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FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR THE URANIUM MILL TAILINGS REMEDIAL ACTION GROUND WATER PROJECT

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SUMMARY

This programmatic environmental impact statement (PEIS) was prepared for the Uranium Mill Tailings Remedial Action (UMTRA) Ground Water Project to comply with the National Environmental Policy Act (NEPA). This PEIS provides an analysis of the potential impacts of the alternatives and ground water compliance strategies as well as potential cumulative impacts.

On November 8, 1978, Congress enacted the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978, Public Law, codified at 42 USC '7901 et seq. Congress found that uranium mill tailings ". . . may pose a potential and significant radiation health hazard to the public, and that every reasonable effort should be made to provide for stabilization, disposal, and control in a safe, and environmentally sound manner of such tailings in order to prevent or minimize other environmental hazards from such tailings." Congress authorized the Secretary of Energy to designate inactive uranium processing sites for remedial action by the U.S. Department of Energy (DOE). Congress also directed the U.S. Environmental Protection Agency (EPA) to set the standards to be followed by the DOE for this process of stabilization, disposal, and control.

On January 5, 1983, EPA published standards (40 CFR Part 192) for the disposal and cleanup of residual radioactive materials. On September 3, 1985, the U.S. Court of Appeals for the Tenth Circuit set aside and remanded to EPA the ground water provisions of the standards. The EPA proposed new standards to replace remanded sections and changed other sections of 40 CFR Part 192. These proposed standards were published in the Federal Register on September 24, 1987 (52 FR 36000). Section 108 of the UMTRCA requires that DOE comply with EPA's proposed standards in the absence of final standards. The Ground Water Project was planned under the proposed standards. On January 11, 1995, EPA published the final rule, with which the DOE must now comply. The PEIS and the Ground Water Project are in accordance with the final standards. The EPA reserves the right to modify the ground water standards, if necessary, based on changes in EPA drinking water standards. Appendix A contains a copy of the 1983 EPA ground water compliance standards, the 1987 proposed changes to the standards, and the 1995 final rule.

Under UMTRA, DOE is responsible for bringing the designated processing sites into compliance with the EPA ground water standards and complying with all other applicable standards and requirements. The U.S. Nuclear Regulatory Commission (NRC) must concur with DOE's actions. States are full participants in the process. The DOE also must consult with any affected Indian tribes and the Bureau of Indian Affairs.

Uranium processing activities at most of the inactive mill sites resulted in the contamination of ground water beneath and, in some cases, downgradient of the sites. This contaminated ground water often has elevated levels of constituents such as but not limited to uranium and nitrates. The purpose of the UMTRA Ground Water Project is to eliminate or reduce to acceptable levels the potential health and environmental consequences of milling activities by meeting the EPA ground water standards.

The first step in the UMTRA Ground Water Project is the preparation of this PEIS. This document analyzes the potential impacts of four alternatives for conducting the Ground Water Project. These alternatives do not address site-specific ground water compliance strategies because the PEIS is a planning document only. It assesses the potential programmatic impacts of conducting the Ground Water Project, provides a method for determining the site-specific ground water compliance strategies, and provides data and information that can be used to prepare site-specific environmental impacts analyses more efficiently. Participation by affected states, tribes, and local government agencies will be encouraged during preparation of this PEIS, and during implementation of the alternative selected in the Record of Decision.

This PEIS differs substantially from a site-specific environmental impact statement because multiple ground water compliance strategies, each with its own set of potential impacts, could be used to implement all the alternatives except the no action alternative. In a traditional environmental impact statement, an impacts analysis leads directly to the defined alternatives. The impacts analysis for implementing alternatives in this PEIS first involves evaluating a ground water compliance strategy or strategies (Figure 1), the use of which will result in site-specific impacts. This PEIS impacts analysis assesses only the potential impacts of the various ground water compliance strategies, then relates them to the alternatives to provide a comparison of impacts.

DESCRIPTION OF THE PROPOSED ACTION (PREFERRED ALTERNATIVE) AND ALTERNATIVES

Table 1. Ground water compliance strategies that apply under each alternative

Strategy	Alternative			
	Proposed action	No action[a]	Active remediation to background levels	Passive remediation
Active ground water remediation methods	%		%[b]	
Natural flushing [c]	%			%

No ground water remediation Sites that qualify for supplemental standards [d] or alternate concentration limits[e].	%			%
Sites that meet maximum concentration limits or background levels (no impacts).[f]	%			%

[a]The analysis of the no action alternative is required by the CEQ and DOE.

[b]Active remediation methods would not be used at sites where contamination does not exceed background and likely would not be used at sites that qualify for supplemental standards based on the existence of limited use ground water.

[c]Natural flushing means allowing the natural ground water movement and geochemical processes to decrease contaminant concentrations.

[d]Supplemental standards applicable for certain site conditions, as identified in the EPA standards, that are protective of human health and the environment, and may be applied in lieu of prescriptive levels.

[e]Concentrations of contaminants that may exceed the maximum concentration limits; or, limits for those constituents without maximum concentration limits. If DOE demonstrates, and NRC concurs, that human health and the environment would not be adversely affected, DOE may meet an alternate concentration limit.

[f]"No remediation" at sites that do not exceed maximum concentration limits or background levels is not the same as "no action" because these sites would require activities such as site characterization to show that no remediation is warranted.

The PEIS considers four programmatic alternatives for implementing the UMTRA Ground Water Project: 1) the proposed action (DOE's preferred alternative), 2) no action, 3) active remediation to background levels, and 4) passive remediation. A Record of Decision will identify the alternative that will become the programmatic foundation for conducting the Ground Water Project at all sites. All the alternatives listed except the no action alternative would use one or more ground water compliance strategies to meet the EPA ground water standards. Table 1 shows the alternatives and the strategies that are described below.

1) Proposed action (Preferred Alternative)

The proposed action which is DOE's preferred alternative would use ground water compliance strategies tailored for each site to achieve conditions that are protective of human health and the environment. The proposed action would consider ground water compliance decisions in a step-by-step approach, beginning with consideration of "no remediation" strategy and proceeding, if necessary, to the passive strategy, such as natural flushing with compliance monitoring and institutional controls, and to a more complex, active ground water cleanup method, such as pump and treat or other engineered approaches to cleaning up contaminated ground water. For example, under the proposed action, if a site risk assessment and site observational work plan indicate that the strategy of "no remediation" would still be protective of human health and the environment, a more complex and potentially disruptive strategy involving active cleanup methods would not be necessary.

The proposed action is intended to establish a consistent risk-based framework for implementing the UMTRA Ground Water Project and determining appropriate ground water compliance strategies at the UMTRA Project former processing sites. The determination of site-specific ground water compliance strategies would take into account site-specific ground water conditions; human and environmental risks; participation of the tribes, States and local communities; and cost. This approach is sufficiently flexible to allow for interim actions, such as alternate water supply systems, should these activities be necessary in order to reduce risk and/or support institutional controls. The proposed action would also allow the consideration of new ground water cleanup methods that become available.

2) No action alternative

The Council on Environmental Quality (CEQ) regulations for implementing the NEPA require assessment of the no action alternative (40 CFR '1502.14(d)), even if the agency is under a legislative mandate to act (51 FR 15618). The analysis of the no action alternative "provides a benchmark, enabling decision makers to compare the magnitude of environmental effects of the action alternatives" (51 FR 15618). Under the no action alternative, no further activities would be carried out to comply with EPA standards at the inactive UMTRA Project's former processing sites.

3) Active remediation to background levels alternative

Under this alternative, ground water at the former processing sites would be restored to background levels or to levels as close to background as possible using active ground water remediation methods. The rationale behind this alternative is that ground water at most of the former uranium processing sites was of better quality before uranium processing activities occurred and that the ground water should be restored to its preprocessing quality. If this alternative were implemented, most of the UMTRA Project sites would require the use of active ground water remediation methods such as gradient manipulation, ground water extraction and treatment, or in situ ground water treatment, regardless of the quality of the unaffected background ground water. The active ground water restoration method for each site would be determined by the observational approach and site-specific analyses would appear in the site-specific observational work plans.

4) Passive remediation alternative

Under this alternative, only passive remediation strategies would be used to meet the EPA ground water standards. The passive remediation strategies are 1) performing no remediation at sites that qualify for supplemental standards or alternate concentration limits or sites where contaminant concentrations are below maximum concentration limits or background levels, and 2) relying on natural flushing. Natural flushing means allowing the natural ground water movement and geochemical processes to decrease contaminant concentrations. This alternative differs from the no action alternative in that it includes site characterization, monitoring, and risk assessment activities.

Under the first strategy of this alternative, the DOE would apply supplemental standards or alternate concentration limits if maximum concentration limits and/or background concentrations were exceeded. If supplemental standards or alternate concentration limits are proposed at any site, concurrence by the NRC would be required.

Under the second strategy of this alternative, natural flushing would be used to achieve background levels or maximum concentration limits if supplemental standards and alternate concentration limits are not applied. Concurrence by the NRC would be required. According to the EPA standards, natural flushing can be used if it is shown to be protective of human health and the environment, meets the EPA standards within 100 years, and complies with the other criteria established for its use as discussed in Section 1.4.1. However, natural flushing may not meet the standards in 100 years and may not be protective of human health and the environment at all sites. For these cases, the passive remediation alternative may not result in compliance with the EPA standards.

The passive ground water compliance strategy selected for each site would be dependent on the observational approach and evaluating data gathered and included in Site Observational Work Plans. Active ground water remediation methods would not be used, even if EPA standards cannot be met by implementing the above mentioned strategies.

EXISTING CONDITIONS

The designated UMTRA Project processing sites were active for varying lengths of time from the 1940s into the 1970s. These sites, the surrounding areas, and the underlying ground water constitute the affected environment for this PEIS. Minority or low income groups near UMTRA sites that have the potential for disproportionately high and adverse effects include those near the Tuba City and Monument Valley, Arizona; Shiprock, New Mexico; Mexican Hat, Utah; and Riverton, Wyoming, sites. Land contaminated by uranium mill tailings and other contaminants ranged from a low of 21 acres (ac) (8 hectares [ha]) at the Spook, Wyoming, site to a maximum of 612 ac (248 ha) at the Ambrosia Lake, New Mexico, site. The amount of contaminated materials ranged from 85,000 cubic yards (yd^3) (65,000 cubic meters [m^3]) at the North Continent Slick Rock, Colorado, site to 5,764,000 yd^3 (4,407,000 m^3) at the Falls City, Texas, site. The total amount of contaminated material at the sites is 39,000,000 yd^3 (30,000,000 m^3). As a result of uranium processing, contaminants have entered the ground water at most of the UMTRA Project sites. Some of the more common hazardous constituents that exceed maximum concentration limits at UMTRA sites include but are not limited to net gross alpha, molybdenum, nitrate, selenium, and uranium.

DOE currently estimates that approximately 10 billion gallons (gal) (39 million m^3) of ground water are contaminated. One site (Lowman, Idaho) shows no sign of contamination related to processing activities. The site with the largest amount of contamination, Gunnison, Colorado, has an estimated 1.9 billion gal (7.0 million m^3) of contaminated ground water.

Surface remediation of the designated sites has been in progress since the mid-1980s; surface remediation is complete at 18 sites and under way at four sites. The Belfield and Bowman, North Dakota, sites are not scheduled for surface remediation at the request of the state. Affected states are required by UMTRCA to cost share 10 percent of remedial action costs. Table 2 summarizes the environmental resources that are present at the former processing sites.

IMPACTS ANALYSIS

To evaluate the impacts of alternatives, a qualitative analysis of potential impacts of the ground water compliance strategies is used in this PEIS. This qualitative analysis compares the potential impacts of one alternative to another alternative rather than to site-specific impacts. For example, if the no action alternative is said to have a high potential for ecological risk, this potential impact is high only in relation to the other alternatives' potential for such an impact. These comparisons are not site specific; that type of assessment would be provided in the site-specific NEPA documents that tier off the PEIS. (Tiering is the process in which broad environmental issues are analyzed to facilitate subsequent site-specific decision making.) Further, this comparison treats all impacts equally so that, for example, the significance of potential impacts to human health are equated with potential impacts on cultural resources (Table 3).

To give more weight to impacts that may have more significant consequences (for example, human health), long-term and short-term impacts are compared separately. Long-term impacts are those that would occur from leaving contaminated ground water in place or from implementing institutional controls for an extended period of time. Short-term impacts would usually occur only during construction activities. In general, these impacts would be potentially less significant than long-term impacts, because most (for example, habitat destruction, noise, and dust emissions) would be relatively minor and temporary, and could be mitigated. While these impacts are of concern, there is a greater concern regarding potential long-term health and environmental effects.

Potential short-term impacts of the alternatives

Potential short-term impacts to air quality, background noise levels, visual resources, transportation systems, utilities, and energy supplies would occur principally during site characterization, monitor well construction, and construction of ground water remediation facilities. There would be little or no impact on these resources due to the short duration and small scale of the ground-disturbing activities. Site characterization, monitoring, and construction activities have the potential to disturb sensitive habitats, species, and cultural/traditional resources. The probability of these disturbances would be remote because site characterization and construction activities can take place in areas away from these resources. In addition, if impacts to these resources occurred, their effects could be mitigated. Therefore, the potential for site characterization and construction activities to adversely affect these resources would be considered minor.

Potential long-term impacts of the alternatives

Potential long-term impacts could arise under the following circumstances:

- If the contaminated ground water did not comply with EPA standards and its use was not controlled. This could occur under the no action alternative.
- If the ground water compliance strategy was not protective of human health and the environment at all sites. This could occur under the passive remediation alternative.
- If institutional controls were in place for many years. This could occur under all the alternatives except the no action alternative.

Significant adverse impacts to human health and the environment could result under the no action alternative. Under this alternative, the public could be exposed to hazardous contaminants by drinking contaminated ground water or surface water that is a surface expression of contaminated ground water. Further, minority and/or low-income communities would be disproportionally impacted under no action. Adverse impacts to the environment could potentially occur if contamination enters the food chain (such as through livestock or produce) or affects sensitive habitats (such as wetlands) or threatened and endangered species. These potentially significant adverse impacts probably would not occur under the proposed action or the active remediation to background levels alternative, because these alternatives would comply with EPA standards at all UMTRA Project sites. In addition, surface and ground water monitoring would take place before and during implementation of the proposed action and the active remediation to background levels alternative to ensure the public is not exposed to existing or potential surface and ground water contamination.

Implementation of the passive remediation alternative also could result in potential exposure of humans and the environment to hazardous contaminants. During the time required to implement the passive remediation alternative, contaminated ground water could reach potential receptors such as domestic wells or surface water features. Both the proposed action and active remediation to background levels alternatives would use hydrogeologic data and risk assessments to identify the need for implementing active remediation strategies to remediate ground water quickly or divert the flow of contamination.

Implementation of institutional controls could result in potentially significant long-term land use and social and economic impacts. The passive remediation alternative could result in the need for institutional controls for more than 100 years if protection of the public and the environment were necessary. The proposed action and the active remediation to background levels alternatives would implement strategies to achieve ground water compliance within 100 years.

In summary, the proposed action and active remediation to background levels alternatives are most effective in protecting human health and the environment from the contaminated ground water at the UMTRA Project sites. When cost is factored in, the proposed action likely would be more cost-effective than the active remediation alternative, because it can rely on less costly passive ground water compliance strategies at sites where these strategies are shown to be protective of human health and the environment. Implementing the active remediation to background levels alternative would be the most costly because active ground water remediation methods would be used at most sites. In addition, both alternatives would result in compliance with the EPA ground water standards so the active remediation to background levels, with its reliance on active ground water remediation, would provide no additional benefits to human health and the environment.

Table 2. Resources at UMTRA Project processing sites

	Site characteristics								
UMTRA Project Site	Tribal lands	Urban setting	Suburban setting	Rural setting	Annual precipitation inches/centimeters)	Wetlands	Surface water	Cultural/traditional resources	Threatened and endangered species

Monument Valley, AZ	%			%	6/15	%	%	%	
Tuba City, AZ	%			%	6/15				
Durango, CO			%		19/48		%		%
Grand Junction, CO		%			8/20	%	%		%
Gunnison, CO			%		11/28	%	%		%
Maybell, CO				%	13/33	%	%	%	%
Naturita, CO				%	9/23	%	%	%	%
Old Rifle, CO			%		11/28	%	%		%
New Rifle, CO			%		11/28	%	%		%
Slick Rock, CO (Union Carbide)				%	7/18	%	%	%	%
Slick Rock, CO (North Continent)				%	7/18	%	%	%	%
Lowman, ID				%	27/69	%	%		
Ambrosia Lake, NM				%	9/23			%	
Shiprock, NM	%		%		6/15	%	%		%
Belfield, ND			%		16/41	%	%	%	%
Bowman, ND				%	16/41	%	%	%	%
Lakeview, OR			%		17/43	%	%		
Canonsburg, PA		%			37/94		%	%	
Falls City, TX				%	30/76	%	%		%
Green River, UT				%	6/15		%	%	

Mexican Hat, UT	%			%	6/15	%	%		
Salt Lake City, UT		%			15/38	%	%		
Riverton, WY	%[a]			%	8/20	%	%	%	
Spook, WY				%	11/28		%		%
Total	5	3	7	14		18	22	11	14

[a] Tribal lands adjacent to the site.

Table 3.Comparison of the potential adverse environmental impacts of alternatives

Environmental factor	Alternative			
	Proposed action	No action	Active remediation to background levels	Passive remediation
Human health	Low	High	Low	Medium
Surface water	Low	High	Low	Medium
Ground water	Low	High	Low	Medium
Ecology				
Habitat destruction	Medium	Low	High	Low
Contaminated ground water	Low	High	Low	Medium
Land use				
Land acquisition	Medium	Low	High	Low
Institutional controls	Medium	Low	Medium	High
Contaminated ground water	Low	High	Low	Medium
Cultural/traditional resources				
Surface	Medium	Low	High	Low
Ground water	Medium	High	Low	High
Social and economic				
Institutional controls	Medium	Low	Medium	High
Contaminated ground water	Low	High	Low	Medium
Environmental justice	Low	High	Low	Low
Waste management	Medium	Low	High	Low

1. High indicates high potential for negative impact relative to the other alternatives.
2. Medium indicates medium potential for negative impact relative to the other alternatives.
3. Low indicates little to no potential for negative impact relative to the other alternatives.
4. The degree of actual negative impact, if any, would be addressed once the site-specific ground water compliance strategies are determined;

the analyses would appear in the site-specific NEPA document.

1.0 INTRODUCTION

From 1943 to 1970, much of the uranium ore mined in the United States was processed by private companies under procurement contracts with the U.S. Atomic Energy Commission. This ore was used in national defense research, weapons development, and the developing nuclear industry. After fulfilling their contracts, many of the uranium mills closed and left large quantities of waste, such as uranium mill tailings and abandoned mill buildings, at the mill sites.

Beginning in the late 1960s and 1970s, direct gamma radiation, radon gas, and uranium decay products at the abandoned mill sites were determined to be potential health hazards. In 1972 concern for the potential long-term adverse health affects from uranium mill tailings used as fill material in construction projects in Grand Junction, Colorado, led Congress to pass Title II of Public Law 92-314, which authorized the Atomic Energy Commission to pay for 75 percent of the cost of remediating such contaminated buildings. Public concern about other abandoned uranium mill sites led to engineering and radiological studies to identify other mill sites in need of cleanup. As a result of these studies Congress passed the Uranium Mill Tailings Radiation Control Act (UMTRCA) on November 8, 1978 (42 USC §7901 et seq.).

The UMTRCA directed the U.S. Department of Energy (DOE) to stabilize, dispose of, and control, in a safe and environmentally sound manner, uranium mill tailings at the designated inactive uranium mill sites. To comply with the law, DOE established the Uranium Mill Tailings Remedial Action (UMTRA) Project. Under the UMTRA Project, DOE has been performing remedial action of the surface contamination (including uranium mill tailings and abandoned mill buildings) since 1983; this effort is called the UMTRA Surface Project. The first site to be cleaned up is in Canonsburg, Pennsylvania; surface remediation has now been completed at 18 sites and is under way at four sites. The designated uranium mill sites at Belfield and Bowman, North Dakota, will not be remediated by DOE because the state of North Dakota has declined to provide their statutorily required cost-sharing to remediate the sites. Although it is unlikely that these two sites will be part of the UMTRA Ground Water Project, discussion of the sites is still included in the programmatic environmental impact statement (PEIS). The Surface Project is responsible for controlling the exposure and dispersion of uranium mill tailings and other contaminated materials by stabilizing this material in disposal cells. However, the Surface Project does not address the remediation of contaminated ground water at the UMTRA Project sites. Information about the Surface Project is summarized in Sections 3.1 and 3.2 of this PEIS.

The UMTRA Ground Water Project addresses residual ground water contamination, if any, from the UMTRA Project processing sites. The Ground Water Project would take measures to protect human health and the environment by complying with EPA standards in a cost- effective and publicly acceptable manner. The UMTRA Ground Water Project also would address potential ground water contamination associated with vicinity properties (properties outside the processing site boundary contaminated with tailings) on a case-by-case basis.

The volume of tailings at vicinity properties is, in almost all cases, much less than the volume of the tailings at the abandoned processing sites. The volume of tailings is just one of the criteria for determining if the vicinity property would be a source for ground water contamination and would fall within the Ground Water Project. Another difference between contamination from a processing site and a vicinity property site is that processing sites had the potential to impact ground water due to the use of chemicals, water discharge, and exposed saturated tailings. In most cases, the tailings were exposed to the environment for many years before remediation. Tailings at vicinity properties were not processed and typically were not exposed to the environment for many years, which would minimize or eliminate the potential for vicinity properties to be a source of ground water contamination. Other factors include depth to ground water, magnitude of source, soil and bedrock geochemistry, ground water recharge and discharge, background water geochemistry, climate, and condition of the vicinity property.

1.1 PURPOSE OF AND NEED FOR DOE ACTION

In the UMTRCA, Congress acknowledged the potentially harmful health effects associated with uranium mill tailings. As required by the UMTRCA, the U.S. Environmental Protection Agency (EPA) developed standards to protect the public and the environment from potential radiological and nonradiological hazards from the abandoned mill processing sites; these standards include exposure limits for surface contamination and concentration limits for ground water protection. DOE is responsible for performing remedial action to bring the surface and ground water contaminant levels at the abandoned mill processing sites into compliance with EPA standards. DOE accomplishes this function through the UMTRA Project. Remedial action is conducted with the concurrence of the U.S. Nuclear Regulatory Commission (NRC) and the full participation of affected states and in consultation with Indian tribes. In addition, the NRC, Hopi Tribe, and Navajo Nation are cooperating agencies in the preparation of this PEIS.

Uranium processing activities at most of the processing mill sites designated for remediation under the UMTRCA resulted in the formation of contaminated ground water beneath and, in some cases, downgradient of the sites. This contaminated ground water often has elevated levels of hazardous constituents such as uranium and nitrates. The purpose of the DOE UMTRA Ground Water Project is to protect human health and the environment by meeting EPA standards in areas where ground water has been contaminated with hazardous constituents from former processing sites.

A major first step in the UMTRA Ground Water Project is the preparation of this PEIS. This document analyzes potential impacts of the alternatives, including the proposed action, which is DOE's preferred alternative. These alternatives are programmatic in that they are plans for conducting the UMTRA Ground Water Project. The alternatives, which are described in Section 2.0, do not address site-specific ground water compliance. This PEIS is a planning document for the Ground Water Project and assesses the potential programmatic impacts of conducting the Project. It provides a method for determining the site-specific ground water compliance strategies and identifies data and information that are needed to prepare site-specific environmental impacts analyses more efficiently.

This PEIS satisfies a National Environmental Policy Act (NEPA) (42 USC §4321 et seq.) requirement by describing the proposed action and the alternatives and the existing conditions at the UMTRA sites, assessing potential impacts of the Ground Water Project as defined by the proposed action and the alternatives, and comparing the potential impacts of the proposed action and the alternatives.

1.2 URANIUM MILL TAILINGS RADIATION CONTROL ACT

Congress passed the UMTRCA in 1978 in response to concerns raised about potential radiation health hazards to the public from long-term exposure to uranium mill tailings (Figure 1.1).

The purposes of the UMTRCA are to stabilize and control uranium mill tailings at designated inactive mill sites and to regulate uranium mill tailings at active processing sites.

The UMTRCA has three parts, or "titles." Title I directs DOE to complete remedial action at 22 inactive uranium mill sites at which all or a substantial portion of uranium was processed for sale to a federal agency, and which no longer had a license to process uranium ore as of January 1, 1978. The Secretary of Energy was given the authority to add sites to the list. Designated uranium processing sites will be or have been remediated under Title I (Figure 1.2) . Title II directs NRC to regulate uranium mill tailings at those processing sites having an active license on January 1, 1978. Title II sites are in various stages of surface and ground water remediation by private mill site operators (under Title II ground water remediation is conducted in conjunction with surface remediation). Title II sites are being remediated independently of one another and of the Title I sites. Title III directs NRC to study whether two New Mexico uranium mill sites should be designated by the Secretary of Energy as processing sites under Title I; the mill sites were not so designated.

In an amendment to the UMTRCA, DOE was authorized to perform ground water remediation at the designated processing sites without a time limitation (42 USC §7922(a)). Congress also directed DOE to comply with EPA's proposed ground water regulations until such time as EPA promulgates final regulations (42 USC §7918(a)(3)). EPA issued its proposed ground water protection standards on September 24, 1987 (52 FR 36000). Planning for the Ground Water Project occurred while the proposed rules were in effect. On January 11, 1995, the EPA published the final rule (60 FR 2854).

The responsibility for fulfilling the legislative mandate under the UMTRCA is divided between DOE, NRC, EPA, Indian tribes, and states. Their roles are described in the following subsections.

1.2.1 U.S. Department of Energy

As the lead agency in the execution of the UMTRCA, DOE is responsible for the overall management of the UMTRA Project. This includes responsibility for all programmatic decisions and the review and supervision of all work completed by DOE contractors.

Within DOE, the Assistant Secretary for Environmental Management at DOE Headquarters oversees the administration of the UMTRA Project. The DOE Albuquerque Operations Office is the responsible field office, and daily operation of the UMTRA Ground Water Project is conducted by DOE's UMTRA Project Office in Grand Junction, Colorado.

DOE is committed to conducting the UMTRA Project in an environmentally sound manner that is protective of human health and the environment consistent with DOE Order 5400.1, General Environmental Protection Program, and in accordance with all applicable environmental laws.

1.2.2 U.S. Nuclear Regulatory Commission

The UMTRCA designated NRC as the federal regulatory oversight agency for the UMTRA Project. As part of this oversight responsibility, NRC published the Final Generic Environmental Impact Statement on Uranium Milling in 1980 (NRC, 1980). This document assessed the nature and extent of the impacts of uranium milling and provided information on what the regulatory requirements for management and disposal of mill tailings and mill decommissioning should be. This generic environmental impact statement is the programmatic environmental impact statement for the UMTRA Surface Project.

Remedial actions are selected and performed with the concurrence of the NRC. The NRC also licenses the completed disposal sites for long-term care. (Refer to Section 1.4, Regulatory Compliance, for a discussion of licensing.)

NRC provides technical and regulatory review of certain UMTRA Project documents, including remedial action plans, completion reports, long-term surveillance plans, and certification reports. An NRC concurrence with these documents is required to obtain a license for the disposal sites.

1.2.3 U.S. Environmental Protection Agency

As specified in the UMTRCA, EPA was required to establish standards for remediating and disposing of contaminated material from inactive uranium processing sites. Section 1.4, Regulatory Compliance, describes the EPA standards.

1.2.4 Indian Tribes and States

Under the plan established by the UMTRCA, states participate fully in the selection and performance of remedial action for which states pay part of the cost (10 percent). Remedial action on Indian lands is to be selected and performed in consultation with the affected Indian tribes and the Bureau of Indian Affairs. Indian tribes are not required to pay any of the costs of remedial action.

The DOE has entered into cooperative agreements with the states and Indian tribes for the performance of the surface remedial action. New cooperative agreements for the UMTRA Ground Water Project, which would outline the new roles and responsibilities of the parties, would be negotiated between the DOE and the states and Indian tribes.

The participation of the states and Indian tribes in the UMTRA Ground Water Project would include review of major technical documents and activities related to site-specific ground water compliance. The states (including local governments) and Indian tribes also would play a key role in the implementation of institutional controls during ground water remediation, as appropriate.

The states and Indian tribes participated in the initial ground water PEIS activities, including the scoping meetings and hearings, and provided comments on the draft PEIS. In addition, the Hopi Tribe and Navajo Nation are cooperating agencies in the preparation of the PEIS.

The DOE recognizes that as a federal agency, it has a fiduciary duty to act in the best interests of the affected Indian tribes under the United States' trust responsibility with Indian nations. The DOE's policy with respect to its relationships with Indian tribes is more fully described in DOE Order 1230.2,American Indian Tribal Government Policy.

1.3 NATIONAL ENVIRONMENTAL POLICY ACT

The NEPA of 1969 (42 USC §4321 et seq.) declared a national policy for promoting efforts to prevent or eliminate damage to the environment. This act requires federal agencies to prepare a detailed statement that identifies and analyzes the environmental impacts of a proposed action that may significantly affect the quality of the human environment (42 USC §4321(c)). The Council on Environmental Quality (CEQ) regulations that implement NEPA (40 CFR Parts 1500-1508) provide requirements for carrying out the substantive and procedural elements of NEPA. The regulations also require that each federal agency develop its own implementing procedures (40 CFR §1507.3). The DOE implementing requirements for compliance with NEPA are contained in 10 CFR Part 1021.

As discussed in Section 1.2, UMTRCA directed DOE to perform remedial action that would stabilize and control the uranium mill tailings and associated contamination at inactive uranium processing sites in 10 states and on tribal lands. Implementation of UMTRCA represents a major federal action subject to NEPA requirements. In 1982, EPA prepared an environmental impact statement that analyzed the impacts of implementing the compliance standards (40 CFR Part 192) for the UMTRA Project (EPA, 1982). The DOE NEPA documents (environmental impact statements and environmental assessments) analyzing site-specific impacts of surface remediation have been completed for the sites. These documents are referenced in Section 3.2, Site Descriptions. Site-specific NEPA documents would be prepared for ground water activities.

One approach considered to address the programmatic impacts was to assess the impacts of the UMTRA Ground Water Project in DOE's waste management PEIS. Site-specific UMTRA Ground Water Project NEPA documents would have tiered off the waste management PEIS (the concept of tiering is described in Section 1.3.1). Although the UMTRA Project is part of DOE's Environmental Restoration Program, DOE is evaluating UMTRA Ground Water Project activities in a separate PEIS for four reasons. First, the UMTRA Project is an autonomous project with a clearly defined legislative, regulatory, and technical scope that is distinct from other DOE programs. Second, the NEPA process is complete for surface disposal of tailings at most UMTRA Project sites, and the Surface Project is expected to be near completion before a Record of Decision is issued for the Environmental Management Program PEIS. Third, the Environmental Management Program PEIS will not provide the level of detail necessary so that the site-specific NEPA documents can tier off the PEIS. Fourth, the UMTRA Project is regulated by NRC, while the Environmental Management Program sites are regulated primarily by EPA and the states. This PEIS is a comprehensive planning and decision-making document that would 1) provide the basis for determining the appropriate ground water compliance strategy at each UMTRA Project processing site; 2) assess the potential programmatic impacts of the UMTRA Ground Water Project; and 3) provide a tiering document for the site- specific NEPA documents.

The regulations for implementing NEPA provide for the preparation of program-wide environmental impact statements (40 CFR §1502.4(b)) for broad federal actions such as implementation of a new program or regulation. Programmatic NEPA documents are subject to the same preparation, issuance, and circulation requirements as other NEPA documents (10 CFR §1021.330).

1.3.1 Tiering

Preparation of the UMTRA Ground Water Project PEIS is consistent with the concept of tiering (40 CFR §1508.28), in which broad-scope environmental impact statements analyze general policy or program issues to facilitate subsequent site-specific decision-making. The NEPA implementing regulations encourage this tiering approach. These regulations indicate that the issues discussed in the broad, policy-level environmental impact statement need only be summarized or incorporated by reference into the site-specific NEPA documents that are published after the policy-level environmental impact statement. These site-specific documents focus on issues specific to actions that followed publication of the PEIS (40 CFR §1502.20). Programmatic issues that are analyzed in this ground water PEIS and would be summarized or incorporated by reference in the site-specific NEPA documents include the following:

- The framework for determining the ground water compliance strategy for meeting the EPA ground water standards at each UMTRA Project site (refer to Section 2.1)
- The categories of impacts to be assessed for each ground water compliance strategy (refer to Section 4.0)
- The assessment of impacts of programmatic alternatives (refer to Section 4.0)
- The methods for assessing risk (refer to Appendix B)
- The detailed discussions of ground water characterization and remediation methods (refer to Section 2.8 and Appendix C).

The site-specific NEPA documents would focus on issues relevant to ground water compliance decisions for a particular site. This approach would minimize the length of each site-specific NEPA document but would allow the assessment to address all pertinent environmental issues. This would include enough ground water data and analyses so the public and agencies can determine if the proposed ground water compliance strategy is appropriate.

Pollution prevention

Pollution prevention was addressed in the CEQ memorandum of January 12, 1993, "Pollution Prevention and the National Environmental Policy Act." Pollution prevention includes ". . . reducing or eliminating hazardous or other pollution inputs which can contribute to both point and non-point source pollution, . . ." and ". . . preventing the disposal and transfer of pollution from one media to another . . . ." Overall, the UMTRA Project can be considered a pollution prevention project because the Surface Project stabilizes the uranium mill tailings and other contaminated material into disposal cells, which prevents or inhibits the spread of contamination onto the land surface or into the ground water, and the Ground Water Project remediates contaminated ground water.

The Ground Water Project would address the prevention and potential spread of pollution, including contaminated ground water that has the potential to create human and ecological health risks; the discharge of contaminated sludge and water generated from ground water cleanup; the prevention of fugitive dust emissions from remedial action; and the prevention of the use of contaminated ground water through institutional controls. The site-specific environmental documents would assess specific avenues for pollution and measures to prevent this pollution at each of the UMTRA Project sites.

1.3.2 Cooperating Agencies

NEPA mandates that all federal agencies seek comments from governmental agencies that have jurisdiction or special expertise with respect to any environmental impact involved in a proposed action or alternative (42 USC §4321(c)). The extent of participation by a cooperating agency varies from active participation in developing information and analyses for the environmental impact statement to the roles of consultation and review. The Navajo Nation, Hopi Tribe, and NRC are cooperating agencies for the PEIS.

Participation by affected tribes, states, other agencies, and local governments also is encouraged in the preparation of the PEIS. Representatives of the tribes, states, local governments, other agencies, and the public participated in scoping meetings and hearings, and provided comments on the draft PEIS (refer to Section 1.6). Information obtained from these sources was used to identify issues addressed in the draft PEIS and to revise it, where necessary. The PEIS implementation plan (DOE, 1994a) discusses the comments received during scoping and how those comments were addressed in the draft PEIS. Volume II of this final PEIS contains all comments received during the hearings and comment period, and DOE's responses. The affected tribes, states, and public, along with local and federal government agencies, would continue to be actively involved in the PEIS process and the site-specific environmental documents that would tier off the PEIS.

1.4 REGULATORY COMPLIANCE

The UMTRA Project is regulated by both EPA and NRC regulations (40 CFR Part 192 and 10 CFR Part 40, respectively). DOE must comply with EPA and NRC regulations for remediation of uranium mill tailings and associated ground water contamination and for long-term care. This section provides an overview of the regulations pertaining to ground water protection standards and describes the general requirements for long-term surveillance and monitoring at processing sites.

Decisions regarding consistency with tribal and state laws and regulations would be made by DOE, in consultation with the tribes and states. These decisions would consider cases where an approved wellhead protection area, under the Safe Drinking Water Act, is associated with the site. DOE would comply with the provisions of that legislation unless the President of the United States, through the EPA, grants an exemption.

1.4.1 EPA Standards

The UMTRCA requires that EPA promulgate standards for protecting public health, safety, and the environment from radiological hazardous constituents associated with the processing, possession, transfer, and disposal of residual radioactive materials. The UMTRCA and EPA define residual radioactive materials as tailings and other wastes that DOE determines to be radioactive that have resulted from uranium ores processing. These wastes may be in the form of tailings or other materials such as demolition debris and nonradiological hazards associated with residual radioactive materials. EPA has interpreted this definition to include sludges and captured contaminated water from the processing sites (60 FR 2854).

On January 5, 1983, EPA published standards (40 CFR Part 192) for the disposal and cleanup of residual radioactive materials. On September 3, 1985, the U.S. Court of Appeals for the Tenth Circuit set aside and remanded to EPA the ground water provisions of the standards. EPA proposed new standards to replace remanded sections and changed other sections of 40 CFR Part 192. These proposed standards were published in the Federal Register on September 24, 1987 (52 FR 36000). Section 108 of the UMTRCA requires that DOE comply with EPA's proposed standards in the absence of final standards. The Ground Water Project was planned under the proposed standards. On January 11, 1995, EPA published the final rule, with which the DOE must now comply. The PEIS and the Ground Water Project are in accordance with the final standards. The EPA reserves the right to modify the ground water standards, if necessary, based on changes in EPA drinking water standards. Appendix A contains a copy of the 1983 EPA ground water compliance standards, the 1987 proposed changes to the standards, and the 1995 final rule.

The EPA standards have three subparts that apply to the UMTRA Project: Subpart A, Subpart B, and Subpart C.

Subpart A—Standards for residual radioactive materials

Subpart A, "Standards for the Control of Residual Radioactive Materials From Inactive Uranium Processing Sites," addresses control or disposal of the residual radioactive materials at processing or disposal sites. Compliance with Subpart A is being met under the UMTRA Surface Project. This subpart is not discussed further in the PEIS.

Subpart B—Background levels, maximum concentration limits, alternate concentration limits, monitoring, natural flushing

Subpart B, "Standards for Cleanup of Land and Buildings Contaminated With Residual Radioactive Materials From Inactive Uranium Processing Sites," requires conducting remedial action at processing sites to ensure that the amounts of residual radioactive materials and associated hazardous constituents in ground water do not exceed any one of the following three standards in 60 FR 2854:

- Background levels for these constituents
- Maximum concentration limits—EPA's maximum concentration of certain hazardous constituents for ground water protection. Hazardous constituents with maximum concentration limits that may be present in contaminated ground water at UMTRA Project sites include arsenic, barium, cadmium, chromium, lead, mercury, molybdenum, nitrate, radium, selenium, silver, and uranium.
- Alternate concentration limits—concentrations of contaminants that may exceed the maximum concentration limits; or, limits for those constituents without maximum concentration limits. If DOE determines, and NRC concurs, that human health and the environment would not be adversely affected, DOE may meet an alternate concentration limit.

Subpart B also defines limited use ground water. Ground water may be classified as limited use if the total dissolved solids exceed 10,000 milligrams per liter (mg/L); there is widespread surrounding contamination that cannot be cleaned up using treatment methods reasonably employed in public water supply systems; or the quantity of ground water available is less than 150 gallons (gal) (570 liters [L]) per day.

Subpart B also has provisions that allow natural flushing as a way to meet the EPA ground water standards. Natural flushing means letting natural ground water processes reduce the contamination in ground water to background levels, below the maximum concentration limits, or to alternate concentration limits. The following conditions must be met before natural flushing can be implemented:

- Natural flushing must allow standards (background levels, maximum concentration limits, or alternate concentration limits) to be met within 100 years.
- Institutional controls with a high degree of permanence that will effectively protect public health and the environment, and satisfy beneficial uses of ground water must be viable and enforceable (a description of institutional controls is provided below).
- Ground water must not be a current or projected source for a public water system during the period of natural flushing. A public water system is defined in 40 CFR §125.58 as a "system for the provision to the public of piped water for human consumption, if such system has at least fifteen (15) service connections or regularly serves at least twenty-five (25) individuals. This term (public water system) includes 1) any collection, treatment, storage, and distribution facilities under the control of the operator of the system and used primarily in connection with the system; and 2) any collection of pretreatment storage facilities not under the control of the operator of the system which are used primarily in connection with the system."

Subpart B also requires that DOE monitor the ground water contamination for compliance with Subpart B standards and define the extent of ground water contamination so that measures can be taken, if necessary, to protect human health and the environment.

The EPA standards specify a point of compliance for disposal of the surface contamination but indicate that this does not suffice for the cleanup of contaminated ground water. For the Ground Water Project, "compliance must be achieved anywhere contamination above the levels established by these standards is found or projected to be found in ground water outside the disposal area and its cover" (60 FR 2854).

Subpart C—Implementation

Subpart C, Implementation, provides guidance for implementing methods and procedures that will reasonably assure the public that the provisions of Subparts A and B are satisfied. The conditions of Subpart B should be met on a site- specific basis, using information gathered from site characterization and monitoring. The plan to meet the conditions of Subpart B should be stated in the compliance strategy document or remedial action plan. This plan should also consider future ground water plume movement. If natural flushing is the selected compliance strategy, Subpart C requires compliance monitoring to verify anticipated plume movement and the associated reduction in plume contamination. Finally, the plan should specify details of the method to be used to meet the standards and, if necessary, the remedial action.

Supplemental standards

Subpart C specifies eight conditions for which DOE may apply supplemental standards to contaminated ground water. These standards are supplemental to background levels, maximum concentration limits, or alternate concentration limits. Supplemental standards as cited below in 40 CFR §192.21 may be applied if any one of the following conditions is met:

a. Remedial actions required to satisfy Subpart A or B of the standards would pose a clear and present risk of injury to workers or to members of the public, notwithstanding reasonable measures to avoid or reduce risk.
b. Remedial actions to satisfy the cleanup standards for land and ground water, notwithstanding reasonable measures to limit damage, would directly produce health and environmental harm that is clearly excessive compared to the health and environmental benefits, now or in the future. A clear excess of health and environmental harm is harm that is long-term, manifest, and grossly disproportionate to health and environmental benefits that may reasonably be anticipated.
c. The estimated cost of remedial action to meet the standards at a "vicinity" site is unreasonably high relative to the long-term benefits, and the residual radioactive materials do not pose a clear present or future hazard. The likelihood that buildings will be erected or that people will spend long periods of time at such a vicinity site should be considered in evaluating this hazard. Remedial action will generally not be necessary where residual radioactive materials have been placed semi-permanently in a location where minor quantities of residual radioactive materials are involved. Examples are residual radioactive materials under hard surface public roads and sidewalks, around public sewer lines, or in fence post foundations. Supplemental standards should not be applied at such sites, however, unless individuals are likely to be exposed for long periods of time to radiation from such materials at levels above those that would prevail under the standards.
d. The cost of a remedial action for cleanup of a building under the standards is clearly unreasonably high relative to the benefits. Factors that should be included in this judgment are the anticipated period of occupancy, the incremental radiation level that would be affected by the remedial action, the residual

useful lifetime of the building, the potential for future construction at the site, and the applicability of less costly remedial methods than removal of residual radioactive materials.

e. There is no known remedial action.
f. The restoration of ground water quality at any designated processing site is technically impracticable from an engineering perspective.
g. The ground water is not a current or potential source of drinking water, in the absence of contamination from residual radioactive materials, due to the following:
    - the concentration of total dissolved solids is in excess of 10,000 mg/L or,
    - widespread, ambient contamination not due to activities involving residual radioactive materials from a designated processing site exists that cannot be cleaned up using treatment methods reasonably employed in public water systems. Ambient conditions caused by natural or human-induced conditions exclude contributions from residual radioactive materials or,
    - the quantity of water reasonably available for sustained continuous use is less than 150 gal (570 L) per day. The parameters for determining the quantity of water reasonably available shall be determined by the DOE with the concurrence of the NRC.
h. Radionuclides other than radium-226 and its decay products are present in sufficient quantity and concentration to constitute a significant radiation hazard from residual radioactive materials.

The standards that most likely would apply to the Ground Water Project are b, e, f, and g above.

The EPA final rule states that if supplemental standards are applied, DOE must select and perform remedial action that comes as close to meeting the otherwise applicable standard as reasonably achievable. Supplemental standards must also ensure that current and projected uses of the affected ground water are preserved.

Institutional controls

Institutional controls are controls that effectively protect public health and the environment. They typically depend on some social order to ensure that protection is effective. On the UMTRA Ground Water Project, institutional controls would reduce exposure to or mitigate health risks by 1) preventing intrusion into contaminated ground water, or 2) restricting access to or use of contaminated ground water for unacceptable purposes. As a last resort, institutional controls could limit human access to the land above the contaminated ground water. The EPA standards allow the use of institutional controls in place of remediation only if their effectiveness can be verified and maintained. The EPA standards permit the use of institutional controls at sites where remediation can occur through natural flushing of the aquifer within 100 years. However, the standards do not limit the use of institutional controls to the sites that can meet the standards through natural flushing. Institutional controls may also be used to protect public health or the environment when DOE finds them necessary and appropriate prior to commencing active remedial action, during active remedial action, or during implementation of other compliance strategies.

The EPA standards require that institutional controls

- have a high degree of permanence.
- protect public health and the environment.
- satisfy beneficial uses of ground water.
- are enforceable by administrative or judicial branches of government entities.
- can be effectively maintained and verified.

An example of acceptable institutional controls cited in the EPA standards is deed restriction that can be enforced by a unit of government (either administratively or through judicial processes). Another example is federal or state ownership of land containing contaminated ground water. EPA recognizes that a combination of controls may be needed to adequately protect public health and safety. Measures such as signs, health advisories, or other measures that require voluntary cooperation of private parties can be used to complement other enforceable institutional controls but cannot be considered as primary protective measures. In addition, the use of an alternate water supply in conjunction with institutional controls that would prevent human contact with contaminated ground water would be a viable institutional control.

Key to identifying, implementing, and enforcing institutional controls is participation by tribal, state, and local governments. While DOE is responsible for compliance with the EPA standards at UMTRA sites, its authority to implement and enforce institutional controls may be limited, particularly where tailings are disposed of off the processing site and land is privately owned or is owned or controlled by tribal, state, or other public agencies. Similarly, ground water contamination from uranium processing may have moved beyond the processing site to areas that are not within the DOE jurisdiction.

The need for and duration of institutional controls depends on the compliance strategy selected for a site, the type and level of risk, and existing site conditions. As risks decrease over time, so should the restrictiveness of institutional controls. Contaminated plume movement might require applying the restrictions to an extended area over time. Therefore, to ensure extended protection of public health, the environment, and beneficial uses the water could have satisfied, it is important that the effectiveness of institutional controls can be verified and modified as necessary.

Institutional controls, if any, will be selected in cooperation with the Indian tribes, states, and local governments. DOE will verify that the institutional controls are effective. Site-specific institutional controls will not be selected and implemented without DOE and NRC concurrence.

1.4.2 NRC Licensing Regulations and Program

The UMTRCA authorized DOE to care for the uranium mill tailings disposal sites under a license issued by NRC. The UMTRCA stipulates the NRC will promulgate regulations to ensure the permanent disposal sites are monitored and maintained in accordance with the general license. Regulations in 10 CFR §40.27, General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites, describe the licensing mechanism for the long-term care of each UMTRA Project disposal site, when NRC accepts the site-specific long-term surveillance plan. Long-term care includes surveillance and maintenance needed to protect public health and safety.

On-site stabilization

At former processing sites where tailings are stabilized in on-site disposal cells, contaminated ground water may require remediation. This could occur if ground water moves from below the disposal cell. The NRC may license these disposal sites in two steps. The first step is NRC's acceptance of the long-term care program for all surface remedial action that includes compliance with the EPA standards that protect the ground water from further contamination from the tailings. In the second step, the DOE must verify, and NRC must concur, that ground water compliance has been met in accordance with 40 CFR Part 192, Subpart B. The long-term surveillance plan will be appropriately amended, signifying that the second step of the licensing process is complete.

Off-site stabilization

For the disposal cells where the residual radioactive materials were relocated off the processing site, NRC will license the disposal site in one step. The processing sites themselves will not be licensed by NRC. Compliance with EPA ground water standards will require NRC concurrence.

1.4.3 DOE Requirements

DOE Order 5400.1, General Environmental Protection Program, established environmental protection program requirements for DOE operations, including the UMTRA Project, for ensuring compliance with executive orders and applicable federal, tribal, state, and local environmental protection laws and regulations. DOE also established requirements for the protection of the public and workers from radiological hazards in DOE Order 5400.5, Radiation Protection of the Public and the Environment; DOE Order 5480.11, Radiation Protection for Occupational Workers; and 10 CFR Part 835, Occupational Radiation Protection. These and all other applicable requirements are routinely incorporated into UMTRA Project activities.

1.4.4 DOE Office of Environmental Justice Requirements

Executive Order 12898, Federal Action to Address Environmental Justice in Minority Populations and Low Income Populations, 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 and low-income populations. Executive Order 12898 also directs the EPA administrator to convene an interagency Federal Working Group on Environmental Justice. The Working Group is directed to provide guidance to federal agencies on criteria for identifying disproportionately high and adverse human health or environmental effects on minority and low-income populations. The Working Group has not yet issued the guidance directed by Executive Order 12898. In coordination with the Working Group, the DOE is in the process of developing internal guidance on implementing the Executive Order. Because both the Working Group and the DOE are still in the process of developing guidance, the approach taken in this analysis may depart somewhat from the guidance that is eventually issued, but will comply with the intent of the Executive Order.

1.4.5 Other Presidential Executive Order Requirements

Executive Order 11990, Protection of Wetlands, requires all federal agencies to issue or amend existing procedures to ensure wetlands protection is considered in decision-making. This requirement is routinely incorporated into UMTRA Project activities.

Executive Order 11988, Floodplain Management, requires each federal agency to issue or amend existing regulations and procedures to ensure that the potential effects of any action it may take in a floodplain are evaluated and that its planning programs and budget requirements reflect consideration of flood hazards and floodplain management. The UMTRA Project activity planning routinely identifies and considers the impacts of Project actions on floodplains.

1.4.6 Tribal law Requirements

The DOE shall follow all applicable tribal laws and regulations in performing ground water compliance activities on Indian lands. In the event of conflicting applications of federal, state, and tribal law, the subject activity will be carried out pursuant to the following order of priority in application:

1. federal,
2. tribal, and
3. state.

1.5 PROPOSED ACTION SUMMARY

This PEIS considers four approaches (also called "alternatives") for implementing the UMTRA Ground Water Project. These alternatives are described in Section 2.0. The proposed action (preferred alternative) is summarized below.

The proposed action provides a consistent approach, based on a health- and environmental risk-based framework, for implementing the UMTRA Ground Water Project and determining appropriate ground water compliance strategies at the UMTRA Project processing sites. The success of the proposed action in determining these strategies would depend on the analysis of site-specific data to characterize the hydrogeological conditions and determine the potential human health and environmental risks.

The following site-specific ground water compliance strategies could be used under the proposed action:

- No remediation
- Natural flushing
- Active ground water remediation.

These strategies could be used individually or in combination to meet the standards. For example, active ground water remediation methods could be used in conjunction with natural flushing.

The proposed action is flexible because it provides a framework for the Ground Water Project decision-making process if new ground water cleanup methods become available. The proposed action considers ground water compliance in a step-by-step approach, beginning with the no remediation strategy and ending with more complex, active ground water cleanup strategies. When a site baseline risk assessment for ground water contamination and a site observational work plan indicate the no remediation strategy would be protective of human health and the environment, a more complex and potentially disruptive strategy involving active cleanup methods would not be necessary. The proposed action would tailor ground water compliance strategies for each site, based on the likelihood that they would result in conditions that are protective of human health and the environment. A more detailed description of the proposed action appears in Section 2.1.

1.6 PUBLIC PARTICIPATION

An important component of the PEIS is the participation by government agencies, organizations, the public, and other interested parties in determining the scope and content of this PEIS and reviewing and commenting on the draft and final PEIS. Throughout the UMTRA Ground Water Project, the DOE will provide opportunities for productive, ongoing discussions with the public and local, state, tribal, and federal officials as part of DOE's daily activities.

Regulations that implement NEPA (in 40 CFR §1501.7) stipulate there must be an early, open, and continuing public participation process for determining the scope of the issues that will be addressed and for identifying significant issues related to the proposed action. This process is called scoping. The UMTRA Ground Water Project PEIS scoping process began with the preparation of a Notice of Intent, published in the Federal Register on November 18, 1992 (57 FR 54374). This notice provided dates, locations, and times of the first scoping meetings. Dates, locations, and times of the remaining public scoping meetings were published in the Federal Register on February 8, 1993 (58 FR 7551). Nineteen public scoping meetings in 16 communities were held between November 18, 1992 and April 15, 1993 to solicit public input regarding the scope and content of the PEIS (Figure 1.3).

The UMTRA Ground Water Project PEIS implementation plan summarizes the comments received during scoping and provides DOE's response to how the comments were addressed in the PEIS (DOE, 1994a). A complete list of all comments received is archived in the UMTRA Project Document Control Center.

The NEPA and DOE implementing regulations also require that at least one public hearing be held for the public to comment on the draft PEIS (10 CFR §1021.313). A notice of availability (NOA) of the draft PEIS was published in the Federal Register on May 17, 1995 (60 FR 26417). The NOA summarized the proposed action, provided background information on the UMTRA Ground Water Project, described the public comment process, and announced the dates, times, and locations of the public hearings. Nine public hearings were conducted in nearby site communities between June 7 and 28, 1995, to solicit public input on the draft PEIS (Figure 1.3).

The PEIS public affairs program provides continued opportunities for public involvement throughout the UMTRA Ground Water Project. This section provides an overview of the participation process for the PEIS and the planned course of action for future public participation in the Ground Water Project.

1.6.1 Scoping Process and Results

DOE encouraged members of the public, tribal and state representatives, and other agencies to participate in scoping. Notices announcing the start of scoping were placed in the Federal Register and advertisements were placed in local newspapers and on local radio stations. Orientation meetings were held at some sites to explain the scoping process to the public. Congressional representatives and state and local agencies were contacted during prescoping community assessments to determine the scoping activities that would work best in individual communities. Media briefings were held and media briefing kits were available prior to scoping meetings to announce the opportunities for public participation. UMTRA Project spokespersons were available before and after scoping meetings for interviews.

Several communication methods facilitated scoping: fact sheets were prepared and distributed that described the PEIS process, the proposed action and alternatives, ground water contamination, ground water remediation technologies, and site-specific conditions. In recognition of non-English speaking community members, DOE offered translation services upon request. At meetings held for the Navajo Nation, a Navajo language interpreter was used during the presentation and group discussions. A Navajo language audio tape of the scoping materials was produced and distributed to Navajo Nation radio stations, chapter houses, and libraries. The scoping meetings included viewgraph presentations and small group discussions with technical staff.

More than 500 scoping comments were received. Comments were accepted at the scoping meetings, through the mail, and by telephone via a toll-free number.

DOE reviewed all scoping comments. The comments generally indicated four categories of concern: human health and the environment, programmatic issues, ground water monitoring and site characterization, and site-specific Surface Project comments. The PEIS Implementation Plan (DOE, 1994a) summarizes these comments and describes how they were to be addressed in the draft PEIS.

1.6.2 Public Hearings and Comment Period

A 120-day public comment period and nine public hearings were held after the draft PEIS was published. Information on the availability of the draft PEIS, methods for submitting comments, and the date, time, and place of the public hearings were announced in the Federal Register, in local newspapers, and on radio stations.

Many of the same communication methods that were used in the scoping meetings were used to encourage participation at the public hearings. Both before and after media briefings, UMTRA Project spokespersons were available for interviews and further discussion. Fact sheets were prepared that described the PEIS and the Ground Water Project, and translation services were provided at hearings held at Navajo Nation and Hopi Tribe sites. The public hearings followed an interactive format to facilitate communications between DOE representatives and people who attended the hearings. An independent facilitator conducted the meetings following overview presentations by DOE UMTRA Project site managers and Ground Water Project managers. Oral comments were recorded on flip charts and clarified as necessary to ensure accuracy in recording. Project personnel also responded to comments and discussed issues raised during the meetings.

A total of 576 comments were received at the public hearings, through the mail, and by telephone via a toll-free number. Comment topics included, but were not limited to, the alternatives, ground water compliance strategies, EPA ground water standards, institutional controls, costs, human health and environmental risks, prioritization, ground water characterization, and future public participation. Comments were evaluated and incorporated as applicable into this final PEIS. The comments and response document (Volume II) that accompanies the PEIS provides all written and oral comments received, DOE's responses, and changes made to the document, as appropriate.

1.6.3 Future public participation activities

The final PEIS will be distributed to the public for at least 30 days before the Record of Decision is issued. The Record of Decision will announce the DOE decision regarding how to conduct the Ground Water Project. It also will summarize the mitigation measures that will be taken to avoid or minimize potential human health and environmental impacts (40 CFR §1505.2).

DOE's commitment to encouraging public participation would continue during site-specific ground water compliance activities at many UMTRA Project processing sites. This would include providing information on ground water characterization activities and risk assessments, and seeking input regarding site-specific ground water compliance decisions. DOE will use various methods of communication including announcements through local media to notify the public of opportunities to meet with DOE representatives.

Site-specific NEPA documentation (for example, categorical exclusions and environmental assessments) would be prepared. They would assess preremediation activities, the proposed ground water compliance strategy and alternatives, analyze impacts of implementing compliance actions, and specify any mitigation measures that might be necessary to reduce adverse impacts. DOE expects that environmental assessments will be appropriate in most cases for final compliance action.

If DOE determined that an environmental assessment is appropriate, DOE would notify the host state and host tribe of the determination to prepare an environmental assessment and would involve the public to the extent practical during its preparation; early public notice of the intent to prepare this document would be provided concurrent with tribal and state notification (10 CFR §1021.301(c); 40 CFR §1501.4(b)).

Before approving any site-specific plans, DOE would make the plans available to the host state and tribe for review and comment, in compliance with NEPA and DOE. Under the Secretary of Energy's NEPA policy statement, DOE ordinarily provides enhanced opportunities for interested persons to review and comment on environmental assessments concurrently with tribal and state review.

In accordance with DOE policy, the UMTRA Project intends to conduct public meetings on the site-specific plans in the affected site communities. The DOE would solicit input from the public, local organizations, and educational institutions on site-specific issues that should be identified, considered, and analyzed in the effort to meet ground water compliance.

2.0 ALTERNATIVES

This section describes the options (alternatives) for conducting the UMTRA Ground Water Project at the inactive UMTRA Project processing sites and summarizes the comparison of the potential impacts of the alternatives. These impacts are considered in detail in Section 4.0. This section also describes alternatives considered but eliminated from further analysis, site-prioritization methodology, risk assessment methodology, ground water characterization and remediation methods, waste management methods, and costs.

CEQ requires that an environmental impact statement "rigorously explore and objectively evaluate all reasonable alternatives" (40 CFR §1502.14(a)). Reasonable alternatives include those that are practical or feasible from a technical and economic standpoint using common sense, and are not simply desirable from the standpoint of the applicant (51 FR 15618). Reasonable alternatives can be outside the jurisdiction of the lead agency and potentially in conflict with existing federal law. When there are many potential alternatives, a reasonable number of examples covering the full spectrum of alternatives must be analyzed and compared (51 FR 15618).

Numerous alternatives were evaluated during the planning stages of the PEIS. Five alternatives, including the proposed action, were included in the published Notice of Intent to prepare the PEIS (57 FR 54374). These alternatives represented a preliminary list; public comment on these and other alternatives was part of prescoping and scoping meetings (DOE, 1994a). As a result of the scoping process and other planning activities, four alternatives, including the proposed action, were selected for analysis in this PEIS.

All these alternatives, except no action, would rely on at least one of three ground water compliance strategies to meet the EPA ground water compliance standards (Table 2.1). The simplest strategy is one in which no remediation is required, and there are two conditions where this strategy can be used. The first condition where no remediation would work is if the tailings have not contaminated the ground water or if the contamination is limited and does not meet the numerical EPA standards referred to as maximum concentration limits; i.e., the contamination is so low that it is below the level allowed by EPA. Second, if the concentrations of certain constituents exceed the maximum concentration limits or background concentrations, there are two situations in which the EPA has determined that cleanup is not required. One is the use of supplemental standards. One example of Supplemental Standards is where the ground water was of such poor quality prior to the milling operation that removing the tailings-related contamination from the groundwater would not raise the quality of the water such that it would or could be used (referred to as limited-use ground water). The second is the use of alternate concentration limits. An alternate concentration limit is a numerical concentration for a contaminant that is higher than the maximum concentration limit in the EPA standards or background, but for which it can be shown that human health and the environment would not be adversely affected. If alternate concentration limits are used, the DOE must demonstrate that the higher levels of contamination do not pose excessive health and environmental risks.

A potentially more complicated ground water compliance strategy is natural flushing. Once the surface tailings and other contaminated materials are contained in disposal cells, contamination of the groundwater should greatly diminish. At some of the sites, the natural processes of nature will attenuate the contamination over time. If these natural processes can reduce the contamination to acceptable numerical levels such as maximum concentration limits, background levels, or alternate concentration limits within 100 years, and meet the other criteria for the use of natural flushing as discussed in Section 1.4.1, its use is permitted by the EPA standards. Under this strategy the DOE must demonstrate through analysis that the constituents will be reduced by natural flushing within 100 years or less. One element of implementing natural flushing that is permitted by the EPA standards is the use of institutional controls. Institutional controls, if any, will be selected in cooperation with the Indian tribes, states, and local governments. If natural flushing is implemented, a monitoring program will be established. If it is determined that natural flushing does not work as predicted, DOE would then consider implementing the active ground water compliance strategy.

Finally, the most complex strategy is active remediation. If there is excessive contamination and if natural processes will not attenuate it as required by the EPA standards, active control or removal of the contamination is necessary. The classic approach is to pump the contaminated water and treat it to remove the contamination, but other, newer, more effective technologies may also be possible.

The process of selecting a site-specific ground water compliance strategy includes several levels of analysis that are not explicitly required by the current regulations, but will help in selecting the best strategy. One of these is to prepare a baseline risk assessment. The baseline risk assessments were prepared using existing ground water quality data collected during the Surface Project and limited additional data. They provide detailed analysis of human and environmental exposures to all of the known contaminants of concern, as well as data gaps, if any. Risks can then be evaluated to determine the appropriate strategy (risk assessments are described in more detail in Section 2.7 and Appendix B). Another key document is the site observational work plan. The site observational work plan addresses the ground water conditions at a site and documents how DOE will demonstrate compliance with the standards. It includes the various techniques that will be used to further characterize a site and is the basis for making the final recommendation to the NRC.

The four alternatives analyzed in this PEIS are as follows:

- Proposed action—DOE would use a consistent, risk-based decision process to comply with the EPA standards at the processing sites. The DOE would use active, passive, and/or no remediation ground water compliance strategies to meet the EPA ground water standards at the UMTRA Project sites. The site-specific ground water compliance strategies would be based on site conditions, potential risks, and input from the affected tribes, states, and public.
- No action—DOE would not conduct the UMTRA Ground Water Project. Contaminated ground water would remain as is, and no further action would be made to protect human health and the environment.
- Active remediation to background levels—DOE would use a combination of active remediation strategies at most sites to clean up ground water quality to as close to background levels as possible and meet the EPA ground water standards.
- Passive remediation—DOE would use natural flushing or no remediation strategies, including application of alternate concentration limits and supplemental standards, to meet the EPA ground water standards.

These four alternatives are discussed in detail in Sections 2.1 through 2.4. The EPA ground water standards are described in Section 1.4.1. The potential programmatic impacts of implementing the proposed action and alternatives are provided in Section 4.0.

This PEIS differs substantially from a site-specific environmental impact statement because multiple ground water compliance strategies, each with its own set of potential impacts, could be used to implement all the alternatives except the no action alternative. In a traditional environmental impact statement, the identification of alternatives leads directly to an impacts analysis. On the other hand, an impacts analysis for implementing alternatives in this

PEIS involves an intermediate step of evaluating a ground water compliance strategy or strategies, the use of which would result in site-specific impacts. This PEIS impacts analysis assesses the potential impacts of the various ground water compliance strategies, then relates them to the alternatives to compare impacts.

Table 2.1 Ground water compliance strategies that apply under each alternative

Strategy	Alternative			
	Proposed action	No action[a]	Active remediation to background levels	Passive remediation
Active ground water remediation methods	X		X[b]	
Natural flushing [c]	X			X
No ground water remediation - Sites that qualify for supplemental standards [d] or alternate concentration limits[e].	X			X
- Sites that meet maximum concentration limits or background levels (no impacts).[f]	X			X

[a]The analysis of the no action alternative is required by the CEQ and DOE.

[b]Active remediation methods would not be used at sites where contamination does not exceedbackground and likely would not be used at sites that qualify for supplemental standards based on existence of limited use ground water.

[c]Natural flushing means allowing the natural ground water movement and geochemical processes to decrease contaminant concentrations.

[d]Supplemental standards applicable for certain site conditions, as identified in the EPA standards, that are protective of human health and the environment, and may be applied in lieu of prescriptive levels.

[e]Concentrations of contaminants that may exceed the maximum concentration limits; or, limits for those constituents without maximum concentration limits. If DOE demonstrates, and NRC concurs, that human health and the environment would not be adversely affected, DOE may meet an alternate concentration limit.

[f]"No remediation" at sites that do not exceed maximum concentration limits or background levels is not the same as "no action" because these sites would require activities such as site characterization to show that no remediation is warranted.

2.1 PROPOSED ACTION (Preferred Alternative)

The proposed action, which is DOE's preferred alternative, would result in the selection of a ground water compliance strategy tailored for each site to achieve conditions that are protective of human health and the environment. The proposed action would consider the full range of ground water compliance strategies in a step-by-step approach, beginning with consideration of the "no remediation" strategy and proceeding, if necessary, to natural flushing with compliance monitoring and institutional controls, and to a more complex, active ground water cleanup methods, such as pump and treat or other engineered approaches to cleaning up contaminated ground water. For example, under the proposed action, if a site risk assessment and site observational work plan indicate that the strategy of "no remediation" would be in compliance with the EPA standards and be protective of human health and the environment, a more complex strategy involving active cleanup methods would not be necessary.

The proposed action is intended to establish a consistent risk-based framework for implementing the UMTRA Ground Water Project and determining appropriate ground water compliance strategies at the UMTRA Project former processing sites. The determination of site-specific ground water compliance strategies would take into account site-specific ground water conditions; human and environmental risks; participation of the tribes, states, and local communities; and cost. This approach is sufficiently flexible to allow for interim actions, such as an alternate water supply system, should these activities be necessary in order to reduce risk and/or support institutional controls. The proposed action would also allow the consideration of new ground water cleanup methods that become available.

The proposed action uses a logic framework to identify the appropriate ground water compliance strategy or strategies for a site (Figure 2.1). Each step in the decision process considers meeting the EPA standards and the protection of public health and the environment in determining the appropriate ground water compliance strategy.

The first step in the decision process would be to determine if the uranium processing activities at a specific site have resulted in ground water contamination exceeding background levels or maximum concentration limits (Figure 2.1). If ground water contamination has not exceeded these standards and is not expected to, remediation would not be required.

If ground water has been contaminated by uranium processing activities and the contamination exceeds background levels or maximum concentration limits, the next step would be to determine if compliance with the EPA ground water standards could be achieved by applying supplemental standards based on the existence of limited use ground water. (Refer to Section 1.4.1 for a discussion of supplemental standards.) If limited use ground water were shown to exist and if supplemental standards were protective of human health and the environment, no site-specific remediation would be required. If supplemental standards based on limited use were not protective, the next step would be to determine whether alternate concentration limits would apply. (Refer to Section 1.4.1 for a discussion of alternate concentration limits.) If alternate concentration limits were protective of human health and the environment, alternate concentration limits would be applied. If not, it would be necessary to determine whether the contaminated ground water plume would qualify for supplemental standards based on the criterion that remediation would cause more environmental harm than benefit. At some sites where supplemental standards or alternate concentration limits may be applied, ground water monitoring and institutional controls may be required to ensure that the application of alternate concentration limits or supplemental standards would continue to be protective of human health and the environment. In addition, when limited use ground water applies, supplemental standards "shall ensure that current and reasonably projected uses of the affected ground water are preserved" (60 FR 2854). The use of supplemental standards would be determined on a site-by-site basis and the DOE would abide by the EPA ground water standards when proposing the use of supplemental standards. All proposed supplemental standards would require NRC concurrence.

If supplemental standards would not be protective, the next step would be to determine whether natural flushing would bring the contaminated ground water into compliance (i.e., within maximum concentration limits, background levels, or alternate concentration limits) within 100 years. Natural flushing is a ground water remediation strategy by which natural ground water processes result in compliance with the EPA ground water standards. (Refer to Section 1.4.1 for a discussion of EPA standards related to natural flushing.) Natural flushing could be used if it were determined that institutional controls could be implemented, maintained, and enforced during the natural flushing period; that this strategy was protective of human health and the environment; and that all other conditions, as described in Section 1.4.1, are met.

If natural flushing would not be protective, it would be necessary to determine whether natural flushing combined with active remediation methods would meet the EPA ground water standards and would be protective of human health and the environment. If so, this two-part strategy would be implemented. When combined with natural flushing, active remediation methods could be used for a short time to remove the most contaminated ground water that may occur in a restricted area; then natural flushing would be applied. Another option would be to use low-operation and low-maintenance active methods, such as gradient manipulation or geochemical barriers, in conjunction with natural flushing.

Site characterization data may show that natural flushing combined with active remediation would not result in ground water quality that is protective of human health and the environment. That being the case, the next step in the framework would be to determine if active ground water remediation techniques would meet the EPA ground water standards and if so, to implement these techniques. Several methods of active ground water remediation could be used, including gradient manipulation, ground water extraction, and in situ ground water treatment. The active remediation methods could be used individually or in combination with other cleanup methods. Section 2.8 and Appendix C provide details on active ground water remediation methods. If active remediation resulted in compliance with the EPA standards, remedial action would be complete. If these methods did not result in compliance, supplemental standards based on technical impracticability of remediation would be applied, along with institutional controls where necessary.

2.2 NO ACTION

The regulations for preparing an environmental impact statement require that the no action alternative be assessed (40 CFR §1502.14(d)), even if the agency is under a legislative mandate to act (51 FR 15618). The analysis of the no action alternative "provides a benchmark, enabling decision makers to compare the magnitude of environmental effects of the action alternatives" (51 FR 15618).

Under the no action alternative, no further activities would be conducted to comply with the EPA ground water standards (40 CFR §192) at the inactive UMTRA Project processing sites. The UMTRA Surface Project would be completed but the Ground Water Project would be terminated and the contaminated ground water would be left as it is. DOE would not collect ground water data to continue characterization of ground water, no monitoring of contaminated ground water would take place, and no institutional controls would be used.

The no action alternative would comply with the EPA ground water standards only at the site where there is no ground water contamination (the Lowman, Idaho, site).

2.3 ACTIVE REMEDIATION TO BACKGROUND LEVELS

Under this alternative, the DOE would attempt to clean up ground water to background levels at the UMTRA Project processing sites, using active ground water remediation methods. This attempt would be limited by the technology available. Therefore, it may not be possible to restore some contaminated ground water to background levels. In these cases, the DOE would attempt to reduce contamination to levels as closely as possible to background levels. The rationale behind this alternative is that ground water at most of the uranium processing sites was of better quality before the processing activities occurred and that the ground water should be restored to its preprocessing quality. At most UMTRA Project processing sites, implementation of this alternative would require the use of active ground water remediation methods such as gradient manipulation, ground water extraction and treatment, or in situ ground water treatment (active ground water remediation methods are summarized in Section 2.8). Active remediation methods would be used at the UMTRA Project processing sites regardless of the health and environmental effects and regardless of cost and time. Because active remediation methods would be required at most UMTRA Project processing sites, this alternative would likely reduce the potential risks associated with the ground water contamination and would be protective of human health and the environment.

If this alternative were implemented, DOE would meet the EPA ground water standards at the UMTRA Project sites. Active ground water remediation methods would not be used at sites where the ground water quality beneath the site is currently at background levels and likely would not be used at sites that qualify for supplemental standards based on the existence of limited use ground water.

Under the active remediation to background levels alternative, alternate water systems or interim actions could be used should they be necessary to reduce risk and/or to support an institutional control.

2.4 PASSIVE REMEDIATION

The implementation of this alternative would result in the use of only passive remediation strategies to meet the EPA ground water standards. The passive remediation strategies are 1) performing no remediation at sites that meet supplemental standards or alternate concentration limits, or are at background levels or below maximum concentration limits; and 2) relying on natural flushing. This alternative uses site characterization and risk assessments to determine the most appropriate passive remediation strategy for each site. However, risk assessment and other data may indicate that passive remediation strategies alone would not be protective of human health and the environment at all processing sites.

This alternative is distinct from the no action alternative because, as indicated in Section 2.2, under the no action alternative, activities would not be conducted to restore contaminated ground water at the UMTRA Project sites. In addition, the Ground Water Project would be terminated and the contaminated ground water would be left as is. Under the passive remediation alternative, site characterization would take place before the determination of the appropriate ground water compliance strategy. Ground water monitoring would take place where needed. In addition, institutional controls would be used, if necessary, to protect human health and the environment.

In general, if this alternative were implemented, DOE would follow the same initial steps as for the proposed action (Figure 2.1). However, the final step for this alternative would be to determine whether natural flushing would result in meeting background levels, maximum concentration limits, or alternate concentration limits. Institutional controls and monitoring generally would be required to restrict access to contaminated ground water (refer to Section 1.4.1 for a discussion of natural flushing and institutional controls). For sites where natural flushing would reduce the concentrations of contaminants to below the standards in less than 100 years and be protective of human health and the environment, the EPA ground water standards would be met.

Under the passive remediation alternative, active remediation would not be conducted at a site, even if compliance with the EPA ground water standards would not be met. At sites that would not meet standards within 100 years, institutional controls and monitoring would be required for more than 100 years. This would result in noncompliance with the EPA ground water standards and may not protect human health and the environment. The passive remediation alternative may not be protective of beneficial uses of the ground water, such as irrigation or livestock watering.

Under the passive remediation alternative, alternate water systems or interim actions could be used should they be necessary to reduce risk and/or to support an institutional control.

2.5 COMPARISON OF ALTERNATIVES

In accordance with CEQ regulations (40 CFR §1502.14), this document compares the four alternatives and summarizes their potential impacts. The comparison of alternatives below summarizes the detailed comparison found in Section 4.4.

The qualitative analysis of potential impacts of the ground water compliance strategies (Section 4.2) and of the no action alternative (Section 4.3) were used to compare the potential impacts of the alternatives (Section 4.4). The assumptions used to compare the alternatives also appear in Section 4.4.

The potential impacts of the alternatives can be divided into short-term and long-term impacts. Short-term impacts are associated with site characterization and the construction of ground water facilities. Long-term impacts are those that could occur if the ground water was not remediated or if ground water remediation took many years.

Short-term potential impacts

The proposed action and the active remediation to background alternative would require site characterization, monitoring, and construction of remediation facilities. The passive remediation alternative would require site characterization and monitoring.

Potential impacts to air quality, noise levels, visual resources, transportation systems, utilities, and energy supplies would occur principally during site characterization and during the construction of ground water remediation facilities for the proposed and the active remediation to background levels alternatives. As indicated in Section 4.4, the alternatives would have little or no impact on these resources due to the short duration and small scale of the ground disturbance activities. Site characterization, construction, and monitoring activities have the potential to disturb sensitive habitats, species, and cultural resources. However, these impacts potentially can be avoided by conducting site characterization and remediation activities in areas away from these resources. In addition, if impacts to these resources occurred, their effects could be mitigated. Therefore, the potential for site characterization and construction activities to adversely affect these resources would be considered relatively minor. Potential short-term impacts to land use could also occur, but would also likely be minor.

Long-term potential impacts

Based on the analysis in Section 4.0, long-term adverse impacts could arise under the following circumstances:

- If the contaminated ground water did not meet EPA standards and was not controlled. This would occur under the no action alternative.

- If the ground water compliance strategy were not protective of human health and the environment. This could occur under the passive remediation alternative.
- If institutional controls were in place for many years. This could occur under all the alternatives except the no action alternative.

Implementing the no action alternative would not comply with the EPA standards at all UMTRA Project processing sites. As a result, significant long- term adverse impacts to human health and the environment could occur under the no action alternative. For example, the public could be exposed to site- related hazardous contaminants by drinking contaminated ground water or surface expression of ground water, ingesting contaminated livestock and/or plants, or ingesting contaminated fish and/or wildlife. Adverse impacts to wildlife could occur if the contaminants entered the food chain and/or affected sensitive resources such as wetlands or threatened and endangered species.

Potentially adverse impacts would be less likely under the proposed action or the active remediation to background alternative because all UMTRA Project sites would comply with the EPA standards. In addition, surface and ground water monitoring would take place before and during implementation of the proposed action and the active remediation to background alternative to ensure that protective measures could be maintained or implemented, if necessary.

Implementation of the passive remediation alternative also could result in the exposure of humans and the environment to site-related hazardous contaminants. The potential occurrence of such impacts is less than from the no action alternative, but such impacts could occur at sites where hydrogeological data and risk assessments have demonstrated that the use of passive ground water remediation strategies would not be protective of human health and the environment. For example, this could occur at sites where institutional controls are not viable or would not effectively restrict access to contaminated ground water or at sites where the potential ecological risk from contaminated surface expression of ground water (now or in the future) cannot be avoided or prevented with passive remediation strategies. These potential long-term impacts would have a low probability of occurring under the proposed action or the active remediation to background levels alternatives.

Institutional controls can be used in conjunction with natural flushing for up to 100 years. These controls may need to be used even longer with the passive remediation alternative because contaminant plumes may still exist after 100 years of natural flushing. The use of institutional controls could result in long- term land use and socioeconomic impacts, as discussed in Sections 4.4.6 and 4.4.11. The passive remediation alternative could have the greatest impact in this area, followed by the proposed action, then the active remediation to background alternative.

In summary, the proposed action and the active remediation to background alternatives are most effective at protecting human health and the environment because under these alternatives all of the UMTRA Project sites would comply with the EPA standards. Implementing the proposed action would potentially result in fewer short-term impacts associated with construction than implementing the active remediation alternative. The proposed action would potentially be more cost-effective because it would use passive remediation strategies such as natural flushing or no remediation at sites where these strategies are shown to be protective of human health and the environment and meet the EPA standards. The active remediation alternative would be the most costly because of its widespread use of active ground water compliance methods. Under this alternative, active methods would be used at sites where active remediation is justified under the proposed action based on site-specific risk assessments. In addition, active remediation would also be used at many sites where no additional risk reduction would occur as a result of active remediation.

2.6 ALTERNATIVES ELIMINATED FROM DETAILED ANALYSIS

The CEQ regulations require that an environmental impact statement 1) evaluate all reasonable alternatives, 2) briefly discuss those alternatives eliminated from detailed impact analysis in the environmental impact analysis, and 3) provide the reasons for their elimination (40 CFR §1502.14(a)).

Reasonableness is defined as practical or feasible from a common sense, technical, and economic standpoint (51 FR 15618). Four alternatives were considered early in the PEIS planning stages but were eliminated from further evaluation. A fifth alternative, use of tribal and state standards, was considered as a result of comments received on the draft PEIS, but was eliminated from further consideration. All these alternatives and the reasons for their elimination are provided in the following subsections.

2.6.1 Delay the UMTRA Ground Water Project

Delaying the Ground Water Project until the Surface Project is completed was not considered a viable alternative because surface remediation is complete at 18 sites and resources have become available to address ground water compliance. To further delay ground water remediation at some of the processing sites may not be protective of human health and the environment.

2.6.2 Use existing data to make Ground Water Project decisions

Under this alternative, no new site characterization or risk assessment data would have been collected at any of the sites. The UMTRA Ground Water Project would have proceeded using only existing data. Existing site characterization data include geologic, hydrogeologic, geochemical, geotechnical, and radiological conditions at the processing sites. These data were collected for the purposes of designing and implementing surface remediation. This information may not have fully characterized ground water conditions, leading to the possibility of making incorrect decisions regarding site- specific ground water compliance; therefore, this alternative was not considered further.

2.6.3 Provide clean water at the point of use

This alternative would have required the DOE to provide an alternate water source at the point of any use in situations where ground water used by humans has become or soon would become contaminated. Clean water sources could have been bottled water, connection to a municipal water supply, or new wells tapping uncontaminated ground water resources. Under this alternative, the DOE would not have complied with EPA standards.

This alternative was considered because it meets the immediate purpose and need of protecting human health and agricultural applications. It was eliminated from detailed study for the following reasons:

- A basic assumption in regard to this alternative is that the DOE would provide an alternate water source at the point of human use (e.g., domestic water sources, livestock watering, and/or crop irrigation) but would do nothing to protect the biological communities from the contaminated ground water. Therefore, use of this alternative would not be protective of the environment since contaminated ground water could discharge into rivers, streams, wetlands, and other biological systems. Furthermore, these biological systems would not be monitored so the degree of contamination, if any, would not be known. This raises the possibility of contaminants entering the biological foodchain which could include humans.

- The use of this alternative would require ground water monitoring to determine the location of the plume over time and changes in the level of contamination to determine if the plume is nearing points of use not previously protected. In some cases, this monitoring would be needed for a very long period of time because plumes at some of the UMTRA Project sites move slowly.
- This alternative would not meet the EPA standards at all sites. In one sense, this alternative would have to continue until the threat to human health no longer exists. The EPA standards stipulate that ground water contaminants must meet the standards within 100 years. Under this alternative, meeting the standards within 100 years may not occur at all sites.
- Treatment at the point of use is not excluded from the alternatives analyzed in the PEIS (except no action). If the drinking water (or other beneficial uses) is threatened at a given site during the Ground Water Project, DOE may provide an alternate source.
- Treatment at the point of use that includes institutional controls is part of the passive remediation alternative. Sites that require institutional controls for the passive remediation alternative also would require institutional controls under the treatment at the point of use alternative, so as to reduce the likelihood of using contaminated ground water.

2.6.4 Achieve ground water compliance without a programmatic approach

This alternative would have required the UMTRA Ground Water Project to proceed without a programmatic approach. This would have meant that ground water compliance would have been treated as discrete tasks for each site. Compliance with EPA's ground water standards would have been met at all processing sites. All NEPA and technical documents would have been produced independently of one another. Scheduling of site activities would have been based on preliminary risk prioritization data.

This alternative was eliminated from further analysis because it would have had many variables and the determination of potential environmental impacts would not be meaningful. In addition, it is not consistent with CEQ regulations, which consider related activities a single course of action (for example, the UMTRA Ground Water Project) that must be evaluated in a single impact statement (40 CFR §1502.4(a)).

2.6.5 Use tribal and state standards

Even though the UMTRCA requires DOE to meet the EPA standards, this alternative would require the UMTRA Project to use tribal and state standards, where they exist, rather than EPA standards. Because the UMTRA Project sites are in 10 different states and on or near lands of four different tribes, the UMTRA Project could be subject to 14 different sets of standards administered by 14 different agencies. This approach would be unacceptable because:

- The standards for specific constituents likely vary from agency to agency, which could lead to unequal treatment of the sites.
- Some agencies may have standards for specific constituents while others may not have a standard for that specific constituent. This could also lead to unequal treatment of the sites.
- Jurisdictional problems would likely arise under this alternative. For example, an UMTRA site may be on

land under the jurisdiction of one agency, but a contaminated ground water plume may cross the border into the jurisdiction of another agency.

- This alternative would likely increase remedial action costs due to the DOE's having to address so many sets of standards.
- Preparing site-specific ground water compliance documents and implementing the site-specific ground water compliance strategies would be difficult, given the large number of varying standards that would have to be addressed.

2.7 SITE PRIORITIZATION AND RISK ASSESSMENT

2.7.1 Site prioritization

Site prioritization ensures that appropriate, relevant, and objective considerations are given to each site during planning stages. The cumulative scores of each site are ranked to determine which sites have the greatest urgency for early actions.

The prioritization system developed for the UMTRA Ground Water Project is based on the modified Environmental Restoration Priority System which used multiattribute utility analysis to prioritize sites. This system is described in detail elsewhere (DOE, 1991a) and is summarized here.

This prioritization approach was shared in draft with all the affected tribes and states. Comments were rigorously encouraged. The DOE conducted meetings on the application of this prioritization methodology with three states and two tribes.

The six criteria below were used to prioritize the sites; for each UMTRA site, each criteria was scored from 1 to 7. A score of 1 indicates conditions defined by the factor are acceptable, while a score of 7 indicates highly unfavorable conditions.

Population health risk

This criterion is based on annual health risks to potentially affected populations (i.e., populations consuming ground water directly or indirectly). It can be extrapolated from individual risks calculated in ground water risk assessments, or can be determined by using EPA Hazard Ranking Scores for the ground water exposure pathway.

On the population health risk scale, a score of 7 is equivalent to the occurrence or likely occurrence of 10 adverse health effects per year. The scale decreases logarithmically to 1, which signifies an annual population risk of one in 10,000,000.

Individual health risk

This criterion is based on increased individual risks over a lifetime from direct or indirect consumption of ground water. These values are calculated from worst- case, point-of-exposure wells. If the water quality in the area is unsuitable for drinking, another pathway (such as crop irrigation or livestock watering) may be calculated.

These risks are based on the EPA's Risk Assessment Guidance for Superfund documents and produce results in the form of a hazard index and carcinogenic risk. These scores are converted to a logarithmic scale of 1 to 7, where 1 signifies an individual lifetime risk of one in 10,000,000, and 7 signifies a risk of one in 10.

Timing

Timing is an important factor in prioritizing ground water restoration sites because it quantitatively incorporates the current or anticipated use of ground water. Sites where affected ground water is in use should have higher priority than sites where alternate water supplies are abundant, accessible, and inexpensive. This criterion makes the risk estimates more meaningful since it ties them to actual site factors (such as probability of ground water use).

Additionally, hydrologic factors such as aquifer flushing time, contaminant migration rate, or increased plume spread can be incorporated into the timing criterion.

Environmental risk

The baseline environmental risk scores are determined from the product of two factors:

- The sensitivity of the environmental resource at risk
- The magnitude of the threat associated with the contaminated ground water.

The definition for sensitivity of resources was adapted from the EPA's Final Hazard Ranking System (40 CFR Part 300) and includes scenic or wild rivers, unique riparian habitats, wetlands, threatened or endangered species, spawning areas, or any critical habitat. The threat to these resources is based on largely qualitative criteria (including criteria for exceedance of ambient water quality and observed contaminant uptake or toxicity in biota) and threats to the population abundance.

Socioeconomic impact

Socioeconomic impact scores are derived from three components:

- Public concern
- Cultural/traditional impacts
- Community losses/opportunity costs.

The first factor scores public and political interest. This is significant on the UMTRA Project because many stakeholders are very concerned about ground water restoration.

The second factor, cultural impacts, is significant primarily to tribal sites. It recognizes the spiritual values the Hopi Tribe and Navajo Nation associate with their ground water.

The last factor is used to score economic impacts to a community that loses the use of an affected aquifer. This factor relates to the size of the contaminant plume as well as the demand for its use.

Regulatory noncompliance

The primary criterion in this factor was compliance with applicable ground water standards, including tribal or state laws addressing ground water.

After each factor was scored, the scores were weighted as follows: 10 percent for population risk; 30 percent for individual risk; 20 percent for timing factors; 15 percent for environmental impacts; 10 percent for socioeconomic impacts; and 15 percent for regulatory impacts.

Sites were assigned to one of five groups based on this prioritization, allowing for flexibility in planning compliance activities. Category I sites with the highest priority are New Rifle, Old Rifle, and Gunnison, Colorado; Tuba City, Arizona; and Riverton, Wyoming. The Gunnison Category 1 classification does not take into account the implementation of the alternate water supply. Category II sites with the next highest priority are Monument Valley, Arizona; Lakeview, Oregon; Shiprock, New Mexico; and Durango, Colorado. Category III sites are Naturita, Slick Rock, and Grand Junction, Colorado; and Green River and Salt Lake City, Utah. Category IV sites are Bowman and Belfield, North Dakota; Canonsburg, Pennsylvania; Falls City, Texas; and Maybell, Colorado. Category V sites are Ambrosia Lake, New Mexico; Mexican Hat, Utah; Lowman, Idaho; and Spook, Wyoming. The UMTRA Ground Water Project site prioritization system took into account the likelihood that exact scores, and therefore priority, may change as additional data are gathered.

The site prioritization groups would be considered when site-specific decisions are being made. Ground water remediation at the sites would be further prioritized based on additional health or environmental risk information. The following factors would be taken into account when determining the risk at a site:

- Is the contaminated ground water likely to be used soon?
- How much contamination is present?
- How toxic is the contaminated ground water?
- Can access to the ground water be controlled?

Prioritization is one element of the Ground Water Project. It would be applied objectively to the maximum extent possible.

2.7.2 Site-specific risk assessments

The purpose of the UMTRA Ground Water Project baseline risk assessments is to determine whether there is current use of the contaminated ground water and whether ground water contamination at the former processing sites has the potential to adversely affect public health or the environment. The results of the site-specific baseline risk assessments are or would be used to:

- Evaluate potential current and future public health and ecological risks at the sites.
- Determine the need for an alternate water supply, based on the potential for adverse human health effects.
- Identify additional data, if any, needed to characterize risks at UMTRA sites.
- Determine current and potential future land uses at and near the sites.
- Inform the public of current and/or future potential public health and ecological risks.
- Help determine site-specific ground water compliance strategies.
- Determine whether access to ground water should be restricted through the use of institutional controls.

As indicated in Section 2.1 and as shown in Figure 2.1, the proposed action is a health and environmental risk-based approach for implementing the Ground Water Project. The risk assessments and the ground water characterization data would be used to help determine the appropriate ground water compliance strategies that would be implemented at each UMTRA Project site.

The baseline risk assessments have been or will be made available to the public and libraries near the sites. If the risk assessment identified a significant health risk associated with short-term use of ground water near the sites, mechanisms for restricting access to the ground water would be discussed.

Because the baseline risk assessments are being conducted in the early stages of the Ground Water Project, they may be prepared before comprehensive characterization of the contaminant plume is complete at some sites. The baseline risk assessments identify data gaps and recommend additional data collection efforts. After site characterization is completed, risk assessments may be updated, if necessary.

Risk assessments would be used in deciding how to meet the UMTRA ground water protection standards. In developing site-specific ground water compliance strategies under the proposed action, the baseline risk assessments would be used to determine if a given strategy would be protective of human health and the environment. As indicated on Figure 2.1, protection of human health and the environment is considered in the application of all ground water compliance strategies. For example, if supplemental standards based on limited use ground water were considered for a site, the risk assessment would analyze any potential health effects of consuming contaminated ground water, and consider potential adverse effects on other beneficial uses (e.g., agricultural or industrial). The assessment also would address the potential impacts of contaminated ground water on area plant and animal communities. If supplemental standards based on limited use are determined to be protective of human health and the environment and all other requirements can be met, this strategy may be proposed for a site.

Risk assessments also could be used on the Ground Water Project to assess the risks of natural flushing. As indicated in Section 1.4.1, the use of natural flushing is permitted if it would result in meeting background levels, maximum concentration limits, or alternate concentration limits within 100 years; if institutional controls would protect public health and the environment from the contaminated ground water; and if ground water is not currently or projected to become a source of public drinking water. The risk assessment would be an important tool in determining the protectiveness of proposed alternate concentration limits; determining if the public would be protected from exposure to contaminated ground water; determining the potential for contaminated ground water to adversely affect biological resources; and determining if the contaminated ground water could be used as drinking water or for other beneficial uses.

Appendix B describes the human health and ecological risk assessment methodologies used on the UMTRA Ground Water Project.

2.8 GROUND WATER CHARACTERIZATION AND REMEDIATION METHODS

The nature and extent of ground water contamination must be evaluated before a ground water compliance strategy can be determined. The former processing sites must be characterized to the extent necessary to 1) define the physical, chemical, and biological conditions at the sites; 2) identify the sources and extent of contamination related to processing activities; and 3) obtain additional data which will be used together with historical data in evaluating potential impacts to human health and the environment. A ground water compliance strategy for a particular site would be selected only after adequate hydrogeological and geochemical characterization is completed. Hydrogeological and geochemical characterization activities would reduce uncertainties to the extent practical, to ensure the compliance strategy selected would be protective of human health and the environment.

At UMTRA Project sites, inorganic contaminants are the principal constituents that have been found in underlying aquifers. Hazardous constituents that have exceeded maximum concentration limits in ground water at UMTRA Project sites include arsenic, cadmium, chromium, lead, molybdenum, nitrate, selenium, radium-226 and -228, net gross alpha, and uranium. Additional metals that do not have maximum concentration limits have exceeded background concentrations at some sites. This section summarizes ground water characterization requirements and processes. These characterization methods may be implemented for all alternatives except the no action alternative. More detailed descriptions of ground water characterization methods are presented in Appendix C.

2.8.1 Site hydrogeologic and geochemical characterization

Ground water characterization

Under the proposed action, ground water characterization for the UMTRA Ground Water Project would be consistent with the requirements of Subpart B and Subpart C of the EPA ground water protection standards. In support of the proposed action, three programmatic documents would provide guidance for ground water characterization and compliance and ensure project continuity and consistency: the Technical Approach to Groundwater Restoration (DOE, 1993a), the Guidance Document for Preparing Water Sampling and Analysis Plans for UMTRA Sites (DOE, 1993b), and the UMTRA Project Technical Assistance Contractor Quality Assurance Implementation Plan for Surface and Ground Water (DOE, 1994b). These documents would also provide guidance for the Ground Water Project if either the active remediation to background or passive remediation alternative became the proposed action. If the no action alternative became the proposed action, these documents would not be used because future work on the Ground Water Project would cease.

The Technical Approach to Ground Water Restoration provides technical guidance for implementing the Ground Water Project. This document addresses the regulatory basis and requirements for ground water compliance, ground water characterization and remediation methodologies, and the requirements for meeting NRC concurrence.

The Guidance Document for Preparing Water Sampling and Analysis Plans for UMTRA Sites provides a consistent technical approach for water sampling and monitoring activities to be performed under site-specific water sampling and analysis plans. The plans would identify and justify specific sampling locations, ground water constituents for analysis, detection limits, and sampling frequency for the ground water and surface water sampling locations.

The Quality Assurance Implementation Plan describes the policy, organization, functional activities, and quality assurance and quality control protocols for environmental characterization. It provides specifications for collecting and analyzing environmental samples and assessing data. It also addresses quality issues associated with data and samples related to geology, hydrology, chemistry, biology, and engineering.

Assuming that one of the PEIS alternatives other than the no action alternative is implemented, the technical guidance in these three programmatic documents would be used to prepare site observational work plans. The site observational work plan would present the initial evaluation of existing information related to each site, a conceptual site model of the hydrogeological and geochemical processes, and additional data needed to adequately characterize the ground water conditions. Further data collection would be of sufficient quality and quantity to support future project planning and the necessary activities associated with the ground water compliance strategy selection and implementation.

The impacts of the proposed ground water compliance strategy would be assessed in site-specific environmental documents. Baseline risk assessments have been prepared for most sites. When relevant and applicable, these assessments would be modified and updated as additional monitoring and site characterization data are obtained. Site-specific remedial action plans would be prepared for sites where an active ground water remediation strategy would be most appropriate, or the Surface Project remedial action plan would be modified.

The observational method would be used during the planning for and collection of site characterization data. The observational method is an approach that would establish a ground water characterization plan and remedial action based on most probable site conditions; identify reasonable variations from those conditions; identify parameters for detecting variations from the most probable conditions during characterization and compliance; and provide plans for addressing potential variations (Peck, 1969). The observational method would be an effective and economical means to manage uncertainties associated with remediating ground water resources.

Examples of currently available data for the UMTRA Project sites include information on hydrogeologic properties, background ground water quality, contaminant sources, hazardous constituents in ground water, and ground water use, value, and alternative supplies. The extent of ground water characterization during the Surface Project depended on the preferred disposal alternative. Processing sites with disposal cells within their boundaries were characterized in greater detail to justify their selection, provide data for disposal cell design, define the extent of surface contamination, and generate a defensible ground water protection strategy for surface remediation that was protective of human health and the environment. The processing sites where surface remediation activities were completed or were in progress before the EPA ground water regulations were issued generally were characterized to a lesser extent.

For processing sites where contaminated materials were or will be removed off the site, characterization efforts consist of defining tailings-related ground water contamination and determining if conditions at the processing site would adversely affect human health and the environment.

Site-specific ground water characterization would require short-term activities on or near the site. To carry out characterization activities, a crew of 10 or fewer people would be on the site temporarily to conduct activities such as drilling monitor wells, constructing access roads, and excavating test pits. Support vehicles and heavy equipment (for example, drilling rigs) may use roads around the site for brief periods. Certain ground water characterization activities would require electrical power. For example, the pumps used for long-term aquifer tests would require a continuous electrical power supply, which could be drawn from a nearby utility line.

2.8.1.1 Hydrogeologic characterization

Hydrogeologic characterization is important in defining the ground water flow system and the extent of contamination related to uranium processing activities at the UMTRA Ground Water Project sites. Hydrogeologic characterization efforts would also be essential in developing and evaluating ground water compliance strategies.

Hydrogeologic characterization would include the following:

- A description of the hydrogeologic characteristics of the site and surrounding land
- A determination of aquifer hydraulic characteristics

- The quantity of ground water and the direction of ground water flow
- A determination of ground water recharge and discharge areas that may influence human health and the environment. Ground water discharge areas would include surface water bodies and water supply wells.
- The proximity and withdrawal rates of ground water users
- The current and future uses of ground water in the region surrounding the site.

Most hydrogeologic information is obtained from boreholes drilled for the installation of monitor wells. Geophysical methods may also be used to evaluate subsurface hydrogeologic conditions in the vicinity of the UMTRA Project sites. Borehole information and geophysical methods (under the appropriate conditions) can be used to characterize hydrogeologic conditions such as depth to bedrock, presence of sand and clay layers, and fracture zones that may control ground water flow and contaminant migration. Examples of some hydrogeological characterization features are shown in Figure 2.2.

Monitor wells are used for static water level measurements, ground water quality sampling, and aquifer testing (for example, aquifer pumping tests or water displacement tests). Monitor wells would be designed and installed to provide representative ground water quality samples and aquifer test results. Ground water flow patterns and velocities in the vicinity of the sites would be characterized on the basis of ground water elevations obtained from monitor wells and aquifer test data. Hydraulic parameters that describe the way ground water moves through the aquifer (including transmissivity, hydraulic conductivity, and storativity) would be calculated from aquifer test data. Figure 2.3 shows examples of a monitor well and an extraction well.

Ground water models could be used to analyze and predict ground water and contaminant plume movement. Models would be useful in determining points of exposure at land surface, estimating arrival times at specific downgradient locations or points of exposure, and estimating contaminant concentrations at points of compliance or points of exposure. These models would support risk assessments and ground water compliance strategy development.

Ground water models could also be used in remediation activities. For example, models could be used to assess ground water compliance strategies, compare long-term effects of ground water remediation designs, and optimize performance of aquifer remediation systems.

Site-specific environmental impact statements, environmental assessments, and remedial action plans for the Surface Project have previously described existing and potential future water uses in the vicinity of the processing sites. As the UMTRA Ground Water Project progresses, water uses and alternative supplies would be monitored and addressed as needed.

2.8.1.2 Geochemical characterization

Geochemical characterization is important in defining ground water contaminants related to uranium processing activities and in determining contaminant interactions with the aquifer matrix. Geochemical characterization efforts are essential to developing ground water compliance strategies because the geochemical composition of the aquifer matrix affects the quality of ground water and the rate of contaminant migration.

The scope of geochemical characterization would include the following:

- A review of the historical record of chemicals used in the milling operation
- A determination of the source of contamination and its cumulative impact on the ground water quality

- A determination of the contaminated and uncontaminated ground water quality
- A determination of the geochemistry of the sediment or rock that contains the ground water (known as the aquifer matrix material).

Ground water quality

Existing ground water characterization data would be used to determine the need, if any, to collect additional data for ground water characterization and risk assessments. In some cases, additional background and downgradient ground water quality characterization data would be collected to reduce uncertainties in the conceptual risk model.

Background ground water quality is the water quality in an aquifer that would be expected at a site if contamination from the uranium processing had not occurred. Background ground water quality is determined from hydrologically upgradient locations or adjacent areas that have not been affected by uranium processing activities. Some UMTRA Project sites have naturally poor background ground water due to their proximity to uranium ore bodies. An assessment of background ground water quality would provide a comparison for determining the magnitude and extent of ground water contamination caused by processing. At processing sites with surface water in the area, background surface water quality would also be defined upstream. See Appendix B for an expanded discussion regarding the determination of background water quality.

The distribution of hazardous constituents in the unsaturated zone, ground water, and surface water would be defined on the site and downgradient from the processing sites. Figure 2.4 shows an example of a ground water contaminant plume moving downgradient from a processing site. This information would be used to predict contaminant migration for each site, assess risk, and select ground water compliance strategies.

Through the geochemical processes of dissolution, precipitation, adsorption, desorption, and ion exchange, geochemical interactions between the ground water contamination and the aquifer matrix influence the rate at which chemical elements and compounds migrate through the aquifer (Table 2.2). Therefore, geochemical characterization of the aquifer matrix would allow for more accurate predictions of contaminant migration velocities. Contaminant migration velocity estimates would be critical for selecting natural flushing versus active ground water remediation and for assessing active remediation designs. Therefore, a detailed knowledge of the aquifer matrix chemistry would play an important role in ground water compliance.

Geochemical characterization methods

Water quality would be assessed by collecting and analyzing water samples from ground water monitor wells, springs, seeps, and surface water bodies. Some basic ground water quality characteristics could be determined in the field. Concentrations of major and minor chemical components in the ground water would be determined in the laboratory. Ground water quality would be evaluated using statistical procedures such as those recommended by EPA (EPA, 1989).

The geochemistry of the aquifer matrix material is characterized to determine mechanisms and the nature of ground water constituent interactions with aquifer matrix material. These data could be used in geochemical models to predict interactions and changes in contaminated ground water as it moves downgradient. Where the ground water compliance strategy depended on the aquifer matrix geochemistry, geochemical modeling could be used in conjunction with ground water flow and contaminant transport models to assess contaminant mobility in the ground water and to predict reactions with minerals in the unsaturated and saturated zones.

Table 2.2 Geochemical processes that control contaminant migration through an aquifer

Process	Definition
Dissolution	The process of dissolving minerals from the aquifer matrix.
Precipitation	The separation of chemical constituents from ground water to form new minerals on the aquifer matrix.
Adsorption	The adhesion of chemical constituents on minerals within the aquifer matrix.
Desorption	The removal of a chemical constituent from the aquifer matrix by the reverse of adsorption.
Ion exchange	The replacement of adsorbed chemical constituents by constituents in the ground water.
Biological	The process of transforming chemical compounds into different chemical compounds.

2.8.2 Ground water remediation methods

Two ground water compliance strategies are described in this section: natural flushing and active ground water remediation. Natural flushing is passive because it does not involve manipulation of ground water flow, quantity, or quality. Natural flushing means letting the natural ground water processes reduce the contamination in ground water. This process is commonly referred to as natural attenuation and often involves some or all of the geochemical

processes identified in Table 2.2. To effectively meet EPA standards, natural flushing must reduce contamination to background levels, to maximum concentration limits, or to alternate concentration limits within 100 years. Active remediation methods involve the engineered manipulation of ground water flow, quantity, or quality to achieve ground water quality standards in a specified period of time. Active remediation methods could be used in combination with natural flushing to minimize remediation costs and to expedite remediation.

Natural flushing

Natural flushing allows the natural ground water movement and geochemical processes (Table 2.2) to decrease contaminant concentrations. EPA ground water standards require that natural flushing must reduce contamination to levels within regulatory limits within 100 years. To select natural flushing at a specified UMTRA Project ground water site, investigations described in Section 2.8.1 would take place to demonstrate its potential effectiveness at achieving EPA ground water standards in 100 years (Figure 2.5). Under Subpart B of the EPA ground water standards, natural flushing may be used if compliance with the standards would occur within a period of 100 years or less; if adequate monitoring and institutional controls were established and maintained throughout the flushing period; if institutional controls resulted in conditions that were protective of human health and the environment; and if the ground water were not currently nor projected to be a source for a public drinking water system.

Active ground water remediation methods

Active ground water remediation includes several methods that could be used in the Ground Water Project. These methods are described in detail in Appendix C and are summarized below.

Gradient manipulation—Gradient manipulation uses either wells or trenches to add water to an aquifer to increase ground water velocity in a specific direction. Gradient manipulation could be used to accelerate the process of natural flushing. Conversely, gradient manipulation could be used to temporarily prevent discharge of a contaminant plume into surface water bodies by creating a hydraulic diversion to contaminated ground water flow. Gradient manipulation could be used in conjunction with natural flushing to decrease concentrations over a unit area at a faster rate and to temporarily prevent the migration of contaminants into areas where ground water was not previously contaminated or where institutional controls cannot be effectively applied.

Contaminant isolation—Ground water contamination sources are the tailings and associated highly contaminated water or adsorbed hazardous constituents in theunsaturated zone above the water table. Zones of highly contaminated ground water below a processing site are the result of the contamination source. Ground water contamination sources could be mitigated or eliminated through engineered measures to control or contain their hazardous constituents.

Hydrologic, geochemical, and reactive barriers could be used to keep a contaminant source from entering the ground water. These technologies could prevent hazardous constituents from migrating into the ground water. In areas of highly contaminated ground water under a former tailings pile, a barrier could be used for more efficient ground water extraction (Figure 2.6). Because of the expense involved, these techniques would be limited to small areas of highly contaminated material or ground water.

Ground water extraction—Ground water extraction controls movement of contaminated ground water and removes it from the aquifer. In many cases, it would be necessary to extract ground water only from the most highly contaminated zones (Figure 2.7). Ground water flow information and ground water hydraulic parameters would be used in conjunction with optimization codes to design the extraction network including well numbers, depths, spacing, and pumping or injection rates. With the aid of ground water models, the time required for the remedial actions could be estimated.

Well systems could be used to extract contaminated ground water for treatment or to create hydraulic barriers to ground water flow and increase the efficiency of extraction. These wells would then be pumped at specified rates to control the movement of contaminated ground water. In some cases, it could be necessary to combine periods of well pumping with periods of no pumping. When pumping has stopped, contaminants can diffuse out of less permeable (fine grain) zones or desorb from the aquifer matrix until equilibrium concentrations are reestablished in the ground water. Subsequent pumping would remove the minimum volume of contaminated ground water at the maximum possible concentration.

In shallow ground water systems, a well point network consisting of closely spaced, shallow wells connected to a pipe with a centrally located suction lift pump could be used. These systems can create an effective hydraulic barrier by capturing contaminated ground water. Well point networks would be used mainly for shallow water table aquifers because the maximum drawdown obtainable by suction lift is limited to approximately 25 feet (ft) (8.0 meters [m]) at sea level. Because well points are smaller in diameter and shallower than monitor wells, they are simpler and cheaper to install. This method is temporary (i.e., when the pumping is stopped the barrier ceases to function).

The land application option of ground water disposal would use extracted ground water for agricultural irrigation.

Extracted ground water would undergo treatment before use as irrigation water when necessary. This option would be used at processing sites located close to agricultural lands. Processing sites with ground water contaminant plumes containing nitrates would be the most likely candidates for this type of water disposal design.

Contaminated ground water treatment—Once contaminated ground water is extracted from an aquifer, it may be necessary to treat it to protect human health and the environment. The need for treating extracted contaminated ground water before it is discharged depends on the concentrations of contaminants in the extracted ground water and the regulations regarding discharge of effluent to the surface and ground water. Once treated, ground water could be discharged to surface water bodies, recharged back into a shallow aquifer, or used as irrigation water for agricultural purposes.

Contaminants in water and wastewater could be removed by physical, chemical, and biological methods. These methods are discussed in detail in Appendix C.

In situ ground water treatment—In situ (in place) treatment uses chemical agents in the affected soil or ground water to degrade, remove, or immobilize the contaminants. It also includes methods for delivering solutions to the subsurface and for controlling the spread of contaminants and chemical agents beyond the treatment zone.

In situ treatment processes are generally divided into three categories: biological, chemical, and physical. In situ bioremediation accelerates or enhances the rate of microbial reactions to transform the contaminants into benign or insoluble compounds. At UMTRA Project sites, in situ treatment could be used to reduce nitrates through denitrification or to remove metals using sulfate. With chemical in situ treatment, specific chemicals are injected into the soil or ground water to degrade, immobilize, or release contaminants that are in the ground water or attached to the soil particles. Physical in situ methods physically change the soil or ground water using heat, electric energy, or other means to immobilize or to expedite the release or movement of contaminants from the soil or water. In most instances, in situ treatment would be combined with aboveground treatment to achieve the most cost-effective treatment at the UMTRA Project sites.

In some cases, geochemical barriers may be effective in eliminating or reducing ground water contamination. A subsurface permeable barrier would be placed to intercept the flow of contaminated ground water for shallow ground water systems. As the ground water passes through the barrier, the contaminants interact with the barrier material and are removed from the ground water by precipitation or adsorption.

2.9 WASTE MANAGEMENT METHODS

Various types of wastes may be generated during ground water characterization, monitoring, and remediation. The UMTRA Project would follow the Technical Approach for the Management of UMTRA Ground Water Investigation-Derived Wastes to manage field-generated wastes from well drilling, well development, sampling, testing, ground water monitoring, and remediation (DOE, 1994c). This report also provides details on the regulatory requirements for managing and disposing of ground water investigation-derived wastes. The information below summarizes this report (DOE, 1994c). When a ground water compliance strategy is determined and has the potential to form waste material, the management and regulation of this waste would be analyzed on a site by site basis in the site-specific environmental document.

The proposed action, the active remediation to background alternative, and the passive remediation alternative have the potential of generating the following materials that may be contaminated:

- Well development water—Well development water is generated when new wells are drilled for site characterization, installation of a monitoring system, and active remediation field operations. If necessary, well development water would be treated, and either reinjected into the ground water, applied to the land, or transported to an open UMTRA Project cell or other licensed facility for disposal in a manner consistent with UMTRA Project standards and/or DOE orders.
- Drill cuttings and drilling muds—Drill cuttings and drilling muds are the soil and rock brought to surface by the drill when drilling a well. These materials are generated during site characterization, installation of a monitoring system, and drilling during active remediation. Drill cuttings and drilling muds would be analyzed and either applied to the land or transported to an open UMTRA Project cell or other licensed facility for disposal in a manner consistent with UMTRA Project standards and/or DOE orders.
- Purge water—Purge water is generated prior to ground water sampling. Ground water sampling from wells would occur during site characterization and monitoring. Purge water would be analyzed and either be evaporated, applied to the land, or discharged in a manner consistent with UMTRA Project standards and/or DOE orders.
- Sludge and brine—Sludge and brine result from the treatment of contaminated ground water. Sludge and brine could be generated during site characterization or active remediation field operations. Sludge and brine would be analyzed and disposed of at an open UMTRA Project cell or at an alternate disposal site in a manner consistent with UMTRA Project standards and/or DOE orders.
- Ground water and soils—Contaminated ground water and soils may be generated during active remediation field operations. If necessary, contaminated ground water would be analyzed and treated. Ground water would then either be reinjected into the ground water, applied to the land, or discharged to a surface water body in a manner consistent with UMTRA Project standards and/or DOE orders. Soils would either be applied to the land or transported to an open UMTRA Project cell for disposal in a manner consistent with UMTRA Project standards and/or DOE orders.

Prior to disposal in an UMTRA Project disposal cell, wastes would be evaluated to ensure they would not compromise the cell design. If the quantity of liquid wastes exceeds the design parameters of a disposal cell, the liquid waste quantity would be reduced. Waste that could not be accommodated in an UMTRA Project disposal cell would be disposed of at a licensed disposal facility.

All these materials would have the potential of being contaminated with constituents typical of uranium mill processing and being considered residual radioactive materials. These materials would be managed in accordance with the requirements of the UMTRCA, the DOE, EPA, and the appropriate Indian tribes and states. Current data from most sites do not suggest contaminated materials from sources other than uranium processing activities would be encountered, although at some sites naturally occurring ore bodies may be encountered. However, all contaminants from non-UMTRA sources, if encountered, would be managed in accordance with the appropriate requirements.

2.10 COST ESTIMATE METHODS

Since a budget must be developed to obtain yearly federal appropriations, assumptions concerning site-specific compliance strategies must be made in advance to derive a cost estimate that will support budget submittals. These assumptions are for budgetary reasons only and in no way indicate that site- specific ground water compliance strategy decisions have been made prior to completion of the PEIS or a site-specific environmental document.

In estimating costs for each of the three ground water compliance strategies (no remediation, natural flushing, and active remediation), certain generic activities are assumed to support all three. However, the duration, complexity, and cost range of these generic activities vary with the type of compliance strategy selected. These activities include 1) preparing baseline risk assessments, site observational work plans (considered part of detailed site characterization), environmental assessments, and remedial action plans or modifications; 2) conducting a limited monitoring program until implementation of a compliance strategy or closeout activity; 3) performing some type of closeout activity, such as a certification report, a modification to the long-term surveillance plan, and/or licensing; and 4) performing program support activities. The cost estimates include escalation and contingency.

Activities for the no remediation compliance strategy would include those listed above plus, in certain cases, additional site characterization, wells, and revisions to the site observational work plans. Activities for the natural flushing compliance strategy would include longer durations of the same activities plus various phases of monitoring (calibration monitoring and verification monitoring) and a longer period to close out the site following verification monitoring and prior to turning the site over to another DOE project for compliance monitoring. Natural flushing also would include institutional controls. In addition to the above, active compliance strategy sites require detailed construction estimates. In developing these estimates, the Project used a software package called the "G-2 Estimator" in conjunction with environmental construction databases based on UMTRA Surface Project experience. All major cost elements were priced separately using historical data and supplier quotes. Cost elements included utility installation, numbers of wells required, collection systems, installation of water treatment plants, plant operations, testing, land application of treated or untreated water, closure, demobilization, and site restoration. The plant size and length of operations were generated on a site-specific basis using current assumptions on technical parameters of the plume, soil, and contaminants.

Each activity was individually reviewed. Cost estimates were developed based on related historical actuals (approximately 10 years on the UMTRA Surface Project), similar experience on other projects, and/or best professional estimates. The activities were then tailored to each site based on such site- specific attributes as the estimated volume of the plume and contaminants present. A critical path method analysis was then used to develop sequential logic for each compliance strategy, since some activities occur concurrently while others are sequential, and then summarized to develop an overall schedule. The overall Project schedule supported development of non-site- specific Project support activities, processes, or deliverables. The non-site- specific cost estimates were allocated against activities each year and combined to develop a total Project cost.

The last step in developing the cost estimates was to apply contingency to the base estimates to cover uncertainties. Acceptance of the proposed strategies used for the federal budgeting exercise accounts for the largest share of the Project's identified contingency. Other uncertainties to the UMTRA Project's estimates include 1) delays in state-share funding; 2) perturbations and delays in federal funding; 3) lack of access to existing site wells or the inability to drill new wells due to lack of access; 4) changes in currently understood plume size and contaminant concentrations; and 5) unknowns. The basis of estimates has attempted to cover a portion of the above risks; however, each time a project estimate is made, the DOE reexamines contingency application.

The basis of estimates for costs is reviewed several times during the fiscal year beginning in January. The estimates are continually reviewed for reasonableness, adaptability to the technical and political environment, and sound estimating practices.

3.0 AFFECTED ENVIRONMENT

This section describes the environment that could be affected by implementing any of the alternatives described in Section 2.0. Section 4.0 analyzes the potential impacts of implementing these alternatives. Section 3.1 describes the resources that may be affected during the Ground Water Project; this information was derived from NEPA documents and other reports generated during the Surface Project. Section 3.2 describes the UMTRA Project sites. Site-specific NEPA documents that would tier off this PEIS would provide additional details about the affected environment.

3.1 ENVIRONMENT OVERVIEW

The UMTRA Project processing sites were active for varying lengths of time from the 1940s into the 1970s. These sites, the surrounding areas, and the underlying ground water comprise the affected environment for this PEIS.

Land contaminated with uranium mill tailings and other hazardous constituents ranged from 21 ac (8 ha) at the Spook, Wyoming, site to 612 ac (248 ha) at the Ambrosia Lake, New Mexico, site (Table 3.1). In total, about 3900 ac (1600 ha) of land were contaminated at the sites. The amount of contaminated materials ranged from approximately 85,000 cubic yards (yd^3) (65,000 cubic meters [m^3]) at the North Continent Slick Rock, Colorado, site to 5,764,000 yd^3 (4,407,000 m^3) at the Falls City, Texas, site. The total amount of contaminated material at the sites is approximately 39,000,000 yd^3 (30,000,000 m^3).

The stabilization of the surface contamination at the sites was almost evenly divided between on-site and off-site disposal (Table 3.1). Most sites that had or will have uranium tailings transported off the site are either in urban settings or in river floodplains.

Surface remediation of the sites has been in progress since the mid-1980s. Canonsburg, Pennsylvania, the first site to undergo remediation, was completed in December 1985 (Table 3.1). Surface remediation is completed at 18 sites, and is under way at 4 sites. The Canonsburg, Shiprock, and Salt Lake City disposal cell designs were based on EPA standards that were remanded, in part, in 1983. The EPA has determined, based on information from the DOE, that modifications of these disposal cells are not warranted; the final determination will be made by DOE with the concurrence of the NRC (60 FR 2854).

3.1.1 Resources

This section summarizes the environmental resources at or near the processing sites. In general, "near" refers to a location where the resource has the potential to be affected by site-related contamination or remedial action.

3.1.1.1 Human health

The human environment at each UMTRA Project site includes everyone who lives in or near the direction of the contaminated ground water plume. The Surface Project addresses human exposure to the tailings, and the Ground Water Project addresses human exposure to ground water contamination.

3.1.1.2 Climate

All UMTRA Project sites except the Canonsburg, Pennsylvania, site and the associated Burrell vicinity property are in the western United States, generally in arid or semiarid environments. Fifteen sites are in dry climates and receive less than 12 inches (30 centimeters [cm]) of precipitation annually; six sites receive 12 to 20 inches (30 to 50 cm) annually; and three sites receive more than 20 inches (50 cm) annually (Table 3.2).

3.1.1.3 Surface water

Twenty-two sites are near surface water bodies, including major rivers such as the Colorado, Dolores, San Juan, and Yampa Rivers (Table 3.2). Perennial streams and ponds occur near a few sites. Ephemeral and intermittent washes and arroyos occur near many of the sites.

3.1.1.4 Ground water

Ground water contamination in varying degrees has been observed at all but one of the sites. Lowman, Idaho, is the only site where ground water contamination does not exist. Milling at the Mexican Hat, Utah, and the Ambrosia Lake, New Mexico, sites created areas saturated with contaminated ground water in geological formations that previously did not contain ground water; however, contamination of naturally occurring ground water has not been observed. Seepage of contaminated water has affected the naturally occurring underlying aquifers at the remaining 21 sites. Some of the more common hazardous constituents that exceed maximum concentration limits at UMTRA sites include uranium, molybdenum, and selenium. Table 3.3 shows constituents that have exceeded maximum concentration limits at least twice. This summary includes only the constituents for which EPA has established an UMTRA Project maximum concentration limit; other constituents associated with uranium processing exceed background levels at some sites and may be detrimental to human health and the environment. Ground Water Project documents that will address all site-specific constituents of concern include the baseline risk assessments and site observational work plans.

The estimated total amount of contaminated ground water at the UMTRA sites is 10,436,000,000 gal (39,318,000 m^3) (Table 3.1). The volume of contaminated ground water ranges from none at the Lowman site to approximately 1,900,000,000 gal (7,000,000 m^3) at the Gunnison site. At sites with contaminated ground water, the percent of off-site contamination ranged from none at the Belfield, Canonsburg, and Slick Rock Union Carbide sites to 98 percent at the Gunnison site.

3.1.1.5 Ecological resources and wetlands

Most UMTRA Project sites are in areas dominated by desert shrub or desert grassland plants. Riparian plant communities along rivers, streams, washes, and arroyos occur at or near most sites. Threatened, endangered, and other species of concern occur at or near 14 sites, including several species of plants, endangered fish, and birds such as the bald eagle and peregrine falcon. Wetlands have been identified at or near 18 sites (Table 3.2). Wetlands at 10 of these sites have been or will be affected by the Surface Project; these impacts have been or will be mitigated.

3.1.1.6 Land use

Land use in and around UMTRA Project sites in urban areas ranges from industrial and commercial to residential and public. In rural settings, land use includes farming and ranching. Some rural lands are managed by the Bureau of Land Management.

3.1.1.7 Cultural/traditional resources

Areas at or near 11 of the UMTRA Project sites contain cultural resources (Table 3.2). These include archaic Native American lithic scatters, Anasazi ruins, and limited property from historical industrial and mining activities. In addition, water resources, including ground water and seeps, have traditional value to Native Americans. Many UMTRA Project sites fall within or near boundaries of tribal lands. Cultural resource investigations conducted primarily for the UMTRA Surface Project have identified cultural resources at two sites associated with tribal lands (Monument Valley, Arizona, and Riverton, Wyoming). Other resources of cultural interest to Native Americans may occur on other sites located on tribal lands (such as Tuba City, Arizona; Shiprock, New Mexico; and Mexican Hat, Utah) or lands associated with historic Indian occupation. More detailed information on cultural resources would be included in site-specific Ground Water Project environmental documents. Additional cultural resource investigations would be conducted, if required, prior to any site-disturbing activities associated with ground water compliance actions.

3.1.1.8 Transportation

Existing transportation networks at and near the processing sites accommodate local uses. All sites are accessible to vehicles. Remote areas that may be affected by the Ground Water Project may not be readily accessible to vehicular traffic.

3.1.1.9 Social and economic resources

Of the designated UMTRA Project sites, three are in cities, seven are at the edge of towns or cities, and 14 are in rural areas or remote settings (Table 3.2); five sites are on tribal lands representing four Native American tribes. Typically, the population characteristics and economies of the more rural, sparsely populated site areas are related primarily to agricultural activities such as ranching, grazing, and dryland farming, or to mining and energy exploration and development. Two sites in forested areas also are involved in forest-related uses such as logging. Suburban or urban sites have more diverse population and economic bases that include light industrial and commercial activities; residential areas also are located near these sites. Site ownership includes private, tribal, and public lands managed by the U.S. Forest Service and the Bureau of Land Management.

3.1.1.10 Environmental Justice

Achieving environmental justice is part of DOE's mission. DOE identifies and addresses the disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. For the UMTRA Ground Water Project, the potential exists for disproportionately high and adverse effects on five sites that are on or partially on tribal lands. The sites on tribal lands are the Tuba City and Monument Valley, Arizona, sites; Shiprock, New Mexico, site; and the Mexican Hat, Utah, site. The contaminated ground water at the Riverton, Wyoming, site has migrated off-site and underlies tribal lands. This PEIS addresses the potential programmatic effects of the ground water compliance strategies and alternatives. Site-specific NEPA documentation would further analyze potential effects.

3.1.2 Policy issues context

The policy issues identified below define the fiscal and regulatory context of the UMTRA Ground Water Project. These issues may affect or be affected by implementing the proposed action or alternatives.

3.1.2.1 Fiscal context

The UMTRA Project participates in the federal budget development process by requesting annual requirements which are included in the annual budget requests from DOE that the President submits to Congress. Because Congress cannot appropriate funds without a fully justifiable estimate, assumptions concerning site-specific compliance strategies must be made so as to derive cost estimates that will support budget submittals. These assumptions are for budgetary purposes only and in no way indicate that site-specific ground water compliance decisions have been made prior to completion of the PEIS or site-specific environmental documents.

With input from UMTRA Project contractors, budget development is managed by the DOE in accordance with DOE orders and guidance. Budget development includes preparing a "bottom-up" budget for the annual field budget submittal, developing and controlling contingencies, and examining and reestimating budget requirements through Project completion. The budget development process ensures that the DOE adequately plans for its fiscal year requirements and conducts and assesses the long-range planning needed to complete the Project. To accomplish these objectives, a total Project (or life-cycle) budget is developed each year with input from all Project participants/contractors. Although congressional appropriations are for only one year, the estimated budget for the entire UMTRA Project must be presented to DOE Headquarters, the Office of Management and Budget, and finally, to Congress to identify future budget requirements. The current Ground Water Project cost projection is $497 million with a completion date of 2014; these estimates are based on the fiscal year 1997 field budget.

At times, the field budget submitted by the UMTRA Project is not fully funded. This can be the result of budget changes as program priorities are balanced at the DOE Headquarters level. Reductions in the requested funds can and often do affect the Project schedule, such as pushing work further into the future. These schedule slips have the potential to increase the overall Project cost due to escalation; schedule slips that extend work beyond the currently identified completion date can add additional Project management costs. Section 2.10 describes the basis for estimates of the ground water compliance strategies analyzed in Section 4.0.

3.1.2.2 Regulatory context

Section 1.4, Regulatory Compliance, describes the EPA, NRC, DOE, Executive Order, and tribal law requirements with which the UMTRA Project must comply.

3.2 SITE DESCRIPTIONS

Numerous documents, including environmental impact statements, environmental assessments, and remedial action plans, have been published or are being prepared that describe the existing site environment and surface remediation construction conditions at the UMTRA Project sites. These documents form the basis for the site descriptions presented in this document. The descriptions focus on factors most relevant to ground water remediation, including existing ground water data, local population and private well information, and other sensitive resources (for example, surface water bodies and wetlands) that may be affected by contaminated ground water. Descriptions of ground water quality were based on the 1992 Annual Environmental Monitoring Report (DOE, 1993c) for sites where remedial action is under way or complete. Other ground water quality information was obtained from the latest site-specific Surface and Ground Water Project documents.

The discussion of ground water is limited to ground water in the uppermost aquifer, background ground water quality, and water-bearing units and aquifers that have been contaminated by milling activities. At some sites, contaminated ground water has migrated downward into previously unsaturated geologic formations above the natural water table. These formations contain small zones of saturation that resulted from milling activities. At most of the remaining sites, milling-related contaminants have entered only the shallow aquifers beneath the sites. Deeper aquifers are discussed only if they represent the uppermost aquifer or have been contaminated. Background ground water quality at some UMTRA Project sites is naturally poor due to uranium ore bodies and past mining activities, and natural highly mineralized aquifer matrix material.

3.2.1 Monument Valley, Arizona

The Monument Valley UMTRA Project site is in Apache County, Arizona, in an isolated setting along Cane Valley Wash on tribal land. The county per capita income is $5399; the population is predominantly Native American (DOC, 1990). The site is approximately 13 miles (mi) (21 kilometers [km]) east of the scenic Monument Valley tribal park. Comb Ridge, the most prominent topographic feature, is east of the site. The Monument Valley tailings site consisted of two tailings piles, windblown-contaminated soil, and piles of debris. The total amount of contaminated material at the site was 942,000 yd^3 (720,000 m^3) on 83 ac (34 ha). All the contaminated material has been moved to the Mexican Hat, Utah, disposal cell 17 road mi (27 km) to the north, and surface remedial action was completed in May 1994.

The Monument Valley site is in a sparsely populated area. The nearest town is Dennehotso, about 5.0 mi (8.0 km) south, in Apache County; the county population is 61,591 (DOC, 1990). The climate is arid, with an average annual precipitation of 6.0 inches (15 cm) and an average annual snowfall of 3.3 inches (8.4 cm) (DOE, 1993d). Six cultural resource sites have been identified near the site and are eligible for inclusion on the National Register of Historic Places (DOE, 1989a). The region is characterized by a desert shrub habitat with scattered junipers occurring on higher terrain and rocky areas. There are no known threatened or endangered species at or near the site (DOE, 1989a).

Surface water features at the Monument Valley site consist of Cane Valley Wash and several small ephemeral drainages. These drainages flow northeast into Cane Valley Wash (DOE, 1989a). A series of springfed wetlands and ponds occur along Cane Valley Wash, northeast of the tailings site area and extending at least 3.0 mi (4.8 km) north. The Frog Pond is the surface water body closest to the site (2000 ft [600 m] to the east); this pond has not been contaminated. Downstream from the site (2.2 mi [3.5 km]), are additional surface water bodies and wetlands that have not been affected by site-related contaminated ground water.

Ground water occurs in the alluvium and dune sand underneath the Monument Valley site and in the underlying bedrock formations. The depth to ground water in the alluvium is from a few feet in Cane Valley Wash to slightly more than 10 ft (3.0 m) under the site. This ground water is recharged by occasional infiltration from precipitation and upward leakage from the underlying aquifers. The ground water in the alluvium flows north at an estimated velocity range of 90 to 200 ft (27 to 61 m) per year. Below the alluvial aquifer, ground water occurs in the Shinarump Conglomerate and the confined De Chelly Sandstone aquifer. Ground water flows north at an estimated rate of 6.0 to 100 ft (2.0 to 30 m) per year in the Shinarump Conglomerate and 150 ft (46 m) per year in the De Chelly Sandstone.

Background ground water quality in these three aquifers shows no statistical evidence that any hazardous constituent exceeds maximum concentration limits. Contamination in the alluvial ground water beneath the site has exceeded the maximum concentration limits for net gross alpha, nitrate, radium-226 and 228, and uranium twice since 1990. A nitrate plume approximately 3000 ft (900 m) extends north of the site. The estimated amount of contaminated ground water at the Monument Valley site is 1.2 billion gal (4.5 million m^3). Concentrations of nitrate, net gross alpha, and radium-226 and -228 have exceeded the maximum concentration limits in the Shinarump at least twice since 1990. The maximum concentration limits for gross alpha and uranium have been exceeded in the De Chelly at least twice since 1995.

Two domestic wells are completed in the alluvial aquifer just south and upgradient of the site. Other residents near the site use artesian ground water from the De Chelly Sandstone that flows from monitor wells or former production wells. Ground water analyses from all these sources show no sign of contamination (DOE, 1993d).

3.2.2 Tuba City, Arizona

The Tuba City UMTRA Project site is in Coconino County, Arizona, 6.0 air mi (10 km) east of Tuba City (population 7300) (DOC, 1990) on tribal land. The county per capita income is $8683; the population in the vicinity is predominantly Native American (DOC, 1990). The site is on the Kaibito Plateau in the desert shrub vegetation zone. The surrounding terrain is dominated by dissected sandstone formations, mesas, and alluvial terraces. The tailings, windblown and waterborne deposits, demolished mill building, and other contaminated material, which totaled 785,000 yd^3 (600,000 m^3) on 327 ac (132 ha), were stabilized on the site in a 50ac (20ha) disposal cell (DOE, 1989b). Surface remediation was completed in May 1990.

The site is arid, with an average annual precipitation of 6 inches (15 cm) and an average annual snowfall of 4.0 inches (10 cm) (DOE, 1986a). There are no known cultural resources or threatened or endangered species at the site (DOE, 1986a). The site is approximately 7000 ft (2100 m) northwest of Moenkopi Wash, an intermittent stream that joins the Little Colorado River to the southwest. No other watercourses exist in the vicinity of the site. A natural spring and seeps appear along the base of an escarpment, approximately 6000 ft (1800 m) east-southeast of the site. The largest of these is used to water livestock. The other seeps have very little flow and are evident most often by the occurrence of riparian plant species and damp areas on the cliff face. Analysis of water and saturated soil samples from one seep south of the site indicates these seeps are not contaminated. The flow in Moenkopi Wash varies from periods of no flow to flows of more than 14,500 cubic feet per second (ft^3/s) (411,000 L per second) (DOE, 1986a). Surface water and sediment sample analysis from Moenkopi Wash indicates this wash is not affected by contaminants from the Tuba City site (DOE, 1986a).

The uppermost aquifer at the Tuba City site is in the Navajo Sandstone. This formation is up to 430 ft (130 m) thick in the site area. The water table ranges from 20 to 150 ft (6.0 to 50 m) deep. Ground water in this aquifer flows southeast toward Moenkopi Wash at an estimated average velocity of 2.0 to 100 ft (0.6 to 30 m) per year. Ground water beneath the site is contaminated, and levels of molybdenum, nitrate, selenium, uranium, and net gross alpha and radium226 and 228 activity have exceeded the maximum concentration limits at least twice since 1990. The plume of contamination extends approximately 1500 ft (460 m) downgradient from the site. The estimated amount of contaminated ground water at the Tuba City site is 780 million gal (3.0 million m^3). Ground water is not withdrawn from the plume area. Water is taken from springs near Moenkopi Wash and from the wash itself, downgradient of the site. These use areas are all greater than 1.0 mi (1.6 km) from the Tuba City site (DOE, 1989b).

3.2.3 Durango, Colorado

The Durango processing site is in La Plata County, Colorado, just southwest of the city of Durango. The site is on the west side of the Animas River, extending from the floodplain to the base of Smelter Mountain. The site consisted of two areas: the tailings piles in the milling area and the raffinate pond area about 0.5 mi (0.8 km) to the south. Approximately 2,534,000 yd^3 (1,937,000 m^3) of contaminated material were removed from the 127ac (51ha) site and associated vicinity properties (DOE, 1985a). The contaminated material was transported to the Bodo Canyon disposal site, approximately 3.5 mi (5.6 km) from the processing site. Surface remedial action was completed at the Durango processing site in May 1990.

The Durango site was revegetated after the completion of remedial action and contains a healthy stand of vegetation. Surface water bodies include the Animas River and Lightner Creek, both of which border the site. Surface water and sediment samples indicate contaminated ground water from the site has not contaminated these water bodies or their sediments. Riparian vegetation along the Animas River consists of cottonwoods and box elders. Threatened or endangered species are known to exist at or near the site (DOE, 1985a). These species include the bald eagle, which winters along the river, and the peregrine falcon, which nests about 1.0 m (1.6 km) from the site.

The Durango area has a semiarid climate, with an average annual precipitation of 19 inches (48 cm). The processing site is near the city of Durango, with an estimated 1990 population of 12,430. La Plata County had an estimated 1990 population of 32,284 (DOC, 1990). The nearest year-round resident is immediately west of the site. The processing site contains no known cultural resources (DOE, 1985a).

The Durango processing site is underlain by approximately 1760 ft (520 m) of Mancos Shale bedrock. The Mancos Shale bedrock is truncated along the Smelter Mountain fault at the south end of the terrace supporting the site. The bedrock is overlain by approximately 5.0 to 20 ft (1 to 6 m) of alluvium and man-made fill. Ground water moves through the alluvium (uppermost aquifer) as a thin (less than 3.0-ft [1.0-m]-thick) layer on top of the almost impermeable shale. The depth to ground water ranges from less than 3.0 ft (1.0 m) along the river to more than 40 ft (12 m) near the mountain. The ground water moves toward Lightner Creek and the Animas River, but the irregular surface of the bedrock makes it impractical to calculate a hydraulic gradient or the rate of ground water movement.

The former raffinate pond area is underlain by alluvium similar to the mill and tailings piles area and overlies relatively permeable sandstone. Ground water moves toward the Animas River through both the alluvium and the bedrock. The rate of ground water movement is estimated to be 800 ft (240 m) per year in the alluvium and 75 ft (22 m) per year in the sandstone. The amount of discharge to the Animas River is probably minimal compared to flow in the river. The minimum seven-day low flow recorded in the Animas River was 100 ft^3/s (3.0 m^3 per second) in December 1917.

Analysis of background water quality of the alluvial aquifer indicates that concentrations of cadmium, chromium, molybdenum, net gross alpha, and selenium have exceeded the maximum concentration limits several times. Seven hazardous constituents have exceeded the EPA maximum concentration limits in the alluvial aquifer beneath both areas of the site at least twice since 1990: cadmium, lead, molybdenum, net gross alpha, radium-226 and -228, selenium, and uranium. The estimated amount of contaminated ground water at the Durango site is 100 million gal (0.38 million m^3).

Water beneath the former processing site is not used for human consumption, and there is no evidence of elevated hazardous constituents in the Animas River as a result of alluvial aquifer discharge into the river. The city of Durango and properties near the site are served by a municipal water supply system. Water for this system is withdrawn from the Animas River upstream of the Durango UMTRA Project site. In addition, the water intake for a planned irrigation project will be in the river in the southern portion of the Durango site.

3.2.4 Grand Junction, Colorado

The Grand Junction site is on state-owned land in the city of Grand Junction, in Mesa County, Colorado, along the north side of the Colorado River. Approximately 4,655,000 yd^3 (3,559,000 m^3) of contaminated material were on 114 ac (46 ha) at the processing site (Sanders, 1993). During surface remedial action, all the contaminated material was moved to the Cheney disposal cell, 18 mi (29 km) southeast of the Grand Junction site (DOE, 1986b). The transportation of this material began in 1991; remedial action was completed in August 1994.

The population of Grand Junction is 29,034 (DOC, 1990). There are no cultural or historic resources at the Grand Junction site (DOE, 1986b). The site was constructed in the floodplain of the Colorado River, and a series of small islands and river side channels occurs between the site and the river. This area supports a dense growth of riparian vegetation and a diverse wildlife species. Other than 8.0 ac (3.0 ha) that were cleaned up during surface remediation, there is little or no site-related contamination in the area (based on analysis of surface water and sediment samples).

The Grand Junction site is arid, with an average annual precipitation of 8.0 inches (20 cm). Snowfall averages 27 inches (69 cm) annually (DOE, 1986b). Threatened or endangered species have been identified near the site (DOE, 1986b). These include the bald eagle, which winters along the river, and the Colorado squawfish, which may occur in the side channels of the Colorado River next to the site.

The Grand Junction processing site is underlain by Colorado River alluvium (uppermost aquifer) that ranges in saturated thickness from less than 10 ft (3.0 m) to more than 20 ft (6.0 m). Alluvial ground water levels beneath the site vary from 2.0 to 5.0 ft (1.0 to 2.0 m) annually, with the lowest levels occurring during the fall and winter. Ground water in the alluvial aquifer flows west and southwest, depending on the stage of the Colorado River, and eventually discharges to the river. The estimated ground water velocity is 73 to 1800 ft (22 to 550 m) per year. The uppermost aquifer is underlain by the Mancos Shale, which functions as an aquitard in the area.

At this time, there is some uncertainty regarding background ground water quality at the Grand Junction site. The background water in the alluvial aquifer has high concentrations of salts such as sulfate. Concentrations of molybdenum, selenium, and uranium and activities of net gross alpha exceeded maximum concentration limits in background ground water at least once. Seeping tailings fluids have contaminated ground water in the alluvium beneath the processing site. This contaminated ground water extends west from the site for approximately 2500 ft (760 m). Concentrations of molybdenum and uranium and activities of net gross alpha have exceeded the maximum concentration limits beneath and downgradient from the site at least twice since 1990. The estimated amount of contaminated ground water at the Grand Junction site is 330 million gal (1.3 million m^3). The Mancos Shale aquitard prevents contaminated ground water from moving any deeper (DOE, 1991b).

3.2.5 Gunnison, Colorado

The Gunnison processing site is on state-owned land and is adjacent to the city of Gunnison in Gunnison County, Colorado. In 1990 the city of Gunnison had an estimated population of 4636, while Gunnison County had an estimated population of 10,273 (DOC, 1990). The site is on a drainage divide between the Gunnison River and Tomichi Creek in the Gunnison River valley. Approximately 719,000 yd^3 (550,000 m^3) of contaminated material were on 68 ac (28 ha). The contaminated material was moved to the Gunnison disposal site approximately 6.0 mi (10 km) from the processing site. Surface remedial action began in May 1992 and was completed in December 1995.

The processing site is on the floodplain alluvium between the Gunnison River and Tomichi Creek. The site is about 0.4 mi (0.6 km) east of the Gunnison River and 0.4 mi (0.6 km) west of Tomichi Creek. It is bounded on the west by small storm drainage ditches and on the south and west by irrigation ditches. Surface water and sediment samples have been collected from the Gunnison River and Tomichi Creek upstream and downstream from the processing site and from shallow ponds near the site. No site-related contaminants have adversely affected the surface water and sediments in surface water bodies near the site.

An analysis of threatened and endangered species indicates the Gunnison River contains no endangered fish species (DOE, 1992a). Endangered species near the site include the whooping crane, which stops and feeds in the floodplain of Tomichi Creek during migration, and the bald eagle, which occurs along the Gunnison River during the winter. The Gunnison milk vetch, a federal candidate plant species, was growing on the tailings pile. There are no known cultural resources at the site (DOE, 1992a). The site is semiarid, receiving an average annual precipitation of 11 inches (28 cm) and an average annual snowfall of 58 inches (147 cm) (DOE, 1992a).

The uppermost aquifer at the site is in the alluvial deposits of the Gunnison River and Tomichi Creek. These floodplain alluvial deposits extend to at least 110 ft (34 m) beneath the processing site. This aquifer is recharged from rain, snowmelt, the Gunnison River, Tomichi Creek, and seasonal recharge from irrigation ditches around the site. Ground water discharges into the Gunnison River and Tomichi Creek. The average depth to ground water beneath the site is 5.0 ft (2.0 m). This ground water flows southwest at an average of 270 ft (80 m) per year.

Background ground water quality in the alluvial aquifer does not exceed EPA ground water standards. Tailings seepage has contaminated the alluvial ground water beneath the processing site; net gross alpha, radium226 and 228, and uranium have exceeded the maximum concentration limits at least twice since 1990. The uranium plume extends approximately 7000 ft (2000 m) southwest from the site to the Gunnison River. The estimated amount of contaminated ground water at the Gunnison site is 1.9 billion gal (7 million m^3).

Downgradient of the site, 311 private wells are completed in the alluvial aquifer. Twenty-two of these private wells are known to contain elevated levels of uranium from the processing site plume. A permanent alternate water supply system was constructed for the residents who have wells in and adjacent to the contaminant plume. The municipal water supply for the city of Gunnison is unaffected by the contamination because it comes from wells in the alluvial aquifer upgradient of the processing site (DOE, 1991c).

3.2.6 Maybell, Colorado

The Maybell processing site is in Moffat County, Colorado, 25 mi (40 km) west of the city of Craig and 5.0 mi (8.0 km) northeast of the unincorporated village of Maybell. Approximately 3,500,000 yd^3 (2,700,000 m^3) of contaminated material are at the processing site and in the windblown contaminated areas on 214 ac (87 ha). In addition, 1.9 mi (3.0 km) of Johnson Wash and 1.0 mi (1.6 km) of Lay Creek were contaminated by the inadvertent discharge of 200,000 to 400,000 pounds (90,000 to 180,000 kilograms) of tailings and the routine discharge of tailings pond effluent into these streams in the early 1960s. The surface remedial action will stabilize all contaminated material in place, and is expected to be completed in July 1997.

The Maybell processing site is in a remote area of sagebrush and piZon-juniper habitat. The site is partly on Bureau of Land Management land and partly on private land. The principal land uses are grazing and hunting (for mule deer, pronghorn antelope, and sage grouse). Wetlands occur along Johnson Wash and Lay Creek near the site. Johnson Wash is a dry arroyo that runs near the eastern border of the site. This wash joins Lay Creek about 1.0 m (1.6 km) south of the site. This creek is a tributary of the Yampa River and the confluence is about 5.0 mi (8.0 km) southwest of the site. No site-related contaminated ground water has entered or is expected to enter these bodies of water. The population of Moffat County is 11,357 (DOC, 1990). Although one historic site occurs near the site, it is not considered eligible for inclusion on the National Register of Historic Places (DOE, 1995a).

The Maybell site is semiarid. The average annual precipitation is more than 13 inches (33 cm); snowfall averages more than 80 inches (200 cm) annually (DOE, 1995a). Threatened or endangered species that occur near the site along the Yampa River include wintering bald eagles and the Colorado squawfish (DOE, 1995a).

The processing site is underlain by the Browns Park Formation. The uppermost aquifer is in the upper sandstone unit of this formation. Ground water within this formation ranges in depth from 35 to 300 ft (11 to 90 m) beneath the site. Ground water flows southwest at an average velocity of approximately 40 ft (12 m) per year. Recharge to the uppermost aquifer is principally from infiltration of precipitation and snowmelt. Ground water from this aquifer discharges into the alluvial aquifer of the Yampa River.

Background ground water quality is affected by natural mineralization related to the uranium ore body; selenium and uranium levels exceed the maximum concentration limits. Contaminants from the processing site have entered the aquifer beneath the site but because of advantageous geochemical conditions, the contamination has not passed the site boundary. Contaminants that have exceeded the maximum concentration limits in the tailings pore fluid and the ground water beneath the site at least twice since 1990 are arsenic, cadmium, molybdenum, nitrate, net gross alpha, radium226 and 228, selenium, and uranium. The estimated amount of contaminated ground water at the Maybell site is 230 million gal (0.87 million m^3).

The domestic well nearest the site is 3.0 mi (5.0 km) to the southwest in the alluvial aquifer of the Yampa River. Contaminants from the processing site likely will not affect this aquifer because favorable geochemical conditions limit downgradient contaminants migration. In addition, the ground water in the uppermost aquifer is unsuitable for drinking due to widespread ambient contamination that is related to naturally occurring uranium mineralization and to mining activities not related to the uranium milling operations.

3.2.7 Naturita, Colorado

The Naturita processing site is in Montrose County, Colorado, approximately 2.0 mi (3.0 km) northwest of the town of Naturita along the San Miguel River. Much of the site is in the floodplain of the river. Between 1977 and 1979, the tailings were moved to a facility 3.0 mi (5.0 km) south of the processing site for reprocessing. There are 547,000 yd^3 (418,000 m^3) of contaminated material on 247 ac (100 ha) at the site. This total includes 194 ac (79 ha) that were contaminated with windblown and waterborne tailings. Tailings washed down the San Miguel River and contaminated approximately 56 ac (23 ha) of the mostly wooded riparian zone along the river. The contaminated material will be moved out of the floodplain to an off-site disposal cell. Surface remedial action began in April 1995 and is scheduled for completion in September 1997.

The Naturita processing site is in a sparsely populated area on the south side of the San Miguel River. The population of the town of Naturita is 430 (DOC, 1990). The San Miguel River is the only surface water body in the site area. Surface water samples have shown that site-related contaminated ground water is not adversely affecting the water in the river. Cottonwoods and willows dominate a riparian wetland zone along the river. Junipers and piZon pines dominate the surrounding hillsides. The San Miguel River contains no endangered fish species. The endangered southwestern willow flycatcher may occur at the site (DOE, 1994d). Wintering bald eagles also occur along the river in the processing site area.

The site is on private land. The nearest residence is approximately 2000 ft (600 m) northnorthwest of the site. The Naturita site is arid, with an estimated average annual precipitation of 9.0 inches (23 cm). The average annual snowfall is approximately 30 inches (80 cm). Three prehistoric sites near the site are eligible for inclusion on the National Register of Historic Places (DOE, 1994d).

Ground water beneath the Naturita site occurs in the alluvial deposits of the San Miguel River floodplain. This aquifer is recharged by the river southeast of the site and discharges into the river northwest of the site. The alluvial aquifer flows approximately parallel to the river at an estimated linear velocity of 22 ft (7.0 m) per year. Background ground water quality in the alluvium near the processing site did not exceed the EPA maximum concentration limits. Uranium concentrations indicate a contaminant plume in the alluvial ground water extending approximately 1500 ft (460 m) downgradient from the processing site. Other site-related contaminants that have exceeded maximum concentration limits in this aquifer at least twice since 1990 are arsenic, molybdenum, selenium, radium-226 and 228, and net gross alpha. The estimated amount of contaminated ground water at the Naturita site is 100 million gal (0.38 million m^3).

Ground water in the Salt Wash aquifer, which is below the alluvial aquifer, is not contaminated by the processing site. Contaminated ground water is likely entering the San Miguel River, but surface water and sediment samples indicate this ground water has not affected the river. There are no known uses of the contaminated ground water beneath or downgradient of the processing site.

3.2.8 Rifle, Colorado (two sites)

The Old and New Rifle UMTRA Project sites are near the city of Rifle, Colorado, in Garfield County. The Old Rifle site is 0.3 mi (0.5 km) southeast of the center of Rifle. The New Rifle site is 2.0 mi (3.0 km) southwest of the center of Rifle. Approximately 661,000 yd^3 (505,000 m^3) of contaminated material were on 88 ac (36 ha) at the Old Rifle site, and approximately 3,474,000 yd^3 (2,656,000 m^3) of contaminated material were on 238 ac (96 ha) at the New Rifle site (DOE, 1990). The contaminated materials from both sites are being transported to the Estes Gulch disposal site, approximately 6.0 mi (10 km) north of the Rifle sites. Remedial action began during the spring of 1992 and is scheduled for completion in October 1996.

The Old and New Rifle sites are in the floodplain of the Colorado River. The base of the Old Rifle site is slightly above the Colorado River during average flow and is separated from the river by the tracks of the Denver & Rio Grande Western Railroad. The Colorado River flows 1000 ft (300 m) east and 600 ft (180 m) south of the New Rifle tailings pile. The mill and ore storage areas were located between the tailings pile and the river to the east.

Before surface remedial action, the Old Rifle site contained a small wetland (0.7 ac [0.3 ha]). In addition, 20 ac (8.0 ha) of wetlands occurred at the New Rifle site, including wetlands in the southeast portion of the site and in the contaminated area west of the site. These wetlands were destroyed during surface remediation and a 44-ac (18-ha) mitigation wetland was constructed near the former New Rifle tailings pile. In addition, sediments and fish in a fishing pond downgradient of the Old Rifle site had elevated uranium levels. Several surface water bodies west of the New Rifle site, including a drainage ditch and a gravel pit pond, also have elevated uranium levels. Sampling in the Colorado River indicated no elevated contaminant levels (DOE, 1992b).

The population of the city of Rifle is approximately 4600, the population in Garfield County is 30,000 (DOC, 1990). The region is semiarid, with an annual average precipitation of 11 inches (28 cm) and an average annual snowfall of 41 inches (104 cm) (DOE, 1990). Threatened or endangered species in the site area include the endangered fish in the Colorado River and the bald eagle (DOE, 1990). Cultural resources were not identified at or near the Old and New Rifle sites.

Both Rifle sites are underlain by Colorado River alluvium. Beneath the alluvium, semiconfined ground water occurs in interlayered sandstone, siltstone, and claystone beds in the Wasatch Formation. In general, ground water in the alluvium and in the Wasatch Formation flows southwest. Seasonal water level fluctuations in the river influence flow in the aquifers. During periods of high flow, the river recharges the alluvium. During periods of low river flow, the alluvial aquifer tends to discharge into the river. The alluvium at the Old Rifle site is approximately 20 ft (6.0 m) thick, with depth to ground water generally ranging from 2.0 to 12 ft (1.0 to 4.0 m). At the New Rifle site, the alluvium is 25 to 30 ft (8.0 to 9.0 m) thick, with depth to ground water generally ranging from 5.0 to 10 ft (2.0 to 3.0 m). The average linear ground water velocity in the alluvial aquifer is 800 ft (250 m) per year at the Old Rifle site and 300 ft (90 m) per year at the New Rifle site. The average linear ground water velocity in the Wasatch Formation is 0.3 ft (0.09 m) per year at the Old Rifle site and 3.0 ft (0.9 m) per year at the New Rifle site (DOE, 1992b).

Background ground water in the alluvial aquifer has exceeded the maximum concentration limits for chromium, molybdenum, selenium, uranium, and net gross alpha at various times since sampling began. The maximum concentration limits have been exceeded for molybdenum, selenium, uranium, and net gross alpha in the Wasatch Formation background ground water. In addition, background ground water for the Wasatch Formation exceeds the maximum concentration limits for barium and activities of radium226 and -228.

Both the alluvial and Wasatch aquifers are contaminated by seepage from the tailings piles at both sites. Contaminants introduced into the ground water from the tailings at the Old Rifle site that have exceeded the maximum concentration limits at least twice since 1990 are arsenic, molybdenum, selenium, and uranium, and activities of net gross alpha and radium-226 and -228. In addition, levels of fluoride, vanadium, and zinc are elevated above background levels.

Tailings seepage has also contaminated the Wasatch Formation below the Old Rifle site; cadmium and chromium concentrations and activities of net gross alpha and radium-226 and 228 have exceeded the maximum concentration limits at least once since 1990 in monitor wells 623 and 624. Antimony, strontium, vanadium, and zinc are above background levels. The estimated amount of contaminated ground water at the Old Rifle site is 70 million gal (0.26 million m^3). Most of the contaminated ground water at the Old Rifle site discharges into the Colorado River, several hundred feet downriver from the tailings pile (DOE, 1991d).

At the New Rifle site, ground water contamination in the alluvial aquifer extends at least 5000 ft (1500 m) downgradient from the pile. Downgradient contaminant concentrations in the alluvium generally are higher at the New Rifle site than the Old Rifle site. Concentrations of arsenic, cadmium, molybdenum, nitrate, selenium, and uranium, net gross alpha, and radium226 and 228 activity have exceeded the maximum concentration limits at least twice since 1990. In addition, levels of antimony, fluoride, strontium, vanadium, and zinc exceed background levels in the alluvial aquifer.

The horizontal extent of contamination in the Wasatch Formation at New Rifle extends 3500 ft (1100 m) downgradient from the tailings pile. The estimated amount of contaminated ground water at the New Rifle site is 600 million gal (2.3 million m^3). Concentrations of molybdenum, nitrate, selenium, uranium, and activities of net gross alpha and radium226 and -228 have exceeded the maximum concentration limits at least once since 1990; levels of antimony, fluoride, strontium, sulfide, vanadium, and zinc are elevated above background levels in the Wasatch Formation (DOE, 1990).

The Colorado River is the primary source of municipal water in the Rifle area. The Colorado River intake is approximately 0.5 mi (0.8 km) upriver from the Old Rifle site. The city obtains about 10 percent of its water from Beaver Creek, southwest of the New Rifle site and south of the Colorado River. The DOE has sampled 16 private wells and springs in the Rifle vicinity. An UMTRA Project position paper discusses potential impact to local private wells and springs near the Rifle sites (DOE, 1995b).

3.2.9 Slick Rock, Colorado (two sites)

Two processing sites are near Slick Rock, Colorado, along the Dolores River in San Miguel County. The population of San Miguel County is approximately 3700 (DOC, 1990). The Union Carbide processing site is approximately 1.0 mi (1.6 km) downriver from the North Continent processing site. Both sites are partially in the floodplain of the Dolores River in a sparsely populated area. There are 488,000 yd^3 (373,000 m^3) of contaminated material on 92 ac (37 ha) at the Union Carbide site and 85,000 yd^3 (65,000 m^3) of contaminated material on 47 ac (19 ha) at the North Continent site. The proposed surface remedial action is to move the contaminated material out of the floodplain to the Burro Canyon disposal cell, 2.0 mi (3.0 km) north of the sites. The current schedule calls for completion of surface remedial action at the two sites in December 1996.

The Union Carbide and North Continent sites are in a steep canyon of the Dolores River, in the floodplain of the river. The Dolores River is the only permanent water body in the area of the sites, although there are dry washes. Surface water and sediment samples indicate contaminated ground water at the site has not adversely affected the water or sediment quality of the river. Willows and other shrubs dominate the riparian wetland zone along the river. A total of 96 ac (39 ha) of the riparian plant communities occurs in the contaminated zone at the Union Carbide and North Continent sites. The riparian zone supports many productive plant communities, which in turn support diverse wildlife. The surrounding canyon contains steep cliff faces or steep slopes dominated by desert shrubs. No endangered fish species are in the river in the area of the sites; endangered species are wintering bald eagles along the river and nesting peregrine falcons within 8.0 mi (13 km) of the sites. The river otter, a federal candidate species, occasionally occurs in the river near the sites.

Cultural resources near the processing and disposal sites have been identified and are being addressed during remedial planning (DOE, 1994e).

Both processing sites are on private land. The major land use in the area is grazing. A gas sweetener plant is adjacent to the Union Carbide site.

The Slick Rock site area is arid. The mean annual precipitation is 7.0 inches (18 cm). The average annual snowfall is approximately 30 inches (76 cm).

Ground water beneath the Slick Rock sites occurs in the alluvial aquifer of the Dolores River and in the underlying Entrada Sandstone and Navajo Sandstone Formations. These three hydrostratigraphic units are believed to be hydraulically interconnected. Ground water in the alluvium generally flows northwest, parallel to the flow of the river. Depth to ground water ranges from 10 to 20 ft (3.0 to 6.0 m) beneath the sites. The average linear ground water velocity in the alluvium ranges from 100 ft (30 m) per year at the North Continent site to 150 ft (50 m) per year at the Union Carbide site. The alluvial aquifer is recharged by seepage from the Dolores River upstream and by precipitation. Ground water discharges from the alluvium into the Dolores River downgradient.

Concentrations of molybdenum and uranium have exceeded the maximum concentration limits in one or more background alluvial monitor wells. These elevated constituent levels may be influenced by nearby mines upriver from the processing sites. Tailings seepage has affected the ground water quality in the alluvium beneath the Union Carbide site. Contaminant plume migration has been limited to within or slightly downgradient of this site. Concentrations of molybdenum, nitrate, selenium, and uranium and activities of net gross alpha and radium-226 and 228 have exceeded the maximum concentration limits at least twice since 1990. The estimated amount of contaminated ground water at the Union Carbide site is 26 million gal (100,000 m^3).

Tailings seepage also has contaminated the alluvial ground water beneath the North Continent site, although the concentrations generally are lower than at the Union Carbide site. Hazardous constituents that have exceeded maximum concentration limits at least twice since 1990 are net gross alpha, radium226 and 228, and uranium. Contaminant migration appears to be limited to within the site boundary. The estimated amount of contaminated ground water at the North Continent site is 12 million gal (50,000 m^3).

The contaminated ground water in the alluvium at both sites discharges into the Dolores River. Surface water sampling of the river detected none of the contaminants found in the alluvium. Ground water quality of the Entrada Sandstone underlying the alluvium also has been affected by uranium milling activities based on concentrations of selenium and total dissolved solids that are elevated above background levels. Ground water in the underlying Navajo Sandstone aquifer is not contaminated by tailings seepage from either the Union Carbide or North Continent site. Three water supply wells are upgradient or crossgradient from the processing sites. One of these wells is completed in the alluvium and lower formations. The other two are completed in the Navajo Sandstone. There are no known human uses of the contaminated ground water in the alluvium beneath or downgradient of either the Union Carbide or North Continent site.

3.2.10 Lowman, Idaho

The Lowman processing site is in Boise County, Idaho (population 3509), 0.5 mi (0.8 km) northeast of the unincorporated town of Lowman and 70 mi (112 km) north of Boise (DOC, 1990). The site is in the northern Rocky Mountains in heavily wooded terrain within the Boise National Forest. It is surrounded by ponderosa pine forest on the north, south, and east sides. Clear Creek, a perennial trout stream, forms the site's western boundary. Contaminated material from the processing site was deposited in a small portion of the Clear Creek floodplain and associated wetland. The principal land uses in the surrounding forest are logging, recreation, wildlife management, and livestock grazing. The site is characterized by a continental climate with dry, hot summers and cold winters. The average annual precipitation is 27 inches (69 cm); the average annual snowfall is 95 inches (241 cm) (DOE, 1991e). There are no known threatened or endangered species or historic or cultural resources at the site (DOE, 1991e).

A total of 128,000 yd^3 (98,000 m^3) on 30 ac (12 ha) was stabilized on the site in a 8.2-ac (3.3-ha) disposal cell. Surface remedial action was completed in June 1992.

The uppermost aquifer beneath the site consists of ground water in alluvium and weathered granodiorite. Depth to ground water varies from 27 to 78 ft (8.0 to 24 m) at the processing site. Ground water flows west-to-southwest along the alluvium/weathered granodiorite bedrock contact and discharges into Clear Creek. The estimated linear ground water velocity is approximately 55 ft (18 m) per year. Water quality analyses indicate none of the EPA maximum concentration limits are exceeded in the upgradient or downgradient monitor wells or in the tailings pore fluid. Therefore, the ground water beneath the site and the water discharging into Clear Creek does not contain contaminants that are the result of milling operations at the Lowman processing site. Residents in the village of Lowman obtain their water from wells in the deep granodiorite bedrock aquifer or from the South Fork Payette River, which flows through town (DOE, 1991e; 1991f).

3.2.11 Ambrosia Lake, New Mexico

The Ambrosia Lake UMTRA Project site is in McKinley County, New Mexico, approximately 20 mi (32 km) north of Grants. The population of the city of Grants is 8626; the population of McKinley County is 60,686 (DOC, 1990). The site is in the Ambrosia Lake Valley, a broad, elongated valley dominated by desert grassland plant communities with basalt-capped mesas to the north. An estimated 3,759,000 yd^3 (2,874,000 m^3) of contaminated material at the processing site and windblown area covered 612 ac (248 ha). Surface remediation consisted of stabilizing all contaminated material on the site in an 88ac (36ha) disposal cell. Remedial action was completed in June 1995.

The Ambrosia Lake site is in a sparsely populated area. Cultural resources have been identified near the site. The site lies within the drainage basin of Arroyo del Puerto, an intermittent stream 1.0 mi (1.6 km) southwest of the site. No permanent surface water bodies, including wetlands, are at or near the site. No threatened or endangered species are known to occur at or near the site. The Ambrosia Lake site is arid, with an average annual precipitation of 9.0 inches (23 cm) (DOE, 1987a).

The uppermost waterbearing unit beneath the Ambrosia Lake site consists of alluvium that grades into weathered Mancos Shale in the eastern portion of the site and into the Tres Hermanos-C Sandstone in the western portion of the site. Ground water in the alluvium and upper weathered bedrock is the result of uranium milling and mining activities in the area. This ground water occurs at depths ranging from 15 to 45 ft (5.0 to 14 m) and flows southwest at an estimated 15 ft (4.0 m) per year. It is unlikely that ground water from the alluvium would be used for drinking water due to its low yield, limited saturated extent, and poor quality.

Background water quality data are not available because the alluvium and upper bedrock did not contain water before the advent of uranium mining and milling in the area. Concentrations of molybdenum, nitrate, selenium, and uranium and activities of radium-226 and -228 have exceeded the maximum concentration limits in the alluvium and upper Mancos Shale ground water beneath the site at least twice since 1990. Ground water in the Tres Hermanos-C Sandstone unit has exceeded the maximum concentration limits of molybdenum, nitrate, selenium, uranium, and the activities of net gross alpha at least twice since 1990. The estimated amount of contaminated ground water at the Ambrosia Lake site is 320 million gal (1.2 million m^3). Ground water in aquifers below the Tres Hermanos-C unit does not appear to have been contaminated by seepage from the contaminated ground water units beneath the Ambrosia Lake site.

No domestic, stock watering, or irrigation wells are completed within the alluvium and upper weathered bedrock in the Ambrosia Lake Valley. This is not expected to change due to the low yield of water from these units.

3.2.12 Shiprock, New Mexico

The Shiprock UMTRA Project site is on Navajo Nation land in San Juan County, New Mexico, on the southeast edge of Shiprock (population, 7687). The county per capita income is $8911 and the population in the site vicinity is predominantly Native American (DOC, 1990). The residents of Shiprock use the public water system, which is supplied by the San Juan River.

Approximately 1,600,000 yd^3 (1,200,000 m^3) of contaminated materials on 130 ac (53 ha) were stabilized in a 72ac (29ha) disposal cell in the same location as the former milling operations. Remedial action was completed in September 1986. The site is arid, averaging 6.0 inches (15 cm) of precipitation and 4.1 inches (10.4 cm) of snowfall annually. Threatened and endangered species occur near the site, including wintering bald eagles along the river and the Mesa Verde cactus in the upland desert/shrub plant community. No historic resources occur at or near the site (DOE, 1984a).

The site is along the south side of the San Juan River on an elevated terrace about 50 ft (21 m) above the river. Bob Lee Wash traverses the west side of the site and flows into the floodplain of the San Juan River. This wash is ephemeral, except for the lower 600 ft (200 m) that receives a constant discharge of about 60 gal (200 L) per minute from a potable water artesian well west of the wash. This water has created wetlands within Bob Lee Wash and at the mouth of the wash where it discharges into the floodplain of the river. In addition, two seeps flow from the base of the escarpment below the disposal cell into the floodplain of the river. These seeps flow at an estimated rate of 0.3 to 1.0 gal (1.0 to 4.0 L) per minute. A canal and ditches in the floodplain contain water year-round. Other surface water and small wetland areas are in the San Juan River floodplain below the disposal cell.

Surface water and sediment samples from the San Juan River downgradient of the site and from Bob Lee Wash indicate site-related contaminants have not affected these waters. Water quality data from the two seeps show elevated concentrations of nitrate, sulfate, and uranium (DOE, 1993e).

The Shiprock disposal cell is on unconsolidated alluvial terrace deposits underlain by Mancos Shale. Ground water occurs at the contact between the terrace alluvium and the upper portion of the Mancos Shale, where it has been weathered. There are an insufficient number of water level measuring points to prepare a reliable ground water contour map, but perched ground water on the terrace is believed to follow paleochannels to the southwest and west. The ground water layer in the alluvium above the bedrock is thin (generally less than 3.0 ft [1.0 m]), and the rate of recharge to the monitor wells is slow. Ground water levels in the monitor wells continue to decrease. Ground water also moves through fractures in the Mancos Shale and seeps from the escarpment.

Background ground water quality has not been defined for the terrace alluvium and upper Mancos Shale because all monitor wells installed have intercepted contaminated ground water. Background ground water quality for the floodplain alluvium was defined by ground water quality north of the river. Uranium milling and processing activities have resulted in ground water contamination in the alluvium and upper Mancos Shale on the terrace and in the floodplain alluvium. The contaminated ground water in the river terrace alluvium and upper Mancos Shale beneath the site and in the floodplain alluvium along the river have exceeded the maximum concentration limits for cadmium, net gross alpha, nitrate, radium226 and 228, selenium, and uranium (DOE, 1993e). In addition, the maximum concentration limits for radium-226 and -228 exceed the maximum concentration limits in the contaminated ground water beneath the site. The volume of contaminated ground water is estimated to be 160 million gal (610,000 m^3).

3.2.13 Belfield, North Dakota

The Belfield, North Dakota, processing site is in Stark County. The Belfield site is 1.0 mi (1.6 km) south of the city of Belfield (population, 881) (DOC, 1990). The estimated amount of contaminated material is 58,000 yd^3 (44,000 m^3) on 31 ac (13 ha) of land. The once proposed remedial action alternative was to transport the contaminated material from the Belfield site 65 mi (104 km) to the Bowman site and stabilize all the material in a 12ac (5.0ha) disposal cell at Bowman. However, surface or ground water remedial action at these sites will not be completed at the request of the state.

The Belfield site is in the Northern Great Plains; the climate is semiarid. Annual temperature extremes are common; the recorded maximum and minimum temperatures are 105 degrees Fahrenheit (EF) (35 degrees Celsius [EC]) to 35EF (19EC). The average annual precipitation is almost 16 inches (41 cm), with an average annual snowfall of 30 inches (80 cm) (DOE, 1993f).

The Belfield site is in a light industrial use area just outside Belfield along the North Branch of the Heart River. Part of the contaminated land is in the floodplain of this river. The Heart River is a wooded draw with steep sides. It is 5.0 to 10 ft (2.0 to 3.0 m) wide with intermittent flow. Contaminated ground water from the site does not discharge into the Heart River in the site area. Cultural resources near the site have been identified and will undergo further study. No federally listed or candidate plant or animal species are known to occur in the site area. U.S. Army Corps of Engineers-designated wetlands occur along the Heart River near the site (DOE, 1993f).

Ground water occurs beneath the Belfield processing site in the fine-grained sediments and lignite layers. Depth to ground water ranges from 15 to 38 ft (5.0 to 12 m). Ground water flow is generally east. The average linear ground water velocity is 26 ft (7.0 m) per year. There is no evidence that contaminated ground water from the Belfield processing site is entering the Heart River, nor has ground water discharged to the land surface at this site. The volume of contaminated ground water at the Belfield site is an estimated 4.7 million gal (18,000 m^3).

Background ground water quality at the Belfield site exceeds the EPA drinking water standards for sulfate and total dissolved solids and the EPA maximum concentration limit for selenium. Contaminants have entered the shallow ground water, and concentrations of chromium, radium-226 and -228, molybdenum, selenium, and uranium exceed the maximum concentration limits. Because of the diffuse nature of the contaminant source, which originated from airborne ash, the development of a contaminant plume in ground water is insignificant. No evidence suggests site-related contaminants have entered deeper aquifers.

Ground water from the shallow aquifer system is used for limited stock watering and some domestic purposes but it is not a drinking water source. Water for most domestic uses is obtained from deep aquifers in the Belfield site area. The water supply for the city of Belfield is obtained from a 1000ft (300m) deep aquifer 1000 ft (300 m) upgradient from the Belfield UMTRA Project site (DOE, 1993f).

3.2.14 Bowman, North Dakota

The Bowman, North Dakota, site is in Bowman County, 7 mi (11 km) northwest of the city of Bowman (population, 1713) (DOC, 1990). A total of 128,000 yd^3 (98,000 m^3) of contaminated material on 71 ac (29 ha) will be cleaned up at the Bowman site. This contaminated material, along with contaminated ground water, will not be remediated at the request of the state.

The site is in a rural area surrounded by short-grass prairie and other grasslands used for grazing and dryland farming. One small ephemeral wetland occurs within the zone of contamination. The nearest permanent water bodies are a pond and stream 1200 ft (360 m) west of the site; these water bodies are not affected by the site. Historical structures from early 1900s settlements have been identified at the site and need further study. Two federal candidate species (ferruginous hawk and loggerheaded shrike) have been observed within 1.0 mi (1.6 km) of the site. U.S. Army Corps of Engineers-designated wetlands occur near the site (DOE, 1993f). The annual precipitation is the same as the Belfield site.

Ground water beneath the Bowman processing site occurs in fine-grained sediments and in lignite layers. Depth to ground water ranges from 6.0 to 20 ft (2.0 to 6.0 m), and flow is generally to the east. The average ground water velocity is 2.0 ft (0.7 m) per year at the Bowman site. There is no evidence of ground water discharge to the land surface.

Background ground water quality at the Bowman site exceeds the EPA drinking water standards for sulfate and total dissolved solids, as well as the EPA maximum concentration limits for chromium, selenium, and uranium. Contaminants from the Bowman site have entered the shallow ground water, and concentrations of chromium, radium-226 and -228, molybdenum, selenium, and uranium exceed the maximum concentration limits. The estimated amount of contaminated ground water at the Bowman site is 58 million gal (0.22 million m^3). There is no evidence that site-related contaminants have migrated into deeper aquifers.

Ground water from the uppermost aquifer is not used as a drinking water source but is used for limited stock watering and some domestic purposes. Public water for most uses is obtained from deep aquifers in the Bowman site area.

3.2.15 Lakeview, Oregon

The Lakeview processing site is in Lake County, Oregon, about 1.0 mi (1.6 km) north of the city of Lakeview. About 926,000 yd^3 (708,000 m^3) of contaminated material on 116 ac (47 ha) at the Lakeview processing site were stabilized off the site at the Collins Ranch disposal cell, 7.0 mi (11 km) northwest of Lakeview. Surface remedial action was completed in October 1989.

The Lakeview processing site is nearly surrounded by ranch lands. Two lumber mills to the southeast constitute most of the industrial facilities in the immediate area. The population is approximately 7200 in Lake County and 2500 in the city of Lakeview (DOC, 1990). No historic or prehistoric sites were reported in the vicinity of the processing site (DOE, 1985b).

Surface water bodies at the site include Hunters Creek and associated wetlands along the northern boundary of the site, Warner Creek just west of the site, the East Branch of Thomas Creek along the east and south boundaries, Hammersley Creek on the east side, and a pond near the site of the former mill buildings. Surface water and sediment samples from these water bodies indicate site-related contaminated ground water has not adversely affected the water or sediment quality. The Lakeview site is in a semiarid, high desert climate, with cool temperatures and an average annual precipitation of about 17 inches (43 cm). No threatened or endangered species are known to exist at or near the site; however, migrant species may find suitable habitat near the site (DOE, 1985b).

Ground water beneath the site occurs in an alluvial/lacustrine aquifer. The water table beneath the site generally occurs at a depth of 5.0 to 15 ft (1.5 to 4.6 m). Ground water moves south and southwest at approximately 50 to 160 ft (15 to 49 m) per year. Recharge to the alluvial/lacustrine aquifer is from precipitation and from surface water infiltration from nearby cold water and geothermal water streams. Ground water is withdrawn from agricultural, industrial, municipal, and domestic wells in the site vicinity and discharges into surface water channels that drain into Goose Lake, about 8.0 mi (13 km) south of the site.

Background ground water consists of low-temperature water and hot water from geothermal sources. The background ground water has exceeded maximum concentration limits for molybdenum, and radium-226 and 228 at least once. Arsenic, molybdenum, and net gross alpha have exceeded the maximum concentration limits in the alluvial/lacustrine aquifer beneath the processing site at least twice since 1990. Current information indicates a contaminant plume extends approximately 1500 ft (460 m) southwest from the processing site, as determined from sulfate and total dissolved solids concentrations (DOE, 1992c). The estimated amount of contaminated ground water at the Lakeview site is 1.2 billion gal (4.5 million m^3). Alluvial/lacustrine ground water is used for domestic, livestock watering, and industrial purposes in the processing site area.

3.2.16 Canonsburg, Pennsylvania

The Canonsburg site is in Washington County in western Pennsylvania. This site consists of the former processing site in the borough of Canonsburg, approximately 20 mi (32 km) southwest of downtown Pittsburgh. The Canonsburg disposal cell is surrounded on the north, south, and west by a buffer zone that separates it from nearby residential and commercial properties. The population of the borough of Canonsburg is 9200 (DOC, 1990). Approximately 172,000 yd^3 (132,000 m^3) of contaminated material on 30 ac (12 ha) were stabilized in an on-site disposal cell. Surface remedial action was completed in December 1985.

The Canonsburg site is in the humid continental climate region. The average annual precipitation is 37 inches (94 cm); the average annual snowfall is 45 inches (114 cm).

Chartiers Creek bounds the site on the north, east, and west sides. This creek is bordered by wooded riparian vegetation. The water quality of this creek is poor near the site as a result of sewage and industrial waste. Water samples and limited sediment samples indicate that site-related ground water has not adversely affected the water and sediment quality at Chartiers Creek. There are no known threatened or endangered species at the site. Within a 1.0mi (1.6km) radius of the Canonsburg site are two places that are listed on the National Register of Historic Places (DOE, 1983).

Ground water occurs in unconsolidated fill at a depth of 3.0 to 14 ft (1.0 to 4.0 m) and in the bedrock beneath the Canonsburg site. Ground water in both aquifers flows toward Chartiers Creek. Ground water recharge occurs from precipitation and underflow from upgradient areas. Uranium and net gross alpha have exceeded the maximum concentration limits at least twice since 1990. The estimated amount of contaminated ground water at the Canonsburg site is 5.3 million gal (20,000 m^3). In general, contaminant concentrations in ground water have decreased since post-closure monitoring started. Public water supplies are obtained from protected surface water sources upstream of the site (DOE, 1983).

The Burrell site is a vicinity property disposal cell associated with the Canonsburg site. It is in Indiana County, Pennsylvania, approximately 40 mi (64 km) east of downtown Pittsburgh and 50 mi (80 km) east-northeast of the Canonsburg site. At the Burrell site, 54,000 yd^3 (41,000 m^3) of contaminated material covering 49 ac (20 ha) were stabilized in place in a 6.0ac (2.4ha) disposal cell. Surface remedial action was completed in July 1987. Some radioactively contaminated materials were transferred to Burrell from the Canonsburg site from 1956 to 1957. The Burrell site is in a rural setting. Blairsville, the nearest borough, is approximately 0.75 mi (1.2 km) west of the site. The population is 3595 in the borough of Blairsville (DOC, 1990).

The average annual precipitation is 44 inches (112 cm), while the average annual snowfall is 45 inches (114 cm). The Burrell site is within the floodplain of the Conemaugh River. It is surrounded by abandoned fields on the north and east sides and the floodplain of the Conemaugh River on the west and south sides. A spring has created wetlands at the base of the south-facing slope of the disposal cell. This spring drains into the nearby Conemaugh River, which is contaminated by mine drainage, industrial pollution, and municipal wastewater discharge. A small wetland (less than 1.0 ac [0.4 ha]) has developed along the northern boundary of the disposal cell. There are no known threatened or endangered species at the site. Several historical resources are located within a 1.0mi (1.6km) radius of the site (DOE, 1983).

Ground water occurs in unconsolidated fill at depths greater than 30 ft (9.0 m) and in the bedrock beneath the site. It flows south toward the Conemaugh River. Surface water samples indicate that constituents associated with the Burrell disposal cell have not entered the Conemaugh River or the wetlands on the south side of the cell. Water samples have not been collected from the wetlands along the north side of the cell. Sediment samples have not been collected from any water bodies near the site. Domestic water supplies for the surrounding population are from protected surface water sources (DOE, 1983).

3.2.17 Falls City, Texas

The Falls City, Texas, site is in Karnes County, 46 mi (74 km) south of San Antonio and 8.0 mi (13 km) southwest of Falls City. During surface remedial action, 593 ac (240 ha) of land and 5,764,000 yd^3 (4,407,000 m^3) of contaminated material are being cleaned up at this site. Contaminated material covered 593 ac (240 ha) of land at this site. The contaminated material was stabilized on the site in a 127-ac (51-ha) disposal cell. Surface remedial action began in 1992 and the disposal cell was completed in June 1994.

The Falls City site is in a rural setting. Grazing is the principal land use for the mesquite-dominated woodlands around the site. The area around the Falls City site is sparsely populated. Falls City, the nearest town, had an estimated population of 497 in 1990 (DOC, 1990). Cultural resource surveys identified prehistoric sites within a 5.0mi (8.0km) radius of the site. However, cultural resource surveys were not required at the processing or borrow sites because of previous major disruption to the area (DOE, 1991g).

Surface water bodies that occur on-site or at the site boundary are Tordilla and Scared Dog Creeks, which are intermittent streams, and a pond along the south end of what had been tailings pile number three. Small wetlands occur at these water bodies. Four additional ponds are within 3000 ft (900 m) of the site. Water samples from the surface water bodies indicate site-related contaminated ground water has not adversely impacted water quality. Limited sediment, vegetation, and fish samples from the on-site surface water bodies indicate site-related contaminated ground water likely has not contaminated these media. However, further sampling, including the collection of background samples, is needed to verify this.

The climate at the site is considered subtropical, with hot summers and mild winters. High humidity is typical, and the average annual precipitation is 30 inches (76 cm). No federally listed threatened and/or endangered species occur in the site area. Extensive field surveys determined that none of the state-designated threatened and/or endangered species that may occur in Karnes County occur at the site (DOE, 1991g). However, subsequent observations during remedial action show the Texas horned lizard occurs at the site. In addition, the Texas tortoise and indigo snake may occur in the site area.

Two low-yield aquifers have been identified in the upper 200 ft (60 m) of the clastic sedimentary strata underlying the site. These aquifers are separated by 30 to 50 ft (27 to 46 m) of clay. However, because improperly abandoned exploratory boreholes form a potential hydraulic interconnection between these two aquifers, they are considered together, as the uppermost aquifer. Shallow ground water in the uppermost aquifer occurs at depths of 5.0 to 30 ft (1.5 to 9.0 m) below land surface. The maximum average linear ground water velocity is approximately 130 ft (40 m) per year, and the aquifers yield small amounts of water (1.0 to 2.0 gal per minute) (0.06 to 0.12 L per second). The site is bisected by a drainage divide; the shallow ground water flows primarily northeastward and southwestward, paralleling intermittent drainages. Shallow ground water may discharge into these intermittent drainages from ephemeral seeps. The uppermost aquifer is underlain by a 300ft (100m) thick formation of clay and lignite seams that prevents the downward migration of contaminants.

Background water quality is highly variable with depth and location because it occurs within the uranium ore body. The background ground water is classified as limited use, based on high average uranium concentrations and activities of net gross alpha and radium that render the water untreatable by methods reasonably employed by public water systems in the region (DOE, 1992d).

Tailings fluids have migrated into the uppermost aquifer; as a result, concentrations of arsenic, cadmium, chromium, lead, mercury, molybdenum, net gross alpha, nitrate, radium-226 and 228, selenium, and uranium have exceeded the maximum concentration limits at least twice since 1990. However, because the background ground water is of poor quality, this water is of limited use for stock watering and is of no use for any other purpose. The estimated amount of contaminated ground water at the Falls City site is 1.2 billion gal (4.5 million m^3). Because area residents currently do not use the Deweesville/Conquista ground water, human health is not at risk from direct ground water use (DOE, 1994f). Potable water is obtained from one domestic well more than 800 ft (240 m) deep and a water cooperative's well 2000 ft (600 m) deep (DOE, 1991g; 1991h, 1994f).

3.2.18 Green River, Utah

The Green River processing site is in Grand County, Utah, 1.0 mi (1.6 km) southeast of the city of Green River. The site is partially in the floodplain of Brown's Wash, an intermittent tributary of the Green River. The tailings pile covered 8.0 ac (3.0 ha); an additional 40 ac (16 ha) were contaminated with tailings. An estimated 382,000 yd^3 (292,000 m^3) of contaminated material were placed in a 6.0ac (2.0ha) disposal cell on the site. Surface remediation was completed in October 1989.

The Green River disposal cell is on a terrace above Brown's Wash. This wash is approximately 800 ft (240 m) north of the cell. The original tailings pile was in the floodplain of Brown's Wash, along the southern border of the wash. The wash flows only during periods of heavy precipitation and is dry for most of the year. However, pools of water that may be created by the discharge of contaminated ground water into Brown's Wash are often present downstream of the site. Sampling over the years has shown that these pools contain elevated concentrations of nitrates, selenium, uranium, and other constituents that have the potential to be harmful to aquatic and terrestrial organisms. The Green River is about 2000 ft (610 m) west of the site and surface water samples from the river indicate that site-related contaminated ground water is not adversely affecting surface water quality.

The site is in a sparsely populated area. The population of the city of Green River is 881; the population in Grand County is 6620 (DOC, 1990). Two cultural resource sites near the processing site are eligible for inclusion on the National Register of Historic Places. The Green River site is arid; the average annual precipitation is 6.0 inches (15 cm), with an average annual snowfall of 10 inches (25 cm). No threatened or endangered species occur at or near the site (DOE, 1988).

Four distinct water-bearing units occur at the Green River site: the alluvium of Brown's Wash and the upper, middle, and lower Cedar Mountain Formation aquifers. The Brown's Wash alluvial aquifer is limited to 300 to 400 ft (90 to 120 m) on each side of the wash and is up to 35 ft (11 m) thick. Depth to ground water ranges from 9.0 to 17 ft (3.0 to 5.0 m) below ground surface. Ground water in this unit flows west, parallel with the wash toward the Green River, at a velocity ranging from 0.6 to 2.0 ft (0.2 to 0.7 m) per day. The alluvial aquifer is recharged from underflow and by infiltration of surface runoff in the channel of Brown's Wash.

Ground water in the upper Cedar Mountain aquifer flows west toward the Green River at a velocity ranging from 4.0 to 260 ft (1.0 to 70 m) per year. Ground water is about 26 ft (8.0 m) deep at the old tailings pile area. Ground water in this unit is recharged by the overlying alluvial aquifer and the underlying middle Cedar Mountain aquifer.

The middle Cedar Mountain aquifer flows west toward the Green River. This aquifer is an estimated 60 ft (20 m) deep beneath the old tailings pile area; however, there is a strong upward gradient between this unit and the overlying aquifers. Due to fracturing, this aquifer likely is connected to the upper Cedar Mountain aquifer. Because of an overlying confining layer and a strong upward hydraulic gradient, the lower Cedar Mountain aquifer is not recharged by the aquifers above it.

In background ground water of the alluvial aquifer, chromium, molybdenum, net gross alpha, nitrate, and selenium have exceeded maximum concentration limits. Concentrations of net gross alpha, nitrate, and selenium in the background ground water in the upper Cedar Mountain aquifer have exceeded the maximum concentration limits. Concentrations of molybdenum, nitrate, selenium, uranium, and net gross alpha have exceeded the maximum concentration limits in background ground water of the middle Cedar Mountain aquifer. Analysis of background ground water in the lower Cedar Mountain aquifer indicates levels of chromium, molybdenum, and selenium exceed the maximum concentration limits. The estimated amount of contaminated ground water at the Green River site is 180 million gal (0.68 million m^3).

Seepage of hazardous constituents from the former tailings pile area has contaminated the alluvial and upper Cedar Mountain aquifers. Net gross alpha and radium-226 and -228 activity and concentrations of molybdenum, nitrate, selenium, and uranium have exceeded the maximum concentration limits beneath and downgradient of the former tailings pile at least twice since 1990. The extent of contamination is confined to these two aquifers by strong upward hydraulic gradients between the upper Cedar Mountain aquifer and the underlying aquifers.

There are no known uses of the ground water at or near the Green River processing site. The city of Green River uses water from the Green River, upriver of the tailings site, for its water supply (DOE, 1988).

3.2.19 Mexican Hat, Utah

The Mexican Hat processing site is in the Navajo Nation in San Juan County, Utah. The village of Halchita is approximately 0.5 mi (0.8 km) from the site, and the estimated population is approximately 500. The per capita income in the county is $5907 and the population is 54 percent Native American (DOC, 1990). The village of Mexican Hat, Utah, is 2.0 mi (2.2 km) from the site, and the estimated population is 43 (DOE, 1987b). This site consisted of two tailings piles totaling 69 ac (28 ha). An estimated 2,810,000 yd^3 (2,150,000 m^3) of contaminated material are contained in these two tailings piles and on an additional 250 ac (101 ha) of adjacent land. The contaminated material at this site and contaminated material from the Monument Valley, Arizona, processing site are being stabilized in a 72ac (29ha) disposal cell at the Mexican Hat site. Surface remediation was completed by January 1995.

The climate is arid with an average annual precipitation of 6.0 inches (15 cm). The Mexican Hat site is in a rural setting surrounded by desert shrub habitat. The site is adjacent to an unnamed intermittent arroyo (called the North Arroyo) that is a tributary to Gypsum Creek, a larger ephemeral arroyo that, when flowing, empties into the San Juan River. The site is approximately 1.0 mi (1.6 km) from the San Juan River. There are no known threatened or endangered species or historic resources at or near the processing site (DOE, 1987b). The population of San Juan County is 12,621 (DOC, 1990).

During construction of the Mexican Hat disposal cell, seeps were discovered in the North Arroyo. In Gypsum Creek northeast of the site, naturally occurring seeps are present. The North Arroyo and Gypsum Creek seeps discharge site-related contaminated ground water with concentrations or activities of nitrate, molybdenum, selenium, uranium, net gross alpha, and radium-226 and 228 that have exceeded EPA maximum concentration limits at various times in the past (DOE, 1993d). Surface water samples from the San Juan River indicate that if the site-related contaminated ground water is discharging into the river, it is not adversely affecting water quality.

The tailings site is on top of the Halgaito Shale outcrop. Ground water beneath the Mexican Hat site occurs in the Halgaito Shale and the underlying Honaker Trail Formation. Perched water in the Halgaito Shale occurs only as a result of uranium milling operations. It is only in a localized area of saturation beneath the site at a depth ranging from 35 to 60 ft (11 to 18 m). Perched water in the Halgaito Shale generally flows northeast, and is controlled by the structural dip and fractures in the Halgaito Shale. The water discharges with very low flow rates (less than 1.0 gal [4.0 L] per minute) into isolated seeps in the North Arroyo. Gypsum Creek seeps flow intermittently.

The Honaker Trail Formation is considered the uppermost aquifer at the site. The Honaker Trail Formation occurs at a depth of 100 to 150 ft (30 to 50 m) beneath the site; ground water in this formation flows at an average velocity of 4.0 ft (1.0 m) per year. This ground water flows generally northeast. Recharge of this unit occurs at higher elevations, and it discharges to seeps in Gypsum Creek or as underflow to the northeast. The occurrence of a thick lowpermeability unit and an upward hydraulic gradient has prevented contaminated water from the Halgaito Shale from entering the Honaker Trail Formation aquifer.

Because the ground water in the Halgaito Shale occurs as a result of milling operations, background ground water quality could only be defined from seeps isolated from site-related contamination. Background ground water in the Honaker Trail Formation shows maximum observed concentrations of arsenic, chromium, net gross alpha, radium226 and 228, selenium, and uranium that have exceeded maximum concentration limits (DOE, 1993d). Ground water in the Halgaito Shale has concentrations of arsenic, chromium, and nitrate that have exceeded the maximum concentration limits at least twice since 1990. The estimated amount of contaminated ground water at the Mexican Hat site is 110 million gal (0.42 million m^3).

There are no records of past or current users of the ground water from these two formations in the Mexican Hat site area. Domestic water for Halchita is supplied by a treatment facility that obtains water from the San Juan River. The Mexican Hat water supply is from a converted oil exploration well and the San Juan River (DOE, 1987b; 1993d).

3.2.20 Salt Lake City, Utah

The Salt Lake City processing site is in Salt Lake County, Utah, 4.0 mi (6.0 km) south-southwest of the center of Salt Lake City. A total of 2,710,000 yd^3 (2,070,000 m^3) of tailings was removed from 128 ac (52 ha) on this site and transported to the South Clive disposal site, 85 mi (136 km) west of Salt Lake City. Surface remedial action was completed in June 1989.

The Salt Lake City processing site is in an urban area, bounded by a sewage treatment plant on the north, a railroad on the east, and city streets on the south and west. The population of Salt Lake County is 725,956; the population of Salt Lake City is 159,936 (DOC, 1990). The site is close to the Jordan River (1500 ft [460 m] west of the site) and Mill Creek, a perennial stream that flows along the site's northern boundary. In addition, an irrigation ditch (South Vitro Ditch) traverses the site and a small wetland is just east of the site. Surface water samples indicate that the site-related contaminated ground water has not adversely affected water quality. Limited sediment sampling indicates that the South Vitro Ditch may have high levels of molybdenum while the remaining samples showed no adverse effects from site-related contamination. The Salt Lake City site has a semiarid climate, receiving an average annual precipitation of 15 inches (38 cm); the average annual snowfall is 59 inches (150 cm) (DOE, 1984b). There are no threatened or endangered species or cultural resources at or near the processing site (DOE, 1984b).

An unconfined aquifer approximately 45 ft (14 m) thick and composed of sand, silt, and clay is the uppermost aquifer under the processing site. The major sources of recharge for this aquifer are infiltration of precipitation and upward leakage from the lower confined aquifer. Water levels of the unconfined aquifer beneath the site range from 5.0 to 15 ft (1.5 to 5.0 m). This aquifer flows primarily toward the northwest and discharges into surface water bodies such as Mill Creek and the Jordan River. The estimated ground water velocity is 170 ft (50 m) per year.

Background water has a total dissolved solids content ranging from 300 to 550 mg/L, and sulfate levels ranging from 2.0 to 6.0 mg/L. Arsenic has exceeded the maximum concentration limit in most background ground water samples. A contaminant plume exists beneath the site, and molybdenum, net gross alpha, and uranium have exceeded the maximum concentration limits in some on-site and downgradient monitor wells at least twice since 1990. The estimated amount of contaminated ground water at the Salt Lake City site is 350 million gal (1.3 million m^3).

There is no evidence that contaminants derived from uranium processing have entered the lower confined aquifer beneath the site, undoubtedly due to the upward gradient between the lower confined and unconfined aquifers. Because of its poor quality and minimal well yield the upper aquifer has very limited potential use for domestic or agricultural purposes (DOE, 1993g). Residents of Salt Lake City obtain water from a municipal supply system that is upgradient of the processing site. However, the city of South Salt Lake is planning to install a water supply well within the site boundary. This well will draw water from an uncontaminated aquifer below the site.

3.2.21 Riverton, Wyoming

The Riverton, Wyoming, site is in a rural setting 2.0 mi (3.0 km) southwest of the city of Riverton in Fremont County. The per capfta income in the county is $9806 and the population in the site vicinity is predominantly Native American (DOC, 1990). The site is on private land within the boundary of the Wind River Indian Reservation (Northern Arapaho and Shoshone Indian Tribes). Contaminated material totaling 1,793,000 yd^3 (1,371,000 m^3) was on 140 ac (57 ha) of land at the processing site and at off-site vicinity properties. All the contaminated material was transported 45 mi (72 km) to the Gas Hills uranium district, consolidated into an active uranium tailings pile, and stabilized. Surface remedial action at the Riverton site was completed in November 1989.

The Riverton site is on alluvial deposits between the Wind River, 1.0 mi (1.6 km) to the north, and the Little Wind River, 0.5 mi (0.8 km) southeast of the site. The confluence of these two rivers is 2.5 mi (4.0 km) east of the site. The site is bordered by drainage ditches and irrigation canals on the north, east, and southwest sides. Wetlands are nearby to the east and southwest. Surface water and sediment samples from the drainage ditches and wetlands indicate that the site-related contaminated ground water has not adversely affected these bodies of water. Elevated levels of uranium were detected in a side channel of the Little Wind River, which may represent the discharge of site-related contaminated ground water. The predominant land use in the site vicinity is agricultural; the primary crop is hay grown on irrigated fields. Cultural resources identified at the site are extensive and are considered eligible for listing on the National Register of Historic Places. No known threatened and/or endangered species exist at the site (DOE, 1987c).

A sulfuric acid plant that was used during the former uranium milling is still in operation near the site boundary. Residences exist along the north, south, southeast, and east boundaries of the site. The population of the city of Riverton is 9202, and Fremont County has a population of 33,662 (DOC, 1990). The climate is arid, with an average annual precipitation of almost 8.0 inches (20 cm); the average annual snowfall is almost 36 inches (91 cm) (DOE, 1987c).

Two ground water systems occur in the vicinity of the Riverton processing site. The uppermost aquifer consists of unconfined ground water in the shallow alluvial deposits and the hydrologically connected semiconfined sandstone unit of the Wind River Formation. The second system contains confined ground water in the deeper sandstone layers of the Wind River Formation. Depth to water in the uppermost aquifer is approximately 6.0 ft (2.0 m) below the site; the aquifer has an average saturated thickness of 50 ft (15 m). Ground water flow in the uppermost aquifer is predominantly to the southsoutheast toward the Little Wind River. Water from this aquifer discharges into this river approximately 2800 ft (850 m) downgradient of the site and probably to the wetlands east and southwest of the site. The estimated ground water velocity is 160 ft (50 m) per year. Recharge to the uppermost aquifer is from precipitation, snowmelt, and ephemeral and perennial creeks.

Background water quality data from the uppermost aquifer system show that chromium exceeded the maximum concentration limit in one well once. Molybdenum, net gross alpha, selenium, radium-226 and -228, and uranium have exceeded the maximum concentration limits at various times in onsite and downgradient monitor wells in the uppermost aquifer. Molybdenum, net gross alpha, radium226 and 228, and uranium have exceeded maximum concentration limits in on-site and downgradient ground water at least twice since 1990. Plume movement is in the direction of ground water flow, which is to the south-southeast. The estimated amount of contaminated ground water at the Riverton site is 500 million gal (1.9 million m^3). Surface water samples from the Little Wind River downgradient of the processing site contained detectable concentrations of net gross alpha, radium226 and -228, and uranium, but these all were below the maximum concentration limits.

The uppermost aquifer is of low quality. Only two wells in the area of the processing site are known to be completed in this unit. One is located about 200 ft (60 m) upgradient of the site and the other is 2000 ft (600 m) downgradient along the boundary of the contaminant plume. Both wells are used for livestock watering. There are no known domestic water supply wells in this aquifer system in the site area. The confined aquifer is of good quality and is used for domestic water supplies in the area (DOE, 1987d).

3.2.22 Spook, Wyoming

The Spook UMTRA Project site is on private ranch land in central Wyoming in Converse County. The site is approximately 48 mi (77 m) northeast of Casper, Wyoming. A total of 315,000 yd^3 (241,000 m^3) of contaminated material was on 21 ac (8.0 ha) at the site. In addition, 1,600,000 yd^3 (1,200,000 m^3) of overburden material from open pit uranium mines on 115 ac (47 ha) were on the site. All the contaminated and overburden material was stabilized in an on-site open pit mine. Surface remedial action was completed in November 1989 (DOE, 1989c).

The Spook site is in rolling sagebrush and grassland terrain and is surrounded by cattle and sheep ranches. Approximately 1.0 mi (1.6 km) south of the Spook site is the Dry Fork of the Cheyenne River, an ephemeral tributary that supports a large stand of mature cottonwood trees and other stream-side vegetation. The nearest residence is a ranch house 1.4 mi (2.3 km) southwest of the site. The population is 11,128 in Converse County (DOC, 1990). The climate is arid, with an average annual precipitation of 11 inches (28 cm). The average annual snowfall is 74 inches (190 cm) (DOE, 1989c).

The Spook site has suitable habitat for three migratory birds of federal interest, and the endangered bald eagle roosts in wooded areas throughout northern Wyoming. The State Historic Preservation Officer does not consider the few cultural resources within a 270 ac (109 ha) radius of the site eligible for the National Register of Historic Places (DOE, 1989c).

Ground water in the uppermost aquifer beneath the Spook site occurs within the Wasatch Formation in a sandstone unit that ranges from 40 to 120 ft (12 to 40 m) deep. There is no evidence of ground water discharge to the surface in the site vicinity. Ground water flows predominantly northeast. The average ground water velocity in the upper aquifer is 150 ft (37 m) per year.

Background ground water quality in this aquifer is affected by naturally occurring mineralization related to the uranium ore body. Concentrations of uranium and selenium in the background ground water exceed the regulatory limits. Contaminants in the ground water beneath the processing site and downgradient that exceed the maximum concentration limits are cadmium, chromium, molybdenum, net gross alpha, nitrate, radium-226 and -228, selenium, silver, and uranium at least twice since 1990. The contaminant plume extends 2500 ft (1200 m) downgradient from the tailings pile. The estimated amount of contaminated ground water at the Spook site is 1.0 billion gal (3.8 million m^3). Ground water in the underlying lower sandstone aquifer is not contaminated from the milling operations.

The ground water in the uppermost aquifer is considered limited use ground water because it is not a current or potential source of drinking water, and it contains widespread ambient uranium and selenium contamination from natural sources.

The lower sandstone aquifer is used as a drinking water source beyond the site area. This aquifer has not been contaminated by tailings seepage or by naturally occurring contaminants (DOE, 1989c).

Table 3.1 UMTRA Project surface remedial action status

UMTRA Project Site	Surface remedial action completion date	On-site disposal	Off-site disposal	Cubic yards of contaminated materials (thousands)	Cubic meters of contaminated materials (thousands)	Acres of contaminated land	Hectares of contaminated land	Estimated amount of contaminated ground water[a]	
								Gallons (millions)	Cubic meters (thousands)
Monument Valley, AZ	5/94		X	942	720	83	34	1200	4,500
Tuba City, AZ	5/90	X		785	600	327	132	780	3,000
Durango, CO	5/90		X	2534	1937	127	51	100	380
Grand Junction, CO	8/94		X	4655	3559	114	46	330	1,300
Gunnison, CO	12/95		X	719	550	68	28	1900	7,000
Maybell, CO	7/97[b]	X		3500	2700	214	87	230	870
Naturita, CO	9/97[b]		X	547	418	247	100	100	380
Old Rifle, CO	10/96		X	661	505	88	36	70	260
New Rifle, CO	10/96		X	3474	2656	238	96	600	2,300
UC Slick Rock, CO	12/96[b]		X	488	373	92	37	26	100
NC Slick Rock, CO	12/96[b]		X	85	65	47	19	12	50
Lowman, ID	6/92	X		128	98	30	12	0	0
Ambrosia Lake, NM	6/95	X		3759	2874	612	248	320[c]	1,200
Shiprock, NM	9/86	X		1600	1200	130	53	160	610
Belfield, ND	-[d]		X	58	44	31	13	4.7	18
Bowman, ND	-[d]	X		128	98	71	29	58	220
Lakeview, OR	10/89		X	926	708	116	47	1200	4,500
Canonsburg, PA[e]	12/85	X		226	173	79	32	5.3	20

Falls City, TX	6/94	X		5764	4407	593	240	1200	4,500
Green River, UT	10/89	X		382	292	48	19	180	680
Mexican Hat, UT	1/95	X		2810	2150	250	101	110[c]	420
Salt Lake City, UT	6/89		X	2710	2070	128	52	350	1,300
Riverton, WY	11/89		X	1793	1371	140	57	500	1,900
Spook, WY	11/89	X		315	241	21	8	1000	3,800
Total		11	13	38989	29809	3894	1577	10,436	39,318

[a]From TAC, 1995.
[b]Anticipated completion date.
[c]Areas of saturation of contaminated ground water in geologic formations beneath the site that previously did not contain ground water.
[d]At the request of the state, DOE plans to revoke the designation of these two sites and surface remediation will not take place
[e]Includes Burrell, Pennsylvania, vicinity property disposal cell volume and area.
UC-Union Carbide. NC-North Continent.

Table 3.2 Resources at UMTRA Project processing sites

UMTRA Project Site	Site characteristics								
	Tribal lands	Setting			Annual precipitation (inches/cm)	Wetlands	Surface water	Cultural resources	Threatened and endangered species
		Urban	Suburban	Rural					
Monument Valley, AZ	X			X	6/15	X	X	X	
Tuba City, AZ	X			X	6/15				
Durango, CO			X		19/48		X		X
Grand Junction, CO		X			8/20	X	X		X
Gunnison, CO			X		11/28	X	X		X
Maybell, CO				X	13/33	X	X	X	X
Naturita, CO				X	9/23	X	X	X	X
Old Rifle, CO			X		11/28	X	X		X
New Rifle, CO			X		11/28	X	X		X
Slick Rock, CO (Union Carbide)				X	7/18	X	X	X	X
Slick Rock, CO (North Continent)				X	7/18	X	X	X	X
Lowman, ID				X	27/69	X	X		
Ambrosia Lake, NM					9/23			X	
Shiprock, NM	X				6/15	X	X		X
Belfield, ND			X		16/41	X	X	X	X
Bowman, ND				X	16/41	X	X	X	X
Lakeview, OR			X		17/43	X	X		
Canonsburg, PA		X			37/94		X	X	
Falls City, TX				X	30/76	X	X		X
Green River, U T				X	6/15		X	X	
Mexican Hat, UT	X			X	6/15	X	X		

Salt Lake City, UT		X			15/38	X	X		
Riverton, WY	X[a]			X	8/20	X	X	X	
Spook, WY				X	11/28		X		X
Total	5	3	7	14		18	22	11	14

[a]Tribal lands adjacent to the site.

Table 3.3 Constituents that have exceeded UMTRA Project maximum concentration limits at least twice in ground water beneath UMTRA Project processing sites (19901995)

UMTRA Project Site[b]	Hazardous constituent[a]													
	Off-site migration	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Molybdenum	Net gross alpha	Nitrate	Radium-226/228	Selenium	Silver	Uranium
Monument Valley, AZ	X								X	X	X			X
Tuba City, AZ	X							X	X	X	X	X		X
Durango, CO				X		X		X	X		X	X		X
Grand Junction, CO	X							X	X					X
Gunnison, CO	X								X		X			X
Maybell, CO		X		X				X	X	X	X	X		X
Naturita, CO	X	X						X	X		X	X		X
Old Rifle, CO	X	X						X	X		X	X		X
New Rifle, CO	X	X		X				X	X	X	X	X		X
Slick Rock, CO (UC)	X							X	X	X	X	X		X
Slick Rock, CO (NC)	X								X		X			X
Lowman, ID														
Ambrosia Lake, NM[c]	X							X	X	X		X		X
Shiprock, NM	X			X					X	X	X	X		X
Lakeview, OR	X	X						X	X					
Canonsburg, PA									X					X
Falls City, TX	X	X		X	X	X	X	X	X	X	X	X		X
Green River, UT								X	X	X	X	X		X
Mexican Hat, UT[c]	X	X			X					X				

Salt Lake City, UT	X							X	X					X
Riverton, WY	X							X	X		X			X
Spook, WY	X			X	X			X	X	X	X	X	X	X
Total	18	7	0	6	3	2	1	15	20	11	15	12	1	19

[a]Some of the constituents that exceed the maximum concentration limits may be naturally occurring and not from uranium milling activities. For regulatory compliance purposes, the mean exceedance would be used with all alternatives except no action.

[b]The Belfield and Bowman, North Dakota, processing sites are not shown. They will not be remediated by DOE since the state has declined to provide their statutorily required cost-sharing to remediate the sites.

[c]Areas of saturation of contaminated ground water were created in geological formations beneath the site that previously did not contain ground water.

UC- Union Carbide. NC- North Continent.

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4.0 ENVIRONMENTAL IMPACTS

This section analyzes the potential impacts associated with the alternatives for implementing the Ground Water Project. These alternatives, except the no action alternative, implement one or more of three strategies for complying with the EPA ground water standards (Table 4.1).

These strategies are described below:

- Active ground water remediation- This includes methods such as gradient manipulation, ground water extraction, and in situ ground water treatment. Section 2.8 summarizes active ground water remediation methods. This strategy would be used with both the proposed action and active remediation to background levels alternative.
- Passive ground water remediation by natural flushing—Natural flushing is described in Sections 1.4.1 and 2.8.2. This strategy would be used under the proposed action as well as the passive remediation alternative.
- No ground water remediation- In this PEIS, this strategy is considered in two parts: first, "no remediation" sites that do not have ground water contamination above maximum concentration limits and/or background levels, and second, "no remediation" sites that have ground water contamination above maximum concentration limits and/or background levels but qualify for supplemental standards or alternate concentration limits. In the first part of this strategy, site characterization may cause minor environmental impacts, with no impacts expected from implementation. Therefore, this part of the "no remediation" strategy is not considered further in this PEIS. Some minor environmental impacts may result from implementing the second part of this strategy; therefore, these environmental impacts are analyzed in Section 4.2.3 of this PEIS. This strategy would be used for all the alternatives except the no action alternative.

This PEIS differs substantially from a site-specific environmental impact statement because multiple ground water compliance strategies, each with its own set of potential impacts, could be used to implement all the alternatives except the no action alternative. In a traditional environmental impact statement, an impacts analysis leads directly to the defined alternatives. The impacts analysis for implementing alternatives in this PEIS first involves evaluating a ground water compliance strategy or strategies (Figure 4.1), the use of which would result in site-specific impacts. This PEIS impacts analysis assesses only the potential impacts of the various ground water compliance strategies, then relates them to the alternatives to provide a comparison of impacts.

The potential impacts of site characterization are analyzed in Section 4.1. Site characterization is used to help determine the site-specific ground water compliance strategies for the alternatives being evaluated. Impacts analyses for the ground water compliance strategies are presented in Section 4.2, followed by the potential impacts of the no action alternative in Section 4.3. The comparison of alternatives (Section 4.4) and the cumulative impacts analysis (Section 4.5) follow the analysis of the no action alternative.

The following categories were analyzed for potential impacts:

- Human health
- Air quality

- Surface water
- Ground water
- Ecological resources
- Land use
- Cultural/traditional resources
- Background noise
- Visual resources
- Transportation
- Social and economic resources
- Environmental justice
- Utilities and energy resources
- Waste management
- Estimated costs.

Mitigation of the potential impacts analyzed in this section are discussed under each appropriate resource category subheading. Descriptions of the mitigation measures are general. For example, contaminated wastewater produced during ground water remediation would be treated to meet the requirements of a National Pollutant Discharge Elimination System (NPDES) Permit before the water is released into the environment. Other examples are mitigation plans for impacts that may occur to archeological resources or threatened and endangered species. Under all the alternatives except no action, when a site-specific ground water compliance strategy is proposed, its environmental impacts would be assessed in the site-specific environmental documents and specific mitigation measures would be recommended.

Table 4.1 Ground water compliance strategies that apply under each alternative

Strategy	Alternative			
	Proposed action	No action[a]	Active remediation to background levels	Passive remediation
Active ground water remediation methods	X		X[b]	
Natural flushing [c]	X			X
No ground water remediation				
- Sites that qualify for supplemental standards [d] or alternate concentration limits[e].	X			X
- Sites that meet maximum concentration limits or background levels (no impacts).[f]	X			X

[a]The analysis of the no action alternative is required by the CEQ and DOE.

[b]Active remediation methods would not be used at sites where contamination does not exceed background and likely would not be used at sites that qualify for supplemental standards based on the existence of limited use ground water.

[c]Natural flushing means allowing the natural ground water movement and geochemical processes to decrease contaminant concentrations.

[d]Supplemental standards applicable for certain site conditions, as identified in the EPA standards, that are protective of human health and the environment, and may be applied in lieu of prescriptive levels.

[e]Concentrations of contaminants that may exceed the maximum concentration limits; or, limits for those constituents without maximum concentration limits. If DOE demonstrates, and NRC concurs, that human health and the environment would not be adversely affected, DOE may meet an alternate concentration limit.

[f]"No remediation" at sites that do not exceed maximum concentration limits or background levels is not the same as "no action" because these sites would require activities such as site characterization to show that no remediation is warranted.

4.1 SITE CHARACTERIZATION AND MONITORING IMPACTS ANALYSES

Ground water characterization would be performed to describe the ground water characteristics at the UMTRA Project sites. This characterization would take place under all the alternatives except the no action alternative. Site characterization data would also be used to prepare and/or update the site-specific risk assessments. These risk assessments, ground water characterization, and input from affected tribes, states, and public would be used to determine the appropriate ground water compliance strategy. Monitoring would take place to determine the effectiveness of the ground water compliance strategy and to protect human health.

Field site characterization activities would consist primarily of drilling boreholes and installing monitor wells; sampling ground water, surface water, soil, and other media; and conducting geophysical surveys and aquifer tests. Some of these activities, such as drilling boreholes, would require clearing small amounts of land (e.g., less than 1.0 ac [0.4 ha]) and developing or improving access roads to site areas (if necessary), while other activities such as collecting surface water samples would not result in any environmental disturbance. The potential environmental impacts associated with these types of field activities discussed below are based on the descriptions of site characterization activities in Section 2.8. Table 4.2 summarizes field activities that could affect the environment.

No disproportionally high or adverse human health or environmental effects would occur to minority or low-income populations due to site characterization or monitoring because the impacts of site characterization are minor or nonexistent.

Table 4.3 summarizes the potential impacts of site characterization and monitoring activities. Impacts associated with these activities are minor and generally short-term. The construction and use of access roads may generate dust, which may require the use of dust suppressants. Site characterization aquifer tests may pull contaminated ground water into uncontaminated areas; these tests would be conducted in areas where the possibility of such an impact is remote. Potential impacts on ecological or cultural/traditional resources would also be unlikely because site characterization facilities would be located away from sensitive areas such as wetlands or archaeological sites. Potential visual impacts may arise from the long-term use of monitor wells. However, these potential impacts could be reduced by using flush-mounted monitor wells or landscaping. There is the potential for the active remediation to background levels alternative to have a greater chance of affecting resources in the floodplain of rivers due to its reliance on the active ground water remediation strategy. However, these potential impacts could be mitigated by conducting activities outside the floodplain or implementing erosion control measures. The potential for site characterization activities to impact the remaining resources listed in Table 4.3 is also unlikely.

Table 4.2 Hydrogeolic data collection activities and potential environmental effects

Field activity	Objective	Potential Environmental Effect
Drilling/monitor well installation, core sampling	Ground water sampling, hydraulic parameter data collection, geologic data collection.	Small amount of surface clearing for each location (less than 1.0 ac [0.4 ha]); access road construction; contaminated cuttings and ground water generation requiring proper disposal.
Ground water sampling	Water quality determination.	Contaminated ground water generation requiring proper disposal.
Soil sampling - test pits or soil borings	Unsaturated and saturated zone contamination determination; attenuation determination.	Small amount of surface clearing (less than 1.0 ac [0.4 ha]); contaminated soil requiring proper disposal.
Geophysics	Depth to bedrock, depth to ground water, other hydrogeologic information. Zones of ground water contamination.	Small amount of surface clearing for survey grid; access road construction.
Aquifer testing	Determination of aquifer parameters.	Contaminated ground water generation requiring proper disposal.

Table 4.3 Potential environmental impacts associated with ground water site characterization and monitoring activities

Resource category	Potential impact
Human health	The potential for unauthorized personnel to enter the site characterization work area would be controlled and workers would be trained in appropriate health and safety procedures. Consequently, human health impacts are not expected.
Air quality	Dust emission would be minor and temporary. In situations when such emissions would be excessive, dust suppressants could be applied.
Surface water	Ground disturbance activities could result in erosion into a surface water body. Facilities would be placed well away from surface water bodies. If this were not possible, erosion control measures such as silt fences or hay bales would be used to control erosion.
Ground water	Aquifer tests could pull contaminated ground water into uncontaminated ground water. This would be avoided by conducting aquifer tests where this situation could not occur.
Ecological resources	Only small amounts of land would be disturbed. Facilities would be situated well away from sensitive ecological areas such as wetlands.

Land use	Installation of monitor wells and temporary land disturbances from soil borings and test pits would have a minor, short-term impact on land and land use.
Cultural/ traditional resources	Cultural resource surveys and contacts with appropriate tribal groups would be conducted before land disturbance activities begin. Cultural/traditional resources would be avoided where possible. If significant resources could not be avoided, a mitigation plan would be prepared in consultation with the State Historic Preservation Officer, tribal officer, or applicable agency.
Background noise	Site characterization may result in a slight and temporary increase in noise.
Visual resources	Site characterization and monitoring may impact visual resources. Flush-mounted monitor wells and landscaping will be used, as necessary, to reduce visual impacts.
Transportation	Site characterization would result in an occasional slight increase in local traffic at the sites. This increase is not expected to affect local traffic use patterns in the site area.
Social and economic	A few temporary jobs associated with drilling wells or digging test pits could be created during site characterization. This may result in a minor temporary benefit to the local economy. No other social or economic impacts would be expected.
Environmental justice	No disproportionally high or adverse effects would be expected because impacts are minor or nonexistent.
Utilities and energy resources	Electricity and fuel would be needed for some site characterization activities. Use of these resources would not be expected to affect local energy resources due to the small scale of activities and short duration of work.
Waste management	Liquid and solid waste could be generated from contaminated well purge water and cuttings. Any contaminated material generated would be managed in accordance with appropriate regulatory requirements.

4.2 GROUND WATER COMPLIANCE STRATEGY IMPACTS

This section addresses the potential impacts associated with the ground water compliance strategies. Some or all of these strategies would be used in three alternatives: the proposed action, the active remediation to background levels alternative, and the passive remediation alternative (Section 2.0). Information collected during the Surface Project pertains to some of the resources analyzed below (e.g., wetlands and cultural/traditional resources). This information is used, where appropriate, to indicate the potential impacts of the Ground Water Project. The actual site-specific impacts of applying these strategies would be addressed in the site-specific NEPA documents.

4.2.1 Active ground water remediation methods impacts

As summarized in Section 2.8.2 and provided in detail in Appendix C, active ground water remediation methods include ground water extraction, gradient manipulation, and in situ treatment. Currently, there is insufficient information to predict how many sites would require active ground water remediation under the proposed action, although it is expected that a few sites would. Under the alternative of active remediation to background levels, active ground water remediation would be the major ground water compliance strategy. Active ground water remediation would not be used under the passive remediation alternative.

Active methods would involve ground disturbance activities such as constructing wells and access roads or installing utilities and water treatment facilities. The following sections identify the potential impacts of active ground water remediation methods.

4.2.1.1 Human health

Certain active ground water remediation methods could generate contaminated water or sludge. If the contaminated water were discharged to a surface water body, an NPDES permit or other types of permits may be required to protect human health and the environment. Contaminated sludge would be handled so as to reduce risk of worker exposure and would be disposed of in accordance with applicable regulations. The management of potential waste streams is discussed in more detail in Section 2.9.

A risk assessment would be performed to assess the potential effects to human health of applying nitrogen-rich ground water to agricultural crops. This method involves adding high-nitrate ground water directly on the land or to irrigation water. This water could be treated prior to land application if it contained high levels of undesirable constituents, such as heavy metals or salts. Furthermore, if the risk assessment indicated that land application was not protective of human health, this method would not be used.

The use of active ground water remediation methods could result in injury to workers. This risk would be greatest when workers would be using heavy equipment. The potential for worker injury is minimal because of the short construction period (up to a few months) and the small number of worker-years of labor required (5.0 to 10 worker-years). Following construction, the potential for these types of impacts would exist but be reduced during operation of the active ground water remediation facilities because workers would be trained in health and safety procedures and only a small staff would be needed to operate remediation facilities and equipment.

Active ground water remediation could take many years and a potential exists for the use of contaminated ground water. This potential risk would be minimized because monitoring would likely identify potential risks before they occur and institutional controls could be used to limit access to contaminated ground water.

4.2.1.2 Air quality

Dust could be generated from heavy equipment and earth-moving activities as remediation facilities and access roads are constructed. An air quality permit may be required for some construction activities. An air quality permit would provide information on the potential for generating dust and on mitigation measures to keep dust emissions below air quality standards (such as applying water or other dust suppressants). The potential for dust emissions to exceed the standards is unlikely because the construction activities would be temporary and mitigation measures would be used, if necessary, to reduce fugitive dust.

This impact would be short-term, occurring during construction activities. Dust would be minimal during facility operations because there would be no dirt-moving activities. Some fugitive dust could be generated by workers driving on unimproved access roads. Water or some other dust suppressant would be applied, if necessary, to control dust.

The EPA's priority air pollutants, including sulfur oxides and nitrogen oxides, would be emitted from construction equipment during construction of ground water remediation facilities. Studies for the UMTRA Surface Project show that these emissions form a small portion of the total emissions inventory and that the air quality standards are not exceeded (DOE, 1987b). Therefore, the operation of active ground water remediation facilities is not expected to result in exceedance of the EPA standards for these air pollutants. The potential for extracted contaminants to become airborne from the treatment processes is minimal because the contaminants at the UMTRA Project sites are not volatile, and any solid waste would be disposed of in an approved disposal facility.

4.2.1.3 Surface water

During ground water remediation, potential impacts to surface water could occur but would be reduced or eliminated by implementing best management practices.

Ground water remediation facilities would produce water that may be discharged into a nearby stream or river after the water is treated to remove contaminants. If plans called for this type of discharge, an NPDES permit would be obtained that would stipulate appropriate treatment, monitoring, and reporting requirements. This permit would ensure that the water discharged into a surface water body would have minimal impacts. In addition, a storm water permit may be required.

4.2.1.4 Ground Water

Active remediation methods that extract contaminated ground water may cause lateral ground water flow. Lateral flow could mix contaminated ground water with uncontaminated ground water, reducing contaminant concentrations (thus expediting the achievement of remedial goals) but increasing the total volume of contaminated water. Ground water extraction could have a negative impact by depleting an aquifer that is or has the potential to be a ground water resource.

Ground water extracted from contaminated aquifers may be treated, then reinjected into deeper aquifers or in the same aquifer upgradient of the contaminant plume. The quality of the treated ground water would be monitored prior to injection to reduce or eliminate potential adverse affects on the quality of the ground water into which it is injected. At some sites, an NPDES permit would be required to discharge this treated water into an aquifer.

4.2.1.5 Ecological Resources

Site-related contaminants in ground water are known to be entering the surface water at some sites. During active ground water remediation, contaminants from this ground water would continue to enter the aquatic and terrestrial ecosystems, negatively impacting the resources. In the long term, active ground water remediation would reduce or eliminate this source of contaminated ground water entering the environment.

Under some active methods, treated ground water could be discharged to the land (e.g., water with high nitrate concentrations). The potential risks of discharging this water into the environment would be determined to ensure there is no unacceptable ecological risk.

Construction of ground water remediation facilities would have a short-term adverse impact, resulting in the clearing of plant communities and wildlife habitat. The amount of habitat that would be cleared at a site typically would be small (up to 20 ac [8.0 ha]), and active cleanup would last from a few months to 10 years or more.

Once ground water cleanup activities were complete, most of the facilities and access roads would be revegetated with native species and returned to their approximate pre-remedial action conditions. Revegetation back to a grassland or grassland-shrub plant community would take approximately 2.0 to 5.0 years, depending on the plant community type and climate conditions. As can be seen by the annual precipitation statistics shown in Table 3.2, most UMTRA Project sites are in arid and semiarid climates. Revegetation at sites with these types of climates would likely need mulch and irrigation to be successful.

Construction and operation of ground water remediation facilities could create dust, noise, and human activity, which could indirectly affect habitat adjacent to the direct impact area. However, these impacts would be minor due to the low level of human activity (only a few personnel would be at the site) and the low intensity of operational activities.

Active ground water remediation could negatively impact sensitive habitats such as wetlands, riparian areas, and aquatic habitat. These types of habitats are common at and near the UMTRA Project sites, as documented in Section 3.2; 22 of the sites are near aquatic habitat, while wetlands occur at 18 of the sites (Table 3.2). Placement and construction of facilities could affect these sensitive areas, and pumping ground water may dry up wetlands and lower water levels in other aquatic habitat. Usually, remediation facilities could be placed away from sensitive habitats to reduce potential adverse effects. If sensitive areas such as floodplains or wetlands would be affected, the disturbed area would likely be small and the duration of the impact would be short-term (during construction and remediation). These areas would be returned to preconstruction conditions after ground water remediation is complete. A floodplain/wetlands assessment would be prepared consistent with 10 CFR Part 1022, Compliance With Floodplains/Wetlands Environmental Review Requirements, and a U.S. Army Corps of Engineers Section 404 Permit application would be prepared if wetlands under the jurisdiction of the Corps of Engineers were affected. Ground water characterization and data analysis would be used to determine whether ground water extraction would lower the water levels in aquatic habitats. If such an impact were predicted, the active ground water remediation would be altered to avoid this impact. In addition, monitoring during remediation would ensure that drawdowns in sensitive habitats would be detected and corrective action taken.

Threatened and endangered species or other species of concern occur at or near 14 of the UMTRA Project sites (Table 3.2). Active ground water remediation methods could adversely affect these species directly through habitat destruction or indirectly through human activity adjacent to the direct impact zone. In addition, pumping water from aquifers that are hydrologically connected to rivers could adversely affect threatened or endangered fish and/or their critical habitat. The DOE would consult with the Fish and Wildlife Service during the preparation of the site-specific NEPA documents. If impacts to threatened and endangered species were unavoidable, formal consultation with the Fish and Wildlife Service would be initiated and a biological assessment would be prepared.

Construction of ground water restoration facilities, possibly resulting in sediment runoff into surface waters, could adversely affect aquatic resources. Increased sedimentation in surface waters would degrade water clarity, thereby affecting the aquatic food chain. The potential for this type of impact would be slight because erosion protection measures would be implemented, where required, to prevent sediment runoff.

4.2.1.6 Land use

Active ground water remediation methods would require that land be used to construct facilities such as water treatment plants and retention ponds. This would preclude use of the land for other purposes during remediation.

This potential negative impact could be short-term (a few months to a year) or long-term (up to 10 years), depending on the ground water remediation objectives and the method used.

In certain cases, the contaminant plume may extend outside the active ground water remediation work zone, and it would be necessary to restrict human access to contaminated ground water during active remediation. These controls could limit the uses of the land to such activities as grazing and prevent other uses such as home construction. In some cases, restriction could preclude any use of the land until compliance with EPA standards is achieved. This impact could be short or long-term, depending on the goals, methods, and duration of ground water remediation. The potential adverse impacts of institutional controls are discussed in greater detail in Section 4.2.2.6. There is the potential for long-term positive impacts because once the ground water meets the EPA standards, there may be opportunities for more land uses.

4.2.1.7 Cultural/traditional resources

Construction of active ground water remediation facilities could affect cultural resources (for example, archaeological, historic, or Native American traditional areas). The potential for such resources in the area of the UMTRA Project sites is high; during the Surface Project it was determined that there are cultural resources at 11 sites (Table 3.2). The DOE would conduct additional surveys for cultural resources before site-disturbing activities took place in areas that have not been surveyed. Appropriate tribal groups would be contacted regarding the existence of traditional-use areas. Efforts would be made to avoid placing facilities at or near identified cultural/traditional resources. If a site were considered significant (that is, eligible for inclusion on the National Register of Historic Places) and disturbance could not be avoided, the DOE would consult with the State Historic Preservation Officer or tribal officials and other applicable agencies to identify appropriate mitigation.

Water resources, ground water, and seeps have religious significance to many Native Americans. These resources often have ceremonial significance or may be associated with traditional, symbolic plants. The contamination of these resources at the UMTRA Project sites is a negative impact. The remediation of contaminated ground water quality would be a positive benefit.

4.2.1.8 Background noise

Noise from heavy equipment would occur during construction of facilities. If warranted, noise prediction models would be used to determine any increase above background noise. If noise levels were determined to be unacceptable (that is, above EPA hearing protection levels), mitigation measures would be implemented (EPA, 1974). However, potential impacts associated with higher noise levels likely would be minor, given the small scale of the construction operations, and would last only during construction of remediation facilities. Facilities such as ground water extraction wells and water treatment plants would emit noise.

4.2.1.9 Visual resources

Water treatment facilities and retention ponds could be visible from a few months to decades. Impacts on visual resources depend on the extent to which the landscape would be changed by new structures, the scenic value of the landscape, and the potential number of viewers. Facilities constructed in urban areas would be seen by more people; however, urban facilities would be less likely to contrast with the surrounding area. In rural areas, new facilities would be more obtrusive but, in general, fewer people would see the landscape change.

Significant visual resource impacts from remediation facilities are not expected because most facilities would be located on or near a processing site that was already disturbed. Once ground water remediation activities were complete, remediation facilities would likely be removed and the land would be recontoured and revegetated to approximate preoperational conditions.

Monitor wells used during site characterization, ground water remediation, and monitoring may have a visual impact, particularly on residents near the sites. The DOE would work with local landowners, residents, tribes, and states as necessary to reduce potential visual impact, using such measures as flush-mounted monitor wells or landscaping.

4.2.1.10 Transportation

Construction of ground water remediation facilities would involve movement of heavy equipment and increases in traffic from commuting workers. Most of the heavy equipment movement would be on the site and would not increase traffic on local roads. The occasional off-site trip and worker commuting trips would increase traffic levels on local roads. The level of impact would depend on current traffic volumes in the area, load capacity, and the number of additional trips that would result from facility construction. Significant impacts on local traffic patterns are not expected because the construction work force would be small and construction activities would be temporary. Traffic control measures could be implemented if necessary to reduce transportation impacts (for example, traffic lights or turn lanes). During facility operation, the work force would be smaller and potential transportation impacts would be less than during construction.

4.2.1.11 Social and economic resources

Social and economic impacts typically derive from increased employment and circulation of additional monies into local and regional economies as a result of UMTRA Project development. The extent of these impacts depends on the type and level of employment generated by a project. Often these impacts are beneficial, particularly in rural areas with lower employment levels and less diverse economies because Project development offers opportunities for local hiring and an expansion of the local economy. Negative impacts occur when there is a demand for a large work force but few workers are available locally, causing a large, abrupt influx of workers and their families into a community. Social and economic impacts generally occur in four interrelated categories: demographics, employment, economy, and community facilities and services.

Construction and operation of the ground water remediation facilities would minimally increase employment and opportunities for local hiring, particularly during construction. Data from UMTRA Surface Project sites show about 80 percent of the remedial action work force commutes from within 60 mi (100 km). This increased employment would last only during the construction phase. It is expected that fewer, more technically skilled people would be required during facility operation. Workers who relocated during facility operation would be more likely to bring families than construction workers whose employment duration is shorter. The level and extent of impacts on housing, community services, and facilities would depend on the number of workers who relocated with their families and the ability of communities to absorb them. Because operation work force requirements would be small (less than five workers), local communities probably could accommodate their needs for housing, community services, and facilities (for example, schools, fire, and police protection).

Facility construction and operation would temporarily benefit the local and regional economies. This would result from UMTRA Project purchases of goods and services (for example, construction supplies, gasoline, and automotive service contracts); wages paid to employees that are recirculated; and income from employment created by direct and indirect Project-generated monies (that is, as more project money was spent on goods and services, additional employment would be generated to provide these goods and services).

The extent of these economic benefits depends on the number of workers required and the extent to which Project-related materials, supplies, and services are available locally. These beneficial impacts would likely be small given the small work force required for construction and operation of active gound water remediation facilities.

The use of land for active ground water remediation facilities and land use restrictions from institutional controls may reduce the property values of the affected land or limit the types of activities that can take place on the land. These impacts would last for the duration of the active remediation. However, when the ground water is cleaned up, property values that had been devalued due to contamination or construction could be restored and higher or more intense land uses may be possible.

Extracting ground water from aquifers that are a ground water resource has the potential to impinge on the water rights of the users of the aquifer. This could affect uses for agricultural, industrial, and other purposes. During the preparation of the site-specific environmental assessment, the DOE would consult with the tribal water authority or state engineer to determine if such an impact exists.

4.2.1.12 Environmental justice

No disproportionately high or adverse human health or environmental effects to minority or low-income populations would be expected under the active ground water compliance strategy because ground water would likely meet regulatory standards.

4.2.1.13 Utilities and energy resources

It is expected that local utilities would supply electricity, gas, and telephone services during the construction and operation of ground water remediation facilities. In urban areas, water needed during construction likely would come from existing water supply systems; in rural areas, water likely would come from wells or rivers. Because ground water remediation methods are relatively small-scale operations, local utilities probably could meet these short-term Project needs.

Construction equipment would use petroleum products during construction and fuel-powered generators may be used during facility operations. The greatest amount of energy would be used during construction because heavy equipment would be needed to build the facility. Impacts would be minimal, due to the short construction period and the operation's small scale. Energy use during operation would also be minimal due to the low level of activity that would take place.

4.2.1.14 Waste management

The following contaminated materials could be generated during site characterization, operations, and monitoring under the active remediation strategy: well development water, drill cuttings and drilling muds, purge water, sludge and brine, and contaminated ground water and soils. These materials would be analyzed. Based on this analysis, solid material such as mud or soil would be applied to the land or disposed of in a disposal facility such as an existing open UMTRA Project cell capable of accepting these materials. Contaminated water would be treated, if necessary, and applied to the land, reinjected to the ground water, or discharged to surface water, after permits are received. Section 2.9 provides more details on the management of contaminated materials.

Potential adverse impacts on human health or the environment from the generation, treatment, storage, or disposal of contaminated materials are not expected because all such activities would be performed in compliance with applicable regulations and guidelines that were developed to be protective of human health and the environment. However, human error could result in environmental impacts.

4.2.1.15 Estimated costs

As indicated in Section 2.10, activities such as the preparation of baseline risk assessments, site observational work plans, and NEPA documents would be prepared for most UMTRA Project sites, regardless of the proposed ground water compliance strategies. The active remediation compliance strategy also would include site characterization, monitoring, and revisions to site observational work plans; field management, capital equipment, and operations costs associated with implementing an active remediation method; and program support throughout the remediation period.

Estimated costs for active remediation to background levels range from $86 million to $162 million per site (escalated dollars) and include all generic cost elements plus costs associated with field management and operation (Foskey, 1995). These cost elements include utility installation, number of wells required, collection systems, installation of water treatment plants, plant operations, testing, land application of water, closure, demobilization, and site restoration. The plant size and length of operations are generated on a site-specific basis using current assumptions of the technical parameters of the plume, soil, and contaminants.

4.2.2 Natural flushing impacts

Natural flushing in conjunction with institutional controls is a potential strategy for meeting the EPA ground water standards. Sections 1.4.1 and 2.8 summarize the natural flushing process and institutional controls.

Natural flushing would likely be the principal ground water compliance strategy used under the passive remediation alternative. Natural flushing would also be used under the proposed action, either alone or in conjunction with active ground water remediation. This strategy would not be available under the active remediation to background levels alternative because this alternative would rely principally on active ground water remediation.

This impact analysis assumes that the criteria required to implement natural flushing are met. However, under the passive remediation alternative, the use of natural flushing at certain sites may not be protective of human health or the environment; compliance may not be accomplished within 100 years as required by the EPA ground water standards; or required institutional controls may not be viable. In these cases, the standards would not be met and the potential for human health or environmental harm exists. At sites that would not comply with the standards within 100 years, institutional controls and monitoring would be required for more than 100 years; this would not meet the EPA ground water standards and would increase the uncertainty in protecting human health and the environment. In addition, natural flushing may not be protective of beneficial uses of the ground water, such as irrigation or livestock watering. The potential impacts on resources of applying natural flushing under these circumstances are discussed in Section 4.4.

4.2.2.1 Human health

Ground water remediation using natural flushing may result in human exposure to contaminated ground and/or surface water. However, the probability of such an exposure is remote because the following conditions must be met before natural flushing can be used:

- The contaminated aquifer must not be a source for a public drinking water system.
- The concentrations of hazardous constituents must meet the EPA standards within 100 years.
- Any institutional controls relied on to control exposure must be effective and enforceable throughout the natural flushing period.

To ensure continued protection, ground and surface water monitoring, as needed, would take place during the natural flushing period.

4.2.2.2 Air quality

The installation of monitor wells or construction of institutional control structures such as perimeter fences could generate small amounts of dust. This impact would be minor and short-term, lasting only during construction or installation. The potential for air quality impacts from other priority pollutants would be remote, given the limited use of construction equipment needed for establishing and maintaining institutional controls.

4.2.2.3 Surface water

During the natural flushing period, contaminated ground water could discharge into surface water bodies such as springs and wetlands. Before implementing natural flushing, the DOE would evaluate the potential for such a discharge. If it were determined that such a discharge may take place and threaten human health and the environment, natural flushing probably would not be a viable ground water compliance strategy. If it were determined that the potential for such a discharge would be remote, this strategy may be viable. However, because the natural flushing period could last up to 100 years, there would be an increased potential for surface water bodies to be affected within this time period. Monitoring would take place during natural flushing, and if monitoring indicated that surface water bodies were being contaminated, an additional risk assessment may be performed. If the contamination levels were not protective of human health or the environment, active remedial action may be undertaken. Institutional controls would be required to control access to areas where surface waters were contaminated.

4.2.2.4 Ground water

Ground water remediation from natural flushing would most likely be slower than active remediation methods. Hazardous constituent concentrations in the plume that exceed the standards would be reduced to meet background levels, maximum concentration limits, or alternate concentration limits during the natural flushing period. The potential for contaminated ground water to affect uncontaminated areas is site specific. There are three general cases: 1) geochemical attenuation limits plume migration and additional ground water contamination is unlikely or would be minimal, 2) the plume has already reached a discharge point and thus the maximum extent of ground water contamination has already occurred, and 3) the plume is migrating and dispersing through the aquifer system with potential for additional ground water contamination. Ground water monitoring would identify any expansion of the ground water plume. Corrective measures, such as expanding the institutional controls area, may be required.

4.2.2.5 Ecological resources

Natural flushing would have minimal impact on wildlife and aquatic and sensitive habitats. The major activity associated with this strategy is the application of institutional controls. Fencing to supplement other controls could positively impact wildlife and aquatic habitat because activities such as grazing, which can degrade these habitats, may be prevented. However, fencing could negatively impact certain species of wildlife by blocking migration corridors and improperly constructed fences could cause wildlife mortality. These impacts could be minimized by installing fences designed to accommodate wildlife needs.

The low levels of human activity are not likely to result in a negative impact on threatened and endangered species. However, the DOE would consult with the Fish and Wildlife Service during preparation of the site-specific NEPA documents to determine whether threatened and endangered species are known to occur in the area.

The potential for contaminated ground water to be released into the environment during the natural flushing period would be evaluated in an ecological risk assessment to determine whether natural flushing would be protective of the environment. This assessment would consider existing and potential future releases of contaminated ground water into the environment. If there were no risk or there were acceptable risks, natural flushing could be implemented if all other requirements were also met. However, as the length of a natural flushing period increases, so does the potential for contaminated ground water to enter the environment. A ground water and surface water monitoring program would be conducted during the natural flushing period, and any releases of contaminated ground water into the environment would be detected. If contaminated ground water were released into the environment, an ecological risk assessment may be performed. If the risks from such a release were unacceptable, active remedial action may be initiated.

4.2.2.6 Land use

The EPA ground water standards require that institutional controls be implemented to limit access to a contaminated aquifer during natural flushing. These institutional controls would be used to restrict the use of the land above the contaminated aquifer. The types of institutional controls used depend in part on the extent of the ground water contamination and the potential for ground water use. These controls could involve posting information warnings on private land, purchasing an interest in the land, preventing access to the land through fencing, or imposing land or water use restrictions. The potential impacts of institutional controls on land use would be restricted use of land and decreased property values. These impacts would be minimal at the UMTRA Project processing sites, because use of these sites is currently restricted in most cases. Impacts could occur outside processing site boundaries, but as the ground water contamination is reduced over time, the restrictiveness of the institutional controls may be reduced.

4.2.2.7 Cultural/traditional resources

Potential impacts to surface cultural resources would be minor because little if any site-disturbing activity would take place. Installation of fencing or monuments (institutional controls) would likely be the most intensive activity. Cultural resource surveys would be performed prior to site-disturbing activities and appropriate tribal officials would be contacted to identify and evaluate cultural or traditional resources that may be affected. In most cases, fencing and monuments could be located to avoid cultural resource sites.

Water is a traditional resource of significance to many Native Americans. These resources often have ceremonial significance, and surficial expressions such as seeps may be associated with traditional, symbolic plants. Remediation of contaminated ground water by natural flushing would have a positive impact on this resource.

Impacts to this Native American traditional resource would be reduced as natural flushing progressed.

4.2.2.8 Background noise

Natural flushing would not affect background noise levels in the site area because no noise-generating activities would occur except for brief periods during the construction of some types of institutional control features.

4.2.2.9 Visual resources

Natural flushing could result in the use of signs, monuments, or fences to control human land use above the contaminated aquifer. These measures typically would be unobtrusive (small and low to the ground), resulting in minor (if any) impact on visual resources. In areas of scenic beauty, structures used to implement institutional controls (such as fences) could negatively impact visual resources.

Monitor wells used during site characterization, ground water remediation, and monitoring may have a visual impact, particularly on residents near the sites. The DOE would work with local landowners, residents, tribes, and states where necessary to reduce this potential visual impact through the use of such measures as flush-mounted monitor wells or landscaping.

4.2.2.10 Transportation

During the operational phase, the only traffic would be for water quality monitoring and monitoring to verify that institutional controls were working as planned. There would be no transportation impacts from these activities.

4.2.11 Social and economic resources

No impacts on demography, employment, community services, or facilities would be expected if natural flushing were implemented, because essentially no activities associated with this strategy would require a work force. Institutional controls may require occasional maintenance and monitoring. There could, however, be a slight, short-term beneficial impact to the local economy from local workers or subcontractors who may install land access controls (for example, fencing).

Institutional controls that restrict land use could represent an economic loss to a property owner by precluding a higher use of the land. For example, grazing might be allowed within an area of institutional control, but a more intense (and potentially profitable) use of the land, such as crop production or residential use, may not be allowed. In some cases, the land could be restricted from any use during the period of natural flushing. The extent of the potential adverse economic impact would depend on the type and duration of the land use restrictions and the reasonable alternative uses of the land that could be precluded because of the institutional controls.

4.2.2.12 Environmental justice

Minority or low-income populations would not experience disproportionately high or adverse environmental impacts if criteria for natural flushing are met. However, under the passive remediation alternative, it is possible that the criteria would not be met and that natural flushing would not be protective of human health and the environment at some sites (see Section 4.2.2). For sites that have minority or low-income populations, there would be a potential for disproportionately higher impacts to human health and the environment.

4.2.2.13 Utilities and energy resources

Natural flushing would not affect utilities or energy resources because no activities would occur that would require the use of these resources.

4.2.2.14 Waste management

Contaminated materials that could be generated during site characterization and monitoring under the natural flushing strategy include well development water, drill cuttings and drilling muds, purge water, sludge and brine, and contaminated ground water and soils. These materials would be analyzed. Based on this analysis, solid material such as mud or soil would be applied to the land or disposed of in a disposal facility such as an existing open UMTRA Project cell capable of receiving these materials. Contaminated water would be treated, if necessary, and applied to the land, reinjected to the ground water, or discharged to surface water, after permits are received. Section 2.9 provides more details on the management of contaminated materials.

Potential adverse impacts on human health or the environment are not expected from the generation, treatment, storage, or disposal of contaminated materials because all such activities would be performed in full compliance with applicable regulations and guidelines that were developed to be protective of human health and the environment. However, human error could result in environmental impacts.

4.2.2.15 Estimated costs

Activities associated with natural flushing include all the generic activities, additional site characterization, new wells, and revisions to site observational work plans. Natural flushing would likely require the use of institutional controls. This strategy would likely result in a longer monitoring period than the other two strategies. Estimated costs for the natural flushing compliance strategy range from $14 million to $24 million per site (escalated dollars) and include all generic costs associated with this strategy.

4.2.3 Impacts from applying supplemental standards or alternate concentration limits at no remediation sites

Ground water at some UMTRA Project sites may exceed maximum concentration limits or background levels and yet require no remediation because the sites would qualify for supplemental standards or alternate concentration limits. Supplemental standards or alternate concentration limits could be used in combination with active ground water remediation methods and/or natural flushing to achieve compliance with the EPA ground water standards. For example, active remediation methods may be used to protect beneficial uses at a site that would otherwise qualify for supplemental standards. However, the analysis in this section considers only potential impacts from applying these standards at the no remediation sites; refer to Sections 4.2.1 and 4.2.2 for discussions of potential impacts of active ground water remediation methods and natural flushing.

Supplemental standards and alternate concentration limits are described in Section 1.4.1. Eight criteria are available for applying supplemental standards. The occurrence of limited use ground water is the criterion that likely would be used most frequently to justify the application of supplemental standards for the UMTRA Ground Water Project. However, site-specific uses of ground water from limited use wells, if any, would be carefully evaluated when a supplemental standards application is prepared. Limited use ground water refers to water from units that have poor background quality or low yield (less than 150 gal [570 L] per day). Supplemental standards based on limited use ground water would not involve ground-disturbing activities. Other criteria for applying supplemental standards that may be used on the UMTRA Ground Water Project include 1) protection of the environment from excessive harm, 2) there is no known remedial action, and 3) inability to perform remedial action because it is technically impracticable. The use of supplemental standards may require monitoring or the use of some form of institutional controls to prevent access to contaminated ground water. The DOE UMTRA Ground Water Project would likely not use the remaining criteria listed in Section 1.4.1.

A risk evaluation would be performed to determine whether the use of supplemental standards would be protective of human health and the environment. In all cases, a supplemental standards application would require NRC concurrence, state participation, and consultation with Indian tribes to become effective.

The use of alternate concentration limits would also require an application that would need NRC concurrence, state participation, and consultation with Indian tribes. A risk evaluation would have been performed to demonstrate that an alternate concentration limit would be protective of human health and the environment. This analysis also assumes that potential environmental impacts may be associated with using alternate concentration limits.

The no remediation ground water compliance strategy would likely be used under all the alternatives except the no action alternative. There are two categories of no remediation sites. One category refers to sites where there is no ground water contamination above maximum concentration limits and/or background levels. Under the proposed action and the passive remediation alternative, this no remediation strategy would be appropriate at such sites. Under the active remediation to background levels alternative, this strategy may be appropriate if all the constituents are at background levels; it would not be appropriate for constituents below the maximum concentration limits but above background levels.

The second category under the no remediation ground water compliance strategy refers to sites that have contamination above background levels and/or maximum concentration limits but are eligible for supplemental standards or alternate concentration limits. The sites that would be eligible for this no remediation strategy under the proposed action would also be eligible under the passive remediation alternative. In addition, some of these sites would be eligible for the no remediation strategy under the active remediation to background levels alternative. At some sites, no remediation in the form of supplemental standards based on the existence of limited use ground water could be part of the active remediation to background levels alternative.

The following analysis includes the potential impacts of applying supplemental standards and of applying alternate concentration limits.

4.2.3.1 Human health

For successful application of supplemental standards or alternate concentration limits, a risk evaluation must show that these standards would be protective of human health and the environment. Monitoring or institutional controls may be required if alternate concentration limits or supplemental standards are used. Monitoring may be required to assess the degree and extent of ground water contamination to ensure that supplemental standards and alternate concentration limits remained protective of human health and the environment. Institutional controls may be used if, for example, it were technically impracticable to clean contaminated ground water, but controls were required to prevent its inadvertent use. Consequently, the likelihood of human exposure to contaminated ground water and the surface expression of this water at sites that met supplemental standards or alternate concentration limits would be remote.

4.2.3.2 Air quality

Dust and priority pollutant emissions would not result from the application of supplemental standards or alternate concentration limits because few or no ground-disturbing activities would occur.

4.2.3.3 Surface water

The potential for discharge of contaminated ground water into surface water bodies would be unlikely. As indicated in Section 4.2.3.1, a monitoring program may be required for the use of some supplemental standards and for alternate concentration limits, that may include sampling surface water bodies. If contamination were discovered, further evaluation would be undertaken and remedial action performed if required.

4.2.3.4 Ground water

The application of supplemental standards would have little or no impact on ground water at sites that qualify for supplemental standards based on the presence of limited use ground water. Contaminated ground water at sites that qualify for supplemental standards based on other criteria or alternate concentration limits could contaminate less contaminated or noncontaminated ground water. Ground water monitoring may be required to assess this possibility under these supplemental standard criteria or alternate concentration limits.

4.2.3.5 Ecological resources

If supplemental standards or alternate concentration limits were applied, terrestrial and aquatic ecological habitat disturbance would be minimal because few or no ground-disturbing activities would occur.

As part of the supplemental standards and alternate concentration limits application processes, an ecological risk evaluation may be prepared or updated to determine the potential for contaminated ground water to result in ecological risk. If unacceptable ecological risks could occur, supplemental standards or alternate concentration limits likely would not be proposed. If there were no ecological risks or the risks were acceptable, these standards could be applied if no other factors precluded their use. As indicated in Section 4.2.3.1, a monitoring program may be implemented as part of the supplemental standards and alternate concentration limits applications. If monitoring indicated contaminated ground water from the UMTRA Project site had been released into aquatic habitats such as wetlands and springs, another ecological risk evaluation may be performed. If the results of this evaluation indicated unacceptable risk, remedial action might be required.

4.2.3.6 Land use

Little or no ground-disturbing activity would occur if supplemental standards or alternate concentration limits were applied. The only activity that would potentially affect land use would be the use of institutional controls.

Institutional controls may be implemented if the limited use criterion were used to apply for supplemental standards. These types of controls also may be required if another criterion (such as excessive environmental harm or the technical impracticability of ground water remediation) were used, or if alternate concentration limits were applied. The potential impacts on land use associated with the use of institutional controls are discussed in Section 4.2.2.6.

4.2.3.7 Cultural/traditional resources

There would be no impacts to surface cultural resources because no surface disturbance would take place. Minor surface disturbance would occur if institutional controls were used in conjunction with supplemental standards. The potential impacts of institutional controls on cultural resources are discussed in Section 4.2.2.7.

With the application of supplemental standards or alternate concentration limits, contaminants associated with the UMTRA Project would most likely not be removed. Therefore, traditional resource impacts associated with ground water would not be mitigated. However, at sites where supplemental standards were applied using the limited use criterion, the surrounding background ground water quality is poor; therefore, the impact of leaving the contaminated ground water would be minor.

4.2.3.8 Background noise

The application of supplemental standards or alternate concentration limits would not affect ambient noise because no noise-generating activities would take place.

4.2.3.9 Visual resources

Impacts on visual resources would be limited to those associated with site characterization activities (refer to Section 4.1) or the implementation of institutional controls. These potential impacts would be minor and temporary.

Monitor wells used during site characterization, ground water remediation, and monitoring may have a visual impact, particularly on residents near the sites. The DOE would work with local landowners, residents, tribes, and states where necessary to reduce this potential visual impact through the use of such measures as flush-mounted monitor wells or landscaping.

4.2.3.10 Transportation

There would be no transportation impacts if supplemental standards or alternate concentration limits were instituted.

4.2.3.11 Social and economic resources

Supplemental standards or alternate concentration limits would have little impact on social and economic resources because no ground water remediation activities would take place. Potential minor negative economic impacts could result from the implementation of institutional controls (refer to Section 4.2.2.11).

4.2.3.12 Environmental justice

Disproportionately high or adverse effects to minority or low-income populations would not occur if application of supplemental standards or alternative concentration limits were protective of human health and the environment.

4.2.3.13 Utilities and energy resources

Supplemental standards would not affect utilities or energy resources because no activities would occur that require these resources.

4.2.3.14 Waste management

The following contaminated materials may be generated during site characterization and monitoring under the no remediation strategy: well development water, drill cuttings and drilling muds, purge water, sludge and brine, and contaminated ground water and soils. These materials would be analyzed. Based on this analysis, solid material such as mud or soil would be applied to the land or disposed of in a disposal facility such as an existing open UMTRA Project cell capable of receiving these materials. Contaminated water would be treated, if necessary, and applied to the land, reinjected to the ground water, or discharged to surface water, after permits are received. Section 2.9 describes the management of contaminated materials.

Potential negative impacts are not expected to human health and the environment from the generation, treatment, storage, or disposal of contaminated materials because all such activities would be performed in full compliance with applicable regulations and guidelines that were developed to be protective of human health and the environment. However, human error may result in environmental impacts.

4.2.3.15 Estimated costs

Activities associated with the no remediation compliance strategy include the general activities required for the other two strategies, including site characterization and possible revision of the site observational work plans. This strategy would also require the preparation of supplemental standards and/or alternate concentration limits applications and the concurrence of these applications by the NRC. The estimated cost of the no remediation compliance strategy is $1.0 million to $10.4 million per site, based on 1995 escalated dollars.

4.2.4 Impacts comparison and Summary

This summary compares the potential negative impacts of the ground water compliance strategies. The relationship of these potential impacts to the alternatives is presented in Section 4.4. The impacts analysis does not relate to the no action alternative because none of the strategies would be used under this alternative. The potential impacts of the no action alternative are assessed in Section 4.3.

It is anticipated that the impacts that could occur for each strategy (see Table 4.4) would be the impacts analyzed in the site-specific NEPA documents. Based on this analysis, the number of potential negative impacts is highest for the active ground water remediation methods, next highest for natural flushing, and lowest for no remediation sites that meet the standards with supplemental standards or alternate concentration limits (Table 4.4).

4.3 NO ACTION

Under the no action alternative, the UMTRA Project would end with the completion of surface remediation. The DOE would perform no ground water compliance or remediation activities. Evaluation of the no action alternative is required under the NEPA, as it provides a baseline against which impacts of other alternatives can be compared.

4.3.1 Human health

The no action alternative could expose humans to contaminated ground water. Under this alternative, there would be no federally sponsored ground water compliance, remediation, monitoring, or controls over the contaminated aquifers. Although unlikely, exposure could occur in the following ways:

- Using contaminated ground water from water supply wells
- Drilling new water supply wells into contaminant plumes
- Using contaminated surface water for drinking water
- Using contaminated ground water and/or surface water for agricultural purposes, such as irrigation or livestock watering
- Using contaminated surface water for recreational purposes, such as swimming or fishing
- Consuming fish and wildlife exposed to contaminated water.

4.3.2 Air quality

There would be no air quality impacts because no ground-disturbing activities would occur.

4.3.3 Surface water

Under the no action alternative, the discharge of contaminated ground water to surface water bodies (streams, rivers, ponds, wetlands, springs, or arroyos) would continue. In addition, there is the potential for currently uncontaminated surface water bodies to become contaminated. The potential impacts to surface water bodies would be greater in areas of standing water because the hazardous constituents would concentrate in the sediments of ponds or wetlands. The accumulation of contaminants in these aquatic habitats could result in human health and ecological impacts, as discussed in Sections 4.3.1 and 4.3.5.

4.3.4 Ground water

Under the no action alternative, uncontaminated ground water in the same aquifer and other aquifers could become contaminated. This could result in adverse human health and environmental impacts. Under the no action alternative, the continued spread of contaminated ground water and surface water may reduce the beneficial uses of the water, such as drinking, irrigating, or stock watering. These impacts likely would be long-term because there would be no federal program to clean up the ground water; remediation would be accomplished by natural processes that could take decades or longer. The spread of ground water contamination also could result in negative impacts on land use (refer to Section 4.3.6) and to social and economic resources (Section 4.3.11).

4.3.5 Ecological resources

Implementation of the no action alternative would not result in the destruction of wildlife or aquatic habitats because site-disturbing activities would not occur.

Habitats and protected species could be adversely affected if contaminated ground water were discharged to the surface or by plant root uptake of contaminated ground water. Contaminant plumes could surface in sensitive areas such as ponds, lakes, and wetlands that may be hydrologically connected to a contaminated aquifer. Contaminants may accumulate in the sediments and be transported through the food chain and into the terrestrial ecosystems. These contaminants could be taken up by aquatic and/or terrestrial threatened and/or endangered species. Contaminants could also be ingested directly by humans drinking contaminated water or indirectly by consuming fish, wildlife, or livestock that have ingested contaminated material from the affected habitat. Since there would be no Ground Water Project under this alternative, DOE would not monitor the fate and transport of the contaminated ground water and would take no measures to mitigate potential contamination of sensitive habitats, threatened and endangered species, other biological resources, or livestock.

4.3.6 Land use

The no action alternative could affect land uses because of the potential for access to and use of contaminated ground water. Contamination could spread to wells currently used for agricultural purposes, causing farmers or ranchers to seek alternative water supplies. The no action alternative also could affect agricultural land use (e.g., crops and livestock grazing) due to the potential for plant uptake of contaminated water or if ground water discharged to the surface. More intense uses such as industrial, commercial, or residential development also would be affected. This impact would be long-term and could extend over larger land areas if the contaminated ground water plume expands over time.

4.3.7 Cultural/traditional resources

The no action alternative could affect cultural and historic resources because contaminants associated with UMTRA Project sites would not be removed. Therefore, traditional Native American water resources would be adversely affected by the contaminated ground water. Some Native Americans already consider ground water a cultural/traditional resource that is adversely impacted.

4.3.8 Background noise

The no action alternative would not affect background noise levels near the sites because there would be no remediation activities.

4.3.9 Visual resources

There would be no impact on visual resources from the no action alternative because there would be no remediation activities.

4.3.10 Transportation

The no action alternative would not affect traffic or transportation patterns because no traffic-generating activities would occur.

4.3.11 Social and economic resources

The no action alternative could result in the contamination of ground water currently used for domestic purposes (refer to Section 4.3.1). Replacing domestic water sources that become contaminated could require drilling new wells, purchasing bottled water, or funding a domestic water supply line.

The potential contamination of domestic and/or agricultural water supplies could adversely affect property values and sales of agricultural products grown in the area.

4.3.12 Environmental justice

Under no action, there is a potential for significant negative effects on human health and the environment as indicated above. Therefore, a potential exists for high or adverse disproportionate impacts at UMTRA Project sites on minority or low-income populations. For example, low-income or minority populations may not have the financial means to provide an alternate source of drinking water if ground water at the site does not meet compliance.

4.3.13 Utilities and energy resources

The no action alternative would have no effect on utilities and energy resources because there would be no remediation activities.

4.3.14 Waste management

No contaminated materials associated with site characterization, monitoring, or remedial action would be generated under the no action alternative; therefore, there would be no impact.

4.3.15 Estimated costs

Fiscal impacts associated with the no action alternative represent the costs expended on the Ground Water Project to date (such as preparation of this PEIS) and estimated costs to close down current ongoing activities associated with preliminary Ground Water Project activities. Estimated total cost of the no action alternative is $20.1 million.

4.4 COMPARISON OF ALTERNATIVES

The qualitative analysis of potential impacts of the ground water compliance strategies and the no action alternative as presented in Sections 4.2 and 4.3 are used below to compare the alternatives.

This analysis compares one alternative to another alternative. For example, if the no action alternative is said to have a high potential for ecological risk, it is high only in relation to the other alternatives' potential for such an impact. These comparisons do not assess the type and degree of impacts at a given site; this type of assessment would be provided in the site-specific NEPA documents that would tier off the PEIS. Assumptions regarding the severity of potential impacts among alternatives for each impact category are based on the impact analyses in Sections 4.2 and 4.3.

In comparing the potential impacts of the alternatives, technical specialists in each field were consulted. These comparisons are subjective because they are based on estimates of potential impacts, not measurements of actual impacts resulting from on-site remediation. Further, the comparisons treat all impacts equally so that, for example, potential impacts to human health are considered equal to potential impacts on cultural resources. To give more weight to potentially more severe impacts, long-term and short-term impacts were compared separately (Section 4.4.16). Long-term impacts would have the potential to be more severe because they would result from leaving contaminated ground water in place or using institutional controls for a long time. In general, short-term impacts would be potentially less severe because most relate to the effects of construction (such as habitat destruction, noise, and dust emissions) that are relatively minor and/or can be mitigated. While these effects are important, there is greater concern about the potential long-term health and environmental effects of leaving contaminated ground water in place.

4.4.1 Human health

The potential short and long-term health effects from contaminated ground water would be low for the proposed action and the active remediation to background levels alternative because they would result in compliance with EPA ground water standards at all UMTRA Project sites. In addition, institutional controls may be in place for sites under all alternatives except no action where contaminated ground water has migrated off the site.

The passive remediation alternative would have some potential for adverse health effects because passive strategies and the duration of institutional controls may not protect human health at some sites. However, it would have less impact than the no action alternative because the viability of using the no remediation compliance strategy would be justified at some sites and the public would be protected from contaminated ground water at most of the remaining sites. The no action alternative would have the highest potential to result in adverse health effects from contaminated ground water because no federally sponsored ground water remediation, controls, or monitoring of the contaminated ground water would take place; this impact could be long-term.

4.4.2 Air quality

The potential for the Ground Water Project to affect air quality would be minimal, especially for the no action and passive remediation alternatives. Potential air quality impacts would be low for the proposed action alternative, which relies, at least partially, on passive ground water remediation strategies and methods. The active remediation to background levels alternative would have a short-term potential for minor air quality impacts because of its reliance on active ground water remediation methods; however, mitigation measures could be taken to ensure that no significant impact occurs. There would be no long-term air quality impacts.

4.4.3 Surface water

The proposed action and the active remediation to background levels alternative would have a low potential to result in the contamination of surface water bodies because ground water (the potential source for surface water contamination) would meet EPA ground water standards under these alternatives. Surface water monitoring would take place during ground water remediation activities at the sites and, if necessary, remedial action would be initiated. The passive remediation alternative would have more potential to result in the contamination of surface water bodies because, while passive measures could be adequate at some sites, active methods could be needed at other sites to control plume migration. Under this alternative, there would be no way to clean up contaminated surface water. However, the use of this water could be restricted, thereby reducing the potential impact of using contaminated surface water. The no action alternative would have the greatest potential to result in the contamination of surface water bodies because there would be no federally sponsored remediation. In addition, the use of the contaminated water would not be controlled.

4.4.4 Ground water

The proposed action and the active remediation to background levels alternative would have the least potential to result in contamination of uncontaminated ground water because these alternatives are expected to clean up the quality of contaminated ground water to at least the EPA ground water standards. Ground water monitoring would detect any expansion of the contamination so that appropriate controls could be implemented. Under the passive remediation and no action alternatives, the potential spread of ground water contamination could not be prevented or slowed because active remediation would not be possible. However, the passive remediation alternative would attempt to meet the standards, resulting in less of an impact than no action. The spread of this contaminated ground water would have a greater potential for negative impacts under the no action alternative because access to this water could not be controlled.

4.4.5 Ecological resources

In general, the impacts of surface disturbance activities associated with site characterization and active ground water remediation would be short-term. However, if active remediation took several years, these impacts could become long-term and significant. The potential ecological impacts of leaving contaminated ground water would likely be long-term.

In terms of potential destruction of wildlife and aquatic habitat due to site characterization and the construction of remediation facilities, the no action and passive remediation alternatives would have the least likelihood for adverse impacts because there would be little or no ground-disturbing activities. The proposed action would result in some habitat disturbance because of the site-disturbing activities associated with active remediation. The active remediation to background levels alternative would result in habitat disturbance at most sites because of its reliance on active ground water remediation methods. Every effort would be made to avoid sensitive habitats or species; in most cases, it is likely that ground-disturbing activities would take place in areas away from these resources. If sensitive resources were affected, those effects would be mitigated to minimize environmental impacts.

In terms of contaminated ground water entering the ecosystem and creating a potential ecological risk, the proposed action and the active remediation to background levels alternative would have the lowest potential impact. If a ground water compliance strategy were not protective of the environment, it likely would not be implemented. Under the active remediation to background levels alternative, active ground water remediation methods would be used to remove the potential source of contamination at most UMTRA Project sites regardless of the risks. Under the passive remediation and no action alternatives, there is a greater potential for the release of contaminated ground water into the environment because the use of active remediation methods would not be available with these alternatives. In addition, their implementation would not result in the cleanup of already existing surface water contamination with its potential for an ecological risk. The no action alternative would have the highest potential for ecological risk to occur because no action would be taken to reduce or limit the use of the contaminated water. Under the passive remediation alternative, certain controls such as fencing would be available to limit wildlife use of contaminated water.

4.4.6 Land use

Land uses could be affected if land were acquired to conduct remediation or to impose controls restricting access to or use of land. The no action alternative would not require land acquisition; the proposed action and the passive remediation alternative could result in land acquisition. The active remediation to background levels alternative would likely result in the temporary use of the most land because more land would be needed to conduct active ground water remediation. In most cases, active remediation methods would require the acquisition or total control of land on which these facilities are placed. Land would likely revert to former uses after ground water remediation was completed.

The no action alternative would not limit or restrict land use because no remediation activities would occur. However, where ground water is contaminated and use could be affected. The proposed action and, to a lesser extent, the active remediation to background levels alternative would likely require land use restrictions because these alternatives would require institutional controls at some sites. The passive remediation alternative would likely result in restricted land use at most sites because institutional controls would be the most frequent restriction to access under this alternative. This impact has the potential to be long-term as well as short-term because institutional controls could be in effect for up to 100 years.

Site-related contamination could affect land use by contaminating ground water and surface water used for domestic, agricultural, or industrial purposes. The potential for such an impact is highest under no action because there would be no Ground Water Project. This potential impact would be less under the passive remediation alternative because monitoring and institutional controls, where necessary, would be available to limit use of contaminated ground water. However, this alternative may not be protective of human health and the environment at all sites and the active ground water compliance strategy could not be used. The potential for this impact is lowest under the proposed action and active remediation to background levels alternatives because compliance with the EPA standards would be achieved at all sites. In addition, the active ground water remediation strategy is available for use with these two alternatives. This strategy could be used to clean up areas of contaminated ground water or surface water that may affect beneficial domestic, agricultural, and industrial uses.

4.4.7 Cultural/traditional resources

During construction, the potential effects on cultural resources would be low for both the no action and the passive remediation alternatives because little or no construction would take place. Potential impacts would be possible under the proposed action because it would use both passive and active ground water remediation methods. The potential impacts to cultural/traditional resources would be highest for the active remediation to background levels alternative because of its reliance on active remediation methods. In most cases, it would likely be possible to avoid cultural resources during ground-disturbing activities. If sensitive cultural resources, including tribal traditional areas, were affected, these impacts would be mitigated.

Impacts to Native American traditional resources associated with water would be highest for the no action and passive remediation alternatives because ground water might not meet standards at sites on tribal lands. Under the proposed action and active remediation to background levels alternatives, ground water would meet standards and would provide a beneficial impact to these traditional resources. The active remediation to background levels alternative would have less impact than the proposed action. This is because of its reliance on active ground water remediation methods which presumably would result in compliance with the standards.

4.4.8 Background noise

The potential for adverse noise impacts under any of the alternatives would be minimal, and any impacts would be temporary.

4.4.9 Visual resources

The potential for the Ground Water Project to negatively impact visual resources would be minimal. None of the

UMTRA Project sites is located in areas of sensitive scenic resources (e.g., national parks or wilderness areas), and most visual impacts would be temporary (e.g., construction-related only). Potential long-term visual impacts from monitor wells would be possible under all alternatives except no action. As indicated in Section 4.2, these impacts could be mitigated.

4.4.10 Transportation

No significant transportation impacts would be expected under any of the alternatives. Any impacts would be minor and temporary.

4.4.11 Social and economic resources

In comparing the alternatives for potential socioeconomic impacts, the following factors are considered:

- The potential beneficial impacts associated with increased employment and economic expansion
- The potential adverse effects on property values from restrictive land uses or contaminated ground water.

Active remediation to background levels has the highest potential for socioeconomic benefits of increased employment and economic expansion. The proposed action would result in some increased employment, particularly at sites where active remedial actions would be implemented to meet EPA standards.

In terms of impacts on property values due to imposed restrictions on land use, the passive remediation alternative would have the highest potential adverse impact because it would likely result in the use of institutional controls at many sites. The proposed action and active remediation to background levels alternative would have less potential for such an impact. Under the proposed action, land use restrictions would be required as a result of the use of institutional controls at some sites and active remediation methods at other sites. The active remediation to background levels alternative would restrict land use at many sites during the active remediation period. The no action alternative would not entail land use restrictions. Under the no action alternative, contaminated ground water could adversely affect property values. Property value impacts associated with active ground water remediation are generally short-term, although the impacts of institutional controls are potentially long-term.

In terms of potential impacts on property values due to the existence of contaminated ground water and/or surface water, the proposed action and the active remediation to background levels alternative would have the least impact because implementation of either of these alternatives would result in compliance with the EPA ground water standards. The passive remediation alternative could have an impact because this alternative may not be protective of human health and the environment at some sites. The no action alternative would have the highest potential for long-term property value impacts because the existence of contaminated water resources could preclude the use of land for agricultural purposes or development, require development and use of alternative water supplies, or affect the sale of land or agricultural products.

4.4.12 Environmental justice

The no action alternative would have the potential to result in a high disproportionate impact to minority or low-income groups relative to the other alternatives. This is because the ground water will not comply with EPA standards.

The passive compliance alternative would have a medium potential to have a disproportionately high effect on minorities and low-income populations because it may not result in compliance with the EPA ground water standards at all sites. The natural flushing ground water compliance strategy may result in compliance with the standard.

The proposed action and active remediation to background levels alternatives would have a low potential to have a disproportionately high effect on minority or low-income populations because both of these alternatives would result in compliance with EPA ground water standards.

DOE has attempted in this PEIS, and will continue in subsequent tiered NEPA documents, to identify and to mitigate when so identified, any disproportionately high and adverse human health or environmental effects on minority and low-income populations resulting from decisions based on this PEIS. The activities required to complete the ground water project are highly localized and would not result in cumulative impacts to air quality, noise levels, visual resources, transportation systems, utilities and energy supplies, waste generation, and cultural resources. Further, the proposed action would result in human health, socioeconomic, and environmental impacts that would be beneficial to any surrounding population. Therefore, the DOE does not anticipate any disproportionately high and adverse human health and environmental effects on minority and low-income populations as a result of the implementation of the proposed action. The DOE will reassess potential environmental justice issues in site-specific NEPA documents that will be tiered from this PEIS.

4.4.13 Utilities and energy resources

The potential for the Ground Water Project to have a negative impact on utilities and energy resources would be none to minimal under any of the four alternatives.

4.4.14 Waste management

No liquid or solid waste management issues would arise under the no action alternative. The passive remediation alternative would produce only a small amount of waste during site characterization and monitoring. Therefore, these two alternatives would have little or no impact in terms of the potential for generating liquid and solid waste. The proposed action would have a medium probability of impacts from the production of wastes because it would rely on a combination of ground water strategies ranging from passive methods (generating little or no waste) to active methods (generating more waste). The active remediation to background levels alternative would have the highest potential to produce waste because of its reliance on active methods. All wastes would be managed in accordance with existing regulations (refer to Section 2.9).

4.4.15 Estimated costs

Highest estimated costs are associated with the active remediation to background levels alternative primarily because of the costs associated with equipment, operations, and field management. The no action and passive remediation alternatives are the least costly alternatives. The proposed action, because it combines passive and active strategies, would be less costly than the active remediation to background levels alternatives but more costly than the other two alternatives. The proposed action provides for compliance with ground water standards, and protects public health and safety by using the most appropriate compliance strategy for each UMTRA Project site.

For this PEIS, only qualitative analysis has been done. Quantitative analysis is not possible at the programmatic level because costs for the alternatives are highly variable and could be applied differently depending on site-specific conditions.

4.4.16 Summary of the comparison of alternatives

Table 4.5 compares potential adverse impacts of alternatives. Estimated cost is not included in the table because high and low expenditures are not necessarily negative or positive impacts. The potential impacts of the alternatives are divided into short-term and long-term impacts. Short-term impacts are associated with site characterization and the construction of ground water remediation facilities. Long-term impacts could occur if no ground water remediation occurred or if ground water remediation took many years.

Short-term potential impacts

The no action alternative would have no short-term impacts associated with site characterization and ground water remediation because such activities would not take place under this alternative. None of the other alternatives are expected to have short-term impacts due to the short duration and small scale of the ground-disturbing activities. Potential negative impacts that could occur under the proposed action and active remediation to background levels alternative include the degradation of air quality (e.g., dust), noise levels, visual resources, transportation systems, and utilities and energy supplies. These resources are not included on Table 4.5 because they are minor and short-term. Site characterization, monitoring, and construction activities have the potential to disturb sensitive habitats, species, and cultural resources. The probability of these impacts occurring would be remote because site characterization and remediation activities can usually take place in areas away from these resources. In addition, if impacts to these resources occur, their effects could be mitigated to minimize impacts. Therefore, the potential for site characterization and construction activities to adversely affect these resources would be considered minor.

Implementation of all the alternatives except no action would have the potential to have a positive short-term effect on minority and low-income populations and other populations if measures such as supplying an alternative source of drinking water are put into effect.

Long-term potential impacts

Based on the analysis below, long-term impacts could arise under the following circumstances:

- If the contaminated ground water did not comply with the EPA standards and use of contaminated ground water was not controlled as under the no action alternative
- If the ground water compliance strategy were not protective of human health and the environment at all sites. This could occur under the passive remediation alternative.
- If institutional controls were in place for many years. This could occur under all the alternatives except the no action alternative.

Significant adverse impacts to human health and the environment could result under the no action alternative. Under this alternative, the public could be exposed to site-related hazardous contaminants by drinking contaminated ground water or surface water from a surface expression of contaminated ground water. Disproportionately high or adverse human health effects to minority or low-income populations could occur because of the lack of means to provide for an alternate water supply.

Adverse impacts to the environment could also potentially occur if contamination enters the food chain (such as livestock or produce) or affects sensitive habitats (such as wetlands) or threatened and endangered species. These potentially significant adverse impacts would likely not occur under the proposed action or the active remediation to background alternative because these alternatives would comply with the EPA standards at all UMTRA Project sites. In addition, surface and ground water monitoring would take place before and during the implementation of the proposed action and the active remediation to background alternatives to ensure that the public is not exposed to existing and potential future surface and ground water contamination.

Implementation of the passive remediation alternative also could potentially result in the exposure of humans and the environment to UMTRA Project site-related contaminants. During the time required to implement the passive remediation alternative, contaminated ground water could reach potential receptors such as domestic wells or surface water features. Both the proposed action and active remediation to background alternatives would use hydrogeologic data and risk assessments to identify the need to implement active ground water remediation strategies quickly or to divert the flow of contamination.

Institutional controls would be required in conjunction with natural flushing. In some cases, institutional controls would be used at active ground water remediation and at no remediation sites. Institutional controls could result in potentially significant long-term land use and socioeconomic impacts. The passive remediation alternative could result in the need for institutional controls for more than 100 years if protection of the public and the environment were necessary. The proposed action and the active remediation to background alternatives would implement strategies to achieve ground water compliance within 100 years. The use of institutional controls could result in long-term land use and social and economic impacts, as discussed in Sections 4.4.6 and 4.4.11.

In summary, the proposed action and the active remediation to background alternative are most effective at protecting human health and the environment from the contaminated ground water at the UMTRA Project sites. When cost is factored in, the proposed action is likely to be the most cost-effective alternative because it would use passive remediation strategies such as natural flushing and no remediation at sites where these strategies are shown to be protective of human health and the environment. Implementation of the active remediation to background levels alternative would be the most costly because of its widespread use of active ground water remediation methods.

4.5 POTENTIAL CUMULATIVE IMPACTS OF THE ALTERNATIVES

Cumulative impacts, as defined in the CEQ regulations (40 CFR '1508.7), are the impacts which result from incremental impacts of the action when added to other past, present, or reasonably foreseeable future action regardless of what agency (federal or nonfederal) or person undertakes such other actions. For example, when the minor impacts of the Ground Water Project on a site-specific resource are combined with similar impacts of other nearby projects, the cumulative impact may become significant. Cumulative impacts in relation to past, present, and future projects at the UMTRA Project sites cannot be fully evaluated at this time because this analysis requires the use of site-specific data that are currently not available. However, the potential cumulative effects of the alternatives, combining the impacts of the Surface Project with potential impacts of the Ground Water Project, were evaluated and are presented below.

Based on the analysis of potential impacts of the ground water compliance strategies in Section 4.2 and the no action alternative in Section 4.3, the potential for the alternatives to result in cumulative impacts to air quality, noise levels, visual resources, transportation systems, utilities and energy supplies, and waste generation is minor.

There is potential for cumulative impacts from other resources, as discussed below.

4.5.1 Human health

The UMTRA Surface Project has a positive impact on human health because it results in the cleanup of surface contamination at the designated processing sites. Under the Surface Project, the cleanup of the uranium mill tailings also prevents the misuse of the tailings that, in the past, resulted in the exposure of many people and the contamination of thousands of vicinity properties. Under the proposed action, the UMTRA Ground Water Project would result in a positive cumulative impact on human health by restoring contaminated ground water through active ground water remediation, preventing the use of contaminated ground water during natural flushing, or assuring the public that the contaminated ground water is not a threat to human health through the mechanism of supplemental standards or alternate concentration limits.

When considered with the Surface Project, the active remediation to background levels alternative would also result in a positive cumulative impact to human health because the EPA ground water protection standards would be met. The passive remediation alternative would also have a positive cumulative impact because it would protect the public from exposure to contaminated ground water at sites undergoing natural flushing. It would also demonstrate to the public that some sites are not a threat since they qualify for supplemental standards or alternate concentrations limits. However, the passive remediation alternative may not be protective of human health at some sites and, in comparison to the above alternatives, has the potential for a less positive cumulative impact on human health.

Implementation of the no action alternative under the Ground Water Project would likely have a negative impact because the federal government would not take any steps to monitor, characterize, or clean up contaminated ground water; protect the public from exposure to contaminated ground water; or provide assurances to the public that the contaminated ground water is not a threat. Under this alternative, only positive impacts on human health would result from the Surface Project.

4.5.2 Surface water

Twenty-two of the UMTRA Project sites are located next to or near surface water bodies. The Surface Project has a positive long-term impact on these surface water bodies by removing surface contamination from the floodplains of rivers or from upland areas where the potential for erosion of tailings into a surface water body existed. In addition, the Surface Project eliminates the source of ground water contamination (tailings), which would result in a decrease, over time, of the flow of contaminated ground water into surface water bodies. Also, the disposal cells are designed to greatly limit the infiltration of water through the cell. The Ground Water Project, under the proposed action, and the Surface Project together have a positive cumulative impact on surface water bodies due to the remediation of contaminated surface material and ground water and, in some cases, the cleanup of surface water contamination. In addition, the remediation of contaminated ground water would prevent future contamination of surface water bodies. The implementation of the active remediation to background levels alternative would have a similar positive cumulative impact on surface water.

Under the passive remediation and no action alternatives, no measures would be taken to prevent the spread of contamination into surface water bodies or to clean up those water bodies that currently are contaminated. However, under the passive remediation alternative, measures could be taken to limit or prevent human use of contaminated surface water and, if necessary, use by some wildlife species. Therefore, the passive remediation alternative, in conjunction with the Surface Project, would result in a positive cumulative impact. However, the no action alternative likely would have a negative impact on surface water, and would not result in a positive cumulative impact on surface water from the UMTRA Project as a whole.

The Surface Project resulted in the disturbance of river floodplains at some sites. These impacts have been addressed in site-specific floodplain assessments. When the Ground Water Project is considered in conjunction with Surface Project impacts on floodplains, no cumulative impacts to river floodplains are expected because ground water remediation activities likely would not take place in floodplains due to standard engineering site-selection requirements.

4.5.3 Ground water

Under the Surface Project, the stabilization of the uranium mill tailings and other contaminated material in disposal cells has a positive impact on ground water because the source of ground water contamination (the tailings) is removed from the system. Implementing the proposed action for the Ground Water Project would add to this positive impact by cleaning up contaminated water. The active remediation to background levels alternative would result in a similar positive cumulative impact.

Implementation of the passive remediation or no action alternatives would result in the spread of contaminated ground water. However, the potential impacts of using this contaminated water would be less under the passive remediation alternative because monitoring would identify the extent of contamination and institutional controls would restrict the use of contaminated ground water. In conjunction with the Surface Project, the passive remediation alternative would have a positive cumulative impact on ground water quality. Under the no action alternative, there would be no monitoring or controls to protect the public or the environment from this water. Consequently, this alternative would not result in a positive cumulative impact to ground water.

4.5.4 Ecological resources

The Surface Project has resulted in the disturbance of approximately 3900 ac (1500 ha) of land and associated plant communities and wildlife habitat. Much of the land consisted of upland plant communities or disturbed land associated with the abandoned processing sites. In some cases, riparian and wetland areas were cleared. Impacts to sensitive habitats such as these were mitigated through various processes, including the U.S. Army Corps of Engineers Section 404 Permit. Consultation with the Fish and Wildlife Service eliminated or reduced impacts to sensitive species such as threatened and endangered species. The implementation of the proposed action and the active remediation to background levels alternatives may cumulatively impact plant communities and habitats during the construction and operation of active ground water remediation facilities. This negative cumulative impact is expected to be relatively small because, as indicated in Section 4.2.1.5, the amount of land required for such facilities would likely be small (20 ac [8 ha] or less). The implementation of passive remediation or the no action alternatives would not result in a negative cumulative impact for this resource because little, if any, land would be disturbed.

The Surface Project has a positive impact on ecological resources because it results in stabilization of the surface contamination that at some sites had entered the biological systems via contaminated soil, surface water, or ground water. The cleanup of this material eliminated the soil pathway and the major source of contamination to the surface and ground water. The implementation of the proposed action and the active remediation to background levels alternatives would have a positive cumulative impact because they would further reduce the potential for ecological risk from contaminated ground water. This is because active ground water remediation at some sites would reduce the amount of contaminated ground water available to enter the ecosystem. Active remediation of existing surface water contamination would also likely take place under these two alternatives.

As indicated in Sections 4.5.2 and 4.5.3, the passive remediation and no action alternatives would not result in the active cleanup of contaminated surface and ground water. However, the passive remediation alternative may result in a positive cumulative impact because the extent of contamination would be known and measures may be available to protect some sensitive ecological resources from contaminated surface and/or ground water. Under the no action alternative, no positive cumulative impact is anticipated because no measures would be taken to monitor the extent of contamination or protect resources from contaminated water.

4.5.5 Land use

The Surface Project results in some negative impacts on land use such as the clearing of land that had been used for grazing. Construction of active ground water remediation facilities under the proposed action or the active remediation to background levels alternatives is expected to result in only a minor negative cumulative impact in terms of land disturbance because these facilities use a relatively small amount of land, and it likely was disturbed during the Surface Project. The passive remediation and no action alternatives would not result in a cumulative impact because little or no construction would take place.

Considering both the Surface and Ground Water Projects together, the passive remediation alternative would result in a negative cumulative impact on land use because it would use the natural flushing compliance strategy more extensively than the other alternatives. With this strategy, institutional controls would be required and these controls could affect land use patterns. Under the proposed action, the negative cumulative impact on land use would be less because natural flushing would not be used as extensively. The active remediation to background levels and the no action alternatives would not result in a negative cumulative impact on land use because institutional controls associated with natural flushing would not be used.

The Surface Project has resulted in positive land use and land value impacts, particularly at processing sites where tailings were removed and disposed of off-site. There, land previously precluded from use because of contamination and federal control during cleanup would be available for public purposes such as parks (if ownership remains with a government agency) or for use by private owners following surface remediation. This positive impact would be balanced against the potentially negative land use and economic impacts that could result from institutional controls and from restricted use due to ground water contamination.

4.5.6 Cultural/traditional resources

Cultural resources are known to exist at 11 of the UMTRA Project sites. The Surface Project had very little negative impact on these resources because efforts were made to avoid or protect such resources, or measures were used to document resources. Implementing any of the alternatives for the Ground Water Project is expected to have little or no impact on cultural resources. Therefore, a cumulative impact on cultural resources is not expected.

4.5.7 Social and economic resources

Surface remedial activities employ between 80 and 300 workers per site during the construction season. The number and types of workers depend on the site and the status of remedial activities. For example, employment associated with surface remediation at Grand Junction totaled nearly 300 workers in 1993; in Naturita, employment is expected to average 54 workers and peak at 76 workers. Similarly, fewer workers are required during initial stages of remediation (e.g., building demolition). Research on the UMTRA Surface Project indicates about 80 percent of the work force is local, from within a 60mi (96-km) commute distance. In addition to direct employment, secondary employment is generated when money spent on remedial action is respent and these expenditures create a demand for new jobs.

Surface remedial activities have a direct positive impact on local economies as well because of wages and salaries paid to workers and expenditures for equipment, materials, supplies, and services. Secondary benefits also result as monies from these wages and salaries are recirculated. Direct and secondary expenditures generate tax revenues that are available for county and state government use.

Similar but lesser impacts could occur with the Ground Water Project. Fewer workers would be required for active ground water remediation than for surface remediation. Consequently, the beneficial cumulative impact of ground water remediation added to the surface activities would be minimal. Higher cumulative beneficial economic impacts (increased employment and economic stimulation) would be expected under the active remediation compliance strategy due to its use of more labor-intensive active remediation methods. No beneficial cumulative impact would occur under the no action alternative.

4.5.8 Environmental justice

The activities required to complete the Ground Water Project under the proposed action and active remediation to background levels alternatives would not result in cumulative negative impacts to air quality, noise levels, visual resources, transportation systems, utilities and energy supplies, waste generation, or cultural/traditional resources. Further, when considered with the Surface Project, these alternatives would result in human health, social, economic, and environmental cumulative positive impacts that would also benefit any surrounding population. Therefore, the DOE does not anticipate any disproportionately high adverse cumulative effects on minority or low-income populations from these alternatives.

Implementation of the passive remediation alternative likely will not be protective of human health and the environment (at some sites) as the proposed action and active remediation to background level alternatives. However, given that the passive compliance alternative would result in characterization and monitoring, and would protect the public from using contaminated ground water (through use of institutional controls), this alternative would have a positive cumulative impact. Therefore, implementation of this alternative is not expected to result in disproportionate negative and adverse cumulative effects to minority and low-income groups.

The no action alternative could result in negative impacts to human health and the environment and when considered with the Surface Project, likely would not have a positive cumulative impact. Further, if the negative impact of no action on human health and the environment is severe enough, there is a potential for the no action alternative to result in a disproportionate adverse cumulative impact on minority and low-income populations.

The DOE will assess potential environmental justice issues in greater detail in site-specific NEPA documents that will be tiered from this programmatic review.

Table 4.4 Summary of potential impacts of the ground water compliance strategies

Impact	Ground water compliance strategy		
	Active ground water remediation	Natural flushing	No remediation [a]
Human health			
Exposure to contaminated water resources	X	X	X
Risks to workers handling contaminated materials	X		
Accidents not involving hazardous constituents	X		
Air quality - Dust emissions	X	X	
Surface water			
Surface water contamination from contaminated ground water	X	X	X
Surface water contamination from wastewater	X		
Ground water			
Expansion of ground water plume into uncontaminated areas	X	X	X
Contaminated wastewater affecting ground water	X		
Ecological resources			
Habitat disturbance	X	X	
Sensitive habitats	X	X	X
Threatened and endangered species effects	X	X	X
Contamination of biological systems (ecological risk)	X	X	
Land use - restrictions	X	X	X
Cultural/traditional resources	X	X	X
Background noise	X		
Visual resources	X	X	X
Transportation	X		

Social and economic			
Economic benefits (employment, goods, services)	X	X	X
Reduction in property values due to remediation activities or implementation of institutional controls	X	X	
Reduction in property values due to contaminated ground water	X	X	X
Water rights	X	X	
Environmental justice[b]		X	X
Utilities and energy resources	X		
Waste management	X	X	X

[a]Refers to no remediation sites where ground water contamination exceeds maximum concentration limits or background levels and that qualify for supplemental standards or alternate concentration limits.
[b]Potential negative impacts may occur only if EPA ground water standards are not met.
X - an impact could occur.

Table 4.5 Comparison of potential adverse environmental impacts of the alternatives

Environmental factor	Alternative			
	Proposed action	No action	Active remediation to background levels	Passive remediation
Human health	Low	High	Low	Medium
Surface water	Low	High	Low	Medium
Ground water	Low	High	Low	Medium
Ecology				
Habitat destruction	Medium	Low	High	Low
Contaminated ground water	Low	High	Low	Medium
Land use				
Land acquisition	Medium	Low	High	Low
Institutional controls	Medium	Low	Medium	High

Contaminated ground water	Low	High	Low	Medium
Cultural/traditional resources				
Surface	Medium	Low	High	Low
Ground water	Medium	High	Low	High
Social and economic				
Institutional controls	Medium	Low	Medium	High
Contaminated ground water	Low	High	Low	Medium
Environmental justice	Low	High	Low	Low
Waste management	Medium	Low	High	Low

Notes:

1. High indicates high potential for negative impact relative to the other alternatives.

2. Medium indicates medium potential for negative impact relative to the other alternatives.

3. Low indicates little to no potential negative impact relative to the other alternatives.

4. The degree of actual negative impact, if any, would be addressed once the site-specific ground water compliance strategies are determined; thus analysis would appear in the site-specific NEPA documents.

5.0 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This section discusses unavoidable adverse environmental impacts of the proposed action. The potential impacts identified in Section 4.0 may not occur every time a ground water compliance strategy is employed, but the potential does exist for the identified impacts to occur. Potential impacts would be analyzed in the site-specific NEPA documents. The following potential unavoidable adverse impacts would likely occur under the proposed action.

5.1 ECOLOGICAL RESOURCES

The proposed action would likely result in the clearing of small areas of terrestrial plant communities and wildlife habitat at sites where ground water remediation facilities would be constructed. Most of the land cleared for these facilities would be land that was previously disturbed during the Surface Project, so the plant communities are of marginal quality for wildlife. When ground water remediation is complete, the facilities would be dismantled, and the ground would be recontoured, if necessary, and revegetated.

5.2 LAND USE

Under the proposed action, active ground water remediation methods and natural flushing could affect land use by restricting land and water use during the remediation period. Active ground water remediation methods would require construction of facilities such as water treatment plants and wastewater evaporation ponds. This land for these facilities would not be available for other uses during the ground water remediation activities. Under the proposed action, institutional controls would be used in conjunction with natural flushing and possibly in conjunction with other ground water compliance strategies. Institutional controls could affect land use within the controlled area by restricting certain land uses or even eliminating all uses. This impact could be more significant to land use practices that require ground water withdrawal. These restrictions could last for an extended period because institutional controls for natural flushing could be in effect for up to 100 years.

6.0 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

In accordance with NEPA, this section discusses the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity.

Under the no action alternative, there would be no remediation of the contaminated ground water at the UMTRA Project sites. Therefore, the impacts associated with ground water remediation, such as the disturbance of wildlife habitat and land use restrictions, would not occur. Long-term productivity at some sites would be adversely affected under the no action alternative because the contaminated ground water would not be cleaned up. This could result in the contamination of domestic wells, surface water bodies, and aquatic and wildlife habitat, resulting in potential human and environmental health effects. In addition, the long-term productivity of the sites could be affected because contaminated ground water and surface water bodies could not be used for practices such as agriculture and ranching.

Cleaning up the contaminated ground water at the UMTRA Project sites with active methods or natural flushing would preclude other short-term uses of the land during remediation. The remediation of contaminated ground water however, would enhance long- term productivity of the affected sites because aquifers that are currently contaminated would become available for use.

7.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The no action alternative would not use any resources because the Ground Water Project would not take place under this alternative. The proposed action and the other alternatives would require the use of resources during site characterization, monitoring, and ground water remediation. These resources would be fuel, electricity, construction materials, water, and land. In addition, the proposed action and the active remediation to background alternative would require the use of chemicals and other materials for water treatment. These are irretrievable commitments.

Site-specific NEPA documents would identify the needed amount of resources. The resources that would be irreversibly lost would be fuel; construction materials such as cement, wood, and metal; electricity; and chemicals and other materials used for water treatment. A net depletion of water would be associated with most treatment technologies.

The use of land would not be permanently committed because the land would be returned to its previous condition after the completion of ground water remediation. Land use restrictions due to institutional controls would be lifted once it had been verified that the affected ground water meets the EPA ground water standards. However, land used during the ground water remediation period would be irretrievably committed for that time period.

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42 USC §7901 et seq., Uranium Mill Tailings Radiation Control Act.

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9.0 GLOSSARY

alternate concentration limits	Concentrations of constituents that may exceed the maximum concentration limits; or, limits for those constituents without maximum concentration limits. If DOE demonstrates, and NRC concurs, that human health and the environment would not be adversely affected, DOE may meet an alternate concentration limit.
aquifer	A body of rock that is sufficiently permeable to conduct ground water and to yield economically significant quantities of water to wells and springs.
aquifer hydraulic characteristics	Properties of an aquifer that describe its capability to transport or store ground water.
aquifer pumping test	A test conducted by pumping water from wells and measuring water level changes in the surrounding aquifer. Pumping tests provide information about aquifer hydraulic characteristics.
aquitard	An underground layer of earth or rock that acts as a confining bed and retards ground water flow to or from an adjacent aquifer.
baseline risk assessment	A baseline risk assessment describes the source of contamination, how that contamination reaches people and the environment, the amount of contamination to which people or the ecological environment may be exposed, and the health or ecological effects that could result from that exposure.
bedrock	Rock that commonly occurs below land surface as a solid mass, not loose granules like sand and gravel.
beneficial use	A beneficial use of a ground water resource is any current and reasonably projected use of that ground water. Examples of a ground water beneficial use are for drinking water, stock watering, crop and garden irrigation, and residential use.
bioremediation	The processes of breaking down or immobilizing certain constituents in water through the use of chemical reactions caused by microorganisms.
capture zone	The area of an aquifer that contains ground water that will eventually be removed or captured by the extraction wells.
cleanup	The removal or stabilization of constituents to eliminate or reduce the risk to human health and the environment.
compliance strategy	The method used to meet the EPA ground water standards at an UMTRA Project site.

confined aquifer	An underground layer of earth or porous rock containing water that is separated from the ground water above it by a layer of sediment or rock that retards ground water flow.
constituent	Any substance found in ground water whether or not it is harmful.
contaminant	An undesirable substance from uranium processing activities that may affect human health and the environment.
cooperating agency	A federal, tribal, state, or local agency that participates in the preparation of an environmental impact statement.
cooperative agreement	An agreement between DOE and an affected Indian tribe or state that defines the roles and responsibilities of the parties in implementing the UMTRA Project.
denitrification	A microbial reaction that causes the removal of nitrate from water by converting the nitrate to nitrogen.
downgradient	Ground water located in the same direction as ground water flow from a specified location.
environmental assessment	A document that determines the potential for significant impacts to the environment from an action.
environmental impact statement	A document that describes and evaluates the potential significant impacts on the environment from several alternative actions, including no action.
fracture zones C	Cracks in bedrock caused by geologic forces. Fractures can conduct ground water flow.
geochemical models	Computer programs used to determine chemical reactions between the aquifer matrix and ground water or chemical reactions in ground water only.
geophysical methods	Methods of investigating the subsurface that involve the analysis of electrical measurements on the land surface or the analysis of subsurface vibrations that are created by an energy source on the land surface.
ground water	Water under the earth's surface that fills spaces between sand, soil, or gravel. When ground water occurs in aquifers, it can be pumped for drinking water, irrigation, and other purposes.
ground water model	A computer program used to estimate ground water flow and contaminant movement rates and directions.
ground water monitoring	The periodic sampling and analysis of ground water to measure water levels and detect the possible presence of chemicals.
ground water plume	A defined area of ground water contamination. In this document, the term "ground water plume" means the contaminated ground water beneath a mill site and surrounding area that DOE determines to contain either soluble radioactive or nonradioactive, hazardous constituents, as a direct or indirect result of the uranium milling process.

ground water recharge area	An area of land surface or a body of surface water that allows water to infiltrate into a shallow aquifer.
ground water remediation	Treatment of ground water to decrease the amount or mobility of constituents.
hydraulic barrier	A natural or constructed restriction of ground water flow.
hydraulic conductivity	A description of an aquifer's capability to transport ground water.
hydraulic diversion	A change in ground water flow direction caused by a higher water table created by injection of water into an aquifer.
hydrogeologic framework	Underground geologic features that control ground water occurrence and movement. Such features include sediment or rock types, their thicknesses, and their orientations.
in situ	Occurring in the original place.
institutional controls	Controls that effectively protect public health and the environment.
maximum concentration limits	EPA's maximum concentration of certain constituents for ground water protection. Constituents with maximum concentration limits that may be present in contaminated ground water at UMTRA Project sites include arsenic, barium, cadmium, chromium, lead, mercury, molybdenum, nitrate, radium, selenium, silver, and uranium.
microbial reaction	A chemical reaction caused by microorganisms.
mill site	(see processing site)
mitigation	Includes avoiding an impact altogether by not taking a certain action or parts of an action; minimizing impacts by limiting the degree or magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and compensating for the impact by replacing or providing substitute resources or environments.
natural flushing	Allowing natural ground water movement and geochemical process to decrease contaminant concentrations.
net gross alpha	Net gross alpha is a radiological term for the activity associated with all alpha-emitting radionuclides except uranium.
plume	(see ground water plume)

point of compliance	Anywhere site-related contamination above the EPA standards is found or projected to be found in ground water outside the disposal area and its cover.
processing site	A location where uranium ore was milled to remove the uranium. The term is used interchangeably with uranium mill site.
public drinking water system	A public water system is defined in 40 CFR §125.58 as a "system for the provision to the public of piped water for human consumption, if such system has at least fifteen (15) service connections or regularly serves at least twenty- five (25) individuals. This term includes (1) any collection, treatment, storage and distribution facilities under the control of the operator of the system and used primarily in connection with the system, and (2) any collection of pretreatment storage facilities not under the control of the operator of the system which are used primarily in connection with the system."
record of decision	A document that identifies the alternative selected for a given action described in an environmental impact statement.
remedial action	The action taken to stabilize, control, or clean up contaminants.
residual radioactive materials	Uranium mill tailings DOE determines to be radioactive that have resulted from the processing of uranium ore, and other waste at a processing site which DOE determines to be radioactive and which relates to such processing. EPA has interpreted this to include sludges and captured contaminated water from processing sites.
riparian habitats	Areas located along the banks of streams, rivers, lakes, and other bodies of water.
saturated zone	The zone of soil and rock below the water table.
scoping	An early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action.
site observational work plan	A document that presents a summary of site hydrogeological data and presents a site conceptual model. It presents an analysis of site environmental and health risks, data gaps in the conceptual model, and identifies appropriate site- specific ground water compliance strategies.
storativity	A description of the volume of water that can be removed from an aquifer in relationship to a decline in water level.
strategy	(see compliance strategy)
supplemental standards	Regulatory standards that are protective of human health and the environment that may be applied when the quantity of certain constituents exceeds the standards.
tailings	(see uranium mill tailings)
	"Tiering" refers to the coverage of general matters in broader environmental impact statements (such as national program or policy statements) with subsequent narrower statements or environmental analyses (such as regional or basin-wide program statements

tiering	or ultimately site-specific statements) incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared (40 CFR §1508.28).
transmissivity	A description of an aquifer's capability to transport ground water in relationship to the aquifer thickness.
unsaturated zone	Soil, sediment, or rock above the water table where the pore spaces are not completely filled with water.
uranium mill tailings	The remaining sand-like portion of the metal- bearing ore after some or all of the uranium has been extracted.
vicinity properties	Properties outside a processing site boundary that have been contaminated by residual radioactive materials. These materials could have been dispersed by wind or water erosion, or removed by people.
water displacement tests	Tests conducted by rapidly adding or extracting a volume of water from a well and measuring the water level change.
water table	The boundary between the underground unsaturated zone and the saturated zone, at which the pressure is equal to that of the atmosphere.

10.0 ABBREVIATIONS AND ACRONYMS

Acronym	Definition
ac	acre
CEQ	Council on Environmental Quality
cm	centimeter
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ft	foot
ft^3/s	cubic feet per second
gal	gallon
ha	hectare
km	kilometer
L	liter
m	meter
m^3	cubic meter
mg/L	milligrams per liter
mi	mile
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
PEIS	programmatic environmental impact statement
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act
UPDCC	UMTRA Project Document Control Center

yd^3	cubic yard

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	Department of the Interior	Washington, D.C.
	Bureau of Indian Affairs	Phoenix, Arizona
Tribal	Arapaho Tribe	Fort Washakie, Wyoming
	Wind River Environmental Quality Committee	Fort Washakie, Wyoming
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State	Colorado Department of Public Health and Environment	Denver, Colorado
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	New Mexico Hazardous and Radioactive Material Bureau	Santa Fe, New Mexico
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	Pennsylvania Department of Environmental Resources	Pittsburgh, Pennsylvania
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	Utah Department of Environmental Quality	Salt Lake City, Utah
	Wyoming Land Quality Division	Lander, Wyoming

13.0 AGENCIES, ORGANIZATIONS, AND PERSONS RECEIVING COPIES OF THE PEIS

The PEIS has been distributed to the following libraries and federal, tribal, and state agencies and representatives. Copies have also been mailed to members of Congress, governors, and state legislators who represent states where UMTRA Project sites are located. Additional copies have been mailed to private citizens and other interested stakeholders.

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- Durango Public Library
- Montrose Regional Library
- Naturita Branch
- Montrose Public Library
- Nucla Public Library
- Glenwood Springs Library
- Gunnison Public Library

Idaho
- Boise Public Library

New Mexico
- Navajo Community College Library
- Shiprock Branch
- Mother Whiteside Memorial Library
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- Grand County Library
- Green River Library

Wyoming
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- Wyoming State Library
- University of Wyoming Library

Washington, D.C.
- DOE Library, Washington, D.C.

University of New Mexico Gallup Library
University of New Mexico General Library
New Mexico Environment Department Library

Federal, tribal, and state agencies and representatives

Department of Interior
Office of Environment, Policy, and Compliance

Army Corps of Engineers
Office of Environmental Policy
Office of Chief of Engineers

U.S. Environmental Protection Agency
Regions I-X

U.S. Nuclear Regulatory Commission
Uranium Recovery Branch
Division of Low-Level Waste and Decommissioning

Office of Scientific and Technical Information

National Technical Information Service

Remedial Action Program Information Center

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South Dakota Department of Environment and Natural Resources

Director
Division of Environmental Regulation
South Dakota Department of Environment and Natural Resources

Nuclear Fuel Supply Branch
Tennessee Valley Authority

Director of Environmental Policy
Governor's Policy Council of Texas

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Arapaho Tribal Chairman

Wind River Environmental Quality Committee

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Shoshone-Arapaho Tribes

APPENDIX A

HEALTH AND ENVIRONMENTAL PROTECTION STANDARDS FOR URANIUM AND THORIUM MILL TAILINGS

PROPOSED STANDARDS FOR REMEDIAL ACTIONS AT INACTIVE URANIUM PROCESSING SITES

GROUND WATER STANDARDS FOR REMEDIAL ACTIONS AT INACTIVE URANIUM PROCESSING SITES, FINAL RULE

COMMENTS AND RESPONSES

LIST OF ACRONYMS

Acronym	Definition
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
NEPA	National Environmental Policy Act
PEIS	programmatic environmental impact statement
RCRA	Resource Conservation and Recovery Act
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act

Comment 1. Explain the difference between no action and passive remediation. (Shiprock)

Response: Under the no action alternative, there would be no more federally sponsored UMTRA Ground Water Project; the DOE would complete the cleanup of the surface contamination at the UMTRA Project sites and end the Ground Water Project. Under the passive remediation alternative, the DOE would conduct a ground water characterization program to determine the degree and extent of ground water contamination just as it would under the proposed action and the active remediation to background levels alternatives. However, in terms of ground water compliance, the DOE would be limited to one of the two strategies: natural flushing or no remediation. Active ground water cleanup methods could not be used with this alternative. The DOE would continue to monitor the ground water at the sites as required and institutional controls would be implemented when necessary to limit access to or use of contaminated ground water. The text of the PEIS was changed in Section 2.4 to further clarify the difference between the no action and passive remediation alternatives.

Comment 2. Congressional funding uncertainties could require reevaluation of the passive compliance alternative.

(Shiprock)

Response: The passive remediation alternative has the potential to be less costly than the proposed action, which may make it a more attractive alternative than the proposed action in this time of funding uncertainties. As explained in the PEIS, however, this alternative may not protect human health and the environment and meet the standards within a 100 year period for natural flushing or at sites that would require active ground water remediation. Therefore, DOE is not planning to consider this alternative as its proposed action. It is the intent of DOE to operate the Ground Water Project in such a way as to protect human health and the environment and the proposed action is the most cost-effective means to achieve this.

Comment 3. Can the passive alternative be changed to active remediation if necessary? Is this a provision of the alternative? (Shiprock)

Response: As indicated in the response to comment 1 above and Section 2.4 of the PEIS, the use of active ground water remediation is not an option with the passive remediation alternative. However, under the proposed action, the passive remediation strategy such as natural flushing could be changed to active ground water remediation strategy if natural flushing is not working. Conversely, the active remediation strategy can be changed to passive remediation strategy if conditions warrant, under the proposed action.

Comment 4. How would ground water conditions at the Shiprock site affect the natural flushing alternative? Wouldn't conditions at different places affect how "mother nature" was effective? (Shiprock)

Response: It is not known at this time if natural flushing would be a viable ground water compliance strategy for the Shiprock site. If either the proposed action alternative or the passive remediation alternative is chosen for the Ground Water Project, an additional investigation would be performed on a site-specific basis to determine if natural flushing or another ground water compliance strategy would meet the EPA ground water standards and would be protective of human health and the environment. Due to differences in environmental conditions, the effectiveness of natural flushing varies from site to site and over time and distance at a specific site. These conditions would be investigated as part of the risk-based decision-making process under either of the above alternatives.

Comment 5. The definition of passive compliance is to do nothing and let mother nature work toward remediation. Does this include a geochemical barrier? (Shiprock)

Response: Under the passive remediation alternative, active remediation technologies such as a geochemical barrier would not be in scope. Under this alternative, no physical manipulation or engineered change of the ground water would take place. As indicated in Section 2.4 of the PEIS, site characterization, monitoring, and possibly institutional controls are the major components of the passive remediation alternative. Under the proposed action, it may be possible to employ a combination of the passive and active remediation strategies. For example, the active remediation strategy could include the use of a geochemical barrier to reduce contaminant concentrations to a level where natural flushing could then be applied.

Comment 6. Was the proposed action framework developed by the Department of Energy or is it in the Environmental Protection Agency standards? (Shiprock)

Response: The proposed action framework (Figure 2.1 in Section 2.0 of Volume I) was developed by the DOE and is not part of the EPA standards. It is a logic framework that represents the DOE's proposed action for meeting the EPA ground water standards.

Comment 7. Is it possible to go from a positive response on ground water contamination directly to active remediation? Or is it necessary to go through the other steps or strategies first? (Shiprock)

Response: It is possible to go directly to active remediation under the proposed action if enough site classification data are available to justify this. However, under the proposed action, which is a risk-based approach, the passive strategies would likely be considered for most sites because they are less disruptive to the environment and more cost effective. If it is determined that a passive approach such as natural flushing would not be effective or likely would not be protective of human health and/or the environment within 100 years, the active ground water remediation strategy would be evaluated.

Comment 8. Is cost effectiveness required in the legislation? (Shiprock)

Response: Cost effectiveness is not explicitly required in the legislation, but is rigorously encouraged. The EPA also expects the DOE to implement the most cost-effective strategy to meet the ground water standards and be protective of human health and the environment.

Comment 9. Are there any sites that will clean themselves in 100 years? Have any known contaminated sites naturally flushed? (Shiprock)

Response: It is not known at this time which UMTRA sites will comply with the EPA standards using the natural flushing ground water compliance strategy. Under the proposed action and passive remediation alternatives, further investigations would be performed at UMTRA sites to determine if natural flushing would meet the EPA ground water standards and would be protective of human health and the environment within 100 years.

Comment 10. Who would decide, over time, that a strategy is still protective? Will there be additional input as site conditions and the ground water remediation and compliance change over time? (Shiprock)

Response: Once a ground water compliance strategy such as natural flushing or active remediation is put into place, a monitoring program will be implemented to determine if the ground water is being cleaned up as predicted and public health and the environment are being protected. During the development of a ground water compliance strategy for each applicable site, the limitations and conditions under which the strategy may fail will be determined and presented in the site-specific remedial action plan and other Ground Water Project documents. These documents would be made available to the public for review and comment and to ensure the public is aware of the potential limitations and failures of a specific ground water compliance strategy before it is used. The public will always be kept informed of the effectiveness of the ground water compliance strategy during the Ground Water Project and then during the long-term surveillance. If it is determined by the DOE in consultation with affected tribes and states that the chosen strategy is not working as planned and/or not protecting public health and the environment, a new ground water compliance strategy may have to be used. The local residents would have been kept apprised of any problems with the chosen compliance strategy and the DOE would seek input from the public during the development of a new ground water compliance strategy. Every effort will be made to ensure that the proposed site-specific ground water compliance strategy will comply with the standards and not need to be revised.

Comment 11. The PEIS should clarify the partnership of the Navajo Nation with the Department of Energy. It is important to recognize the sovereignty of the Navajo Nation. (Note: a separate written statement submitted). (Shiprock)

Response: The DOE fully recognizes the sovereignty of the Navajo Nation pursuant to the DOE's American Indian Policy and DOE Order 1230.2, American Indian Tribal Government Policy, dated April 8, 1992. The UMTRA Project is a cooperative effort and DOE acknowledges the importance of the tribal stakeholders. We look forward to working with the Navajo Nation as well as our other Native American stakeholders to ensure we collectively meet our goals of protecting human health and the environment.

Comment 12. Will there be other opportunities to review data and information? Are other, local agencies participating in the decision making? (Shiprock)

Response: The DOE is committed to ongoing public participation in the Ground Water Project. Section 1.6 of the PEIS explains the public involvement process for the PEIS and describes future opportunities for public input in site-specific decisions regarding ground water compliance actions. DOE provides current information and opportunities for the public to discuss site specific issues during public meetings in the site communities. Technical documents for the Ground Water Project, such as baseline risk assessments, are being made available to state and local agencies and interested persons. Local agencies, such as city councils and county commissions, have been involved in the UMTRA Surface Project and continue to be involved in the Ground Water Project.

Comment 13. How will the Department of Energy know if a strategy is successful; are there annual benchmarks for evaluation of the information and compliance? (Shiprock)

Response: As part of the ground water compliance strategy, a monitoring program will be implemented in most cases to evaluate the progress of ground water compliance. For example, if natural flushing is the chosen compliance strategy, the site-specific analysis will estimate the rate of natural ground water cleanup and the monitoring program will determine if these goals are being met. The monitoring frequency will be determined on a site by site basis. Typically, ground water currently is monitored once or twice a year.

Comment 14. Community input is important in the choice of compliance. If a community wants active clean-up immediately, can we let our position be known? How can we give our opinion and influence the decision? (Shiprock)

Response: The DOE has actively sought input from the local communities during the PEIS process, starting with scoping meetings and continuing with the hearings and comment period on the PEIS. The DOE will continue to encourage communication with the public during the remainder of the PEIS process and throughout the remainder of the Ground Water Project. The DOE encourages the community to express its position and comments at community meetings and through direct communication with DOE representatives.

Comment 15. The PEIS is difficult to read and needs to be simpler and clearer. More graphics and visual are needed and there should be a "lay" explanation of terms. (Shiprock)

Response: As a result of comments received on the draft PEIS, modifications and additions have been made to the text and some of the graphics. These revisions have made the final PEIS simpler to comprehend and clearer to read.

Comment 16. Will the final PEIS rank the sites in order of priority for clean-up? (Shiprock)

Response: The DOE has prioritized the sites; see Section 2.7.1.

Comment 17. Will the Environmental Protection Agency approve the selected alternative? (Shiprock)

Response: No; however the EPA has reviewed the draft PEIS and provided comments (see Volume II of the PEIS for comments 312 through 327 and responses). The EPA has determined that the draft PEIS was well written and is a sound approach. The EPA determined that the preferred alternative (the proposed action) is acceptable.

Comment 18. Is July 17, 1995, the nationwide deadline for submittal of comments? (Shiprock)

Response: Yes; however, the deadline was extended 60 days to September 20, 1995 at the request of the Navajo Nation. A notice of the extension was published in the Federal Register on August 4, 1995 (60 FR 39953).

Comment 19. I am concerned that the public will receive the PEIS but not the comments that were submitted. (Shiprock)

Response: All comments submitted, including those recorded at public hearings, are included in a comment and response document that is part of the final PEIS. This document provides each comment, the DOE's response, and, as appropriate, indicates changes made to the draft PEIS in response to the comment. The comment and response document is Volume II of this final PEIS.

Comment 20. Why are we doing this? It is after the fact; the federal government has used our people and is still using us. We were not told of the risks of uranium mining. (Shiprock)

Response: The DOE understands your concern. While we cannot undo the past, the DOE is charged with completing remedial action of the abandoned tailings and contaminated materials associated with uranium processing and is taking the necessary steps to protect public health and the environment from risks associated with these past activities. The Ground Water Project is the next phase of this process to ensure that public health and the environment is protected from any unacceptable risk due to residual contamination of ground water that resulted from uranium processing. Baseline risk assessments are being prepared to identify the type and extent of these risks. This information is being shared with site communities through DOE's continuing public involvement program which includes community meetings and review of technical documents.

Comment 21. We do not want the UMTRA budget compromised. We want the legislative intent of UMTRA to be met. (Shiprock)

Response: The DOE's goal is to meet the legislative intent of UMTRCA and, on an annual basis, request funds from Congress needed to achieve compliance at the UMTRA Project sites.

Comment 22. Is there a way to expedite the process? Scoping was conducted 2 years ago; how much did headquarters change the document anyway? (Shiprock)

Response: The DOE UMTRA Project worked closely with the DOE Headquarters office in Washington, D.C., so the final PEIS was reviewed and approved more quickly than the draft. Changes were made to the draft PEIS in response to public and internal comments.

Comment 23. Approximately $540 million was allocated to UMTRA under the legislation. What has been spent to date on administration and on clean-up for each of the two projects (ground water and surface)? What are the expenditures for each project's administrative costs versus actual clean-up? (Shiprock)

Response: The $540 million was not allocated to UMTRA under the legislation. That number is the total estimated cost of the project including contingencies and escalations. UMTRA receives a yearly allocation and budgets are requested annually, not as a total project. The administrative costs of the Surface Water Project to date are $216,696,000 out of the $1,264,581,000 in total costs as of May 1994. The administrative costs of the Ground Water Project are $10,667,000 out of the total $19,796,000. The Ground Water Project is in the very early stages.

Comment 24. Competition between UMTRA sites may occur if funding is limited. How much control do we have in seeing that funds are appropriated for clean-up and not just for administrative paper work? (Shiprock)

Response: The DOE has initiated a prioritization process that will support action at the most significant sites first. The UMTRA Project will work to ensure the stakeholders will be involved in prioritization. This should keep the Project focused toward protecting human health and the environment. It is a clear goal of DOE to reduce administrative costs and increase compliance accomplishments. To this end, the DOE commissioned an independent technical review team to provide the Project team with recommendations to improve the Project; recommendations from this team have been factored into the operation of the Ground Water Project.

Comment 25. A lot has been spent to date and there has been no-clean-up; with questions about the fate and funding of the Department of Energy, this could affect clean-up. (Shiprock)

Response: The DOE is funded on a yearly basis. DOE will strive to obtain the necessary funding to complete the Project.

Comment 26. Have field investigations been started that will provide information to prioritize the sites? (Shiprock)

Response: Field investigations are being conducted for the purposes of site characterization. This new information will be used in future evaluations of site prioritization.

Comment 27. If the Department of Energy has already prioritized the sites, the priority list should be in the PEIS. (Shiprock)

Response: DOE has prioritized the sites into five groups as presented in Section 2.7.1. The basis for these prioritization activities was shared with the affected tribes and states in 1991 to receive input on the factors and weighting used in the process. The prioritization section in the final PEIS was expanded.

Comment 28. The PEIS has made conclusionary statements (see page 3-21, limited use aquifer at Ambrosia). Statements need to reworded or clarified so they do not appear to be conclusionary. (Shiprock)

Response: The sentence in Section 3.2.11 has been revised to indicate that the contaminated ground water beneath the Ambrosia Lake site was determined to be limited use in terms of the Surface Project ground water protection strategy. This conclusion was agreed upon by DOE, the state of New Mexico and the U.S. Nuclear Regulatory Commission. In terms of the Ground Water Project, no site-specific decision regarding a ground water compliance strategy at the Ambrosia Lake site or any other UMTRA Project site has been made.

Comment 29. How would the proposed action be affected if contamination is not caused exclusively by uranium processing, for instance if other activities contributed to the contamination? How would this affect the choice of remediation? Public input should be considered in making this decision. (Shiprock)

Response: The DOE is not responsible for contamination at or near the UMTRA Project sites resulting from activities such as mining that are not related to the uranium processing site. Of course, if contaminants from another source have mixed with the UMTRA contamination, these contaminants will need to be addressed during the development of a site-specific ground water compliance strategy. The DOE intends to continue to seek public input in making decisions for the Ground Water Project. Section 1.6 of the PEIS describes the public participation process for the PEIS and future opportunities for public input.

Comment 30. Does the legislation indicate funding by priority? Will the Department of Energy spend its money based on the priorities? (Shiprock)

Response: The DOE has developed a ground water prioritization based on the urgency to conduct activities. The initial prioritization methodology and priority categories were shared in draft form with all the affected states and tribes in 1991. Each site will have its prioritization category identified in the new or modified cooperative agreement. To the greatest extent possible, DOE will spend its funds to proceed with implementing the compliance strategies based on priorities, availability of state share (as required), and Congressional appropriations to carry out the Project. It is expected that there are opportunities to address compliance at some of the lower risk sites concurrent with executing compliance strategies at the higher risk sites without impacting the higher risk sites.

Comment 31. What needs to be done in D.C. to assure funding is provided for the Navajo sites? Limited dollars could result in competition among sites. (Shiprock)

Response: Congress appropriates the funding for the UMTRA Ground Water Project budget. The DOE will continue requesting appropriations until all the sites are in compliance with the EPA standards and protective of human health and the environment.

Comment 32. When the priorities are established, will the money go to those sites? (Shiprock)

Response: The DOE has developed a ground water prioritization based on the urgency to conduct activities. The initial prioritization methodology and priority categories were shared in draft form with all the affected states and tribes in 1991. Each site will have its prioritization category identified in the new or modified cooperative agreement. To the greatest extent possible DOE will spend its funds to proceed with implementing the compliance strategies based on priorities, availability of state share (as required), and Congressional appropriations to carry out the Project. It is expected that there are opportunities to address compliance at some of the lower risk sites concurrent with executing compliance strategies at the higher risk sites without impacting the higher risk sites.

Comment 33. To what extent will political clout influence money spent and priorities? (Shiprock)

Response: DOE intends to comply with the EPA Ground Water compliance standards based on established priorities to the greatest extent possible. At times, other factors may affect priorities and program execution.

Comment 34. There should be more study of the surface cover to ensure that there is no more contamination. I want to assure that the source of contamination is secure. How does the Department of Energy determine that there is no more contamination? (Shiprock)

Response: The completion report document for the Shiprock site contains final verification data and as built plans and specifications for a disposal site. The disposal cell design and calculations are presented in the remedial action plan, which was approved by the DOE, the Navajo Nation and the Bureau of Indian Affairs (for Shiprock and other disposal cells within the Navajo Nation), and the U.S. Nuclear Regulatory Commission. In order to ensure that all tailings-related material and vicinity properties were remediated to EPA standards, verification procedures were employed. These procedures included systematic radiological measurements of surface soils during remedial action and after remedial action. The disposal cell cover was designed to reduce the average radon emissions to levels below EPA standards. Following completion of the Surface Project disposal cell at many of the processing sites, ground water is monitored at a point of compliance in the uppermost aquifer to ensure the disposal cell is performing as planned. This activity also occurs at the relocated disposal cells. In addition, the Long-Term Surveillance and Maintenance Program ensures continued disposal cell performance.

Comment 35. How can a community be aware of risks over 100 years? Will there be people to communicate risks? I want assurance that, over time, there will remain a way to communicate risks. (Shiprock)

Response: Awareness of future potential risks (associated with the contaminated ground water that resulted from the uranium mill tailings and former processing activities) can be accomplished through physical site markers, survey records, reports, publications, and education programs. At some UMTRA communities, local schools and colleges are involved with UMTRA activities. The more information that is available and the greater number of people, particularly local residents, that are made aware of the Project and potential risks, the better the likelihood that knowledge will remain in the communities. The EPA regulations permit the use of institutional controls for limiting access to the contaminated ground water for up to 100 years. The purpose of institutional controls is to ensure that use of the contaminated ground water does not pose a threat to human health and the environment. The use of an institutional control can be applied for up to 100 years, if needed, to ensure improper use of the contaminated ground water does not create a health problem. Tribal, state, and local governments can play a key role in developing and enforcing effective institutional controls. Changes may need to be made to tribal, state, or local laws and ordinances to ensure the enforceability of institutional controls by the administrative or judicial branches of government entities.

Comment 36. What are the health risks now and in the future? (Shiprock)

Response: Since, to the best of DOE's knowledge, no one uses the affected ground water at the Shiprock site for drinking or other domestic purposes, there are currently no human health risks directly associated with the contaminated ground water. Although the floodplain area below the Shiprock disposal cell is fenced and marked with hazardous materials signs, the possibility exists that humans and/or livestock could access this area. Therefore, there is the possibility of incidental exposure to the surface expression of contaminated ground water in this floodplain area. These potential exposures would likely be infrequent and are not expected to threaten public health. If the most contaminated portion of the affected aquifer at the Shiprock site were used for domestic purposes in the future, there is the possibility of the occurrence of human health risks. However, it is unlikely that this contaminated ground water would be used for human consumption because good quality water is available from the Navajo Tribal Utility Authority water supply system.

Comment 37. Currently, a local college is participating in the ongoing research and monitoring at the Shiprock site. This local participation and knowledge is a way to enhance the longevity of information about the site and risks. (Shiprock)

Response: Thank you for your comment. The DOE agrees and will continue to provide opportunities for local participation in the Project and in making decisions regarding site-specific ground water compliance.

Comment 38. Have livestock down river from the Shiprock site been tested? Are the cows safe to eat? (Shiprock)

Response: No testing of livestock tissue is known to have occurred in the vicinity of the Shiprock site. However, livestock are not grazed or watered in the areas where site-related contamination may occur (i.e., the San Juan River floodplain immediately downgradient of the former Shiprock site). Although contaminated ground water from the floodplain probably discharges into the San Juan River, the effect of the contaminated ground water on the river water is negligible due to its great dilution by the river (see the baseline risk assessment of ground water contamination at the uranium mill tailings site near Shiprock, New Mexico). As evidenced by historical and recent sampling of the San Juan River water downstream of the Shiprock site, no exceedances of constituent concentrations protective of livestock were reported at the downstream location (DOE, 1994a; 1996). Therefore, there are currently no health risks to livestock from the river water downstream of the Shiprock site.

Comment 39. Are there any restrictions on land use between the Shiprock cell and the river (on the west side)? (Shiprock)

Response: Yes, the land between the cell and the San Juan River is part of the Shiprock site and access is restricted. Access to the floodplain of the San Juan River below the Shiprock disposal cell is limited because this area is fenced off and hazardous materials warning signs are posted.

Comment 40. If the ground water is contaminated, has it moved to the river? Why don't we see contamination in the river? (Shiprock)

Response: Ground water that has been contaminated from former uranium processing activities at the Shiprock site can enter the San Juan River directly through the alluvium or indirectly after first discharging to the drainage ditch that runs through the floodplain and empties into the river. The UMTRA Project has established surface water sampling locations along the San Juan River, both upstream and downstream of the tailings pile, and at the confluence of the drainage ditch and the river, to monitor surface water quality in the San Juan River. Contaminated ground water does discharge into the San Juan River at a very small flow rate compared to the river flow. This causes dilution of the contaminated ground water as it flows into the river. Limited data (three sampling rounds) suggest there is a slight increase in uranium levels at two river sampling locations when compared to background (0.009 milligrams per liter versus 0.002 milligrams per liter). These levels are below the EPA standard for uranium (0.044 milligrams per liter). No other site-related contaminants have been identified as being above background in the river.

Comment 41. What land uses or land improvements can be made to make the land useful to the community despite the ground water contamination without having to wait 100 years? (Shiprock)

Response: In most cases, the land overlying the contaminated ground water can be fully utilized with the exception of 1) a use that would pose a human or environmental health risk by creating a ground water exposure pathway or 2) a use that would inhibit site access or a ground water cleanup application.

Comment 42. The programmatic approach to environmental impact statement preparation is helpful when there are multiple sites; it is a way to focus issues. (Durango)

Response: The DOE prepared the draft PEIS with the intent of focusing issues and is confident that site-specific documentation will benefit from this programmatic approach. The PEIS has been very helpful in terms of focusing on programmatic issues such as the scope of the Ground Water Project, the potential impacts of the ground water compliance strategies and alternatives, and the various ways the DOE could implement the Ground Water Project. DOE also anticipates that it will also help focus on site-specific issues.

Comment 43. Is the Department of Energy establishing an environmental (aquatic) baseline to provide data to determine an appropriate ground water strategy for each site? (Durango)

Response: Under the proposed action, the DOE will take action to protect human health and the environment from the contaminated ground water. From an aquatic biological perspective, the DOE has prepared screening level ecological risk assessments for most of the sites. In some cases, follow-up study has been conducted or may be conducted in the future based on the recommendations in the screening level ecological assessment. These assessments, which also consider terrestrial biological communities, are factored into the final choice of a ground water compliance strategy at a given site.

Comment 44. Has there been interaction with the Fish and Wildlife Service regarding the ecological risk assessments? (Durango)

Response: The U.S. Fish and Wildlife Service has not been involved in any aspect of the screening level ecological risk assessments prepared thus far. They will become involved if threatened and endangered species become an issue at a given site and may also review the site-specific NEPA documents that will be prepared once the site-specific ground water compliance strategy has been proposed.

Comment 45. Impacts from installation and maintenance of monitoring wells need to be considered; for example, the wells may have visual resource impacts. (Durango)

Response: The potential impacts from the installation and maintenance of monitor wells as well as other site characterization and monitoring impacts has been addressed in Section 4.1. Monitor wells may impact the visual resources in some areas and paragraphs regarding this were added to Sections 4.2.1.9, 4.2.2.9, and 4.2.3.9. The sections also state that DOE would work with the local residents to mitigate these impacts by using such measures as flush-mounted monitor wells or landscaping.

Comment 46. Other potential impacts that could occur if some strategies were implemented need to be considered in the PEIS; examples include: impacts to water rights, potential flooding, and aquifer draw down that could affect wetlands. (Durango)

Response: The PEIS was revised to address potential impacts to water rights in Sections 4.2.1.11, 4.2.2.11, and Table 4.4. It is unclear what is meant by the potential impacts of flooding. As indicated in Section 4.2.1.5, in most if not all cases, the construction of facilities required for active ground water remediation would be placed outside the floodplain of rivers and streams that run near a site. Therefore, flooding of the ground water remediation facilities will not likely occur and the issue of flooding was not addressed in the final PEIS. The potential impact of ground water drawdown on water levels in wetlands was considered in Section 4.2.1.5 of the PEIS.

Comment 47. Include a "laundry list" of potential impacts associated with the strategies and potential mitigation measures for these impacts; this would help in tiering to site-specific environmental documentation. (Durango)

Response: A summary of the potential impacts associated with the ground water characterization, monitoring, and compliance strategies is listed in Tables 4.3 and 4.4. It is agreed that a list will be useful in tiering to the site-specific documents. The DOE believes that a "laundry list" of mitigation measures may be of interest but that its utility for tiering to site-specific environmental documents would be limited because effective mitigation measures will be site-specific. Therefore, a list in the PEIS would not affect the way in which a mitigation measure is selected. However, examples of possible mitigation measures for specific impacts are provided throughout the PEIS. A discussion regarding how mitigation is addressed in the PEIS was added to the end of Section 4.0. In addition, the definition of mitigation as it appears in the Council on Environmental Quality implementing regulations for NEPA was added to the glossary.

Comment 48. Why not just analyze the proposed action since all of the alternatives are included in the proposed action? Addressing the alternatives separately from the proposed action is a waste of paper. It would be easier to just focus on the proposed action. (Halchita)

Response: As indicated in Section 2.0 of the PEIS, the DOE is required to "rigorously explore and objectively evaluate all reasonable alternatives" (40 CFR §1502.14(a). Therefore, consideration of only the proposed action would not be consistent with the regulations.

Comment 49. Residents of Halchita are not represented at the hearing since most of them have been evacuated due to asbestos abatement activities. (Halchita)

Response: We agree the public turnout was very small and that it was due to the asbestos abatement activities. We were unaware of the status of the abatement project and regret the unfortunate circumstances. We contacted the local communities to invite them to comment. In addition, public meetings were just one way of commenting on the PEIS. The DOE extended the public comment period by 60 days to allow all people to have adequate time to comment on the PEIS. Written, faxed, or telephoned comments were also accepted. Comments were also accepted via the internet.

Comment 50. Who approves the final PEIS and the Record of Decision? It took 15 months for Department of Energy Headquarters to approve the draft PEIS. This took too long. The Navajo Nation is concerned that time and money will run out before the necessary remediation is completed. The Ground Water Project will suffer if additional delays occur. The Department of Energy needs to meet the schedule presented at the hearing: completion of the PEIS process by the end of the 1995 calendar year. (Halchita)

Response: Final approval of the PEIS is granted by DOE Headquarters and the Record of Decision is signed by the Assistant Secretary for Environment, Safety, and Health. DOE Headquarters review of the PEIS was extensive and thorough, which contributed to the long approval process for the draft Ground Water Project PEIS. DOE intends to expedite the approval process of the final Ground Water Project PEIS and the publication of the Record of Decision. Funding for the Ground Water Project will be constrained only insofar as Congress limits appropriations to the DOE for conducting its environmental management activities. Budget requests occur annually, and DOE's goal is to receive sufficient funding for the Ground Water Project to implement site-specific ground water compliance strategies that are protective of human health and the environment and meet the EPA standards. The DOE is committed to completing the PEIS process in 1996.

Comment 51. The Navajo Nation requests a 60 day extension to the public comment period for the draft PEIS. More time is needed for tribal staff review of the document. Since the Halchita residents could not attend the hearing, additional time is needed to collect their comments. (Halchita)

Response: The 60-day extension was granted as requested, which extended the comment period to September 20, 1995.

Comment 52. Comments from the PEIS scoping were not published with the draft PEIS (Section 1.6). How did scoping comments impact the draft PEIS? (Halchita)

Response: The PEIS Implementation Plan summarizes comments received during scoping and provides DOE's response to these comments (DOE, 1994b). These comments were categorized into five areas: human health and environment, the National Environmental Policy Act process and programmatic issues, ground water monitoring and site characteristics, site-specific surface comments, and additional comments out of the scope of the PEIS (Section 3.3 of the PEIS Implementation Plan). A complete list of all comments received is archived in the UMTRA Project Document Control Center. The Implementation Plan was transmitted to UMTRA Project libraries and reading rooms. A copy of this document is also available through the National Atomic Museum, Albuquerque, New Mexico.

Comment 53. The PEIS Implementation Plan was not widely distributed. Comments from scoping should be included in the PEIS. (Halchita)

Response: The Implementation Plan was transmitted to tribes and states and other affected agencies and to persons who attended the scoping meetings. The plan was also sent to libraries and reading rooms; copies of the Implementation Plan are available by contacting the DOE Grand Junction Projects Office. Comments from scoping meetings were summarized in the implementation plan.

Comment 54. Department of Energy needs to identify how comments from the public comment period change the final PEIS. In addition, directions for finding a particular comment, its response, and, if applicable, resulting changes to the PEIS should be clear and easy to follow. (Halchita)

Response: A comment and response document (Volume II of the final PEIS) was prepared and accompanies the final PEIS. This document contains all comments received and DOE's response to those comments. This includes comments from public hearings, and written comments that are published verbatim. The response to each comment indicates if changes have been made to the PEIS and where the change can be found.

Comment 55. Page 2-11 of the draft PEIS only discusses water resources in the context of contamination and EPA compliance standards. Section 4.2 should include a water resource section that identifies potential users of water resources and potential uses of an aquifer. (Halchita)

Response: The impacts analysis of the PEIS considers the potential impacts to water resources of the ground water compliance strategies and alternatives. Sections 4.2 through 4.4 discuss and compare potential impacts that the ground water compliance strategies and alternative approaches for the UMTRA Ground Water Project may have on human users as well as on plant and animal communities. The DOE believes that the analysis of potential impacts to water resources is an important component of the impacts analysis in the PEIS and that this topic is adequately addressed from a programmatic perspective. The site-specific NEPA documents will provide a more detailed analysis of the impacts the proposed ground water compliance strategy may have on water resources at individual sites.

Comment 56. Why is the Mexican Hat, Arizona site a lower priority than the Falls City, Texas site, since the aquifer at Falls City is limited use and the site may qualify for supplemental standards? How can the prioritization process be applied to the Mexican Hat site if a baseline risk assessment has not been performed? (Halchita)

Response: The prioritization process has been based on objective determination, to the greatest extent possible. The prioritization discussion in the PEIS was expanded and now appears in Section 2.7.1. In that discussion, six scoring criteria were identified. Based on this scoring system, Falls City, Texas, was a higher priority than Mexican Hat, Utah. Falls City was scored as having a slightly higher health risk to population and individuals than Mexican Hat. It was also determined that the potential for future use of ground water was higher at the Falls City site. Baseline risk assessments were not an integral part of the prioritization. However, they were used to review the prioritization during fiscal year 1996 and it was determined that the Falls City site still ranked higher than the Mexican Hat site. A preliminary ecological risk assessment and environmental impact evaluation have been completed for Mexican Hat, and these items will be considered in future prioritization considerations.

Comment 57. Psycho/social issues are not addressed in the draft PEIS. For example, the Navajo people have a strong tie to water. Seeps have a ceremonial significance. Traditional, symbolic plants are found at seeps and are used as part of religious activities. Modification of seeps will have a long term impact. Department of Energy needs to consider psycho/social concerns in the prioritization process. (Halchita)

Response: The DOE recognizes the special value water resources have for Native Americans. The PEIS discusses these issues in the cultural resource sections of Chapter 4. These sections have been retitled "Cultural/Traditional Resources" to more clearly encompass impacts to these resources of special significance to Native Americans. The impact discussion in these sections has also been expanded in response to your comment.

Comment 58. Trust-responsibility concerns (US government responsibilities to Indian nations) are not addressed in the PEIS. This should be factored into the prioritization process. (Halchita)

Response: DOE recognizes the trust-responsibility to Indian nations. Section 1.2.4 of the PEIS has been expanded to identify this trust-responsibility. DOE has and will continue to factor trust-responsibility to Indian nations and tribes into the prioritization process.

Comment 59. The Mexican Hat site should be ranked as a higher priority than the Falls City site. (Halchita)

Response: The prioritization process was based on objective determination to the greatest extent possible. The description of the process was expanded in the final PEIS and is now in Section 2.7.1. As identified in this section, six scoring criteria were considered. Based on this scoring system, the Falls City site fell in Category IV and Mexican Hat in Category V. Prioritization is a dynamic process and will be reviewed and updated when necessary. Revisions and updates will be discussed with all interested parties.

Comment 60. Indirect pathways need to be addressed in the baseline risk assessment for the Monument Valley site. (Halchita)

Response: It cannot be determined what indirect pathways are referred to here. However, in the exposure assessment section of the Monument Valley baseline risk assessment, several exposure pathways besides the direct ingestion of ground water as drinking water are evaluated. These pathways include dermal absorption of contaminants in ground water while bathing, the ingestion of garden produce irrigated with contaminated ground water, and the ingestion of meat and milk products obtained from livestock watered with contaminated ground water.

Comment 61. A baseline risk assessment should be prepared for the Mexican Hat site. (Halchita)

Response: Two preliminary risk assessments have been completed for the seeps in Gypsum Wash and North Arroyo near the Mexican Hat site. The first assessment was completed in 1990 and addressed potential human health and ecological risks that could result from the contaminated water in the seeps. The second preliminary draft assessment dealt with potential ecological risks from the contaminated water at the seeps. The DOE is in the process of finalizing the ecological risk assessment and is conducting additional sampling in the seeps in Gypsum Wash and the North Arroyo near the Mexican Hat site.

Comment 62. Not all of the definitions in the draft PEIS glossary are defined the same way in the text. For example, confining aquifer is referred to as a hydrogeologic barrier or a no flow boundary. The definitions in the glossary need to match the definitions in the text. (Halchita)

Response: In revising the draft PEIS, the DOE has made every effort to define words in the text the same way they are defined in the glossary.

Comment 63. The baseline risk assessments do not evaluate psycho/social risks. The baseline risk assessment methodology discussion in the PEIS is not adequate to determine if the methodology used as a basis for site-specific decisions was appropriate. (Halchita)

Response: The risk assessments identify potential health and environmental risks associated with contaminated ground water at the UMTRA sites; psycho/social issues are potential consequences of health and environmental risks. Site-specific National Environmental Policy Act documents for the Ground Water Project will discuss these issues in greater detail. Appendix B of the final PEIS provides an expanded discussion of risk assessment methodology. Site-specific ground water compliance decisions have not been made for any UMTRA processing sites.

Comment 64. The proposed action framework should be reversed since the contaminant concentrations for most sites indicate that some kind of remediation will be needed. The contaminant concentration numbers are high for the Navajo sites. (Halchita)

Response: It is true that there is some kind of ground water contamination at most sites (see Table 3.3) and as presented, the DOE believes that the proposed action is the most effective way to address this contamination. The information needed to determine the site-specific ground water compliance strategy will be available after the completion of site characterization work, the revisions of the baseline risk assessment, if necessary, and the site-specific National Environmental Policy Act document. The DOE believes that if the data and information collected during this process support the use of passive remediation ground water strategies for protecting human health and the environment, the consideration of the use of active ground water remediation is not required. The use of active remediation at a site where it is not warranted would not be the most cost-effective approach and may result in adverse impacts and the unnecessary disturbance of land. Therefore, the proposed action framework, which considers the use of passive remediation before the use of active ground water remediation, should provide the most cost-effective and environmentally sound approach for protecting human health and the environment in accordance with the EPA standards.

Comment 65. There is an economic and social impact from contaminated ground water left at a site. (Halchita)

Response: Comment acknowledged. These impacts are discussed in the socioeconomic resources sections of Section 4.0. For the final PEIS, these sections have been retitled social and economic resources and have been expanded to provide more discussion of these potential impacts. In addition, new environmental justice sections have been added to the final PEIS.

Comment 66. The current risk based approach does not incorporate key areas of concern that are important for making site-specific decisions. (Halchita)

Response: The proposed action in the PEIS focuses on protection of human health and the environment in identifying appropriate ways to comply with the EPA ground water standards. However, other considerations would go into determining compliance strategies and methods. Other supporting documents, such as the baseline risk assessments and data gathered during site characterization, would also provide information that would be part of decision making. Issues and concerns expressed by affected states and tribes, local governments and other affected groups and persons will also be considered in decision making. Finally, site-specific NEPA documents will assess potential impacts of implementing compliance alternatives. Public input will be important to ensure that local concerns are evaluated in the impact assessments.

Comment 67. Cost should not be a consideration for cleaning up contaminated ground water. (Halchita)

Response: DOE's ultimate mission with the Ground Water Project is to protect human health and the environment by meeting the EPA ground water standards at the former processing sites. The EPA explains in the final rule to the ground water standards that it is desirable and appropriate for the DOE to implement the most cost-effective strategy that meets the intent of the standards and protects human health and the environment.

Comment 68. Contaminated water that needs to get cleaned up may or may not be cleaned up. (Halchita)

Response: As indicated in the draft PEIS in several sections, the DOE is committed to cleaning up the contaminated ground water at the UMTRA sites to levels that are protective of human health and the environment by meeting the EPA standards. This means that the contaminated ground water at the sites will be characterized to the degree necessary so that potential risks, if any, to human health and environment can be determined. From this information, a ground water compliance strategy will be proposed, and the impacts of implementing this strategy will be analyzed in a site-specific NEPA environmental document. The environmental document and other Ground Water Project documents will be available to the public for their review and comment. As a result of this process, the DOE believes the ground water that needs to be actively cleaned up will be and that contaminated ground water that is controlled through the use of institutional controls under a passive remediation strategy will not pose a threat to human health or the environment.

Comment 69. What is the cost of the proposed action for the entire project? The cost numbers in the draft PEIS do not seem right. The ranges expressed in the document are too broad, and therefore meaningless. The analysis for the cost figures should be made available during the public comment period for public review. (Halchita)

Response: The costs in the PEIS reflect a range of values based on the various types of strategies that could be applied under the proposed action. This range reflects the variability of site conditions, contaminants, future land use, size of plume, and other factors that are evaluated when calculating the cost ranges of each compliance strategy. The total cost of the Ground Water Project as predicted in the fiscal year 1998 budget is $309 million. This sum includes a large contingency for out-of-scope activities associated with activity uncertainties. It reflects a budget estimate based on a strict budget planning strategy for this Project before stakeholder acceptance of the PEIS proposed action and publication of the Record of Decision. The amount encompasses a range of proposed strategies and alternatives in addition to contingency funds needed to meet unplanned occurrences in the execution of the Project. The sum is expected to change once the PEIS process is completed and more definitive strategies can be estimated for each UMTRA site. It should be noted that during the budget preparation process, the DOE encourages stakeholder involvement and shares budget data with the stakeholders during the March-through-June timeframe. Participation in this process provides the most current analysis of cost development for Project implementation.

Comment 70. The level of qualitative and quantitative analysis for determining cost effectiveness of the proposed action needs to be clarified. (Halchita)

Response: Qualitatively, the cost effectiveness of the proposed action is compared with the other alternatives in Section 4.4.15 of the PEIS. Section 4.4.15 was modified for clarity. A quantitative estimate of the cost-effectiveness of the proposed action would not be possible at this point because the final ground water compliance strategies at the UMTRA sites have not been determined. The costs can be highly variable, depending on factors such as the type of active ground water remediation that would take place at a given site, or how long institutional controls would have to be maintained. In general, the DOE believes that the proposed action would be more cost effective than the active remediation to background levels alternative. Although both would meet EPA standards, the proposed action would be less expensive because active remediation at all sites most likely would not be necessary. The proposed action would also be more cost-effective than the no action or passive remediation alternatives because although the latter two could be less expensive, the proposed action would more effectively meet EPA standards and protect human heath and the environment.

Comment 71. Baseline risk assessments are not baseline. They are an evaluation of existing data. Stakeholders need to be able to comment on final baseline risk assessments. Final risk assessments should be based on additional characterization data. (Halchita)

Response: Baseline risk assessments are available for review in local libraries and provided to UMTRA tribal representatives. As defined by the Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, baseline risks are risks that might exist if no remediation or institutional controls were applied at a site. Additionally, as stated in Section B1.1 of the revised Appendix B to the PEIS, an UMTRA baseline risk assessment is baseline in that it describes preremediation ground water conditions at the site, with ground water quality only partially characterized. Critical data gaps identified in the UMTRA risk assessments will be addressed in the site observational work plan for each site. For example, if the potential for adverse human health and/or ecological risk is identified in the baseline risk assessment, and additional study is required to assess these risks, recommendations for further study will likely appear in the Site Observational Work Plan. The assessment of human health and/or ecological risk will be updated and revised as necessary based on the results from the additional data. Stakeholders will have an opportunity to comment on the baseline risk assessments. Copies of the these documents are available for public review at libraries and reading rooms in UMTRA Project communities. News releases were used to publicize availability of the documents. In February 1994, 15 baseline risk assessments were released for public review. News releases of their availability were issued, and the documents were placed in libraries and reading rooms. A toll-free number was also publicized for individuals who wished to receive a copy of the documents. This number currently is (800) 399-5618.

Comment 72. What additional site characterization does Department of Energy plan on doing for the Navajo sites during the Ground Water Project? (Halchita)

Response: Specific characterization activities for each site will be based on the alternative chosen for conducting the Ground Water Project. Under the proposed action, active remediation to background levels, and passive remediation alternatives, site observational work plans will be formulated for each UMTRA site, providing additional site characterization data in the form of a site conceptual model. Examples of potential characterization activities, described in Section 2.8 of the PEIS, include monitor well installation and ground water sampling, soil sampling, and ground water and contaminant transport modeling. Under the no action alternative, additional site characterization data would not be collected.

Comment 73. How is moving the Ground Water Project to Grand Junction Projects Office cost effective? The Navajo Nation will lose the gains that have been made. (Halchita)

Response: DOE does not expect the Navajo Nation will lose gains they have made because the Project moved to the Grand Junction Projects Office. Over the long term, moving the Ground Water Project to Grand Junction will be beneficial because it is expected that long-term monitoring and/or institutional controls will be part of the long-term surveillance program which is managed out of the Grand Junction Projects Office.

Comment 74. Clarify the difference between no action and passive compliance alternatives. (Tuba City)

Response: Text was added to Section 2.4 in the final PEIS to further clarify the difference between these alternatives.

Comment 75. Consider population growth and changes in selection of alternative. (Tuba City)

Response: Consideration of population growth and changes are factored into the EPA standards. Compliance with the standards requires evaluation of current and projected future uses of ground water; population growth and changes are part of this evaluation. For example, natural flushing can be used only if ground water is not currently or projected to become a source for a public water supply system during the period of natural flushing. The application of supplemental standards requires assurances that current and projected uses of the affected ground water are preserved and requires that public health and the environment be protected now and in the future (Section 1.4.1). Finally, requirements for ground water monitoring would also provide protection of future populations. The proposed action alternative, because it would meet EPA standards at all sites, would include population factors in selecting a compliance strategy. Site-specific National Environmental Policy Act documentation would include more detailed analysis of demographic factors that could affect or be affected by implementing a ground water compliance strategy.

Comment 76. Provide an example of how supplemental standards or alternate concentration limits would be protective; explain supplemental standards and alternate concentration limits. (Tuba City)

Response: The regulations require that supplemental standards be applied only to contaminated ground water when a minimum of one of five other EPA regulation criteria is met (40 CFR §192.21(a)(b)(e)(f)(g)). These five criteria are: a. Remedial action poses a clear and present risk of injury to workers or the public. b. Remedial action would directly produce health and environmental harm that is clearly excessive compared to the health and environmental benefits. e. There is no known remedial action. f. Restoration of ground water quality is technically impractical from an engineering perspective. g. The ground water is limited use, meaning that ground water is not a current or potential source of drinking water. The regulations require that if supplemental standards are applied at a site, the DOE must apply any remedial action for the restoration of contaminated ground water that is required to ensure, at a minimum, protection of human health and the environment. In addition, if ground water meets the requirements of limited use and a supplemental standard is applied, current and reasonable projected uses of the affected ground water must be preserved (40 CFR §192.22(d)). The regulations for applying alternate concentration limits (40 CFR §192.02(c)(3)(ii)) state that the DOE may apply an alternate concentration limit, if after considering remedial action to reach background levels, the DOE determines that the constituent will not pose a substantial present or potential hazard to human health and the environment as long as the alternate concentration limit is not exceeded. In considering present or potential hazards to human health and the environment, the standards identify 10 factors that need to be considered for their potential adverse effects on ground water and 10 factors to be considered for their potential adverse effects on surface water. These include determining the characteristics of the aquifer, water quality, potential for human health risks, and potential to damage ecological and agricultural resources. U.S. Nuclear Regulatory Commission concurrence is required before supplemental standards or alternate concentration limits can be applied.

Comment 77. Is the application of supplemental standards or alternate concentration limits made to the Nuclear Regulatory Commission? (Tuba City)

Response: Yes. UMTRCA states that the U.S. Nuclear Regulatory Commission will ensure that the management of the residual radioactive materials is carried out to conform with the EPA standards for UMTRA Project sites (40 CFR Part 192). Supplemental standards and alternate concentration limits are part of these standards.

Comment 78. Financial considerations could affect the choice of alternatives or strategies; will funding be available? (Tuba City)

Response: While the EPA standards anticipate that cost-effectiveness will be considered in selecting the compliance strategy, financial considerations would not result in the selection of a less costly but technically inappropriate compliance strategy. The DOE will request adequate funding to implement the most appropriate compliance strategy at each site. While no guarantees can be made on the amount of funding that Congress will appropriate, Project budget requests are based on the amount of funding required each fiscal year so over the life of the Project, compliance with the standards at each site will be met.

Comment 79. How is the time period for clean-up related to funding? (Tuba City)

Response: Currently the UMTRA Ground Water Project reflects a completion date in fiscal year 2014 based on minimal limitations to proposed budget requirements. These dates do not, however, include the completion of natural flushing where projection indicates the standards would not be met with this compliance strategy until after 2014. Under UMTRCA, the legislation authorizing the Project, DOE is allowed to proceed on this Project without time limitation; thus, as budget constraints are implemented at the federal level, there is potential for the cleanup time period to be extended.

Comment 80. How would changes in the Clean Water Act affect UMTRA Ground Water compliance? (Tuba City)

Response: The UMTRA ground water regulations in 40 CFR Part 192 are totally independent of the Clean Water Act regulations. The Clean Water Act is primarily concerned with preventing discharges, not cleaning up existing contamination, which is the focus of the UMTRA Ground Water Project. The DOE monitors changes to environmental acts and their implementing regulations. Only a major rewrite of the Clean Water Act that changes the current focus of the Act to deal with existing contamination could be expected to impact the UMTRA Ground Water Project. Such a change is not anticipated at this time.

Comment 81. The criteria for sole source aquifer (under the Clean Water Act) should be considered in UMTRA. (Tuba City)

Response: Sole source aquifers are considered under the Safe Drinking Water Act. The purpose of the Safe Drinking Water Act sole source aquifer protection program is to protect sole or principal drinking water sources from contamination that would create a significant hazard to public health. Under the program, no underground injection wells may be operated in such an aquifer without a permit. The UMTRA Ground Water Project is subject to these provisions. UMTRA Project sites that have limited or sole-source water resources are Tuba City, Arizona, and Maybell, Colorado. In addition, a sole-source water resource criterion recently was added to the updated prioritization process.

Comment 82. Regarding drinking water standards, it is important to differentiate between water uses. Water standards may not accurately reflect actual water use (for example, drinking and livestock uses). (Tuba City)

Response: The DOE will consider actual water use when making site-specific decisions. Drinking water is just one use of ground water that the DOE evaluates in the baseline risk assessment. Other uses considered are bathing and agricultural uses, including crop irrigation and livestock watering. Other exposure pathways are also considered, including humans eating fish and livestock that could have come into contact with contaminated ground water. When analyzing site-specific impacts from the ground water compliance strategies, the DOE will also consider cultural and traditional uses of ground water.

Comment 83. An aquifer that is not sole source now, may be in the future; future need may require a different future use. (Tuba City)

Response: Independent of the aquifer classification, the DOE is required to meet the EPA ground water standards at the uppermost aquifer at all Title I former processing sites. Where appropriate, a sole source classification will be considered and discussed in the site-specific environmental documents. DOE will continue to monitor the uses of ground water at the UMTRA Project sites during the Ground Water Project. Therefore, the DOE will be aware if an aquifer is defined as sole source in the future.

Comment 84. There may be a need to revisit decisions. What opportunities would there be to re-evaluate choice of strategies with changing conditions (for example, population growth, climate, and drought). (Tuba City)

Response: It is agreed that it may become necessary to reevaluate the use of a particular ground water compliance strategy at a given site if the monitoring data or other information indicates the strategy may not be protective of human health or the environment as may occur with changing conditions. In most cases, ground water monitoring will take place at the sites and these data will be used to evaluate the effectiveness of a given strategy. For example, monitoring data and changing conditions at and near the site may indicate that natural flushing is not appropriate and that some other strategy such as active remediation may be required. Conversely, monitoring data may indicate ground water contamination has been reduced sufficiently by active remediation so that a passive remediation strategy may be applied.

Comment 85. Who will decide future water needs? (Tuba City)

Response: The PEIS does not discuss who will decide future water needs, and it is beyond the scope of this document to do so; the DOE will work with the appropriate agencies and stakeholders to determine future water needs during site-specific ground water compliance activities.

Comment 86. Flow rates and velocity must also be considered in a natural flushing scenario; to determine if natural flushing is appropriate. Natural flushing is not appropriate at the Navajo sites. (Tuba City)

Response: To evaluate natural flushing as a potential ground water compliance strategy at any site, the hydrogeologic and geochemical properties of the aquifer must be determined, and future migration of the contaminated ground water must be estimated. Ground water velocity (flow rate) is one of the hydrogeologic properties that would be evaluated and its determination is critical before natural flushing is implemented. No site-specific ground water compliance strategies have been selected at any UMTRA Project site.

Comment 87. Regarding prioritization for remediation, is there a priority for site remediation within the general prioritization categories identified in the PEIS? (Tuba City)

Response: At this time, there is no specific priority for site remediation within each general priority category. Prioritization is a dynamic process and will be revised and updated when necessary.

Comment 88. Would site characterization be completed at all Category 1 sites before starting site characterization at lower category sites? If site characterization is completed at lower category sites before it is completed at higher category sites, would remediation be completed at the lower category sites before the higher priority/category sites? (Tuba City)

Response: Characterization will continue to be completed across the category boundaries. The additional characterization is critical to validate conclusions reached during the initial site prioritization process. Remediation will generally follow along the lines of the site priorities. However, in an effort to balance budgets, program capabilities, and other resource considerations, some sites in lower categories may be completed ahead of the higher priority sites. Because finishing some lower priority sites may take a very limited amount of resources, these sites would not significantly impact efforts on the higher priority sites.

Comment 89. What happens if the Department of Energy runs out of funding? (Tuba City)

Response: The DOE receives annual appropriations based on budget requests from the President and negotiations on funding levels at the Congressional level. Thus DOE does not have a limited amount of funding that can run out. Budget cuts that reduce the amount of funding available in a fiscal year are possible. In these instances, work could be delayed to a subsequent fiscal year.

Comment 90. The importance of opportunities for participation by Northern Arizona State/Tribal Environmental Studies program in the ground water program should be stressed. (Tuba City)

Response: The DOE recognizes the importance of local participation in its Ground Water Project. For example, Navajo Community College students are participating in a ground water study at the Shiprock site; this study is being conducted by the University of New Mexico. In addition, Tuba City high school and junior college students are participated in the vegetation studies being conducted by the University of Arizona at the Tuba City site. The DOE will continue to support educational outreach opportunities.

Comment 91. There is confusion regarding the standards and the purpose of clean-up. Is the ultimate purpose of the program to return to background or to return to standards? How do other standards (tribal, state) influence clean-up? (Tuba City)

Response: The purpose of the Ground Water Project is to demonstrate that the EPA ground water standards have been met at each of the Title I former uranium processing sites. For constituents that are listed in the regulations but do not have UMTRA Project maximum concentration limits and those that are above maximum concentration limits in background waters, the EPA regulations set background as the standard. Decisions regarding consistency with applicable tribal and state laws and regulations will be made by DOE in consultation with the tribes and states. These decisions will consider cases where an approved wellhead protection area, under the Safe Drinking Water Act, is associated with the site. A wellhead protection area is an area of land where there are restrictions on development so as to protect ground water supplies used for drinking water or other beneficial uses. DOE must comply with the provisions of that program, unless an exemption is granted by the President of the United States through the EPA. Contamination on the site that is not covered by UMTRCA (because it is not related to the processing operation) is not the responsibility of DOE but may be covered by other federal, tribal, or state programs. A discussion of this issue is presented in the EPA standards (60 FR 2854, 2856) and is in Appendix A to the PEIS.

Comment 92. Can background be an alternate concentration limit? (Tuba City)

Response: No. If the amount of a contaminant in ground water was at background, the standard would be met, and there would be no reason to apply to the U.S. Nuclear Regulatory Commission for an alternate concentration limit.

Comment 93. Regarding page 3-7 on the regulatory context: what if tribal standards are more stringent? Which would the Department of Energy use? This should be clarified in PEIS. (Tuba City)

Response: Decisions regarding consistency with applicable tribal and state laws and regulations will be made by DOE in consultation with the tribes and states. These decisions will consider cases where an approved wellhead protection area, under the Safe Drinking Water Act, is associated with the site. A wellhead protection area is an area of land where there are restrictions on development so as to protect ground water supplies used for drinking water or other beneficial uses. DOE must comply with the provisions of that program, unless an exemption is granted by the President of the United States through the EPA. Contamination on the site that is not covered by UMTRCA (because it is not related to the processing operation) is not the responsibility of DOE but may be covered by other federal, tribal, or state programs. A discussion of this issue is presented in the EPA standards (60 FR 2854, 2856) and is in Appendix A to the PEIS.

Comment 94. How would the Department of Energy address the question of compliance if there are no federal standards but there are tribal standards? (Tuba City)

Response: There are federal standards for the UMTRA Ground Water Project. The federal standards are included in the PEIS under Appendix A. They are 40 CFR Part 192 and Groundwater Standards for Remedial Actions at Inactive Uranium Processing Sites, final rule (60 FR 2854, January 11, 1995). See answer to comment 93 for clarity on applicability of tribal standards. The DOE will review on a case-by-case basis whether or not to comply with standards not covered in the EPA standards.

Comment 95. How will the decision to close the Albuquerque office affect the project? How will the transfer of the Ground Water Project affect the program, for example, accessibility, moving forward on compliance, and tribal participation. (Tuba City)

Response: DOE will continue to respond to the needs and requests from all stakeholders, including the tribes, in a timely manner that is mindful of accessibility, compliance, and stakeholder/tribal participation. DOE and the Grand Junction Projects Office are committed to move forward, with tribal participation, in complying with EPA standards.

Comment 96. Indian tribes get short-changed when there are program changes for the economic benefit of the agency. Previous experience indicates a resulting loss of funding and communication. (Tuba City)

Response: The DOE will attempt to minimize the loss of funding. However, in the event of a funding reduction, DOE will strive to minimize any impact this might have on ground water cleanup on a programmatic and site-specific basis, and will continue to maintain effective communication with the public.

Comment 97. A group should stay in Albuquerque for the Ground Water Project to relate to the tribe. (Tuba City)

Response: The DOE, and Grand Junction Projects Office specifically, are committed to open and continual communication to help meet the public and project goals. We look forward to continuing the working relationship with the Navajo Nation.

Comment 98. We have established working relations with the site manager and this will be taken from us if the Ground Water Project moves to Grand Junction; we need continuity with the Department of Energy site manager. (Tuba City)

Response: The DOE, and Grand Junction Projects Office specifically, are committed to open and continual communication to help meet the public and project goals. We look forward to continuing the working relationship with the Navajo Nation.

Comment 99. The document needs to be culturally sensitive, that is, sensitivity to persons whose first language is not English; use more visual aids, clearer and simpler language. (Tuba City)

Response: The DOE has approved funding for a community involvement specialist who speaks Navajo to work as liaison between the DOE and the Navajo Nation. Additionally, the PEIS has been extensively reviewed and thoroughly edited to make sure it is clear and readable and technically correct.

Comment 100. Section 4.4.7 regarding Native American Resources, does not address Indian/tribal issues. Reference is made to the State Historic Preservation Officer but not to the comparable tribal officer. Tribal requirements and sensitivities need to be added. Use the term Cultural/Traditional Resources to encompass Native American resources (such as spiritual sites, and herb gathering areas). (Tuba City)

Response: Discussions regarding cultural resources were meant to encompass all such resources including historic, archaeological, and traditional Native American resources. As suggested, the title of the impact sections in the PEIS has been changed to "Cultural/Traditional Resources" for clarification. References to the appropriate tribal official have also been added, to Sections 4.2.1.7 and 4.2.2.7.