drying areas would not be necessary, and the resulting latent cancer fatality risk for the population surrounding the Moab site would be reduced to 0.74 over the 5-year duration of activities at the Moab site.

Nearby residents would also be exposed to windblown radioactive particulates (e.g., radium-226, polonium-210, thorium-230, and uranium) from the Moab site and the Crescent Junction site. Estimates based on monitoring data collected during 1998 and 1999 from the Monticello mill tailings site when uranium mill tailings were being excavated indicate that the latent cancer fatality risk from radioactive particulates would be about 0.1 percent of the risk from radon emissions from the Moab site and Crescent Junction site. This is due to the aggressive dust suppression practices that would be used to minimize emissions of radioactive particulates.

4.3.15.2 Construction and Operations Impacts Relating to Transportation

Under the Crescent Junction off-site disposal alternative, there would be a total of 292,888 shipments if trucks were used to move the tailings from the Moab site to the Crescent Junction site (Table 4–37). If rail were used, there would be a total of 30,116 shipments. If a slurry pipeline were used to move the tailings, there would be 26,276 shipments. These shipments would include contaminated material from vicinity properties, uranium mill tailings, and borrow material, which would consist of cover soils, radon and infiltration barrier soils, sand and gravel, riprap, and Moab site reclamation soils.

Table 4–37. Shipments Under the Crescent Junction Off-Site Disposal Alternative

Material	Truck Option		Rail Option		Slurry Pipeline Option	
	Shipments	Mode	Shipments	Mode	Shipments	Mode
Vicinity property material	2,940	Truck	2,940	Truck	2,940	Truck
Borrow material	21,148	Truck	21,148	Truck	21,148	Truck
Uranium mill tailings	268,800	Truck	3,840 2,188	Rail[a] Truck	2,188	Truck
Total	**292,888**		**30,116**		**26,276**	

[a]Each rail shipment would consist of 30 railcars of uranium mill tailings.

The transportation impacts of shipping contaminated materials from vicinity properties, mill tailings, and borrow material would be from two sources: radiological impacts and nonradiological impacts. Radiological impacts would be from incident-free transportation and from transportation accidents that released contaminated material. There would be no radiological impacts from moving borrow material because it is not contaminated. Nonradiological impacts would be from engine pollutants (emissions from the truck or train moving the contaminated materials from vicinity properties, mill tailings, and the borrow material) and from traffic fatalities. The total transportation impacts would be the sum of the

radiological and nonradiological impacts. Additional details on these analyses are provided in Appendix H.

Table 4–38 lists the transportation impacts under the Crescent Junction off-site disposal alternative. For this alternative, there would less than one fatality. In comparison, about 40,000 traffic fatalities occur annually in the United States (U.S. Census Bureau 2000).

Table 4–38. Transportation Impacts Under the Crescent Junction Off-Site Disposal Alternative

Alternative	Radiological			Nonradiological		Total Fatalities
	Incident-Free		Accident Risk LCFs	Pollution Health Effects Fatalities	Traffic Fatalities	
	Public LCFs	Worker LCFs				
Truck Option						
Vicinity properties	2.7×10^{-5}	3.9×10^{-5}	6.9×10^{-9}	3.7×10^{-4}	1.1×10^{-3}	1.5×10^{-3}
Borrow material	0	0	0	8.9×10^{-4}	0.042	0.043
Mill tailings	2.7×10^{-3}	0.017	3.3×10^{-9}	1.6×10^{-4}	0.43	0.45
Total	$\mathbf{2.7} \times 10^{-3}$	**0.017**	$\mathbf{1.0} \times 10^{-8}$	$\mathbf{1.4} \times 10^{-3}$	**0.47**	**0.49**
Rail Option						
Vicinity properties	2.7×10^{-5}	3.9×10^{-5}	6.9×10^{-9}	3.7×10^{-4}	1.1×10^{-3}	1.5×10^{-3}
Borrow material	0	0	0	8.9×10^{-4}	0.042	0.043
Mill tailings	2.7×10^{-5}	1.7×10^{-3}	6.5×10^{-9}	1.1×10^{-4}	0.29	0.29
Total	$\mathbf{5.4} \times 10^{-5}$	$\mathbf{1.7} \times 10^{-3}$	$\mathbf{1.3} \times 10^{-8}$	$\mathbf{1.4} \times 10^{-3}$	**0.33**	**0.33**
Slurry Option						
Vicinity properties	2.7×10^{-5}	3.9×10^{-5}	6.9×10^{-9}	3.7×10^{-4}	1.1×10^{-3}	1.5×10^{-3}
Borrow material	0	0	0	8.9×10^{-4}	0.042	0.043
Mill tailings	2.2×10^{-5}	1.4×10^{-4}	2.7×10^{-11}	1.3×10^{-6}	3.5×10^{-3}	3.7×10^{-3}
Total	$\mathbf{4.9} \times 10^{-5}$	$\mathbf{1.8} \times 10^{-4}$	$\mathbf{6.9} \times 10^{-9}$	$\mathbf{1.3} \times 10^{-3}$	**0.047**	**0.048**

LCF = latent cancer fatality.

Workers. For truck shipments of mill tailings from the Moab site to Crescent Junction, the maximally exposed transportation worker would be the truck driver. This person was assumed to drive the truck containing mill tailings for 1,000 hours per year. For the other 1,000 hours per year, the truck would be empty. This driver would receive a radiation dose of 220 mrem/yr, which is equivalent to a probability of a latent cancer fatality of about 1.1×10^{-4}.

For rail shipments of mill tailings from the Moab site to Crescent Junction, the maximally exposed transportation worker would be an individual who inspected the loading of the rail cars. This person would receive a radiation dose of 440 mrem/yr, which is equivalent to a probability of a latent cancer fatality of about 2.2×10^{-4}.

Public. For truck shipments of mill tailings from the Moab site to Crescent Junction, the maximally exposed member of the public would be a resident who lived along the road on which the tailings were shipped. This person would receive a radiation dose of 1.0 mrem/yr, which is equivalent to a probability of a latent cancer fatality of about 6.3×10^{-7}.

For rail shipments of mill tailings from the Moab site to Crescent Junction, the maximally exposed member of the public would be a resident who lived along the rail line on which the

tailings were shipped. This person would receive a radiation dose of 0.53 mrem/yr, which is equivalent to a probability of a latent cancer fatality of about 3.2×10^{-7}.

Accidents. If trucks were used to transport the mill tailings from the Moab site to Crescent Junction, the maximally exposed individual would receive a radiation dose of 0.16 mrem, or 1.6×10^{-4} rem from the maximum dose reasonably foreseeable for a transportation accident involving a shipment of mill tailings. This is equivalent to a probability of a latent cancer fatality of about 9.6×10^{-8}. The probability of this accident is about 0.1 per year.

If this accident occurred near Moab, the population would receive a collective radiation dose of 1.8×10^{-3} person-rem, which is equivalent to a probability of a latent cancer fatality of about 1.1×10^{-6}. If this accident occurred in a rural area, the population would receive a collective radiation dose of 2.9×10^{-6} person-rem, which is equivalent to a probability of a latent cancer fatality of about 1.7×10^{-9}.

If rail were used to transport the mill tailings from the Moab site to Crescent Junction, the maximally exposed individual would receive a radiation dose of 1.4 mrem or 1.4×10^{-3} rem from the maximum dose reasonably foreseeable for a transportation accident involving a shipment of mill tailings. This is equivalent to a probability of a latent cancer fatality of about 8.5×10^{-7}. The probability of this accident is about 0.5 per year.

If this accident occurred near Moab, the population would receive a collective radiation dose of 0.017 person-rem, which is equivalent to a probability of a latent cancer fatality of about 1.0×10^{-5}. If this accident occurred in a rural area, the population would receive a collective radiation dose of 2.7×10^{-5} person-rem, which is equivalent to a probability of a latent cancer fatality of about 1.6×10^{-8}.

4.3.15.3 Monitoring and Maintenance Impacts

Monitoring and maintenance activities would include checking water quality and installing a long-term ground water remediation system at the Moab site, and conducting periodic maintenance and inspections of the Crescent Junction site (checking for erosion, damaged fencing, etc.). None of these activities would be expected to breach the cap over the tailings; installation of the ground water system would be done in clean areas after remediation was complete. Data from another UMTRCA site indicate that the Crescent Junction alternative would be effective in isolating the contaminants in the tailings from individuals conducting activities on the site. DOE (2001) concluded that both radon and gamma levels associated with the capped-in-place tailings pile at the Shiprock site in New Mexico were indistinguishable from naturally occurring radiation levels. Therefore, the latent cancer fatality risk to workers conducting monitoring and maintenance would be comparable to the risk from background levels of radioactivity in Utah, about 3×10^{-4} per year of exposure.

4.3.15.4 Impacts from All Sources

Under the Crescent Junction off-site disposal alternative, less than one fatality would be estimated to occur from construction activities under any of the transportation options. Transportation of contaminated materials from the Moab site to the Crescent Junction site would result in the exposure of workers and the public to very small amounts of radiation; these exposures would not be expected to result in any latent cancer fatalities to any population.

Ammonia releases from ground water remediation would be well below threshold concentrations for human health effects.

Based on as-built radon flux measurements from completed uranium mill tailings disposal cells constructed under both Title I (federal UMTRA sites) and Title II (private licensees) of UMTRCA, it is anticipated that actual radon flux would be two orders of magnitude less than the 20-pCi/m^2-s EPA protective standard promulgated in 40 CFR 192. However, even though DOE's experience supports a conclusion that radon release rates from the capped pile would be negligible and that DOE's long-term monitoring and maintenance of the site would ensure cap integrity, for the purpose of supporting analyses of long-term performance and impacts, DOE has also assessed impacts assuming the maximum allowable release rate of radon, 20 pCi/m^2-s, under EPA's regulations (40 CFR 192).

Based on this emission rate and the dimensions of the disposal cell, the latent cancer fatality risk for a nearby resident would be 6.2×10^{-7} per year of exposure, or 1.8×10^{-5} over the 30-year period following the end of construction and operations. This latent cancer fatality risk is less than the risk from background levels of radioactivity in Utah, about 3×10^{-4} per year of exposure.

For the population near the Crescent Junction site, the latent cancer fatality risk would be 2.0×10^{-3} over the 30-year period following the end of construction and operations.

At the Moab site, radon emissions would fall to background levels because the mill tailings pile would have been relocated. The latent cancer fatality risk would be comparable to the risk from background levels of radioactivity in Utah, about 3×10^{-4} per year of exposure.

The design life of the disposal cell for the uranium mill tailings is 200 to 1,000 years. Over this period of time, the amount of radioactivity in the disposal cell will decrease slightly, less than 1 percent, due to the half lives of the radionuclides in the uranium mill tailings.

In the time frame of 200 to 1,000 years, the major route of exposure of people would be through the inhalation of radon progeny from the disposal cell. There is no surface water pathway at the Crescent Junction site. The uppermost aquifer at the Crescent Junction site is 3,000 ft below the surface, and the travel time to the uppermost aquifer is over 170,000 years, so it is unlikely that ground water would contribute large latent cancer fatality risks relative to inhalation of radon progeny. With the disposal cell cover in place and the Crescent Junction site under perpetual care, it is likely that the latent cancer fatality risk for an inadvertent intruder would also be low.

After the disposal cell cover was installed, the estimated annual latent cancer fatality risk from radon for a nearby Crescent Junction resident would be 6.2×10^{-7}. As with the radioactivity in the disposal cell, the annual risk would also not decrease appreciably over the 200- to 1,000-year time frame. Therefore, the annual latent cancer fatality risk for a nearby Crescent Junction resident would be about the same immediately after the cover was installed as it would be 1,000 years after the cover was installed. This assumes that the nearby resident remains at his or her present location. If the resident were to move closer to the disposal cell, the annual latent cancer fatality risk would be similar to the risk at the Moab site, 8.9×10^{-5} per year of exposure.

Based on the 20-pCi/m^2-s radon release rate, for the population within a 50-mile radius of the Crescent Junction site, the annual latent cancer fatality risk was estimated to be 6.7×10^{-5}. As with the radioactivity in the disposal cell, the annual risk would also not decrease appreciably over the 200- to 1,000-year time frame. If it is assumed that the population around the Crescent Junction site remains constant over 1,000 years, then the estimated latent cancer fatality risk over the 1,000-year time period would be 0.07.

4.3.16 Traffic

Traffic impacts under the Crescent Junction off-site disposal alternative would be qualitatively identical and quantitatively very similar to those described for the Klondike Flats off-site disposal alternative in Section 4.2.16. Under the truck transportation mode, the percent increase in traffic on US-191 from transporting the tailings would affect approximately 12 more miles of the highway due to the additional distance from the Moab site. A second difference is that road transportation of cover soils borrow material (43 daily round trips; see Table 2–7) required for the Klondike Flats disposal alternative would not be necessary because these soils would be available at the Crescent Junction disposal site. The resulting difference in percent increase in traffic is shown in Table 2–32. Because all other aspects of traffic impacts would be the same, the full analysis of traffic impacts is not repeated in this section.

4.3.17 Disposal Cell Failure from Natural Phenomena

It is possible that a disposal cell failure could occur at the Crescent Junction site. The possibility of failure at this site is much lower than at the Moab site because it was selected for analysis, in part, to avoid the more dynamic characteristics of the Moab site (see Chapter 3.0). The Crescent Junction site is not located near a river, does not have historical seismic activity, and is not prone to settling. In addition, this site is located farther away from populated areas or sensitive habitats than the Moab site, which would reduce the potential risks if a disposal cell failure occurred. Therefore, the possibility of a failure occurring and resulting in potential risks at the Crescent Junction site would be much lower than the potential risks of a disposal cell failure at the Moab site. For this reason, a potential failure at this site was not evaluated.

4.3.18 Environmental Justice

The basis for DOE's analysis of environmental justice impacts is described in Section 4.1.18. One census block area with a reported annual household income less than $18,244 (poverty level for a family of four) is found about 25 miles north of the Crescent Junction site. Although this population could be exposed to small doses of radiation as a result of activities under this alternative, there is no evidence that it would be exposed at a level any higher than the general population. Although traffic in central Moab would be an adverse impact, it does not appear that minority or low-income populations would suffer disproportionately.

DOE has identified no high and adverse impacts, and no minority or low-income populations would be disproportionately affected by the implementation of the Crescent Junction off-site disposal alternative.

4.4 Off-Site Disposal (White Mesa Mill Site)

This section discusses the short-term and long-term impacts associated with off-site disposal at the White Mesa Mill site, the third of the three off-site disposal alternatives. The White Mesa Mill site is located approximately 85 miles south of the Moab site. The impacts are based on the proposed actions described in Section 2.2 and the affected environment described in Sections 3.1 and 3.4. This alternative may result in the following impacts:

- Impacts at the Moab site
- Impacts at the White Mesa Mill site
- Impacts associated with moving tailings from the Moab site to the White Mesa Mill site

The combined impacts that could result from these activities are summarized for each assessment area (e.g., Geology and Soils) at the end of each subsection. For many activities, impacts at the Moab site would not differ significantly from those described in Section 4.2 for the Klondike Flats site. Likewise, construction and operation impacts at the White Mesa Mill site would be similar to those addressed for the Klondike Flats and Crescent Junction sites, with the exception that the White Mesa Mill site is already an operating waste disposal facility.

Transportation impacts would vary depending upon the transportation mode (truck or slurry pipeline). Contaminated vicinity property material would be transported from the Moab site to the White Mesa Mill site along with the tailings. Therefore, impacts associated with transporting vicinity property materials are not addressed separately. Impacts associated with transporting borrow materials are addressed in Section 4.5.

4.4.1 Geology and Soils

4.4.1.1 Construction and Operations Impacts at the Moab Site

Under the White Mesa Mill off-site disposal alternative, the geology and soil impacts at the Moab site would be the same as those described in Section 4.2.1.1.

4.4.1.2 Construction and Operations Impacts at the White Mesa Mill Site

<u>Geology</u>

Impacts related to geology at the White Mesa Mill site would be similar to those described for the Klondike Flats site in Section 4.2.1.2, with some exceptions relating primarily to potential geologic hazards. Although the potential for an impact from a seismic event remains low, there is a potential for subsidence at the edges and slopes of the White Mesa Mill site and for landslides and slumps in the canyons bordering the site. These are not serious hazards and are only of significance over extremely long time frames (many thousands of years).

<u>Soils</u>

Impacts related to soils at the White Mesa Mill site would be similar to those described for the Klondike Flats site in Section 4.2.1.2 with the exception that the estimated maximum area of disturbed soils from construction of a new cell and a staging and support area would be 346 acres for either the truck or slurry pipeline mode of transportation.

4.4.1.3 Construction and Operations Impacts Related To Transportation

The truck and slurry pipeline transportation options would both result in disturbances to soils due to construction of temporary off-site transportation infrastructure elements and corridors between the Moab and White Mesa Mill sites. These would include highway exchanges or the pipeline right-of-way. Because much of the requisite truck transportation infrastructure already exists at the White Mesa Mill site, truck transportation would require only limited additional disturbances, approximately 2 acres. The pipeline right-of-way from the Moab site to the White Mesa Mill site would result in short-term disturbance to approximately 430 acres of soil.

4.4.1.4 Impacts from All Sources

Sand and gravel resources beneath the Moab site would be unavailable for commercial exploitation under all the alternatives due to residual contamination, even after surface and ground water remediation was complete. Geologic hazards near the White Mesa Mill site are not serious and could only affect the stability of the disposal cell over many thousands of years. Table 4–39 summarizes estimated areas of disturbed soils. Areas where soil would be disturbed and subsequently restored include the entire Moab site, areas of new construction at the White Mesa Mill site, and highway exchanges or the pipeline right-of-way.

Table 4–39. Summary of Impacts Related to Soil Disturbance—White Mesa Mill Site Off-Site Disposal Alternative

Soil Disturbance Location or Source	Area of Soil Disturbance (acres)
Moab site	439
White Mesa Mill site	
Truck transportation option	346
Slurry pipeline transportation option	346
Off-site transportation infrastructure or corridor	
Truck transportation infrastructure	2
Slurry pipeline right-of-way	430

4.4.2 Air Quality

Air quality impacts under the White Mesa Mill off-site disposal alternative would be very similar both qualitatively and quantitatively to those described for the Klondike Flats off-site disposal alternative in Section 4.2.2. As shown in Table 4–40 and Table 4–21, the concentrations of criteria air pollutants estimated to occur at the Moab site would be identical under both the White Mesa Mill and Klondike Flats off-site disposal alternatives. As shown in Table 4–41 (White Mesa Mill site) and Table 4–22 (Klondike Flats site), the estimated concentrations of carbon monoxide, nitrogen dioxide, and sulfur dioxide would be approximately 10 percent higher at the White Mesa Mill site than at the Klondike Flats site, and concentrations of PM_{10} would be approximately 8 percent lower at the White Mesa Mill site. The potential for greater emissions at the White Mesa Mill site is associated primarily with the truck haul transportation mode. The estimated concentrations from emissions shown in Table 4–40 and Table 4–41 were derived by applying tailpipe emission factors provided in *Compilation of Air Pollutant Emission Factors* (EPA 2000) to the estimated construction fleet composition and duration of construction operations. All emissions of criteria air pollutants would be well below the primary and secondary NAAQS in 40 CFR 50 under either the truck or pipeline transportation option.

Table 4–40. Criteria Pollutant Concentrations at the Moab Site

Pollutant	Averaging Period	Standard (µg/m^3)	Concentration from Emissions (µg/m^3)
Carbon monoxide	1-hour	40,000	40
	8-hour	10,000	28
Nitrogen dioxide	Annual	100	9.1
Sulfur dioxide	Annual	80	0.90
	24-hour	365	4.5
	3-hour	1,300	10
PM_{10} [a]	Annual	50	3.2
	24-hour	150	16

[a]PM_{10} includes fugitive dust emissions from construction activities.
µg/m^3 = micrograms per cubic meter.

Table 4–41. Criteria Pollutant Concentrations at the White Mesa Mill Site

Pollutant	Averaging Period	Standard (µg/m^3)	Concentration from Emissions (µg/m^3)
Carbon monoxide	1-hour	40,000	59
	8-hour	10,000	41
Nitrogen dioxide	Annual	100	13
Sulfur dioxide	Annual	80	1.4
	24-hour	365	7.0
	3-hour	1,300	16
PM_{10}[a]	Annual	50	3.3
	24-hour	150	17

[a]PM_{10} includes fugitive dust emissions from construction activities.
µg/m^3 = micrograms per cubic meter.

4.4.3 Ground Water

Ground water impacts as a result of construction and operations at the Moab site and of monitoring and maintenance at the White Mesa Mill site would be comparable to those described in Section 4.2.3.1. Therefore, these concerns are not addressed further in this section.

No impacts as a result of monitoring and maintenance under the White Mesa Mill off-site disposal alternative would occur at the site. Therefore, these concerns are not discussed further in this section.

4.4.3.1 Construction and Operations Impacts at the White Mesa Mill Site

The potential exists for adverse impacts to ground water quality at the White Mesa Mill site in the long term due to the shallow perched aquifer in the Burro Canyon Formation. This aquifer, located approximately 50 to 110 ft below land surface, already has milling-related contamination as a result of past operations at the White Mesa Mill, as documented by IUC and others. Any contaminants contributed by the Moab tailings would be in addition to existing contamination. Therefore, the potential would exist for an incremental increase in adverse effects to the shallow aquifer. However, the potential for Moab site tailings to add contamination to the shallow aquifer would be minimized by construction of a designed low-permeability cover on the disposal cell. The cover would minimize the infiltration and migration of constituents to ground water.

The potential also exists for migration of both existing and Moab site-contributed contaminants to reach springs and seeps downgradient of the White Mesa Mill site, which has been investigated by IUC (IUC 2003). The nearest discharge point located most directly downgradient from the tailings cells is Ruin Spring, approximately 10,000 ft south-southwest of the cells. The estimated travel time from the proposed disposal cell location to the perched ground water zone, and then to Ruin Spring, was calculated using assumptions of average porosity, average hydraulic gradient, and an average permeability range. The total estimated average travel time for contaminants contributed by the Moab tailings to reach Ruin Spring under current conditions is between 3,570 and 7,690 years. This assumes no dispersion and an average hydraulic gradient of 0.012 ft/ft over the range of permeabilities used (IUC 2003). However, there is currently no evidence of contaminated ground water reaching Ruin Spring.

A deeper aquifer, the Entrada/Navajo, is located approximately 1,000 ft below the base of the Burro Canyon Formation. This is a confined aquifer that serves as a major regional ground water resource and would not be anticipated to be affected by the proposed disposal cell. However, the State of Utah Division of Radiation Control noted that there is evidence of contamination from the shallow aquifer reaching the deeper confined aquifer according to test results from IUC water supply well WW-2, which is completed in the deeper aquifer. No adverse impacts to sole-source aquifers would occur, as there are none in the area that would be affected by the proposed disposal cell.

The compliance strategy for ground water protection would be consistent with the UMTRCA Title II requirements already in place at the White Mesa Mill site and would depend on the current status of the site's NRC license. Compliance with ground water standards could involve implementation of ACLs if approved by NRC.

4.4.3.2 Construction and Operations Impacts Related to Transportation

Under the White Mesa Mill off-site disposal alternative, depth to ground water in the shallow (uppermost) aquifer varies along the proposed pipeline route from very shallow in the Matheson Wetlands Preserve area to approximately 100 ft below land surface in other areas. Truck transportation would not adversely affect ground water. Because of controls identified in Chapter 2.0 concerning installation and operation of a slurry pipeline, it is also unlikely that there would be any impacts to shallow ground water as a result of this transportation mode.

4.4.4 Surface Water

Under the White Mesa Mill off-site disposal alternative, construction and operations impacts at the Moab site would be similar to those described in Section 4.2.4.1. No impacts to surface water as a result of monitoring and maintenance are anticipated. Therefore, these activities are not discussed further in this section.

4.4.4.1 Construction and Operations Impacts at the White Mesa Mill Site

Construction at the White Mesa Mill site would have a potential short-term impact that could be caused by sediment runoff into adjacent surface waters. However, because of their locations, the stock watering ponds, wildlife pond, ephemeral catch and seepage basins, and intermittent flowing streams would likely not be affected.

Seeps and springs adjacent to the White Mesa Mill site could be affected in the long term by contaminated ground water, as described in Section 4.4.3.1. However, impacts would be considered minimal because of the cell cover design and time frame for ground water to reach these areas.

4.4.4.2 Construction and Operations Impacts Related to Transportation

Under the White Mesa Mill off-site disposal alternative, construction of a slurry pipeline would affect the Colorado River and an estimated 10 other perennial streams and 21 intermittent drainages. An estimated 3,500 ft of directional drilling would be required for stream crossings, and up to 1 mile of open-cut buried crossings for other drainages. Therefore, the potential exists for short-term adverse impacts to surface water as a result of construction of a slurry pipeline in locations where surface waters exist. Such impacts would be associated with sedimentation and increased turbidity from siltation during construction. However, these impacts would be minimized or eliminated by site controls described in Chapter 2.0. No adverse impacts to surface water as a result of truck transportation of the tailings would be anticipated.

4.4.5 Floodplains/Wetlands

4.4.5.1 Construction and Operations Impacts at the Moab Site

Impacts to floodplains and wetlands at the Moab site would be identical to those described in Section 4.2.5.1.

4.4.5.2 Construction and Operations Impacts at the White Mesa Mill Site

There would be no impact from flooding at the White Mesa Mill site because this site is located beyond the potential floodplains of nearby streams. There could be short-term impacts to potential wetland and riparian areas in these streams from increased runoff during disposal cell excavation. Additional potential impacts to wetlands at the White Mesa Mill site are unknown because a detailed assessment of wetlands has not been done.

4.4.5.3 Construction and Operations Impacts Related to Transportation

At the Moab site, the slurry pipeline option would affect the Colorado River floodplain and Matheson Wetlands Preserve during construction. Construction of the pipeline could also involve drilling under other floodplain and wetland areas along the proposed route to the White Mesa Mill site. These areas would be identified and potential impacts more fully assessed prior to completion of the remedial action plan.
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4.4.5.4 Impacts from All Sources

Impacts from all sources would be the same as those described in Section 4.2.5.3. In addition, there would be the potential for short-term impacts to nearby wetlands and floodplains from runoff during disposal cell excavation. There would be the potential for adverse impacts to wetlands and floodplains if the pipeline transportation mode were implemented.

4.4.6 Aquatic Ecology

No monitoring or maintenance impacts to aquatic ecology would be anticipated under the White Mesa Mill off-site disposal alternative. Therefore, these activities are not discussed further in this section.

4.4.6.1 Construction and Operations Impacts at the Moab Site

Under all of the off-site disposal alternatives, the impacts to aquatic biota and habitats at the Moab site would be very similar to those described for on-site disposal (Section 4.1.6.1). It is assumed that the same amount of physical disturbance would occur at the Moab site regardless of the disposal option. Off-site disposal would probably decrease the potential for runoff and siltation at the Moab site. Chemical and radiological impacts to aquatic resources would be similar to those described for the on-site disposal alternative. The annual use of 235 to 730 acre-feet (depending on transportation mode) of nonpotable Colorado River water would be within DOE's authorized river water use rights. (Some of the projected potable water demand would be met using IUC's Recapture Reservoir rights). If Colorado River water use exceeded the 100 acre-foot annual limit set by USF&WS as protective, the unavoidable impact would be mitigated through negotiated water depletion payments.

4.4.6.2 Construction and Operations Impacts at the White Mesa Mill Site

There are no surface waters with sustainable aquatic species near locations where construction and operation activities would occur at the White Mesa Mill site; therefore, no physical, chemical, or radiological adverse impacts to aquatic receptors would occur.

4.4.6.3 Construction and Operations Impacts Related to Transportation

The impacts to aquatic biota and habitat from transporting the Moab tailings to the White Mesa Mill site would depend on the transportation option selected. Surface waters along the transportation corridors to White Mesa Mill are discussed in Chapter 3.0. Aquatic receptors, including benthic macroinvertebrates, could be adversely affected by sedimentation of stream crossings during slurry pipeline construction. Although fish would most likely avoid the turbid area, spawning substrate and stream invertebrates could be adversely affected in the short term. Impacts to aquatic resources could also occur as a result of a truck transportation spill or pipeline breach into aquatic environments along the transportation routes. Impacts from spills would depend on the amount of material released and the ability to retrieve the material before contaminants dissolved into the aquatic environment. However, project controls would ensure that minimal or no impacts would be expected.

4.4.6.4 Impacts from All Sources

Overall potential impacts to aquatic ecology would include impacts from slurry pipeline construction activities in surface waters, including the Colorado River adjacent to the Moab site. Impacts to surface waters could also occur as a result of truck spills. However, because of the volume of materials, the short duration, and site controls, the potential for these impacts would be minimal.

4.4.7 Terrestrial Ecology

4.4.7.1 Construction and Operations Impacts at the Moab Site

Under all the off-site disposal alternatives, impacts to terrestrial biota and habitats at the Moab site would be very similar to those described for on-site disposal (Section 4.1.7.1). It is assumed that the same amount of physical disturbance would occur at the Moab site regardless of the disposal option. Noise levels would probably be comparable under both the on-site and off-site disposal alternatives, because roughly the same numbers and types of equipment would be required. Off-site disposal would probably decrease the potential for runoff and sedimentation at the Moab site. Chemical and radiological impacts to terrestrial resources would be similar to those described under the on-site disposal alternative. Appendix A1, "Biological Assessment," discusses potential effects to federally listed species at this site in more detail.

4.4.7.2 Construction and Operations Impacts at the White Mesa Mill Site

Under the White Mesa Mill off-site disposal alternative, development of a disposal cell and support facilities would disturb approximately 346 acres in the disposal cell area. The effects of physical disturbance would include the loss of foraging and breeding habitat. Wildlife species known to use the White Mesa Mill site include mule deer, which migrate through the area and browse it fairly heavily. Many other wildlife species are known to occur in the site vicinity (Section 3.4.9).

The southwestern willow flycatcher and black-footed ferret are the only federally listed species that could potentially be affected by habitat disturbance resulting from construction of a disposal cell. There was a reported flycatcher sighting in San Juan County in the vicinity of the slurry pipeline corridor (UDWR 2003). However, there is no information on the date of the reported sighting or on whether the sighting was confirmed. There is no suitable habitat for flycatchers known to occur on the White Mesa Mill site. Consequently, impacts to this species from disposal cell construction would not be anticipated.

UDWR (2003) reported a confirmed ferret sighting in the vicinity of the White Mesa Mill disposal site in 1937. However, all black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne counties in 1999 or their offspring could occur on or in the vicinity of the White Mesa Mill site. Black-footed ferrets depend almost exclusively on prairie dog colonies for food, shelter, and denning. Although the area from Moab south along US-191 toward the White Mesa Mill site supports colonies of Gunnison's prairie dog (*Cynomys gunnisoni*) (Seglund 2004), no colonies are currently known to occur at or close to the White Mesa Mill site. Consequently, impacts from construction to the black-footed ferret would not be anticipated.

Impacts of physical disturbance could be avoided or minimized in several ways. The most important action would be to conduct field surveys prior to any site development activities to determine the presence of any species of concern. Additional actions would include minimizing site disturbance to the extent practicable, revegetating disturbed lands and the cover cap once it was completed, and scheduling ground-clearing activities during periods that would not disturb nesting migratory birds.

Noise due to construction and operations could have an adverse effect on terrestrial wildlife. At the White Mesa Mill site, noise would be generated by construction equipment and material transfer operations. The estimated maximum noise levels that would be generated when all equipment was operating would be approximately 95 dBA at 49 ft. The noise level would attenuate over a distance of approximately 6 miles until it reached the quiet desert background level of approximately 30 dBA. However, the White Mesa Mill is an active uranium milling site, which has a relatively high background noise level when operating. Therefore, much of the wildlife currently at or near the White Mesa Mill site is probably already habituated to human presence and noise.

Noise can affect terrestrial organisms by causing physiological changes and behavioral modifications, including nest abandonment. It can also disrupt communication and defense systems. Any of the species that may be present at the White Mesa site could be affected by the noise associated with construction and operations.

The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas. The bald eagle is the only federally listed species in the vicinity of the White Mesa Mill site that could be affected by noise from site operations. However, it is not known to nest or night roost in the area, nor is it commonly seen in the area, and it would therefore be unlikely to be affected.

Other effects of human presence, including night lighting, also would reduce the overall habitat value of the area. As with noise, some species become habituated to human presence, but others such as deer or pronghorn antelope could avoid the site during human activities. The White Mesa Mill site is surrounded by many square miles of similar or better habitat. Therefore, individuals that avoided the area because of construction activities would not be forced into less desirable habitat.

The effects of noise, supplemental lighting, and human presence could be greater at night than during the day. Therefore, double-shift operations would likely have a greater impact than single-shift operations. The effects of noise, supplemental lighting, and human presence could be mitigated by limiting the amount of light off the site, minimizing activities at the periphery of the site, and limiting especially loud activities to daylight hours and to seasons when the effects on biota would be reduced.

There would not likely be chemical impacts at the White Mesa Mill site. Accidental spills of diesel, oil, or other materials would be quickly controlled and mitigated.

4.4.7.3 Impacts of Transportation

The effects of transporting the Moab tailings to the White Mesa Mill site would depend on the transportation option selected. Truck transport would increase collision mortality and highway noise, but a slurry pipeline could disrupt more habitat along the pipeline corridor. Borrow materials would be transported to the White Mesa Mill by truck, regardless of the selected mode of tailings transport.

<u>Truck Transportation Option</u>

Truck transportation of tailings from the Moab site to the White Mesa Mill site would increase the amount of truck traffic on US-191 south of Moab (Section 4.4.16). This increase in traffic

would likely lead to an increase in traffic-related wildlife mortalities and an increase in the average noise levels in the vicinity of the highway.

The highway route between Moab and White Mesa Mill crosses important migration routes for mule deer and critical range for pronghorn antelope. At least during periods of migration, the increase in truck traffic could lead to an increase in mortality of these species.

The bald eagle is the only federally listed species that could incur an increase in traffic-related mortality. The Gunnison sage grouse is the only federal candidate species that could be so affected. The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas. Bald eagles could be found temporarily and infrequently using such areas when there are opportunities to feed on carrion, such as in big-game wintering areas or in prairie dog colonies. Therefore, it is possible that if traffic-related wildlife mortality increased due to the project, an increased number of eagles could be hit on highways. However, without data on this relationship, it is reasonable to assume that the number of eagles hit on highways would be proportional to the number of carrion available. The increase in the number of traffic-related wildlife mortalities is expected to be small. Consequently, the potential increase in associated eagle deaths is also expected be small.

The Gunnison sage grouse was observed in 1999 in San Juan County in the vicinity of the proposed slurry pipeline corridor between Moab and the White Mesa Mill site. Much of the area near the proposed pipeline route between Moab and White Mesa is part of a Gunnison sage grouse conservation area (Sage Grouse Working Group 2000). The increased truck traffic could increase traffic-related mortality for this species.

As described in Section 4.4.10, the increased truck traffic along US-191 resulting from transport of tailings from the Moab site to the White Mesa Mill site would likely increase ambient noise levels by approximately 5 dB (measured at 49 ft). Although the highway noise (average baseline approximately 70 dBA) could be detected by humans over distances of 6 to 7 miles, the additional noise due to the additional trucks would not be perceptible beyond several hundred yards.

The primary federally listed species that could be affected by this increased traffic noise would be the Mexican spotted owl. Designated critical habitat for the spotted owl occurs within 2 miles of the transportation corridor just south (within 25 miles) of the Moab site. However, data provided by UDWR (2003) indicated that there were no occurrences of the Mexican spotted owl in any of the project areas. Thus, it is possible but unlikely that spotted owls occur in this area. If present, the species could potentially be disturbed by noise from increased truck traffic, although the probability of such a disturbance, based on the incremental increase in highway noise, would be minimal.

The potential for impacts to terrestrial wildlife from truck transportation of tailings would be greater in the evening or at night than during the day. Therefore, the impacts of two-shift operations would probably be greater than those of single-shift operations. In either case, the impacts would be of relatively short duration and would cease once the transfer of materials to the disposal cell was completed.

Slurry Pipeline Option

Use of a slurry pipeline system to transport tailings from the Moab site to the White Mesa Mill site would increase the amount of habitat disturbance along the transportation corridor.

Most of the slurry pipeline route to the White Mesa Mill site is parallel and adjacent to either US-191 or existing gas pipeline rights-of-way. However, approximately 28.7 miles of new right-of-way would be required along this route. Construction of the pipeline within existing corridors would not likely have an adverse ecological impact other than disturbance of revegetated previously disturbed areas. Construction within new rights-of-way would affect a greater variety of habitats.

Wetland areas could be inhabited by Utah state-listed plant species of concern. Animal species that could be affected include the black-footed ferret, Mexican spotted owl, southwestern willow flycatcher, and Gunnison sage grouse, as well as numerous animal species listed by Utah as species of concern. Black-footed ferrets have been observed at five locations in the region between the Moab site and the north IUC borrow area (UDWR 2003). However, it is unlikely that ferrets are present along the route of the proposed pipeline, based on the rationale provided in the discussion of the black-footed ferret in Section 4.4.7.2.

Mexican spotted owls are not likely to occur near the proposed slurry pipeline route because the route would not cross through or near any steep-walled canyons that are preferred nesting areas (USF&WS 1995 and 2001). Southwestern willow flycatchers are not likely to occur in the area because the proposed route crosses very little wooded-riparian habitat. Gunnison sage grouse could be affected, since much of the area near the proposed pipeline route between Moab and White Mesa is part of a Gunnison sage grouse conservation area (Sage Grouse Working Group 2000). A thorough survey of the pipeline right-of-way would be performed prior to construction, and appropriate mitigation plans would be developed if any of these species were identified within the right-of-way.

In addition to field surveys to identify populations of these species of concern, mitigation could consist of adjusting the pipeline location if needed and constructing the pipeline during periods of the year that would not disrupt the breeding or nesting of Gunnison sage grouse, spotted owls, willow flycatchers, or migratory birds. Operation of the pipeline would not be expected to have any adverse effects on wildlife species or habitats.

4.4.7.4 Monitoring and Maintenance Impacts

Routine post-closure monitoring and maintenance of a disposal cell at the White Mesa Mill site would not be expected to have any impacts on terrestrial species or habitats. If major corrective actions were needed, some of the recovering vegetation on and around the disposal site could be disturbed.

4.4.7.5 Impacts from All Sources

Overall impacts to terrestrial ecological resources under the White Mesa Mill off-site disposal alternative would include approximately 50 acres of tamarisk habitat lost at the Moab site (the rest of the site is considered to have zero habitat quality). A maximum of approximately 174 acres would be disturbed at borrow areas, approximately 90 percent of which would be for

Moab site reclamation soil assumed to be obtained at the Floy Wash borrow area (White Mesa Mill disposal cell cover soils would be obtained from cell excavation material). Disturbances for disposal cell and borrow material excavation would include approximately 96 acres of disturbed piñon-juniper, scrub, or forested habitat. Approximately 346 acres would be disturbed for disposal cell construction.

The truck transportation option would require only 2 acres of disturbance for infrastructure construction. Total disturbance from all activities (Moab site, borrow areas, transportation, and White Mesa Mill site) from truck transportation would be approximately 570 acres. The slurry pipeline option would require 430 acres of disturbance for the pipeline corridor for a total of approximately 1,000 acres disturbance from all activities. Additional habitat could be lost at the commercial quarry sites for sand and gravel.

There would be a slight decrease in habitat value near US-191 because of the increased truck traffic required to haul tailings if the truck transport option were selected, and there would be a slight increase in traffic-related wildlife mortalities. Impacts of borrow material haulage would be less than those under the on-site disposal alternative because the radon barrier and cover materials would be available near the disposal cell site, and haulage of these materials at highway speeds on US-191 would not be required.

4.4.8 Land Use

4.4.8.1 Construction and Operations Impacts at the Moab Site

Under the White Mesa Mill off-site disposal alternative, the land use impacts at the Moab site would be the same as those described in Section 4.2.8.1 for the Klondike Flats disposal alternative.

4.4.8.2 Construction and Operations Impacts at the White Mesa Mill Site

No impacts that are not part of IUC's existing operating plan would occur from construction and operations on IUC's property at the White Mesa Mill site. In addition, there would be no land use impacts from borrow materials secured from commercial operations. There would be short-term impacts from borrow areas permitted on BLM lands. Obtaining borrow material from areas on BLM lands would create only short-term impacts because these areas would be reclaimed and returned to BLM for prior designated uses. Disposal of tailings from the Moab site would commit 346 additional acres to permanent waste disposal.

4.4.8.3 Construction and Operations Impacts Related to Transportation

The truck haul transportation mode would require an additional 2 acres of disturbance to build an overpass over US-191 and to build additional acceleration and deceleration lanes to the existing highway at the site entrance. It is likely these would be built in the existing right-of-way and would create no additional land use impacts. A slurry pipeline would be built in the existing pipeline right-of-way for most of the distance, but would require an additional 28.7 miles of new right-of-way.

4.4.8.4 Monitoring and Maintenance Impacts

There would be no additional impacts from monitoring and maintenance at the site. If other monitoring locations were required outside IUC's property, wells or other monitoring equipment and the associated access would be negotiated and maintained.

4.4.8.5 Impacts from All Sources

Under the White Mesa Mill off-site disposal alternative, the primary long- and short-term land use impacts would occur from the activities at the Moab site, as described in Section 4.2.8.1. In addition, there could be short-term impacts from securing borrow materials from any borrow area on BLM property.

4.4.9 Cultural Resources

This section addresses the potential for the disturbance of known cultural resources or the discovery of unknown resources under the White Mesa Mill off-site disposal alternative.

4.4.9.1 Construction and Operations Impacts at the Moab Site

Impacts to cultural resources at the Moab site under the White Mesa Mill off-site disposal alternative would be the same as those described in Section 4.1.9.1.

4.4.9.2 Construction and Operations at the White Mesa Mill Site

On the basis of previous cultural surveys, 9 to 12 cultural sites eligible for inclusion in the National Register of Historic Places would be directly affected by construction of a disposal cell at the White Mesa Mill site. Table 4–42 lists the identification number, type, cultural affiliation of the 12 cultural sites, and recommendations made by the author of the Class I cultural resource inventory (Davis et al. 2003) for further cultural work. A minimum of five potential traditional cultural properties also could be adversely affected by disposal cell construction.

Before construction of the disposal cell began, DOE, the State Historic Preservation Officer, affected Native American tribes, and the Advisory Council on Historic Preservation would determine appropriate mitigation measures for these sites through the Section 106 consultation process (Section 3.1.13.3). The archaeological sites would likely be excavated by professional archaeologists, and cultural resource data would be recovered and recorded. Given the archaeological discoveries made elsewhere on the White Mesa Mill facility (Casjens 1980), it is probable that additional archaeological structures, features, and objects would be unearthed during excavating. Mitigation of the potential traditional cultural properties, which may include sacred gathering areas, sacred healing areas, sacred springs, and burial areas, would be extremely difficult given the density and variety of these resources, the importance attached to them by tribal members, and the number of tribal entities that would be involved in consultations.

Table 4–42. Cultural Sites That May Be Adversely Affected by Disposal Cell Construction at the White Mesa Mill Site

Site Identification Number	Site Type	Cultural Affiliation	Recommendation for Further Work
42SA 6392	Limited activity	Unknown	Resurvey; update site form
42SA 6393	Limited activity	Basketmaker III to Pueblo II	Resurvey; update site form
42SA 6397	Limited activity	Early Pueblo II	Resurvey; update site form
42SA 6398	Limited activity	Basketmaker III to Pueblo I	Resurvey; update site form
42SA 6399	Habitation	Pueblo I to Pueblo II	Resurvey; update site form
42SA 6400	Limited activity	Basketmaker III to Pueblo I	Resurvey; update site form
42SA 6401	Limited activity	Basketmaker III	Resurvey; update site form
42SA 6429	Habitation	Pueblo II	Resurvey; update site form
42SA 6430	Habitation	Pueblo II	Resurvey; update site form
42SA 6431	Limited activity	Pueblo II	Resurvey; update site form
42SA 6433	Habitation	Pueblo III	Resurvey; update site form
42SA 13964	Temporary camp	Historical	Resurvey; update site form

4.4.9.3 Construction and Operations Impacts Related to Transportation

Under the trucking option, one cultural site—the historic US-160 that parallels US-191—would be adversely affected by construction of the deceleration lane at the Moab site. Up to three cultural sites could be adversely affected by haul road construction (depending on the final location of the road) at the White Mesa Mill site. Table 4–43 lists the identification number, type, cultural affiliation of the three cultural sites, and recommendations made by the author of the Class I cultural resource inventory (Davis et al. 2003) for further cultural work.

Table 4–43. Cultural Sites That Could Be Adversely Affected by Haul Road Construction at the White Mesa Mill Site

Site Identification Number	Site Type	Cultural Affiliation	Recommendation for Further Work
42SA 6402	Limited activity	Pueblo III	Resurvey; update site form
42SA 7750	Limited activity	Basketmaker III to Pueblo II	Resurvey; update site form
42SA 7753	Limited activity	Basketmaker III to Pueblo I	Resurvey; update site form

A total of 104 cultural sites eligible for inclusion in the National Register of Historic Places are known to exist within 0.5 mile of the proposed slurry pipeline route to the White Mesa Mill site. An additional 90 to 300 sites are estimated to occur in the unsurveyed portions of the pipeline. Of the 194 to 404 total, 50 to 100 could be adversely affected during pipeline construction. The one potential traditional cultural property known to exist along the pipeline route also would be adversely affected. Consequently, DOE estimates that at least 51 to 101 cultural sites could be adversely affected by the pipeline. If additional traditional cultural properties were located along the route (the potential for their occurrence is extremely high), they also would likely be adversely affected.

DOE, BLM, UDOT, the State Historic Preservation Officer, affected Native American tribes, and the Advisory Council on Historic Preservation would determine appropriate mitigation measures for these sites through the Section 106 consultation process (see Section 3.1.13.3). Mitigation measures could include (1) avoiding the sites, (2) monitoring the cultural resource during surface-disturbing activities, (3) excavating and recording cultural resource data before construction activities began, or (4) moving the cultural resource objects from areas of disturbance to nearby undisturbed areas. Given the likely density and variety of potential traditional cultural properties located along the route, the importance attached to them by tribal members, and the number of tribal entities that would be involved in consultations, mitigation of these sites would be extremely difficult.

In addition to these direct impacts, cultural resources located near the pipeline could be adversely affected indirectly through illicit collection, vandalism, or inadvertent destruction as a result of increased human activity in the area.

4.4.9.4 Monitoring and Maintenance Impacts

Under the White Mesa Mill off-site disposal alternative, impacts to cultural resources would not occur from monitoring and maintenance activities.

4.4.9.5 Impacts from All Sources

Table 4–44 lists the total number of cultural sites eligible for inclusion in the National Register of Historic Places that could be adversely affected under each of the White Mesa Mill site transportation alternatives.

Table 4–44. Number of Cultural Sites That Could Be Adversely Affected Under the Two White Mesa Mill Site Transportation Options

Location/Activity	Transportation Mode	
	Truck	Slurry Pipeline
Moab site (construction and operations)	0–2	0–2
Moab site (highway improvements)	1	0
White Mesa Mill site haul road construction	0–3	0–3
White Mesa Mill disposal cell area	14–17	14–17
Radon barrier borrow area (White Mesa Mill borrow area)	6	6
Riprap borrow area (Blanding borrow area)	3	3
Pipeline construction	NA	51–101[a]
Total	**24–32**	**74–132[a]**

[a]Numbers do not include potential traditional cultural properties that have not yet been identified along the pipeline route; the likelihood of their occurrence is extremely high.

4.4.10 Noise and Vibration

This section addresses the impacts of noise and ground vibration under the White Mesa Mill off-site disposal alternative, primarily to human receptors. Where appropriate, impacts to wildlife and cultural resources are also identified. Unless indicated otherwise, all noise and vibration impacts would be temporary and would last only as long as project construction and operations were ongoing.

4.4.10.1 Construction and Operations Impacts at the Moab Site

Noise from the Moab site under the White Mesa Mill off-site disposal alternative would come from construction activities and removal of the tailings pile. The largest sources of noise on the site would be heavy earth-moving equipment. Noise generated from these activities would not differ significantly from the noise generated at the Moab site under the on-site disposal alternative. Section 4.1.10 describes the noise associated with construction and earth-moving activities.

Ground vibration generated by heavy equipment at the Moab site is discussed in Section 4.1.10. No appreciable differences would be expected in ground-level vibration at the Moab site between the on-site disposal alternative and the White Mesa Mill off-site disposal alternative.

4.4.10.2 Construction and Operations Impacts at the White Mesa Mill Site

Noise at the White Mesa Mill site from the disposal of tailings would come from construction activities and hauling the tailings. The type of noise generated from these activities is described in Section 4.2.10.2 for the Klondike Flats site. No appreciable differences would be expected in the source or levels of noise. However, the receptors around the White Mesa Mill site would be different from those around the Klondike Flats site. No residences are within the estimated 1,480-ft region of influence around the White Mesa Mill site.

Ground vibration generated from construction and operations at the White Mesa Mill site would be the same as those discussed in Section 4.2.10.2. There are no receptors at the White Mesa Mill site within the 820 ft estimated for ground vibration to attenuate to background levels. There are no sites of cultural importance that would be affected by ground vibration at the White Mesa Mill site.

4.4.10.3 Construction and Operations Impacts Related to Transportation

Transportation options for disposal at the White Mesa Mill site are truck and slurry pipeline. Truck traffic noise would be from traffic on US-191; the slurry pipeline noise would follow the pipeline route and would persist only during construction of the slurry pipeline. Trucks transporting the tailings would pass through four communities: Moab, La Sal Junction, Monticello, and Blanding. The increase in noise in each of these communities and around the highway sections between the cities would vary according to traffic levels (Table 4–45). Through Moab, due to the low truck speed, the noise levels would be expected to exceed 65 dBA only out to 82 ft from the road. US-191 passes through some residential areas within the city of Moab, so some residential buildings could be exposed to noise levels above the Moab residential standard of 65 dBA (Moab City Ordinance 17.74.080, “Noise Levels”). South of the Moab city limits, speed limits increase, and the region of influence would increase accordingly. For this area, the region estimated to exceed 65 dBA is 422 ft from the highway. It is likely that residents live within this region of influence. In the other communities between the Moab site and White Mesa Mill, some residential structures are likely to be within the 360-ft region of influence estimated for highway sections south of La Sal Junction, at Monticello, and at Blanding.

Table 4–45. Noise Impacts Around Transportation Routes for the White Mesa Mill Off-Site Disposal Alternative

Highway Section	Hourly Average Baseline Noise (dBA) at 25 ft From Source	Hourly Average Project Truck Traffic	Hourly Average Project Truck Traffic Noise (dBA) at 25 ft From Source	Total Noise (dBA) at 25 ft From Source	Region of Influence (ft)	Increase at 25 ft (dBA) From Truck Hauling Activities
Moab[a]	66	40	68	70	82	4.1
La Sal Junction through Moab	73	40	75	77	422	4.1
White Mesa to La Sal Junction	71	40	75	76	360	5.4

Assumptions:
Single project truck vehicle noise 95 dBA[b] at 60 mph[a], 25 ft from source.
Single project truck vehicle noise 85 dBA[b] at 60 mph[a], 25 ft from source.
[a]Project truck speed 30 mph within Moab city limits, 60 mph everywhere else.
[b]Conservative estimation based on values from multiple sources (Bowlby 1991, Sandberg 2001).

Noise emissions from construction of a slurry pipeline are described in Section 4.2.10.3. A 1,480-ft region of influence is estimated around the slurry pipeline route. The proposed routes for the slurry pipeline between the Moab site and the White Mesa Mill site would generally avoid communities. Few if any receptors would likely reside within 1,480 ft of the pipeline route. Construction of a slurry pipeline would likely result in ground vibration above background levels. The estimated maximum level for ground vibrations emitted by construction of a slurry pipeline would be 95 dBV. This level would result in ground vibration above background levels 820 ft from the source and levels above human perception within 330 ft of the source. Some cultural sites containing rock granaries and a historic homestead lie within 2,620 ft of the pipeline, but ground vibration levels at these resources would not reach levels (estimated at 92 to 100 dBV) that would damage these structures.

4.4.10.4 Monitoring and Maintenance Impacts

Monitoring and maintenance of the White Mesa Mill site would not be expected to result in significant generation of noise. Any noise generated by these activities would attenuate to near background levels before leaving the boundary of the disposal site.

4.4.10.5 Impacts from All Sources

Noise generated by the White Mesa Mill truck haul option would exceed the Moab residential noise standard of 65 dBA at some receptor locations. The receptors with the most potential to notice any increase in noise generated by this alternative would include residents living near US-191 in and around Moab, the resident located on the eastern boundary of the Moab site, and residents of communities between Moab and the White Mesa Mill. If two 10-hour shifts were used instead of a single 12-hour shift, the noise generated would not change substantially, but there could be a higher potential for annoyance from late-night and early-morning activities.

4.4.11 Visual Resources

This section describes the impacts to those physical features of the landscape that impart scenic value in the region affected by the White Mesa Mill off-site disposal alternative. The impacts would be imposed on viewers who live in, work in, or visit an area and could see ongoing human activities or the results of those activities.

4.4.11.1 Construction and Operations Impacts at the Moab Site

Under the White Mesa Mill off-site disposal alternative, impacts to visual resources at the Moab site would be the same as those described in Section 4.2.11.1.

4.4.11.2 Construction and Operations at the White Mesa Mill Site

Construction and operations at the White Mesa Mill site would have minor adverse effects on visual resources, primarily because construction activities and the completed disposal cell would not be seen by most people. DOE selected four key observation points from which to assess visual impacts: (1) US-191 southbound, (2) US-191 northbound, (3) the nearest residence, and (4) the White Mesa Ute community. Figure 4–18 shows DOE's visibility analysis results for the proposed disposal cell location. The darkened areas indicate locations from which a disposal cell could potentially be viewed. The visibility analysis used to create this map is based on elevation and topography and does not take into account the potential obstruction of views from cultural modifications or vegetation or the effects of distance on visibility. Without visual aids, such as binoculars, most people would not be able to recognize a disposal cell at distances greater than 5 to 10 miles.

The visibility analysis results indicate that travelers on US-191 would not likely see a cell. In Figure 4–18, small darkened areas are present at two locations along the highway within 5 miles of the site. Given the speed of travel, angle of view, and distance from the site, travelers would more likely notice the existing structures and topsoil salvage piles on the site than a more distant, lower-profile disposal cell. The view of DOE's disposal cell from the nearest residence, located approximately 1.6 miles north of the site's entrance road, would be obstructed by the structures and disposal cells currently located at the site. Because of distance, a disposal cell would not likely be visible from any locations within the White Mesa Ute community. The one potential adverse impact from cell construction at these key observation points would be from the lighting used during dawn and dusk hours (and at nighttime under the double-shift work scenario) during the construction period. Because the White Mesa Mill is a commercial facility, it is not known if night lighting would continue in the long term.

The activities proposed under this alternative would be compatible with BLM's Class III visual resource objectives for the area surrounding the site (BLM 2003). Although DOE is not required to meet the objectives of BLM's visual resource management system on the privately owned White Mesa Mill site, the system provides a useful way to measure the effects of a proposed action on visual resources.

4.4.11.3 Construction and Operations Impacts Related to Transportation

<u>Truck Haul</u>

Under the White Mesa Mill off-site disposal alternative, impacts to visual resources would not occur under the truck haul transportation option.

Slurry Pipeline

Approximately 25 percent of the pipeline corridor would be visible to the general public, mainly to Moab residents and travelers on US-191. DOE selected three key observation points from which to assess visual impacts: (1) US-191 at Kane Springs Canyon, (2) US-191 at the booster pump station in Lisbon Valley, and (3) US-191 at Recapture Creek. The Kane Springs Canyon and Recapture Creek areas have Class II visual resource designations, and the booster pump station in Lisbon Valley has a Class III designation.

From the Kane Springs Canyon key observation point, northbound travelers on US-191 would have a 20-second view of the pipeline corridor's cut through the massive, prominent Entrada Sandstone outcrop located west of the highway (see Figure 3–44). Southbound travelers would not see the cut. The trench-like, vertical cut would contrast strongly with the smooth, horizontal lines created by the Entrada Sandstone. Although the viewing time would be relatively short, the strong contrast in line and form created by the cut would likely draw the attention of some travelers. Construction of a slurry pipeline at this location would not meet the area's Class II visual resource objectives in the short term or long term, as the cut would be a permanent feature.

Northbound travelers on US-191 would have a 10- to 15-second view of the proposed booster pump station in Lisbon Valley. The view of the station by southbound travelers would be obstructed by a large rock outcrop. The simple, angular, geometric form of the pump station, with its smooth surfaces, and the associated barren parking area would contrast strongly with the more complex, semi-rugged, vegetated surroundings. Figure 4–19 shows a photo simulation of the proposed pump station and newly constructed pipeline. Because the size of the station would be relatively small against the massive, prominent rock outcrops and cliff faces in the background, the overall contrast would be weak for most travelers. The proposed action would meet the area's Class III visual resource objectives.

Across Recapture Creek canyon, the pipeline corridor would parallel an existing pipeline at the base of the existing Recapture Creek dam and US-191 road grade. Travelers on US-191 would not likely see the pipeline corridor as they crossed the dam because of the downward viewing angle and their travel speed. Rather, their attention would likely be focused on the strikingly deep blue-green water of Recapture Creek Reservoir and the rugged cliffs of the Burro Canyon Formation. After the pipeline was removed and the corridor revegetated, the corridor would not be visible. Construction of a slurry pipeline at this location would be compatible with BLM's Class II visual resource objectives.

Construction of the remainder of the pipeline route that would be visible to the general public would be expected to meet BLM's Class III and Class IV visual resource objectives. In these areas, the smooth, linear, unvegetated swath created by pipeline construction would contrast moderately with the surrounding landscapes (see Section 3.4.19.9). After the pipeline was removed and the corridor revegetated, the contrast between the corridor and surrounding landscape would be moderate to nonexistent, depending upon the success of revegetation. Figure 4–20 shows a photo simulation of the booster pump station area in Lisbon Valley after reclamation.

4.4.11.4 Monitoring and Maintenance Impacts

Monitoring and maintenance activities under the White Mesa Mill off-site disposal alternative would have no impacts to visual resources.

4.4.11.5 Impacts from All Sources

Moving the uranium mill tailings pile from the Moab site to the White Mesa Mill site would have some moderate, short-term, adverse visual impacts and moderate to no long-term adverse visual impacts, primarily because the short-term construction activities and the completed disposal cell would not be seen by many people. At the Moab site, removal of the pile would have strong beneficial impacts to visual resources. Table 4–46 summarizes visual resource impacts expected under this alternative.

Table 4–46. Summary of Visual Resource Impacts Under the White Mesa Mill Off-Site Disposal Alternative

Location/Activity	Visual Resource Impacts	
	Short Term	Long Term
Moab site	Strong adverse impacts primarily to travelers on US-191 and SR-279	Strong positive impacts from removal of tailings pile
White Mesa Mill site	Minor adverse impacts from night lighting	Unknown impacts from night lighting
White Mesa borrow area	No adverse impacts	No adverse impacts
Blanding borrow area	Moderate adverse impacts to southbound US-191 travelers	No adverse impacts
Truck haul[a]	No adverse impacts	No adverse impacts
Slurry pipeline[a]	Overall, moderate adverse impacts to travelers on US-191	Overall, moderate to no adverse impacts to travelers on US-191
Monitoring and maintenance	No adverse impacts	No adverse impacts

[a]Only one transportation option would be selected.

4.4.12 Infrastructure

This section addresses potential impacts on the availability of electric power, potable water, nonpotable water, sewage treatment, and highways under the White Mesa Mill off-site disposal alternative. Unless indicated otherwise, all infrastructure impacts would be temporary and would last only as long as project construction and operations were ongoing.

4.4.12.1 Construction and Operations Impacts at the Moab Site

The infrastructure impacts associated with construction and operations at the Moab site would be the same as those described in Section 4.2.12.1 for the Klondike Flats site, with the exception of the electric power demand under the slurry pipeline option. Under that option, the power demands would be 6,100 kVA, 2,700 kVA more than for the Klondike Flats site. ESC Inc. developed and reviewed this projected demand with Mathew Yates, Pacific Corporation, Moab. Pacific Corporation indicated that this demand would present no capacity problems to the existing electric supply system at the site, nor would system upgrades be required (ESC 2003).

4.4.12.2 Construction and Operations Impacts at the White Mesa Mill Site

Qualitatively, the infrastructure impacts associated with construction and operations at the White Mesa Mill site would be the same as those described for the truck and pipeline options in Section 4.2.12.2 for the Klondike Flats site and in Section 4.3.12.2 for the Crescent Junction site, with the exception of electric power demands. The impact on the existing electrical infrastructure servicing the White Mesa Mill site would differ for the two alternative modes of transportation. For truck transportation, the total power demand at the White Mesa Mill site would be 300 kVA, which is the basic demand required for site construction and operations. The same basic demand would be required at the Klondike Flats or Crescent Junction sites. For slurry pipeline transportation, the demand would be 3,100 kVA, 600 kVA more than for the Klondike Flats site and 300 kVA more than for the Crescent Junction site. ESC of Fort Collins, Colorado, developed and reviewed this projected demand with Mathew Yates, Pacific Corporation, Moab. Pacific Corporation indicated that capacity of the existing distribution circuit would be adequate for the truck haul option. However, the slurry pipeline transport system would require the addition of a substation transformer at Utah Power's Blanding substation and a distribution upgrade from the substation to the White Mesa Mill site. In addition, the intermediate slurry pump booster station facility would require (1) the addition of a substation transformer at Utah Power's La Sal substation, (2) a new 3-mile power line extension to the proposed site of a pump booster station, and (3) an upgrade of the existing line from the La Sal substation to its current end point (ESC 2003).

Quantitatively, potable and nonpotable water demands would be the same as those previously described for the Moab site in Section 4.2.12.1 and the other two off-site disposal sites in Sections 4.2.12.2 and 4.3.12.2. However, in contrast to the other sites, the sources of the water would not be the city of Moab (for potable water) or the Colorado River (for nonpotable water). The Entrada/Navajo aquifer is capable of yielding domestic quality water at rates of 150 to 225 gpm (216,000 to 324,000 gallons per day) and is used as a secondary source of potable water for the White Mesa Mill. IUC has constructed five deep water supply wells at the White Mesa Mill. The yield capabilities from these wells would be sufficient to meet the maximum demand for potable water from implementing the proposed action at the White Mesa Mill site—that is, 7,500 gallons per day for the truck transportation option. Nonpotable water would be drawn from the existing Recapture Reservoir, where IUC currently holds major water use rights.

Activities at the White Mesa Mill site would generate 5,000 to 11,000 gallons of sanitary waste per week, depending on the transportation mode. This volume would be in addition to the 10,000 gallons per week generated at the Moab site. Sanitary waste generated at the White Mesa Mill site would be disposed of in the on-site, State-approved leach field system or in the city of Blanding's sewage treatment plant. The White Mesa Mill currently disposes of all its sanitary waste in the leach field system. However, it is unknown whether this system has the capacity to manage the sanitary waste that would be generated by the additional workers required at the site. If necessary, the additional sanitary waste could be stored at the White Mesa Mill site in portable toilets and septic tanks and disposed of in the Blanding sewage treatment plant. The Blanding sewage treatment plant has the capacity to serve 5,000 people, but only 3,000 people currently dispose of sanitary waste at the plant. Consequently, there would be sufficient excess capacity to accommodate the additional workers at the site under either transportation mode. There are currently no restrictions for receiving concentrated sanitary waste of the type stored in septic tanks and portable toilets.

4.4.12.3 Construction and Operations Impacts Related to Transportation

For the truck transportation option, there would be no infrastructure impacts above the 300 kVA demand for site construction and operations. However, the slurry pipeline option would represent an additional demand of 2,800 kVA for the pipeline terminal station. The slurry pump booster station that would be required for pipeline operations represents a demand of 4,800 kVA; it would require the installation of a new substation transformer at the Utah Power La Sal substation, approximately 3 miles of new distribution line from the new substation to the proposed booster pump location, and an upgrade of the existing line from the La Sal substation to its current end point.

Impacts to the road infrastructure would be qualitatively similar to those described in Section 4.2.12.3.

4.4.12.4 Monitoring and Maintenance Impacts

Under the White Mesa Mill off-site disposal alternative, monitoring and maintenance activities would be generally limited to periodic inspections and activities to remedy incipient erosion, as necessary. DOE does not expect these activities to affect the local or regional infrastructures.

4.4.12.5 Impacts from All Sources

Regional and local supplies of power, water, and sewage treatment capacity would be adequate to meet the requirements of the White Mesa Mill off-site disposal alternative. Transportation would cause increased wear on roads, which would be paid for through vehicle registration and special permit fees.

4.4.13 Solid Waste Management

Waste management impacts would be the same as those described for the Klondike Flats site in Section 4.2.13, except that the estimated 1,040 yd^3/year of solid waste generated at the White Mesa Mill site would not be sent to a municipal or county landfill. Consistent with White Mesa Mill practice, all solid waste generated at the site would be disposed of in an existing or in the new tailings disposal cell. This additional annual waste volume amounts to a cube approximately 10 yards on a side and would be insignificant compared to the volume of the disposal cell.

4.4.14 Socioeconomics

The socioeconomic impacts from off-site disposal at the White Mesa Mill site would be similar in scope to those described in Sections 4.2.14 and 4.3.14. The aggregate expenditures under this alternative would cover construction and surface remediation at the Moab and White Mesa Mill sites, ground water remediation, remediation of vicinity properties, and transportation of materials from the Moab site and vicinity properties to the White Mesa Mill site. The project cost data and economic impact estimation methodology are described in Section 4.1.14.

The economic impacts of off-site disposal at the White Mesa Mill site are summarized in Table 4–47. Truck transport and slurry pipeline transport options are considered under the White Mesa Mill off-site disposal alternative. Over the 8-year disposal period, the annual project costs are estimated to be $52,522,525 under the truck transport option and $58,224,925 under the slurry pipeline transport option. In both cases, the 75-year ground water remediation/site monitoring phase of the project is estimated to cost $933,000 per year. The truck transport option

Table 4–47. Economic Impacts in the Two-County Socioeconomic Region of Influence Under the White Mesa Mill Off-Site Disposal Alternative

Transport Method	Annual Cost	Annual Output of Goods and Services	Annual Labor Earnings		Jobs
Truck	$52,522,525	$69,214,183		$17,069,821	598
Pipeline	$58,224,925	$76,728,806	Year 1	$18,923,101	778
			Years 2–8	15,336,642	320

Note: Economic impacts for regional output of goods and services and labor earnings are calculated based on final-demand multipliers provided by the Bureau of Economic Analysis. The respective multiplier values (1.3178 and 0.3250) are multiplied by annualized cost to generate the impact values shown. Employment impacts are calculated as the product of the direct-effects multiplier (1.4262) and total direct jobs for each action alternative (see Tables 2−16, 2−17, and 2−18).

would increase regional output of goods and services by $69,214,183 a year. Under the slurry pipeline option, the demand for goods and services would increase by $76,728,806. The new spending would also increase labor earnings and employment. Under the truck transport option, earnings and employment would rise by $17,069,821 and 598 direct and indirect jobs. Under the slurry pipeline option, the increase in labor earnings and employment would be $18,923,101 and 778 direct and indirect jobs during the first-year construction phase of the pipeline. Thereafter, earnings and employment would scale down to $15,336,642 and 320 direct and indirect jobs.

The potential shorter-term impacts under the White Mesa Mill off-site disposal alternative would include increased demand for temporary housing (discussed in Section 4.1.14) and transportation-related inconveniences to motorists (discussed in Section 4.4.16). The extent of these shorter-term impacts would depend on levels of tourism-recreation activities and the mode of transportation used in the remediation process. Longer-term beneficial impacts under the off-site disposal alternative would relate to greater opportunities for economic development in the Moab area and the communities of San Juan County and greater diversification of the tax base (discussed in Section 4.1.14).

4.4.15 Human Health

This section addresses potential impacts to human health under the White Mesa Mill off-site disposal alternative. These impacts are worker deaths that could occur as a result of industrial accidents and worker or public latent cancer fatalities that could occur as a result of exposure to radiation from activities at the Moab and White Mesa Mill sites, at vicinity properties, or during transportation of materials.

4.4.15.1 Construction and Operations at the Moab Site and the White Mesa Mill Site

Under the White Mesa Mill off-site disposal alternative, construction activities would occur at vicinity properties, borrow areas, White Mesa Mill, and the Moab site. Table 4–48 lists the impacts from these activities. For each option under this alternative, less than one fatality would be estimated to occur from construction activities.

Table 4–48. Construction-Related Fatalities for White Mesa Mill Disposal Alternative

Alternative	Construction Fatalities
Truck Option	
Vicinity properties	0.031
Borrow areas	0.042
Moab and White Mesa Mill activities	0.31
Total	**0.38**
Slurry Option	
Vicinity properties	0.031
Borrow areas	0.042
Moab and White Mesa Mill activities	0.47
Total	**0.54**

Workers. Under the White Mesa Mill off-site disposal alternative, workers would be exposed to radon gas (an inhalation hazard) and external radiation from the mill tailings at the Moab site, vicinity properties, and at White Mesa Mill. Monitoring data collected during construction of an evaporation pond on the tailings pile at the Moab site indicate that the highest radon level measured on the pile was 0.096 working levels (21 pCi/L). A worker exposed to this level of radon for 2,000 hours per year would have a latent cancer fatality risk of 6.1×10^{-4} per year of exposure. The highest gamma exposure rate measured on the mill tailings pile was about 0.60 mR/h. A worker exposed to this level of radiation for 2,000 hours per year would have a latent cancer fatality risk of 6.0×10^{-4} per year of exposure. The total latent cancer fatality risk to the worker on the mill tailings pile would be 1.2×10^{-3} per year of exposure (Table 4–49) or 6.0×10^{-3} over the 5-year duration of activities at the Moab site. Assuming that the radon and external radiation levels were comparable at White Mesa Mill, this would also be the latent fatality risk at the White Mesa Mill site.

Table 4–49. Worker Impacts Under the White Mesa Mill Off-Site Disposal Alternative

Worker	Site	Radon Related LCFs[a,b]	External Radiation Related LCFs[a,b]	Total LCFs[a,b]
Annual				
Individual	Moab	6.1×10^{-4}	6.0×10^{-4}	1.2×10^{-3}
	White Mesa Mill	6.1×10^{-4}	6.0×10^{-4}	1.2×10^{-3}
	Vicinity properties	2.9×10^{-4}	1.2×10^{-4}	4.1×10^{-4}
Population	Moab	0.041	0.040	0.081
	White Mesa Mill	0.043	0.042	0.085
	Vicinity properties	6.7×10^{-3}	2.9×10^{-3}	9.6×10^{-3}
	Total	**0.091**	**0.085**	**0.18**
5-Year Duration of Activities				
Individual	Moab	3.0×10^{-3}	3.0×10^{-3}	6.0×10^{-3}
	White Mesa Mill	3.0×10^{-3}	3.0×10^{-3}	6.0×10^{-3}
	Vicinity properties	8.7×10^{-4}	3.7×10^{-4}	1.2×10^{-3}
Population	Moab	0.20	0.20	0.40
	White Mesa Mill	0.21	0.21	0.42
	Vicinity properties	0.020	8.6×10^{-3}	0.029
	Total	**0.43**	**0.42**	**0.85**

[a]Based on 67 workers at the Moab site, 70 workers at the White Mesa Mill site, and 23 workers at vicinity property sites.
[b]LCF = latent cancer fatality.

The Moab site would employ about 67 workers. If they were all exposed to radon and external radiation at the levels discussed for individual workers, the latent cancer fatality risk for this population of workers would be 0.081 per year of exposure, or 0.40 over the 5-year duration of activities at the Moab site. The White Mesa Mill site would employ about 70 workers. If they were all exposed to radon and external radiation at the levels discussed for individual workers, the latent cancer fatality risk for this population of workers would be 0.085 per year of exposure, or 0.42 over the 5-year duration of activities at White Mesa Mill.

Impacts to workers as a result of activities at the vicinity properties would be the same as those under the on-site disposal alternative, as would be the lack of impacts from ground water treatment; these impacts are described in Section 4.1.15.2.

Under the White Mesa Mill off-site disposal alternative, nearby residents would be exposed to radon gas released at the Moab site and at the White Mesa Mill site. The average radium-226 content of the tailings, 516 pCi/g, would produce a latent cancer fatality risk for a nearby resident in Moab of 8.8×10^{-3} over the 5-year duration of activities at the Moab site and 7.8×10^{-6} over the 5-year duration of activities at the White Mesa Mill site. These estimates include radon released from the drying areas at Moab. If a slurry pipeline were used to move the tailings to the White Mesa Mill site, the drying areas would not be necessary, and the resulting latent cancer fatality risk for a nearby resident at Moab would be reduced to 6.9×10^{-3} over the 5-year duration of activities at Moab.

For the population, over the 5 years of activities at White Mesa Mill, the latent cancer fatality risk to the population surrounding the White Mesa Mill site would be 0.012. Over the 5 years of activities at the Moab site, the latent cancer fatality risk to the population surrounding the Moab site would be 1.0. If a slurry pipeline were used to move the tailings to White Mesa Mill, the drying areas would not be necessary, and the resulting latent cancer fatality risk for the population surrounding the Moab site would be reduced to 0.74 over the 5-year duration of activities at the Moab site.

Nearby residents would also be exposed to radioactive particulates (e.g., radium-226, polonium-210, thorium-230, and uranium) windblown from the Moab site and from the White Mesa Mill site. Estimates based on monitoring data collected during 1998 and 1999 from the Monticello mill tailings site when uranium mill tailings were being excavated indicate that the latent cancer fatality risk from radioactive particulates would be about 0.1 percent of the risk from radon emissions from the Moab site and the White Mesa Mill site. This is due to the aggressive dust suppression practices that would be used to minimize emissions of radioactive particulates.

4.4.15.2 Construction and Operations Impacts Relating to Transportation

Under the White Mesa Mill off-site disposal alternative, there would be a total of 292,888 shipments if trucks were used to move the tailings (Table 4–50). If a slurry pipeline were used to move the tailings, there would be 26,276 shipments. These shipments would include contaminated material from vicinity properties, uranium mill tailings, and borrow material, which would consist of cover soils, radon and infiltration barrier soils, sand and gravel, riprap, and Moab site reclamation soils.

Table 4–50. Shipments Under the White Mesa Mill Off-Site Disposal Alternative

Material	Truck Option		Slurry Pipeline Option	
	Shipments	Mode	Shipments	Mode
Vicinity property material	2,940	Truck	2,940	Truck
Borrow material	21,148	Truck	21,148	Truck
Uranium mill tailings	268,800	Truck	2,188	Truck
Total	**292,888**		**26,276**	

The transportation impacts of shipping contaminated materials from vicinity properties, mill tailings, and borrow material would be from two sources: radiological impacts and nonradiological impacts. Radiological impacts would be from incident-free transportation and from transportation accidents that released contaminated material. There would be no radiological impacts from moving borrow material because it is not contaminated. Nonradiological impacts would be from engine pollutants (emissions from the truck moving the contaminated materials from vicinity properties, the mill tailings, and the borrow material), and from traffic fatalities. The total transportation impacts would be the sum of the radiological and nonradiological impacts. Additional details on these analyses are provided in Appendix H.

Table 4–51 lists the transportation impacts under the White Mesa Mill off-site disposal alternative. For this alternative, there would about one fatality if trucks were used to move the tailings. If a slurry pipeline were used, there would less than one fatality. In comparison, about 40,000 traffic fatalities occur annually in the United States (U.S. Census Bureau 2000).

Table 4–51. Transportation Impacts Under the White Mesa Mill Off-Site Disposal Alternative

Alternative	Radiological			Nonradiological		Total Fatalities
	Incident-Free		Accident Risk LCFs	Pollution Health Effects Fatalities	Traffic Fatalities	
	Public LCFs	Worker LCFs				
Truck Option						
Vicinity properties	2.7×10^{-5}	3.9×10^{-5}	6.9×10^{-9}	3.7×10^{-4}	1.1×10^{-3}	1.5×10^{-3}
Borrow material	0	0	0	1.2×10^{-3}	0.053	0.054
Mill tailings	0.026	0.049	1.4×10^{-6}	0.067	1.2	1.3
Total	**0.026**	**0.049**	**1.4×10^{-6}**	**0.069**	**1.3**	**1.4**
Slurry Option						
Vicinity properties	2.7×10^{-5}	3.9×10^{-5}	6.9×10^{-9}	3.7×10^{-4}	1.1×10^{-3}	1.5×10^{-3}
Borrow material	0	0	0	1.2×10^{-3}	0.053	0.054
Mill tailings	2.1×10^{-4}	4.0×10^{-4}	1.1×10^{-8}	5.4×10^{-4}	9.6×10^{-3}	0.011
Total	**2.4×10^{-4}**	**4.4×10^{-4}**	**1.8×10^{-8}**	**2.1×10^{-3}**	**0.064**	**0.067**

LCF = latent cancer fatality

Workers. For truck shipments of mill tailings from the Moab site to White Mesa Mill, the maximally exposed transportation worker would be the truck driver. This person was assumed to drive the truck containing mill tailings for 1,000 hours per year. For the other 1,000 hours per year, the truck would be empty. This driver would receive a radiation dose of 220 mrem/yr, which is equivalent to a probability of a latent cancer fatality of about 1.1×10^{-4}.

Public. For truck shipments of mill tailings from the Moab site to White Mesa Mill, the maximally exposed member of the public would be a resident who lived along the road on which the tailings were shipped. This person would receive a radiation dose of 1.0 mrem/yr, which is equivalent to a probability of a latent cancer fatality of about 6.3×10^{-7}.

Accidents. If trucks were used to transport the mill tailings from the Moab site to White Mesa Mill, the maximally exposed individual would receive a radiation dose of 0.16 mrem, or 1.6×10^{-4} rem from the maximum dose reasonably foreseeable for a transportation accident involving a shipment of mill tailings. This is equivalent to a probability of a latent cancer fatality of about 9.6×10^{-8}. The probability of this accident is about 0.3 per year.

If this accident occurred near Moab, Monticello, or Blanding, the population would receive a collective radiation dose of 1.8×10^{-3} person-rem, which is equivalent to a probability of a latent cancer fatality of about 1.1×10^{-6}. If this accident occurred in a rural area, the population would receive a collective radiation dose of 2.9×10^{-6} person-rem, which is equivalent to a probability of a latent cancer fatality of about 1.7×10^{-9}.

4.4.15.3 Monitoring and Maintenance

Monitoring and maintenance activities would include checking water quality and installing a long-term ground water remediation system at the Moab site, and conducting periodic maintenance and inspections of the White Mesa Mill site (checking for erosion, damaged fencing, etc.). None of these activities would be expected to breach the cap over the tailings. Installation of the ground water remediation system at the Moab site would be done in clean areas after remediation was complete. Data from another UMTRCA site indicate that the White Mesa Mill off-site disposal alternative would be effective in isolating the contaminants in the tailings from individuals conducting activities on the site. DOE (2001) concluded that both radon and gamma levels associated with the capped-in-place tailings pile at the Shiprock site in New Mexico were indistinguishable from naturally occurring radiation levels. Therefore, the latent cancer fatality risk to workers conducting monitoring and maintenance would be comparable to the risk from background levels of radioactivity in Utah, about 3×10^{-4} per year of exposure.

4.4.15.4 Impacts from All Sources

Under the White Mesa Mill off-site disposal alternative, less than one fatality would be estimated to occur from construction activities under either transportation option. Transportation of contaminated materials from the Moab site to the White Mesa Mill site would result in the exposure of workers and the public to very small amounts of radiation; these exposures would not be expected to result in any latent cancer fatalities to any population. Ammonia releases from ground water remediation would be well below threshold concentrations for human health effects.

Based on as-built radon flux measurements from completed uranium mill tailings disposal cells constructed under both Title I (federal UMTRA sites) and Title II (private licensees) of UMTRCA, it is anticipated that actual radon flux would be two orders of magnitude less than the 20-pCi/m^2-s EPA protective standard promulgated in 40 CFR 192. However, even though DOE's experience supports a conclusion that radon release rates from the capped pile would be negligible and that DOE's long-term monitoring and maintenance of the site would ensure cap integrity, for the purpose of supporting analyses of long-term performance and impacts, DOE has

also assessed impacts assuming the maximum allowable release rate of radon, 20 pCi/m^2-s, under EPA's regulations (40 CFR 192).

On the basis of this emission rate and the dimensions of the disposal cell, the latent cancer fatality risk for a nearby resident would be 6.4×10^{-8} per year of exposure, or 1.9×10^{-6} over the 30-year period following the end of construction and operations. This latent cancer fatality risk is less than the risk from background levels of radioactivity in Utah, about 3×10^{-4} per year of exposure.

For the population near the White Mesa Mill site, the latent cancer fatality risk would be 3.0×10^{-3} over the 30-year period following the end of construction and operations.

At the Moab site, radon emissions would fall to background levels because the mill tailings pile would have been relocated. The latent cancer fatality risk would be comparable to the risk from background levels of radioactivity in Utah, about 3×10^{-4} per year of exposure.

The design life of the disposal cell for the uranium mill tailings is 200 to 1,000 years. Over this period of time, the amount of radioactivity in the disposal cell will decrease slightly, less than 1 percent, due to the half lives of the radionuclides contained in the uranium mill tailings. In the time frame of 200 to 1,000 years, the major route of exposure of people is likely to be inhalation of radon progeny from the disposal cell. A person could drill a well into the shallow aquifer near the White Mesa Mill site, but it is more likely that this person would use the surface water at Ruin Spring, located about 10,000 ft from the disposal cell. The travel time for contaminants from the disposal cell to the spring is in the range of 3,570 to 7,690 years, so it is unlikely that the water at Ruin Spring would contribute large latent cancer fatality risks relative to inhalation of radon progeny. With the disposal cell cover in place and the White Mesa Mill site under perpetual care, it is likely that the latent cancer fatality risk for an inadvertent intruder would also be low.

After the disposal cell cover was installed, the estimated annual latent cancer fatality risk from radon for a nearby White Mesa resident would be 6.4×10^{-8}. As with the radioactivity in the disposal cell, the annual risk would also not decrease appreciably over the 200- to 1,000-year time frame. Therefore, the annual latent cancer fatality risk for a nearby White Mesa resident would be about the same immediately after the cover was installed as it would be 1,000 years after the cover was installed. This assumes that the nearby resident remains at his or her present location. If the resident were to move closer to the disposal cell, the annual latent cancer fatality risk would be similar to the risk at the Moab site, 8.9×10^{-5} per year of exposure.

Based on the 20 pCi/m^2-s radon release rate, for the population within a 50-mile radius of the White Mesa Mill site, the annual latent cancer fatality risk was estimated to be 9.9×10^{-5}. As with the radioactivity in the disposal cell, the annual risk would also not decrease appreciably over the 200- to 1,000-year time frame. If it is assumed that the population around the White Mesa Mill site remains constant over 1,000 years, then the estimated latent cancer fatality risk over the 1,000-year time period would be 0.1.

4.4.16 Traffic

This section summarizes potential impacts to traffic in the area affected under the White Mesa Mill off-site disposal alternative. In the following discussions, estimated percent increases in traffic are based on increases over the 2001 AADT for all vehicles or for trucks on segments of US-191 (see Table 3–15). Implementation of this alternative would increase area traffic because of construction and operations at the Moab site, remediation of vicinity properties, transport of tailings from the Moab site to the White Mesa Mill site, and transport of borrow materials from borrow areas to the Moab site, vicinity properties, and the White Mesa Mill site.

There would be initial minor short-term (period of several months) increases in area traffic on US-191 while various preparations took place at the Moab site and at the White Mesa Mill site. These activities would include bringing heavy construction equipment, such as backhoes, graders, front-end loaders, bulldozers, and trucks, to those sites; and constructing secure stockpile areas for various materials to be used during the remedial action (e.g., diesel fuel, water for dust control). In addition, a variety of construction trades would need to access the sites to set up temporary field offices and prepare road access areas. These activities would add to area traffic and could result in minor congestion and inconveniences near the site entrances on US-191.

Construction workers would commute to the Moab site for jobs at the site, at vicinity properties, and at borrow areas. DOE estimates that the average annual vehicle trips associated with 190 workers could increase daily traffic in central Moab by 380 vehicle trips per day on US-191 (truck transportation mode). Transportation-related workers would also commute to jobs. An additional 458 vehicle trips per day on US-191 would be attributed to the 229 transportation-related workers. It is likely that one-half or more of these workers (minimum of 115 workers) would live in towns south of Moab, such as Monticello, Blanding, or White Mesa, and would not affect travel patterns in Moab. However, if all workers commuted through central Moab, it would increase traffic there by 5 percent. (The pipeline transportation mode could increase traffic in downtown Moab by 3 percent). The current traffic situation in Moab is reported by UDOT as highly congested, and these additional vehicle trips would exacerbate the current congestion problem. Miscellaneous trips for supplies and meals would also add to traffic congestion. It is expected that some workers would car-pool, which would reduce travel impacts. In addition, assuming a double work shift, approximately half of these trips would occur before 7:00 a.m. and just after 4:00 a.m., times of the day when traffic volumes are typically lower. The impact associated with the 502 pipeline construction workers was not considered a worst-case scenario due to the relatively short time frame (9 months) and transient nature of the construction. A double work shift would involve the first shift arriving before 7:00 a.m. and leaving just after 5:30 p.m. The second shift would arrive just before 5:30 p.m. and leave just after 4:00 a.m.

Transporting contaminated vicinity property material to the Moab site and transporting clean backfill material to the vicinity properties would require up to 48 daily truck trips on local roads and US-191. Some or most of these trips would transit central Moab (Section 2.1.2.2). Assuming the worst-case traffic scenario of a double work shift, transporting all contaminated material from the Moab site to the White Mesa Mill site would require an estimated 768 daily tandem truck trips (calculated from Table 2–9) on US-191, all of which would transit central Moab. UDOT reports the 2001 average annual daily truck traffic through central Moab as 4 percent of the total vehicle count, or 642 trucks. Truck traffic related to hauling materials (tailings and vicinity property material) through central Moab would result in a 127-percent increase in downtown truck traffic, from 642 trucks to an estimated 1,458. Although this increase would be

distributed evenly over the 20 hours per day that work was ongoing under a double-shift work schedule, it would be an extreme impact to the already congested central Moab area, particularly during the peak tourist season when daily vehicle counts are highest.

For the segments of US-191 from south of central Moab to the White Mesa Mill site, the truck traffic on US-191 constitutes between 7 and 14 percent of the total vehicle traffic, or between approximately 370 to 1,190 trucks per day, depending on the segment of US-191. Adding 768 tandem trucks per day would increase truck traffic between 65 and 186 percent, depending on the segment. Although the percent change would be high, for most of the route between Moab and the White Mesa Mill site, the average daily traffic counts and truck use are low, and UDOT does not report any of the route as congested.

A slurry pipeline would also require limited transport of materials by truck. Transport of oversized materials that could not be transported by pipeline would result in additional minor use of trucks on US-191 (about six truck trips per day). In addition, borrow materials would be transported as described under the truck transportation option above.

Annual monitoring and maintenance activities at the site would result in no increases in traffic volumes.

4.4.17 Disposal Cell Failure from Natural Phenomena

It is possible that a disposal cell failure could occur at the White Mesa Mill site. The possibility of failure at this site would be much lower than at the Moab site because it was selected for analysis, in part, to avoid the more dynamic characteristics of the Moab site (see Chapter 3.0). The White Mesa Mill site is not located near a river, does not have historical seismic activity, and is not prone to settling. In addition, this site is located farther away from populated areas or sensitive habitats than the Moab site, which would reduce the potential risks if a disposal cell failure occurred. Therefore, the possibility of a failure occurring and resulting in potential risks at the White Mesa Mill site would be much lower than the potential risks of a disposal cell failure at the Moab site. For this reason, potential failure at this site was not evaluated.

4.4.18 Environmental Justice

The basis for DOE's analysis of environmental justice impacts is described in Section 4.1.18. The area approximately 20 miles south of the White Mesa Mill site has a large segment in which the minority population is greater than 50 percent. The White Mesa Ute Reservation is adjacent to the White Mesa Mill site, and the Navajo Reservation occupies a significant portion (28 percent) of San Juan County, where the White Mesa Mill site is located. Reported household incomes of less than $18,244 (poverty level for a family of four) per year are found in census group blocks within about one-half of the populated areas south of the site. The lowest income block group is about 15 miles from the site. Although these populations could be exposed to small doses of radiation as a result of activities under this alternative, there is no evidence that they would be exposed at a level any higher than the general population.

To address potential exposure pathways that could be unique to members of the low-income or minority populations using the area around the White Mesa Mill, two additional human health analyses have been generated for (1) an individual consuming water from Ruin Springs and (2) an individual consuming deer meat from a deer that inhabited the vicinity of the White Mesa Mill site**.**

Impacts at Ruin Spring. Impacts were estimated for an individual who occupied the area in the vicinity of the Ruin Spring site, which is located about 2 miles south-southwest of the White Mesa Mill operating facilities and disposal cells. This individual was assumed to occupy the Ruin Spring site for 1 day per week or 1,248 hours per year. The individual was also assumed to breathe air containing radon and radon progeny released from the White Mesa Mill and to drink water from Ruin Spring. The drinking water consumption rate was estimated to be 2 liters per day. Impacts from drinking water consumption were estimated using radionuclide concentrations measured in 2003 at Ruin Spring. The latent cancer fatality risk for this individual was estimated to be 1.5×10^{-5} per year of exposure, or 7.4×10^{-5} over the 5 years of activities at the White Mesa Mill site.

Impacts from Subsistence Consumption of Deer Meat. Mule deer (*Odocoileus hemionus*) graze in the vicinity of the White Mesa Mill site and are harvested by local residents. Environmental data collected from 1998 through 2002 for radionuclide concentrations in forage and soil and radionuclide concentrations in water measured in 2003 were used to estimate impacts for an individual who obtained 100 percent of his meat from mule deer that graze in the vicinity of the White Mesa Mill site. This analysis assumed that the mule deer obtained 100 percent of its food and water near the White Mesa Mill site. The latent cancer fatality risk for this individual was estimated to be 4.7×10^{-8} per year, or 2.3×10^{-7} over the 5 years of activities at the White Mesa Mill site.

The risks calculated under these two unique exposure pathways would be less than those predicted for the nearby resident in Section 4.4.15.1 for the disposal of the Moab site mill tailings at the White Mesa Mill site.

Disproportionately high and adverse impacts to minority and low-income populations would occur under this alternative as a result of unavoidable adverse impacts on potential traditional cultural properties located on and near the White Mesa Mill site, the proposed White Mesa Mill pipeline route, White Mesa Mill borrow area, and Blanding borrow area (see Sections 4.4.9 and 4.5). At least 11 potential traditional cultural properties would be unavoidably and adversely affected. If this alternative were implemented, the likelihood that additional traditional cultural properties would be located (once cultural studies were completed) is extremely high. These sacred, religious, and/or ceremonial sites are associated with the Ute, Navajo, and Hopi cultures and peoples.

4.5 Borrow Areas

Impacts at borrow areas are discussed here as a separate, stand-alone topic in response to a request by BLM, one of the cooperating agencies. BLM indicated that analyzing impacts to borrow areas as a stand-alone topic would facilitate the subsequent analyses necessary to authorize DOE to use borrow material at BLM-managed borrow areas.

DOE assessed the potential impacts of removing borrow materials from 10 borrow areas (Crescent Junction, Floy Wash, Courthouse Syncline, Klondike Flats, Tenmile, Blue Hills Road, LeGrand Johnson, Papoose Quarry, Blanding, and White Mesa Mill). Figure 2−8 shows the locations of the 10 borrow areas analyzed.

As shown in Table 4–52, the impacts of removing materials from the proposed borrow areas would be similar among all the sites. Four of the sites (Floy Wash, LeGrand Johnson, Papoose Quarry, and Blanding) are existing borrow areas. Five other sites are on land managed by BLM (Crescent Junction, Courthouse Syncline, Klondike Flats, Tenmile, and Blanding) and would require the issuance of a borrow area permit by BLM. The acreages identified in Table 4–52 for BLM-managed borrow areas have been segregated for DOE's use.

Construction or upgrading of roads necessary to transport materials from borrow areas to vicinity properties or the Moab site may affect floodplains and wetlands, if present.

Short-term land use impacts would occur on borrow sites providing materials for construction. All borrow sites except those associated with the White Mesa Mill site are within grazing allotments for BLM, and grazing rights could be temporarily vacated. The borrow sites would be reclaimed, and the acreage would be available for any uses designated prior to mineral extraction. There would be no land use impacts from materials procured from commercial operations.

Tenmile, Blue Hills Road, and White Mesa Mill would be the sites with the highest potential for affecting cultural resources. DOE would conduct Class III cultural resource surveys as necessary to identify the precise numbers and types of cultural sites that could be present at the potential borrow sites and would work with BLM (if the area were on land managed by BLM), the State Historic Preservation Officer, affected Native American tribes, and the Advisory Council on Historic Preservation to determine appropriate mitigation measures for affected sites if cultural resources were found.

Only two sites, LeGrand Johnson and Papoose Quarry, would not likely have federally listed threatened and endangered species occurring on or near the site. Appendix A1, "Biological Assessment," discusses potential effects at these locations in more detail. If it is determined that species are present and could be adversely affected, DOE, in consultation with the USF&WS, BLM, and UDWR, would implement mitigation measures. Species that could be affected are discussed in Sections 4.1.7, 4.2.7, 4.3.7 and 4.4.7. Surveys and investigations would not be undertaken for existing commercial sites.

Potential impacts to plants and wildlife would be limited to terrestrial ecological resources during the time the borrow areas would be used. Because the borrow areas have no aquatic resources, no short-term or long-term impacts would occur. No long-term impacts to aquatic or terrestrial resources would occur following reclamation of the borrow areas.

4.6 No Action Alternative

Under the No Action alternative, no contaminated materials would be remediated or removed from the Moab site or vicinity properties. There would be no ground water remediation, and no site controls or activities to protect human health or the environment would be undertaken. All site activities, including operations and maintenance activities, would cease, and public access to the site would be unrestricted.

4.6.1 Geology and Soils

Impacts to geological resources underlying the tailings pile would be the same as those under the on-site disposal alternative, as stated in Section 4.1.1.1. Contaminated on-site soils would not be disturbed. In addition, without the mitigating effect of dike construction, the effects of floods of the Colorado River may progressively erode and remove the east side of the tailings over the next 1,000 years. Soil erosion would not be controlled, and contaminated materials, including soils, could discharge to Moab Wash and the Colorado River during storms.

4.6.2 Air Quality

Without continuing dust control, air quality standards relating to particulate emissions would be violated under the No Action alternative.

4.6.3 Ground Water

Existing conditions at the Moab site would persist under the No Action alternative. Because a ground water compliance strategy would not be developed, no remedial action would be taken. The three mechanisms for contaminant transport described in Section 4.1.3 (downward seepage of contaminated fluids, upward flux of contaminants, and lateral movement of the legacy plume) would probably produce the following impacts under the No Action alternative, assuming the pile remained in the same location and was not capped.

Seepage of tailings fluids from the tailings pile would be expected to contribute a continuous source of 1,100 mg/L ammonia to the alluvial ground water. The seepage rate of pore fluids from the tailings pile would decline from the current rate of 20 gpm until most pore fluids in the tailings were drained (i.e., tailings were consolidated). Once the transient drainage was complete (in approximately 20 years), a steady-state rate of 8 gpm would be reached. The assumptions for ammonia concentrations and seepage rate as a function of time are summarized in Table 4–53.

Ground water flow and transport modeling (DOE 2003a) was performed to evaluate the impact of the No Action alternative to the ground water system near the Colorado River from the three contaminant transport mechanisms. Results of the modeling are presented in Figure 4–21. Predicted concentrations plotted in Figure 4–21 represent the maximum ammonia-N concentration from a series of observations, located along a transect parallel to the Colorado River downgradient from the toe of the tailings pile near the center of the plume. The modeling results indicate that most of the ammonia flux from the brine layer and the legacy plume in the alluvial aquifer would flush naturally to the river in approximately 75 years. At that time, it is anticipated that the maximum ground water concentrations near the river will have declined to approximately 6 mg/L.

Table 4–53. Assumptions for Liquid Drainage from the Tailings Pile and Ammonia Concentrations for the No Action Alternative

Parameter	Value
Infiltration rate	1×10^{-7} cm/s
Gravity drainage	Constant rate: 8 gpm
Transient drainage	Rate would decay from 12 gpm at present to 0 gpm at 20 years
Initial ammonia concentration seepage from base of tailings pile	1,100 mg/L
Breakthrough ammonia concentration from upper salt layer	18,000 mg/L
Arrival time	168 years
Final concentration	1,100 mg/L
Exit time	217 years

Modeling results indicate that ammonia concentrations in ground water near the bank of the Colorado River would decline from the current 500 to 1,000 mg/L ammonia to a maximum of approximately 6 mg/L in 75 years. The predicted concentration in ground water at 75 years is illustrated in Figure 4–22. As shown in Figure 4–21, the No Action alternative would not meet the 3-mg/L target goal, and ammonia concentrations would remain above background.

Discharge of contaminants to the ground water system could be affected by infiltration of precipitation and by rewetting of the base of the tailings pile during flooding, as described in Section 4.1.3. Infiltration of precipitation as a result of not capping the pile would result in seepage of 1,100 mg/L ammonia from the base of the tailings pile at a steady rate of 8 gpm. Infiltration of precipitation could also dissolve salts in the tailings, as described in Section 4.1.3. As a result, there is the potential for ammonia pore fluid concentrations, estimated to be as high as 18,000 mg/L, to influence the ground water system in approximately 168 years. The chemistry of the pore fluid would likely change as it percolated down through the tailings; thus, the ammonia concentration estimated at 18,000 mg/L could be significantly lower.

4.6.4 Surface Water

Contaminated soil and sediment runoff would not be contained and would result in contamination load to the Colorado River over several storm events. Although some soil contamination would be contained by leaving the tamarisk in place, eventually most would reach the Colorado River.

Contaminated ground water would continue to discharge to surface water, and the potential would continue to exist for contaminant concentrations in surface water to exceed federal and state aquatic water quality criteria along the bank of the Colorado River. As with the other alternatives, ground water contaminant concentrations would continue to decrease through time and would result in a corresponding decrease in surface water concentrations as well. However, this decrease would only rely on natural processes and is projected to result in a decrease of ammonia concentrations to approximately 6 mg/L. During the period of time that ground water contaminant concentrations were declining, no active remediation would be conducted, and elevated levels of contaminants, including ammonia, could be expected. Once steady-state concentrations were reached in ground water, ammonia could still be present in surface water, and concentrations would be higher than background levels.

4.6.5 Floodplain/Wetlands

Contaminated soils and the tailings pile would remain in the floodplain of Moab Wash and the Colorado River. Although the No Action alternative would result in fewer short-term surface-disturbing impacts because no construction would take place, implementation of this alternative would contaminate wetlands adjacent to the Colorado River in the long term.

4.6.6 Aquatic Ecology

Under the No Action alternative, ground water would continue to enter the Colorado River at its current state of contamination for an indefinite period of time. As discussed in Appendix A2, contaminants of concern are entering the surface water environment at concentrations that exceed acute and chronic benchmarks for aquatic biota. No ground water remediation to prevent infiltration of contamination in the tailings pile or associated buried mill wastes from reaching the ground water and subsequently entering the aquatic environment would occur under the No Action alternative.

Concentrations of the contaminants of concern are likely affecting the aquatic biota in the nearshore environment of the Colorado River. The concentrations exceed acute and chronic benchmarks (Appendix A2). The Colorado pikeminnow is likely affected by the presence of these contaminants. The bonytail and humpback chub do not inhabit the river near the site and would not likely be adversely affected. The razorback sucker, although not currently found near the site, does use habitat like that near the Moab site and would thus likely be affected. Appendix A1, “Biological Assessment,” discusses potential impacts of this alternative in more detail.

4.6.7 Terrestrial Ecology

Under the No Action alternative, tamarisk at the Moab site would continue to dominate the Colorado River shoreline, and there would be no habitat impacts at the Moab site or at vicinity properties. Consequently, there would be no destruction or displacement of federal- or state-listed species, or wildlife in general, due to habitat alteration. There would also be no disturbance of wildlife except that caused by ambient levels of noise, human presence, vehicles, and other sources.

Because there would be no restoration of the tailings pile at the Moab site, animals could burrow into contaminated soils. This could result in acute and chronic toxic effects to wildlife.

Federal- or state-listed species, or wildlife in general, could be exposed to contaminants in soils at the Moab site and in adjacent nearshore surface water of the Colorado River. Exposure to contaminants in both media may occur via several pathways, including ingestion of prey and water, incidental soil ingestion, dermal uptake from soil and water, and inhalation of airborne contaminants. The primary pathway for wildlife exposure to contaminants in surface water would likely be through ingestion of prey and water within the surface water near the shoreline. Appendix A1, "Biological Assessment," discusses in detail potential impacts to federally listed species from ingestion of prey and water in the nearshore surface water.

No adverse effects are anticipated for wildlife, including federally listed species, from chemical or radioactive contaminants in surface water. However, terrestrial plants could be affected by some of the metals, but only if the plant roots extend into the freshwater aquifer or associated soil water above it. Because the depth of plant roots is currently unknown, potential impacts to plants from contaminants in soils could not be evaluated.

4.6.8 Land Use

Under the No Action alternative, the 439 acres at the Moab site would be unusable for any purpose and would be incompatible with the Grand County land use goals. The site is currently designated as a Specially Planned Area in accordance with Grand County Ordinance 346 of the Grand County North Gateway Plan. This interim planning is valid while reclamation is in effect. Future zoning allows for low-density residential housing. If no actions were taken, the property land use would have to change, because there would be no opportunity for the property to be used for any purpose, and no portion of the property would be available for future beneficial use. The surrounding property values would likely be diminished as a result of the condition of the property and of the uncertainty about the extent of residual contamination. It is also likely that the current and future land use of surrounding properties would change because of proximity to the site.

There would be no land use impacts to BLM lands. There would be no disturbance to BLM lands to secure borrow materials, and no permits or leases on BLM lands would be interrupted.

4.6.9 Cultural Resources

Cultural resources would not be affected under the No Action alternative.

4.6.10 Noise and Vibration

There would be no change in noise or ground vibration levels under the No Action alternative. Similarly, noise and ground vibration impacts associated with the operation of off-site disposal locations, borrow sites, and transportation of tailings and borrow material would not occur.

4.6.11 Visual Resources

The tailings pile would remain in its present condition under the No Action alternative. From the key observation points established for the site (see Section 4.1.11.1), the predominantly smooth, horizontal lines created by the pile would continue to create a moderate contrast with the adjacent vertical sandstone cliffs. Due to its relatively large size, the pile would dominate the view of the casual observer from the southbound US-191 and SR-279 key observation points; however, it would not necessarily be recognized as an anomalous feature, as its red color blends with the reds of the surrounding cliffs. It would likely continue to go unnoticed by many first-time visitors to the Moab area.

The moderate visual contrasts that would occur under this alternative would not be compatible with the Class II objectives that BLM has assigned to the nearby landscapes. Although DOE is not required to meet the objectives of BLM's visual resource management system on the DOE-owned Moab site, the system provides a useful way to measure the effects of the No Action alternative on visual resources.

4.6.12 Infrastructure

Implementation of the No Action alternative would not require the consumption of any additional electric power or water. No additional sanitary waste would be generated.

4.6.13 Solid Waste Management

Under the No Action alternative, DOE would not generate the previously described volumes of solid waste and RRM associated with surface and ground water remediation.

4.6.14 Socioeconomics

Under the No Action alternative, there would be no remediation of ground water or contaminated materials at the Moab site or vicinity properties. Also, public access to the site would be unrestricted, without site controls or activities to protect human health or the environment. Consequently, the potential socioeconomic impacts from the No Action alternative would relate to potential longer-term damages that would result from leaving the pile in its present form. These damages would include potential adverse effects to human health, diminished quality of land and water resources, and potential losses in future economic development opportunities.

As discussed in Section 3.1.19.2, the current risk from exposure to contaminants at the Moab site involves individuals living adjacent to the site (approximately 2,200 ft from the tailings pile) and recreational users of land adjacent to the site (e.g., Moab residents, outdoor recreation visitors). Currently, no members of this public are receiving prolonged exposure to on-site contaminants, which consist of both radioactive and nonradioactive components (e.g., heavy metals). However, in the absence of continued maintenance and monitoring activities at the site, the potential exists for longer-term adverse impacts from exposure to these contaminants.

The No Action alternative also poses greater risks of contamination of the Colorado River due to continued leaching of contaminated materials from the pile and other on-site contamination. The monetary value of these potential environmental damages is difficult to quantify. Nonetheless, the qualitative implications could involve fewer recreational uses of land in the vicinity of the Moab site. Such negative effects could diminish interest in tourism-recreational activities in the two-county socioeconomic region of influence.

As discussed in Section 3.1.18, the regional economy and its tax base are heavily dependent on the seasonally driven tourist-recreation sector. By not undertaking remedial actions at the Moab site, the potential exists for environmental damages, resulting in fewer visitors to the area and thus economic losses to the tourist-based economy in the long term.

4.6.15 Human Health

Under the No Action alternative, people who live in the vicinity properties would continue to be exposed to radon gas and external radiation. In addition, people who live near the Moab site would be exposed to radon gas and radioactive particulates released from the tailings pile.

The vicinity properties near the Moab site have not been extensively characterized. However, on the basis of data from other vicinity properties (DOE 1985), the indoor radon level at vicinity properties was estimated to be about 0.046 working levels (7 pCi/L), and the external gamma exposure rate at vicinity properties was estimated to be 120 μR/h. A person exposed for 8,760 hours per year would have a latent cancer fatality risk of 1.3×10^{-3} for radon and 6.5×10^{-4} for external gamma radiation. The total latent cancer fatality risk for a person at vicinity properties would be 1.9×10^{-3} per year of exposure, or 0.067 if this individual lived at a vicinity property for 35 years, which corresponds to the 5-year operational period plus the 30-year post-operational period evaluated for the on-site and off-site disposal alternatives. If four people lived at each of the estimated 98 vicinity properties, the latent cancer fatality risk for these 392 people would be 0.76 per year of exposure. If these people lived in the vicinity properties for 35 years, about 26 of them would die from cancer caused by the mill tailings contamination.

Monitoring data collected during 2002 and 2003 around the Moab site indicate that the radon concentration at the location of the maximally exposed individual is about 1.9 pCi/L in air. A person exposed for 8,760 hours per year would have a latent cancer fatality risk of 2.4×10^{-4} per year of exposure, or 8.3×10^{-3} for 35 years of exposure. For the population around the Moab site, the latent cancer fatality risk from radon releases would be 0.016 per year of exposure, or 0.56 for 35 years of exposure. On the basis of monitoring data collected during 2002 and 2003, the latent cancer fatality risk from radioactive particulates would be about 7×10^{-7} per year of exposure.

Because there would be no maintenance activities under the No Action alternative, the cover of the mill tailings pile would erode over time and radon releases would increase. For the maximally exposed individual, the latent cancer fatality risk from radon after the cover had been eroded would be about 1.4×10^{-3} per year of exposure, or 0.048 for 35 years of exposure. For the population around the Moab site, the latent cancer fatality risk from radon releases would be 0.15 per year of exposure, or about 5.2 fatalities for 35 years of exposure. Releases of radioactive particulates would also increase and could slightly increase these latent cancer fatality risks.

Under the No Action alternative, no future site-related activities would occur. Therefore, there would be no risks associated with monitoring and maintenance. The only potential future risks would be associated with other uses of the site by recreational users or local residents. Under this alternative, the potential future uses were assumed to be residential (on land northeast of the current tailings pile), rafting (stopping on the site to rest or eat), and camping (overnight stay in areas near the river).

Table 4–54 presents the risks that would occur from on-site contamination to a future resident, rafter, and camper on the Moab site. Using benchmarks of less than a one-in-one-million (1×10^{-6}) probability of developing cancer for the added cancer risks, a hazard index of greater than 1.0 for noncarcinogens, and a dose rate of greater than 100 mrem/yr, indicate that future risks under this alternative would likely exceed this benchmark for the residential scenario but not for the other future land uses. The detailed assumptions and calculation methods used to estimate these risk are presented in Appendix D.

Under the No Action alternative, no maintenance activities would be conducted. Over the 1,000-year time frame, the cover of the mill tailings pile would erode, and radon releases would increase. Over this period of time, the amount of radioactivity in the uranium mill tailings pile will decrease slightly, less than 1 percent, due to the half lives of the radionuclides contained in the uranium mill tailings. The ground water at the Moab site is naturally high in salts and would not be used for human consumption. Releases of radionuclides to surface water would be diluted by the flow of the Colorado River. Consequently, it is unlikely that ground water and surface water would contribute large latent cancer fatality risks relative to inhalation of radon progeny.

For a nearby Moab resident, the annual latent cancer fatality risk from radon after the cover had been eroded would be about 1.4×10^{-3}. As with the radioactivity in the disposal cell, the annual risk will also not decrease appreciably over the 200- to 1,000-year time frame. Therefore, the annual latent cancer fatality risk for a nearby Moab resident would be about the same immediately after the cover had eroded as it would be 1,000 years after the cover had eroded.

For the population around the Moab site, the annual latent cancer fatality risk from radon releases would be 0.15 after the cover had eroded. As with the radioactivity in the disposal cell, the annual risk will also not decrease appreciably over the 200- to 1,000-year time frame. If it is assumed that the population around the Moab site remains constant over 1,000 years, then an estimated 150 latent cancer fatalities over the 1,000-year time period would occur.

It is possible that an inadvertent intruder could occupy the Moab site after the cover eroded. In the short term, the external gamma exposure rates and radon concentrations would be similar to those for workers during remediation of the pile. In the long term, the risks for the inadvertent intruder would be similar to the risks shown in Table 4–54 for the residential scenario.

4.6.16 Traffic

With no work activities at the Moab site, there would be no traffic associated with accessing the site. The minor amount of traffic associated with current site activities would no longer occur.

4.6.17 Tailings Pile Failure from Natural Phenomena

Overall, the possibility of failure and the consequences would be the greatest under the No Action alternative because it would not include the use of engineering controls to mitigate impacts from floods and other natural events, as would occur under the on-site disposal alternative. Because no additional engineered enhancements (e.g., riprap) would be added under the No Action alternative, this alternative would be expected to have consequences closer to the high end of the tailings release assumptions (80 percent tailings release) and risk ranges listed for the on-site disposal alternative assuming a hypothetical failure event.

4.6.18 Environmental Justice

The basis for DOE's analysis of environmental justice impacts is described in Section 4.1.18. An assessment of the census data found that, within the 50-mile radius of the Moab site, less than 1 percent of the population had a household income below $18,244 (the poverty level for a family of four). There is no evidence that a minority population would be exposed to risk at a level higher than the general population.

Although the impacts of the No Action alternative could be high and adverse, DOE has identified no minority or low-income populations that would be disproportionately affected under this alternative.

4.7 Mitigation Measures

The regulations promulgated by the Council on Environmental Quality to implement the procedural provisions of NEPA (40 CFR 1500–1508) require that an EIS include a discussion of appropriate mitigation measures (40 CFR 1502.14[f], 40 CFR 1502.16[h])**.** The term "mitigation measures" includes measures taken to

- Avoid impacts by not taking all or part of an action.
- Minimize impacts by limiting the degree or magnitude of the action and its implementation.
- Rectify impacts by repairing, rehabilitating, or restoring the affected environment.
- Reduce or eliminate impacts by preservation and maintenance operations during the action.
- Compensate for an impact by replacing or substituting resources or environments.

This section specifies measures that could be taken to mitigate adverse impacts associated with DOE's proposed remediation of the Moab site. Most of the mitigation measures discussed would be applicable in some degree to all of the alternative actions and transportation modes described in this EIS. Therefore, mitigation measures are not discussed for each action alternative. Those measures that would be uniquely associated with a specific alternative action or transportation mode (e.g., railroad crossing gates) are identified.

The identification of mitigation measures in this section does not constitute a commitment by DOE to undertake any or all of them. Any such commitments would be incorporated in the ROD following publication of the final EIS. A more detailed description of mitigation measures and an implementation and monitoring plan would be published after the ROD. Mitigation commitments would be tailored to the action selected in the ROD and to the specific location and environment that would be affected by the selected action.

Upon completion of this EIS and the ROD, DOE will develop a remedial action plan and other planning and monitoring documents for remediation of contaminated materials. The remedial action plan and other planning and monitoring documents will provide the conceptual engineering reclamation design and incorporate a ground water compliance strategy and corrective actions. These documents will also integrate into the remediation strategy, measures discussed in the EIS that would reduce or mitigate the impacts that would result from the proposed actions and, where appropriate, identify the mechanisms by which the success of mitigative actions will be evaluated and reported. In addition, as stipulated by the USF&WS in their Biological Opinion (Appendix A3), a biota monitoring plan and a water quality study plan will be generated and implemented to observe and report upon the effects of current and future conditions on fish and evaluate the effectiveness of ground water remediation efforts.

The measures that DOE could implement are delineated below by the specific resource area that they would affect. However, mitigation measures are not repeated where they would apply to multiple impact areas. For example, the use of tarps to cover trucks transporting tailings would mitigate both air quality and human health impacts but are identified only under air quality. Some of the mitigation measures identified below are permit requirements or standard operating procedures but are included here to illustrate the range of activities that would mitigate adverse impacts.

4.7.1 Geology and Soils

- Minimize vegetation disturbance and removal wherever possible.
- Remove and set aside the topsoil overlying borrow soils and maintain the ability of the topsoil stockpiles to support living organisms. Replace, recontour, and revegetate (reseed/replant) topsoil after removal of borrow soil.
- Recontour, revegetate, and maintain all disturbed land areas with diverse, native plant communities to the fullest degree possible.
- Use large-scale (e.g., natural windbreaks/artificial windscreens) and small-scale (e.g., baled straw, drift fences, living fences) wind/erosion control techniques, soil stabilizers (e.g., asphalt emulsions, biomulches, crimped straw, gravel mulches, polymer emulsions, straw blankets, surfactants), soil amendments (e.g., fertilizers), irrigation, and animal damage control measures, as necessary, to ensure establishment of replacement vegetation.
- Minimize soil erosion through recontouring, revegetation, and implementation of the Utah Pollution Discharge Elimination System storm water discharge requirements.
- Apply storm water management measures such as berms, drainage ditches, sediment traps, contour furrowing, retention ponds, and check dams.
- Regularly inspect and maintain project facilities, including the access roads, to ensure that erosion levels remain the same as or less than current conditions.

4.7.2 Air Quality

- Implement a dust control system following provisions in the *Fugitive Dust Control Plan for the Moab, Utah, UMTRA Project Site* (DOE 2002a), which complies with State of Utah requirements specified in the *Utah Administrative Code* titled "Emission Standards: Fugitive Emissions and Fugitive Dust" (UAC 2000). Apply liquid or solid surfactants (e.g., sodium or magnesium chloride or water) as necessary to control fugitive dust.
- Limit vehicle speeds along dirt roads or construction sites to 25 mph.
- Shut down idling construction equipment, if feasible.
- Use tarps or other mechanical means to cover haul truck beds and tailings conveyor belts.
- Use surfactants or car covers to stabilize tailings being hauled by rail.
- Use negative-pressure facilities for sieving/repulping for slurry formation.

4.7.3 Surface Water

- Develop, promulgate, and implement a storm water management plan that complies with all requirements of the Utah Pollutant Discharge Elimination System general permit and U.S. Army Corps of Engineers permit requirements.
- Place new access roads/pipeline corridors outside of ephemeral stream areas, where possible.
- Ensure that engineered crossings comply with UDEQ installation guidelines where access roads/pipeline corridors cross stream beds or dry washes. Methods may include avoiding installation during periods of flow, armoring streambanks near the culvert entrances and exits, installing culverts on straight sections of stream to ensure unimpeded flow, and following the contour of the stream channel. If access roads cross a dry wash, the road gradient should be 0 percent to avoid diverting surface waters from the channel.
- Install appropriate water and sediment control devices at all dry wash crossings, if necessary.
- Develop and implement a spill prevention and contingency plan to minimize the potential for spills of hazardous material, including provisions for storage of hazardous materials and refueling of construction equipment within confines of protective berms.
- Develop a spill containment and recovery plan and notification and activation protocols.
- Keep vehicles and equipment in good working order to prevent oil and fuel leaks.
- If the on-site alternative were selected, conduct additional studies of the upper 10 ft of salt layer in the tailings pile and, if necessary, determine appropriate mitigation options. Options may include excavation and aboveground treatment prior to placing the cap.

4.7.4 Floodplains and Wetlands

- If the on-site disposal alternative were implemented, provide flood/river migration protection to the pile by installing a buried riprap diversion wall.
- If it is conclusively demonstrated that mill-related ground water contamination is reaching the Matheson Wetlands Preserve, install and operate a ground water remediation system on the east bank of the Colorado River.
- Delineate wetlands and, wherever possible, locate construction activities (including pipeline and access roads) away from wetland areas. Where avoidance is not possible, provide

compensation for wetland impacts in accordance with U.S. Army Corps of Engineers Section 404 permitting requirements.

- Revegetate disturbed areas of the floodplain at the Moab site.

4.7.5 Aquatic Ecology

- Screen the intake to the enhanced water pump station to minimize entrainment of aquatic species.
- Implement interim actions designed to reduce contaminant concentrations in ground water to minimize impacts to aquatic species prior to the time when active ground water remediation would begin to reduce the risk to aquatic species.

4.7.6 Terrestrial Ecology

- Conduct field surveys prior to development activities to identify populations of species of concern. Adjust the construction footprint, access road alignments, or pipeline corridors to avoid them if possible.
- Minimize habitat and wildlife displacement/destruction by placing new construction in areas with relatively little habitat value and minimizing site disturbance to the extent practicable.
- Schedule ground-clearing activities during periods that would not disrupt breeding or nesting bird species of concern or migratory birds.
- Minimize the amount of time between ground clearing and site reclamation (establishment of replacement vegetation) in order to reduce the amount of time an area or habitat is taken out of wildlife use (facilitate recolonization by wildlife as expeditiously as possible).
- Avoid impacts by limiting activities near the site periphery, pointing lights downward, and installing light shields to limit the amount of light beyond the site boundary.
- Design the tailings pile cover to limit animal intrusion.

4.7.7 Cultural Resources

- Document and photograph the existing mill facilities in consultation with the State Historic Preservation Officer.
- Minimize potential adverse impacts to buried archaeological or cultural resources**.**

  During construction of the proposed pipeline or disposal cells, there is the possibility of encountering buried archaeological or cultural resources, including human remains. To minimize the potential adverse effects to unanticipated discoveries during construction, basic information would be provided to workers involved in ground-disturbing activities regarding the recognition of archaeological resources and Native American cultural items and the procedures to be followed upon discovery. The construction contractor would be required to ensure that discovery procedures were implemented in all applicable cases. These procedures would address the responsibilities under 36 CFR 800.13, 43 CFR 10.4, Section 3(d)(1) of the Native American Graves Protection and Repatriation Act (NAGPRA), and the State of Utah historic preservation and burial laws.

Discovery procedures (summarized below) would be addressed in detail during consultation with the State Historic Preservation Officer. Should human remains be discovered, the local coroner, law enforcement agency, and DOE must be notified immediately. If the burials were identified as being Native American, NAGPRA regulations could be applicable. Immediately after the discovery, construction in the area would cease. A qualified archaeologist would evaluate the extent of the construction exclusion zone. Construction would not resume in the area until directed by the archaeologist. In compliance with applicable state and federal laws, notification of other agencies, Native American groups, and/or the State Historic Preservation Officer could be required prior to removal to determine which party had a legitimate claim to the remains. In the event that archaeological resources were discovered after the project had begun, a qualified archaeologist would be notified, and all construction in the vicinity of the discovery would cease. An evaluation would be made regarding the extent of the construction exclusion zone, and construction would not resume in the area until directed by the archaeologist. DOE and the State Historic Preservation Officer would be notified. For expediency's sake, the newly discovered property would be considered eligible for the National Register of Historic Places (as stipulated in 36 CFR 800.13[c]) and a treatment plan would be developed to mitigate any adverse effects. However, if the property is clearly ineligible, and there is agreement with this determination by the representative of DOE and the State Historic Preservation Officer, the property would be considered not eligible and would not be subject to further consideration.

- Require site workers to receive training on the need to protect cultural resources and the legal consequences of disturbing cultural resources.
- Document the existing mill facilities in consultation with the State Historic Preservation Officer.
- Perform site-specific cultural and archeological surveys and traditional cultural properties investigations prior to any ground disturbance.
- Plan and conduct all construction (access roads, disposal cells, support facilities, etc.) so as to avoid known cultural resource sites to the fullest extent possible.
- Use existing access roads and previously disturbed land to the fullest extent possible to minimize new disturbances.
- Limit construction equipment to designated areas.
- Limit information regarding the location of cultural resources to a need-to-know basis. On maps and in specifications provided to construction contractors, indicate cultural sites as generic avoidance areas to maintain site confidentiality.
- Monitor an eligible cultural resource during surface-disturbing activities to ensure that it is avoided.
- Move cultural resource objects from areas of disturbance to nearby undisturbed areas.
- Excavate and record cultural resource data prior to the start of construction activities.
- Maintain consultations with affected tribes and communities regarding traditional cultural properties.
- Provide historical information about the former Atlas millsite and its operations to the Dan O'Laurie Canyon Country Museum in Moab, Utah.
- Construct a roadside turnout at the Moab site and erect a kiosk containing historical information about the former Atlas millsite.

4.7.8 Noise and Vibration

- Use equipment with sound-control devices installed to the fullest extent possible.
- Use equipment with muffled exhaust.
- Prohibit noise-generating construction activity within 1,000 ft of a residential structure between the hours of 10:00 p.m. and 7:00 a.m.
- Notify landowners directly affected by remediation of vicinity properties at least 48 hours before initiation of activities.
- Avoid any activities that could pose a vibration hazard to irreplaceable geologic formations (for example, the arches in Arches National Park or elsewhere).

4.7.9 Visual Resources

- Paint temporary field offices and other erected or emplaced facilities or structures a color similar to the background soils or vegetation to reduce visual impacts to potential viewers.
- Shield night lighting to reduce night sky glare that could be visible from Arches National Park.
- Plant a hedgerow of trees and shrubs between the Moab tailings pile and US-191 and SR-279 to reduce visual contrasts.
- To reduce adverse visual impacts of a permanent disposal cell on the Moab site, lessen the steepness of the side slopes, place beige- and red-colored riprap on the side slopes, and recontour the cell to a more complex, less geometric, shape.

4.7.10 Infrastructure

- Stagger or coordinate shipments of sanitary waste to the Moab sewage treatment plant to avoid taxing treatment plant capacities.

4.7.11 Traffic

- Coordinate routing and scheduling of construction traffic with state and county road staff and Union Pacific Railroad.
- Employ traffic control flaggers and post signs warning of construction activity and merging traffic when necessary for short interruptions of traffic.
- Repair any damage to local roads caused by vicinity property remediation.
- Install gates on access roads if requested to reduce unauthorized use.
- Spread debris haulage out over the life of the project to minimize transportation impacts.
- If rail transportation were identified as DOE's preferred alternative, coordinate with the Union Pacific Railroad, the DOT, and the UDOT regarding the need to enhance the safety of grade level rail/road crossings by using approaches such as signing and pavement markings, active warning devices, illumination, crossing surfaces, sight-distance improvements, geometric improvements to the roadway approaches, and closing and/or consolidating crossings.

- If it were determined that projected train frequency and speed combined with projected road traffic warranted installation of the improvements listed above, fund the improvements and, if requested by the railroad, remove and dispose of the improvements after completion of rail haul operations.

4.7.12 Health and Safety

- Use signs and a system of ropes or fences to delineate radiation control areas to reduce exposure to radioactive material.
- Control access to contamination areas.
- Perform radiological surveys and decontamination as needed to reduce the spread of and exposure to radioactive material.
- Perform industrial hygiene surveys to identify potential chemical hazards and reduce exposure.
- Decontaminate trucks and/or railcars hauling radioactive material after loading and unloading of contaminated material.
- Install a leak detection and management system if the slurry pipeline option were selected for an off-site disposal alternative.

4.8 References

36 CFR 800. Advisory Council on Historic Preservation, "Protection of Historic Properties."

43 CFR 10. U.S. Department of the Interior, Bureau of Reclamation, "Native American Graves Protection and Repatriation Regulations."

40 CFR 50. U.S. Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR 192, U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings."

40 CFR 1500–1508. Council on Environmental Quality, "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act."

50 CFR 17. U.S. Department of the Interior, Fish and Wildlife Service, "Endangered and Threatened Wildlife and Plants."

59 FR 7629. *Environmental Justice in Minority Populations and Low-Income Populations*, Executive Order 12898, February 11, 1994.

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