CHAPTER 7
ENVIRONMENTAL CONSEQUENCES DISCUSSION

> Chapter 7 discusses environmental consequences that would occur from implementation of the reasonable alternatives for each of the following: (1) Hanford Site single-shell tank system closure (i.e., tank closure), (2) decommissioning of the Fast Flux Test Facility and auxiliary facilities (i.e., Fast Flux Test Facility decommissioning), and (3) management of waste resulting from other Hanford Site activities and limited volumes from other U.S. Department of Energy sites (i.e., waste management). Chapter 4 presents more-detailed analysis of short-term impacts and Chapter 5 presents more-detailed analysis of long-term impacts. As previously discussed in Chapter 4, Section 4.4, three representative scenarios, or combinations of alternatives, were selected to facilitate comparison of the alternatives and discussion of the analyses.
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> Section 7.1 discusses those mitigation measures that could be implemented to reduce or avoid environmental impacts by resource area and identifies those resource areas where impacts are significant enough to warrant consideration of additional mitigation measures. Section 7.2 discusses those adverse impacts that are unavoidable and would occur even after implementation of all of the reasonable mitigation measures discussed in Section 7.1. Section 7.3 presents the major irreversible and irretrievable resource commitments that would occur for all alternatives. Section 7.4 discusses the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity.
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> Detailed analyses and discussions of the impacts on environmental justice are provided in Chapter 4, Sections 4.1.13, 4.2.13, and 4.3.13, and are not repeated in this chapter. The discussion presented in this chapter on public health and occupational safety includes normal operations, facility accidents, and waste transportation-related impacts.

7.1 MITIGATION

This section describes the mitigation measures that could be used to avoid or reduce environmental impacts resulting from implementation of the alternatives described in previous chapters. As specified in Council on Environmental Quality National Environmental Policy Act regulations (40 CFR 1508.20), mitigation includes:

- Avoiding the 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
- Compensating for the impact by replacing or providing substitute resources or environments

All of the *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)* alternatives, including the No Action Alternative, have the potential to impact one or more resource areas over the timeframes analyzed for this environmental impact statement (EIS). Resources that could be negatively impacted include land; infrastructure; noise; air; geology and soils; water; ecology; cultural and paleontological aspects; socioeconomics and local transportation; public and occupational health and safety (human health); and waste management. To mitigate impacts on resource areas, activities associated with the *TC & WM EIS* proposed action alternatives would follow standard procedures and best management practices for facility construction and would consider incorporating, where applicable, the best demonstrated available technologies for facility operations and closure. The U.S. Department of Energy (DOE) is already applying best management practices to minimize environmental impacts in association with ongoing Waste Treatment Plant (WTP) construction. These practices are required by Federal and state licensing and permitting requirements, as described in Chapter 8.

The 1996 *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement (TWRS EIS)* (DOE and Ecology 1996) described possible mitigation measures for the projected short- and long-term impacts of the proposed action alternatives for tank waste retrieval and treatment. DOE committed to these mitigation measures, as documented in the 1997 *TWRS EIS* Record of Decision (ROD) (62 FR 8693). These mitigation measures would continue to be implemented, as applicable, for the tank waste retrieval and treatment activities discussed in this EIS.

The 1999 *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement (Hanford Comprehensive Land-Use Plan EIS)* (DOE 1999a) identifies specific mitigation measures, policies, and management controls that direct land use at the Hanford Site (Hanford). DOE committed to these mitigation measures, as documented in the 1999 *Hanford Comprehensive Land-Use Plan EIS* ROD (64 FR 61615). These commitments were reaffirmed in the 2008 *Supplement Analysis, Hanford Comprehensive Land-Use Plan Environmental Impact Statement (Hanford Comprehensive Land-Use Plan EIS SA)* (DOE 2008) and in the associated ROD (73 FR 55824). These mitigation measures would continue to be implemented, where applicable, for the tank waste retrieval and treatment activities discussed in this EIS.

Following completion of this *TC & WM EIS* and its associated ROD, DOE would be required to prepare a mitigation action plan that addresses mitigation commitments expressed in the ROD (10 CFR 1021.331). This mitigation action plan would be prepared before DOE would implement any *TC & WM EIS* alternative actions that are the subject of a mitigation commitment.

DOE has incorporated several mitigation measures into the alternatives proposed in this EIS to prevent or reduce the short- and long-term environmental impacts. Some mitigation measures were incorporated for all of the alternatives, and some represent variations in one or more of the elements or technologies used to construct the alternatives. Table 7–1 summarizes the potential mitigation measures by resource area; these mitigation measures are discussed in more detail in the sections to follow. The table is divided into three groups: the first group presents those mitigation measures that would normally be considered regardless of impact severity; the second group presents additional mitigation measures that may be necessary where specific short-term impacts are projected to approach or exceed existing capacities, regulatory thresholds, or other guidelines; and the third group presents additional mitigation measures where specific long-term impacts may require special consideration.

While some mitigation measures have already been incorporated within the actions proposed under the *TC & WM EIS* alternatives, some may yet be identified and implemented after issuance of the ROD. Furthermore, because of the relatively long timeframes required to conclude each alternative's life cycle, additional and more effective mitigation measures may become available in the future that could reduce the environmental impacts associated with a proposed action. DOE will continue to identify and incorporate new technologies or practices that could potentially reduce the impacts throughout the life cycle of a selected alternative.

Table 7–1. Summary of Potential Mitigation Measures

Resource Area	Consideration for Normal Mitigation Measures
Land	• Locate facilities in proximity to related activities. • Maintain and coordinate land use as described in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a), the subsequent *Hanford Comprehensive Land-Use Plan EIS SA* (DOE 2008), and their associated RODs (64 FR 61615 and 73 FR 55824). • Use existing buildings or disturbed land. • Use existing permitted facilities to supplement activities. • Use existing infrastructure and right-of-ways. • Expedite restoration of land upon completion of mission.
Infrastructure	• Incorporate high-efficiency motors, pumps, lights and other energy conservation measures into the design of new facilities. • Schedule operations during non-peak times. • Sequence operations to minimize peak use of utilities.
Noise and Vibration	• Limit construction to daylight hours. • Maintain equipment mufflers. • Restrict use of horns and use appropriately sized heavy equipment. • Plan truck routes and timing of traffic.
Air Quality	• Implement dust suppression techniques such as application of water or surfactants. • Use low-sulfur fuels. • Maintain equipment in peak working condition. • Implement zone ambient air monitoring to monitor effectiveness of engineering controls. • Sequence and time construction and/or operations of activities. • Limit the amount of disturbed land areas and revegetating land as soon as possible. • Incorporate best available air pollution control technologies into design of new facilities. • Use containment structures whenever appropriate for excavation activities.
Geology and Soils	• Manage borrow materials as described in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a), the subsequent *Hanford Comprehensive Land-Use Plan EIS SA* (DOE 2008), and their associated RODs (64 FR 61615 and 73 FR 55824) to address requirements such as contouring and revegetating the landscape to match the natural surroundings. • Use disturbed land areas whenever possible. • Limit the time disturbed soils are exposed and/or using protective covers over denudes areas and stockpiles. • Adhere to best management practices for erosion and sedimentation control. • Restore disturbed areas to pre-existing conditions to the maximum extent possible.
Water	• Implement spill prevention and control and storm water pollution prevention plans. • Incorporate water conservation practices into routine operations. • Adhere to strict waste acceptance criteria for burial at one of the proposed or existing waste disposal facilities. • Compare the impacts on groundwater for various levels of tank waste retrieval (e.g., 90 percent, 99 percent, and 99.9 percent). • Implement groundwater monitoring programs. • Construct engineered surface barriers with liners and leachate collections systems. • Extend post-closure care or administrative control durations.

Table 7–1. Summary of Potential Mitigation Measures *(continued)*

Resource Area	Consideration for Normal Mitigation Measures *(continued)*
Ecology	• Implement similar mitigation measures as those listed for land. • Provide compensatory mitigation of sagebrush habitat or other sensitive plant species encountered. • Demarcate construction and land disturbance zones clearly to limit intrusion into non-work areas. • Avoid special status plant and animal species whenever possible. • Implement spill prevention and control plans. • Avoid areas of, and periods of animal breeding or nesting.
Cultural and Paleontological	• Assign an archaeological monitor during construction and other earth-disturbing activities. • Perform surveys to identify prehistoric or cultural resources prior to initiating earth-disturbing activities and avoid any discovered resources. Visual Aspects: • Removal of unnecessary facilities/infrastructure when no longer needed. • Consolidation of facilities/infrastructure where appropriate. • Restoration and/or revegetation of disturbed areas. • Minimal maintenance of exterior building, equipment, and roads to reduce disturbed areas.
Socioeconomics and Local Transportation	• Construct and operate new facilities in sequence, whenever possible, to level the demand on employment resources and associated public services. • Upgrade select traffic routes or intersections. • Use alternate work schedules or expand the existing carpool and commuter program in accordance with Washington's commute trip reduction policy. • Coordinate shipment of materials and waste with heavy commute or public traffic timeframes.
Public and Occupational Health and Safety	• Incorporate best available demonstrated technologies for reducing release of radiological emission. • Maintain acceptable worker doses by implementing ALARA techniques (e.g., reducing time of exposure, increasing number of workers, shielding, remote operations, etc.). • Prepare shipments of waste in containers certified for the intended purpose and train and license handlers and transporters.
Waste Management	• Continue use of existing permitted disposal facilities (e.g., LLBG trenches 31 and 34) for burial of waste to decrease reliance on IDF and/or RPPDF. • Implement pollution prevention and waste minimization techniques. • Investigate technologies that have the potential to increase WTP melter life and increase waste loading (e.g., sulfate removal).
Additional Considerations for Short-Term Mitigation Measures	
Infrastructure	WTP operations would place a high demand on Hanford's electrical grid for an extended amount of time and are projected to approach or, in some alternatives, exceed existing peak capacity. To mitigate this impact, the following steps could be taken: (1) prepare an energy consumption plan; (2) supplement electric supply from alternate sources; and (3) upgrade Hanford's distribution system.
Air Quality	Construction activities are projected to exceed ambient air quality standards for particulate matter under most alternatives, and in a few cases, carbon monoxide as well. However, the projections do not take into account the implementation of any mitigation measures. Mitigation measures may be necessary to ensure applicable standards are met. A more-refined analysis, assuming the implementation of reasonable engineering controls, would likely result in a substantial reduction in projected emissions or criteria air pollutants.

Table 7–1. Summary of Potential Mitigation Measures *(continued)*

Resource Area	Additional Considerations for Short-Term Mitigation Measures *(continued)*
Geology and Soils	The analysis in this *TC & WM EIS* assumes all borrow material would come from Borrow Area C, and no excavation spoils from waste management disposal facility or new facility construction would be used. To mitigate this impact, the extraction and management of geologic materials would be executed in a manner consistent with the policies and resource management plans as described in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a), the subsequent *Hanford Comprehensive Land-Use Plan EIS SA* (DOE 2008), and their associated RODs (64 FR 61615 and 73 FR 55824).
Public and Occupational Health and Safety	Under *TC & WM EIS* Tank Closure Alternatives 4, 6A, and 6B, which would either partially or completely clean-close the tank farms, the average worker dose for the alternatives' activities would approach, and in some cases potentially exceed DOE's Administrative Control Level of 500 millirem per year. In these cases, a comprehensive evaluation of worker exposures may be warranted to determine which activities are the largest contributors to worker dose and to implement aggressive ALARA techniques to ensure worker doses remain below the appropriate levels. In addition, public exposure during the peak year of activities, although low, would coincide with the relatively short operation of the cesium and strontium capsule processing campaign in the WTP. The processing of this material could be spread over a longer timeframe, thus mitigating the peak impact on the public.
Waste Management	Under *TC & WM EIS* Tank Closure Alternatives 6A, 6B, and 6C, all tank waste would be managed as HLW, representing a significant increase in waste volume managed as HLW by a factor of at least 14 times more than other action alternatives. In these alternatives, the treated radioactive tank waste would be stored on site. To mitigate potential impacts from storing large quantities of HLW, waste management areas could be modified as necessary.
Additional Considerations for Long-Term Mitigation Measures	
Water	Several COPCs are predicted to exceed or approach benchmark concentrations in groundwater at the Core Zone Boundary and/or the Columbia River nearshore at various dates. The COPCs resulting in the majority of impacts include the radionuclides hydrogen-3 (tritium), iodine-129, technetium-99, and uranium-238 and the chemicals chromium, nitrate, and total uranium. These COPC drivers are consistent across all *TC & WM EIS* alternatives. Potential mitigation measures that could be considered include the following: • Increase partitioning of target COPCs into ILAW and/or IHLW waste forms by recycling secondary waste streams into primary waste feeds or adopt pretreatment removal technologies that would target COPCs (e.g., technetium removal). • Continue research and development for more robust, long-term performing secondary waste forms and supplemental treatment primary waste forms. • Design and construct more robust surface barrier designs or require periodic replacements of engineered barriers. • Restrict the receipt of offsite waste to waste that would have low impacts on groundwater over the long term at Hanford (e.g., limit or restrict receipt of offsite waste containing iodine-129 or technetium-99 at Hanford). • Implement comprehensive groundwater monitoring programs with contingency corrective action plans.
Ecology	Long-term impacts on ecological receptors from air emissions and groundwater are expected to be minor; however, because a reduction in impacts on air and water resources would result in a corresponding reduction in ecological receptor risk, the mitigation measures discussed under Air Quality and Water Resources could also reduce ecological resource impacts. Additionally, periodic monitoring programs for ecological receptors could provide early detection of decline and, if necessary, implementation of corrective actions.

Table 7–1. Summary of Potential Mitigation Measures *(continued)*

Resource Area	Additional Considerations for Short-Term Mitigation Measures *(continued)*
Public and Occupational Health and Safety	Impacts to offsite receptors would be negligible when compared with background exposures; however, impacts on onsite receptors that would consume groundwater as a drinking source would exceed dose standards for one or more COPCs. Long-term impacts on human health receptors (e.g., resident farmer) are indirect impacts that would result from long-term impacts on other resources such as groundwater (e.g., water used for irrigating land or drinking water) or ecological resources (e.g., consumption of animals or fish). As such, any potential mitigation measures that could reduce impacts on water resources and/or ecological resources may also be applicable for mitigation of human health impacts.

Key: ALARA=as low as is reasonably achievable; COPC=constituent of potential concern; CTR=commute trip reduction; DOE=U.S. Department of Energy; EIS=environmental impact statement; Hanford=Hanford Site; *Hanford Comprehensive Land-Use Plan EIS=Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement; Hanford Comprehensive Land-Use Plan EIS SA=Supplement Analysis, Hanford Comprehensive Land-Use Plan Environmental Impact Statement;* HLW=high level radioactive waste; IDF=Integrated Disposal Facility; IHLW=immobilized high level radioactive waste; ILAW=immobilized low activity waste; LLBG=low-level radioactive waste burial ground; ROD=Record of Decision; RPPDF=River Protection Project Disposal Facility; *TC & WM EIS=Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*; WTP=Waste Treatment Plant.

DOE has prepared or will potentially prepare a number of area and resource management plans as described in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a), the subsequent *Hanford Comprehensive Land-Use Plan EIS SA* (DOE 2008), and their associated RODs (64 FR 61615 and 73 FR 55824). These plans are currently in draft form, have been completed, are being revised, or are waiting on available funds and program prioritization (DOE 2008). These plans and their status as of 2008 are summarized as follows:

- *Hanford Cultural Resources Management Plan (HCRMP)*: Final pending revision
- *Gable Mountain and Gable Butte Resource Management Plan (sub-tier to HCRMP):* Final
- *Rattlesnake Mountain Cultural Resource Management Plan (sub-tier to HCRMP):* Draft pending
- *Aesthetic and Visual Resources Management Plan (sub-tier to HCRMP):* Draft pending revision
- *Hanford Site Biological Resources Management Plan (BRMaP)*: Final pending revision
- *Hanford Site Biological Resources Mitigation Strategy (sub-tier to BRMaP)*: Final pending revision
- *Fire Management Plan (sub-tier to BRMaP)*: Final pending revision
- *Noxious Weed Management Plan (sub-tier to BRMaP)*: Final pending revision
- *Ecological Compliance Assessment Management Plan:* Final
- *Hanford Bald Eagle Management Plan*: Final pending revision
- *Threatened and Endangered Species Management Plan, Salmon and Steelhead (T&ESMP-SS):* Final
- *Chinook Salmon-Upper Columbia River Spring Run Hanford Management Plan (sub-tier to T&ESMP-SS)*: Final
- *Steelhead-Middle Columbia River Run Hanford Management Plan (sub-tier to T&ESMP-SS):* Final
- *Facility and Infrastructure Assessment and Strategy*: Draft
- *Mineral Resources Management Plan*: Draft

- *Hanford Site Watershed Management Plan*: Pending available funds and program prioritization
- *Hanford Site Ground-Water Protection Management Plan*: Final
- *Groundwater Vadose Zone Integration Project Summary Description*: Final
- *Hanford Institutional Control Plan*: Final
- *ALE Reserve Comprehensive Conservation Plan*: Draft
- *Wahluke Slope Comprehensive Conservation Plan*: Draft
- *Columbia River Corridor Area Management Plan*: Draft
- *South 600 Area Management Plan*: Pending available funds and program prioritization
- *Hanford Long-Term Stewardship Program and Transition: Preparing for Environmental Cleanup Completion*: Final

As these management plans become available, special management or mitigation required by the procedures outlined in the plans would be implemented for the proposed *TC & WM EIS* activities, as appropriate.

7.1.1 Land Resources

Land resources would be used to construct facilities for the treatment, storage, or retrieval of tank closure or Fast Flux Test Facility (FFTF) decommissioning and closure waste. The duration and amount of land used would vary depending on the alternative. Land resources would also be used to construct permanent disposal facilities for the Waste Management alternatives. Construction of tank waste retrieval, treatment, storage, and permanent disposal facilities would occur primarily within the 200 Areas encompassed by the Central Plateau. In the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a) and associated ROD (64 FR 61615), the Central Plateau was designated for Industrial-Exclusive use and the 400 Area was designated for Industrial use. There are two exceptions where new facilities would be constructed outside the Central Plateau. The first exception would be the construction of the Remote Treatment Project (RTP), which would be built either in the 400 Area under the Hanford Option or at Idaho National Laboratory (INL) under the Idaho Option for the FFTF Decommissioning action alternatives. The RTP would be located within Hanford's existing T Plant complex or within INL's existing Materials and Fuel Complex. The second exception would occur under Tank Closure Alternative 6A, where all tank waste would be treated and immobilized as high-level radioactive waste (IHLW). This would require that a portion of the IHLW Interim Storage Modules be constructed outside and east of the Central Plateau (i.e., 86.2 hectares [213 acres]).

In addition to the construction of new facilities, land resources would be mined for geologic materials necessary for implementation of the alternatives. Borrow Area C is an approximately 930-hectare (2,300-acre) borrow area designated to provide all borrow materials, including rock riprap (basalt), aggregate (gravel and sand), and soil (silt and loam), for the facility construction and associated activities described in this EIS. In the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a) and associated ROD (64 FR 61615), Borrow Area C is designated as Conservation (Mining).

As described in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a), the subsequent *Hanford Comprehensive Land-Use Plan EIS SA* (DOE 2008), and their associated RODs (64 FR 61615 and 73 FR 55824) to mitigate impacts, representative locations for new facilities to support tank waste retrieval, treatment, storage, and waste disposal under each of the alternatives may have been chosen based on the following factors or by taking the following steps:

- Location of all facilities, to the maximum extent practical, within the Central Plateau Industrial-Exclusive land use zone (e.g., the 200-East and 200-West Areas and those areas in between).
- Proximity to similar facilities (e.g., landfills near landfills), supporting infrastructure, or the tank farms.
- Proximity of Borrow Area C to the Central Plateau.
- Availability of sufficient uncontaminated space not reserved for use by other Hanford projects.
- Maintenance of proposed land use with the Industrial-Exclusive and Conservation (Mining) land use zones.
- Selection and use of existing buildings whenever possible.
- Collocation of related actions and interdependent facilities to reduce the aerial extent of land disturbance (e.g., supplemental treatment facilities and Cesium and Strontium Capsule Processing Facility adjacent to WTP).
- Use of existing infrastructure and rights-of-way.
- Use of existing and permitted facilities to augment alternatives (e.g., waste burial in low-level radioactive waste burial ground (LLBG) trenches 31 and 34.
- Expedient restoration and relandscaping of open areas upon completion of construction-related activities or upon termination and closure of a facility at the completion of its mission.
- Restoration of Borrow Area C, including regrading, contouring the landscape, revegetation to match the natural landscape, and adherence to best management practices for soil erosion and sediment control in accordance with appropriate resource management plans such as a final adopted version of the *Draft Industrial Mineral Resources Management Plan* (Reidel, Hathaway, and Gano 2001).

Several Tank Closure alternatives would require the construction of more facilities than others; however, such construction would be designed to make use of options that could help mitigate impacts on other resource areas. For example, Tank Closure Alternatives 3A, 3B, and 3C all analyze the construction of supplemental treatment facilities for treating tank waste. Supplemental treatment would shorten the length of time required to treat tank waste, which may help reduce impacts on other resource areas. In other cases, the treatment of all tank waste through the WTP or the clean closure alternatives for tank closure would require long implementation timeframes. This may lead to better performing waste forms, but as a consequence of the longer implementation timeframes, replacement facilities or construction of new double-shell tanks (DSTs) may become a necessity.

Land resources located in the Industrial Exclusive land use area and dedicated to permanent waste management or buffer areas in the long term would not be available for unrestricted use. This particular impact cannot be mitigated and would be considered a long-term impact or commitment of land resources, as discussed in Section 7.3.

7.1.2 Infrastructure

With the exception of electrical power required under Tank Closure Alternative 6A, Base and Option Cases, where all tank waste would be treated as high-level radioactive waste (HLW) in the WTP, none of the other *TC & WM EIS* alternatives are expected to consume energy, fuel, or water resources exceeding that which can be provided through existing infrastructure. Existing facilities and infrastructure could be utilized whenever possible to mitigate any necessary changes or upgrades. Necessary and new facilities associated with the *TC & WM EIS* action alternatives could be constructed within areas that have existing infrastructure and rights-of-way whenever possible. If needed, new infrastructure would be constructed consistent with the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a), the subsequent *Hanford Comprehensive Land-Use Plan EIS SA* (DOE 2008), and their associated RODs (64 FR 61615 and 73 FR 55824).

For short-lived demands on utilities (such as those typically experienced during construction), portable generators, temporary work lighting, portable water and fuel storage vessels, and portable sanitary facilities could be used to mitigate the need for upgrades to the existing, permanent infrastructure. This would be especially true for those activities that would occur in locations that do not have readily available tie-ins to the existing infrastructure.

The estimated peak electrical usages for the Tank Closure action alternatives range from 27 percent to 113 percent of available capacity, as discussed in Chapter 4, Section 4.1.2. The demand for electrical power would be dominated by WTP operations, particularly operation of the HLW melters. For Tank Closure Alternative 6A, Base and Option Cases, which would vitrify all tank waste in the WTP HLW melters, demand is projected to exceed the peak electrical capacity of Hanford's electrical power distribution system. Even though activities under the other Tank Closure alternatives are not projected to exceed the available peak capacity, electrical consumption is expected to remain near Hanford's peak capacity for the duration of the WTP operations analyzed under each alternative. The consumption of electrical power during WTP operations may require mitigation or the implementation of an energy consumption plan. The following steps could be taken to mitigate electrical consumption:

- Incorporate high-efficiency motors, pumps, lights, and other energy-saving equipment into the design of new facilities.
- Schedule operations during off peak times.
- Sequence operations to minimize peak use of utilities.
- Use alternative or supplemental methods to supply electricity that would not disrupt or threaten to disrupt the regional supply grid.

Infrastructure demands under the FFTF Decommissioning and Waste Management alternatives are expected to be relatively low, and so would not require implementation of additional mitigation measures.

7.1.3 Noise and Vibration

Generally, noise impacts to residential developments and other offsite public areas under the proposed *TC & WM EIS* alternatives are expected to be negligible because most activities would take place in the interior portion of Hanford (the Central Plateau) and away from these sensitive locations. The noise impacts projected to occur in the Central Plateau areas would not represent a significant increase over those levels currently experienced. However, noise impacts would be the greatest for wildlife near Borrow Area C. Activities in Borrow Area C could be limited to daylight hours. Noise impacts during construction would be minimized by maintaining the equipment to ensure that the mufflers and other components are operating properly, by restricting the use of vehicle horns, and using appropriately sized equipment. Noise from truck traffic coming and going from work sites could be mitigated by planning the routes and timing of truck traffic.

7.1.4 Air Quality

The *TC & WM EIS* action alternatives would involve construction of (1) new facilities over varying timeframes, (2) large permanent disposal facilities, and (3) surface barriers for tank farms, cribs and trenches (ditches) and disposal facilities. Construction activities would generate criteria and hazardous air pollutants. Emissions would be associated with diesel fueled construction equipment and other fuel-burning equipment (e.g., generators) and vehicles. Construction equipment emissions can be minimized by using more-refined fuels (e.g., low-sulfur diesel fuel) and by maintaining the equipment to ensure that its emissions control systems and other components are functioning at peak efficiency. Most notably, fugitive dust emissions would occur as a result of land disturbance by heavy equipment and vehicles, causing suspension of particulate matter from exposed soil in the air. Ambient monitoring and engineering controls may be necessary to maintain pollutants below acceptable levels. Engineering controls could include watering and/or use of surfactants to control dust emissions from exposed areas, revegetation of exposed areas, sequencing and timing of work, watering of roadways, and minimizing construction activity under dry or windy conditions (during late summer and fall). DOE is currently applying these measures in constructing the WTP. For those activities where contaminated dust may be disturbed (e.g., removal of tank farms), excavation work could take place beneath domed containment structures using negative pressure systems, airlocks, and water sprays.

As discussed in Chapter 4, Sections 4.1.4 and 4.3.4, construction activities and other earth-disturbing actions associated with all Tank Closure and Waste Management alternatives, including No Action, have the potential for particulate matter to exceed standards. The 1-hour average for carbon monoxide is also projected to exceed standards under several Tank Closure alternatives. However, the analysis of emissions did not consider the emissions controls described above that could be employed in construction areas to mitigate impacts. Before implementation of any Tank Closure or Waste Management alternative, a more refined analysis of emissions utilizing reasonable control technologies and more-detailed construction activities would need to be performed, and is expected to result in substantially lower estimates of emissions and ambient concentrations of criteria pollutants under all *TC & WM EIS* alternatives. Concentrations of other hazardous air pollutants are projected to be within acceptable levels under all *TC & WM EIS* alternatives and below any published acceptable source impact levels.

New facility process operations (especially operations of the WTP and its supporting facilities) and subsequent facility deactivation would generate airborne emissions of various pollutants, including radionuclides as well as nonradioactive organic and inorganic chemicals. Due to the variety of air pollutant contributors and processes that could be operating under the action alternatives, there are a variety of air pollutant control technologies that could be considered. For example, for removal of airborne particulates and gaseous emissions, the following control technologies could be considered in process design:

- The cyclone precipitator is a common industrial technology used as a precleaning step ahead of more expensive and effective control systems for removal of particulates. This technology would be a good candidate as a precleaning step for emissions emanating from nonthermal treatment systems, such as the Cast Stone Facility, because it is commonly used at commercial concrete production facilities. It would generally not be a useful control technology for thermal waste treatment systems, such as the WTP and its use in radiological environments may be limited as well.

- The electrostatic precipitator is another useful technology for control of particulate emissions. The current WTP design calls for installation of wet electrostatic precipitators. This technology would remove particulates and some of the vapor included in the air stream and could provide effective treatment for all of the air emissions generated from all waste treatment systems currently considered in this *TC & WM EIS*.

- Direct filtration can also be effective in controlling particulates. One typical industrial application is a baghouse filter system. Direct filtration via high-efficiency particulate air (HEPA) filters has been shown to be very effective at controlling particulates at Hanford. HEPA filters can be used (and will probably be required) for all of the waste treatment systems analyzed in this EIS as long as the exhaust stream temperature can be properly tempered.

- Scrubber systems are another effective air treatment control technology. Currently, the WTP design includes two kinds of scrubbers: caustic and submerged bed. Scrubbers can be used with all currently planned waste treatment technologies. Submerged bed scrubbers are effective at reducing particulate loading in the airborne emissions stream. They can be used on any of the waste treatment technologies considered in this EIS. Caustic scrubbers are effective in treating acid gases produced as part of the thermal treatment system. They would be an effective control on all of the thermal waste treatment system facilities (e.g., WTP, bulk vitrification), but would not provide any additional reduction to the nonthermal systems (e.g., cast stone).

- Thermal oxidation systems are an important treatment technology for controlling emissions of organic chemicals and vapors because they burn these emissions. The current WTP design calls for inclusion of a thermal catalytic oxidizer.

- Carbon adsorption is another treatment technology that helps remove organics from the air emissions stream. This technology is very effective at removing organics and other vapors with the proper chemical affinity. However, as with HEPA filters, carbon adsorption systems are not very effective with high-temperature or liquid-saturated air streams; therefore, the stream must be properly tempered for this technology to be effective. Current WTP design calls for inclusion of a carbon-bed adsorption unit for removal of mercury vapor from the emissions stream.

- The current WTP plan calls for inclusion of a selective catalytic reduction unit for control of nitrous oxide. This type of system can be designed to treat specific chemicals in the airborne stream by using different catalysts and can help reduce acid gases in the emissions stream. This treatment technology could be an effective addition to most of the waste treatment systems and can be effectively implemented to address specific chemicals of concern.

- Pretreatment of waste streams prior to introduction to the WTP or other supplemental treatment processes also can help reduce airborne contaminants and gaseous emissions. Pretreatment would be employed to remove problematic toxic and radiological air pollutants from the waste stream prior to treatment, thus eliminating or reducing the potential for emissions of target contaminants from the process stacks.

7.1.5 Geology and Soils

Impacts on geology and soils would generally be proportional to the total area of land disturbed by construction of new treatment, storage, and disposal facilities, the depth and lateral extent of excavations of the tank farms and other contaminated soils, and the total amount of geologic resources that would be mined from Borrow Area C. Excavation depths for new facility construction generally would not exceed about 12 meters (40 feet); however, deep soil excavation to depths of 20 meters (65 feet) to as much as 78 meters (255 feet) below land surface may be required for clean closure of the single-shell tank (SST) farms under Tank Closure Alternatives 6A and 6B or the clean closure of the BX and SX tank farms under Tank Closure Alternative 4. The majority of impacts on geology and soils would occur from mining of materials for backfilling tank farm excavations and permanent disposal facilities, providing engineered backfill for construction of the WTP and related facilities, and constructing engineered barriers for closure of the tank farms, cribs and trenches (ditches), River Protection Project Disposal Facility (RPPDF), and an Integrated Disposal Facility (IDF). For analysis purposes, it was assumed that all required geologic resources for the *TC & WM EIS* alternatives would come only from Borrow Area C and would potentially involve disturbance of up to 730 hectares (1,800 acres) of land excavated to a depth of approximately 4.6 meters (15 feet) deep. The greatest impact on Borrow Area C would occur for the alternative combination involving Tank Closure Alternative 6A, Option Case; FFTF Decommissioning Alternative 3; and Waste Management Alternative 2, Disposal Group 3. The following mitigating factors could possibly reduce the overall impact of mining operations from Borrow Area C:

- Extraction and management of geologic materials would be executed in a manner consistent with the policies and resource management plans described in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a), the subsequent *Hanford Comprehensive Land-Use Plan EIS SA* (DOE 2008), and their associated RODs (64 FR 61615 and 73 FR 55824).

- Borrow Area C would be restored, including regrading, contouring the landscape, revegetation to match the natural landscape, and adherence to best management practices for soil erosion and sediment control in accordance with appropriate resource management plans such as a final adopted version of the *Draft Industrial Mineral Resources Management Plan* (Reidel, Hathaway, and Gano 2001).

Regardless of the use of borrow materials sources other than Borrow Area C, geologic resources would still be required in large quantities under some alternatives and the long-term impacts of mining these materials would be realized.

Surface soils and unconsolidated sediments exposed in excavations and cut slopes during new facility construction would be subject to wind and water erosion if left exposed over an extended period of time. In all cases, adherence to standard best management practices for soil erosion and sediment control during construction would serve to minimize soil erosion and loss. Due to the number of construction projects that would be ongoing during the early years of each of the action alternatives, erosion of exposed soils cannot be completely eliminated during construction, but a number of practices could reduce overall impacts. Temporary soil disturbance outside the eventual footprint of new facilities could be limited by using inactive areas within the building footprints for material laydown, storage, and parking, as well as by using narrow access and egress corridors for construction equipment usage. In general, limiting the amount of time soils are exposed, limiting the area disturbed during any phase of a construction project, and applying protective coverings to denuded areas during construction (e.g., mulching and/or geotextiles) until the disturbed areas can be revegetated or otherwise covered by facilities could reduce the potential for soil loss. Soil loss and offsite transport could be further reduced by appropriate sedimentation and soil erosion and control devices, including sediment traps, sediment fences, staked hay bales, or other methods that Hanford's arid conditions may dictate. Stockpiles of soil removed during construction could be covered with a geotextile or temporary vegetative covering to protect it from erosion. This material would normally be reclaimed for reuse on site, such as backfill for facility excavations. To reduce the risk from exposing contaminated soils, areas in which new facilities would be constructed would be surveyed prior to any ground disturbance, and any contamination could be remediated as necessary.

Mitigation measures such as controlling the spread of contaminated soil or preventing the recontamination of remediated areas during decommissioning could be implemented through the use of work sequencing, soil stabilization measures, temporary covers, and exclusion zones to reduce contaminant spread. Impacts on soils could also be mitigated by grading the land to create contours consistent with the surrounding environment. This could be accomplished by grading the land to its preconstruction topography.

7.1.6 Water Resources

There would be no direct discharge of effluents to either surface waters or groundwater during new facility construction, operations, or subsequent deactivation, and no appreciable impact on water quality is expected to result from routine activities. Nonhazardous process wastewater would be discharged to the Treated Effluent Disposal Facility in the 200-East Area, while radioactive liquid effluents would be discharged to the 200 Area Liquid Effluent Retention Facility prior to treatment in the Effluent Treatment Facility. It was assumed that these facilities, or their equivalents, would continue to be available to manage process liquids generated under the action alternatives and that any necessary life extensions or replacements would be completed as needed.

Surface water and groundwater would be protected from hazardous materials spills by development and implementation of spill prevention and contingency plans for instances where hazardous materials are being handled. These plans to minimize the potential for hazardous materials spills would include provisions for storage of hazardous materials and refueling of construction equipment within the confines of protective berms, as well as cleanup and recovery plans and emergency response notification plans and procedures. Spills would also be reduced by keeping vehicles and equipment in good working order to prevent oil and fuel leaks. Soil erosion and sediment control plans and stormwater pollution prevention plans would be implemented as required for any earth-disturbing activity to minimize the transport of suspended sediment or other deleterious materials to surface or groundwater bodies.

Portions of the probable maximum flood zone associated with Cold Creek lie within the confines of Borrow Area C. Mining of geologic materials to support tank closure and waste management activities would include consideration of impacts on the watercourse and associated floodplain. Any changes in the extent and nature of predicted mining that could impact the floodplain would be evaluated, and a floodplain assessment would be prepared as required by Executive Order 11988, *Floodplain Management*, and other Federal regulations (10 CFR 1022).

Water resources requirements under any of the *TC & WM EIS* alternatives would be well below available resources; therefore, no mitigation would be required to provide alternate supplies. However, whenever possible, water conservation practices could be implemented.

Impacts on groundwater would occur over the long term under all of the alternatives. Contaminants from past SST system leaks and releases and other historic waste discharges in the 200 Areas that are already resident in the vadose zone would continue migrating downgradient to the unconfined aquifer and toward the Columbia River. Any future leaks from the SST or DST systems and onsite disposal of waste would add to these impacts. The Tank Closure No Action Alternative would have the largest additional incremental contribution to existing contaminant releases over the long term because no tank waste retrieval and treatment or SST system closure would be performed. Even after implementation of corrective action measures to fill deteriorating tanks with grout or gravel, Hanford SSTs, DSTs, and miscellaneous underground storage tanks would fail over time, resulting in the unmitigated release of their entire contents to the vadose zone and unconfined aquifer system. However, elements of the Tank Closure action alternatives for tank waste storage, retrieval, treatment, disposal, and SST closure that are analyzed in this *TC & WM EIS* incorporate mitigation measures to varying degrees for attenuating long-term groundwater quality impacts. Under all of the Tank Closure action alternatives, waste residing in the SSTs and DSTs would be retrieved for treatment, leaving residual waste ranging from 0.1 to 10 percent of the waste volume in place. Although leaks from the SST system were assumed to occur during retrieval operations, overall retrieval and treatment of tank waste would reduce the incremental contribution to past leaks and releases over the long term.

Waste forms generated as a result of tank waste treatment and from contaminated soil and debris would be disposed of in an onsite, engineered disposal facility (either an IDF or the RPPDF). Use of liners and leachate collection systems would be used to control infiltration of surface water, prevent effluent releases to the vadose zone, and actively monitor contaminant release levels so that appropriate corrective actions can be implemented. Corrective actions could include installation of additional containment barriers (e.g., grout curtains) to halt contaminant migration or exhumation of waste for further treatment before redisposal, if necessary. WTP immobilized low-activity waste (ILAW) forms could be formulated to preferentially retain contaminants to retard their release to the subsurface, or pretreatment steps could be employed to remove problematic constituents prior to treatment and disposal. Similarly, grouting of certain mixed low-level radioactive waste (MLLW) streams could prove successful in delaying release of some contaminants. However, in the long-term, contaminants would eventually be released as systems fail and would eventually impact the vadose zone and groundwater.

DOE uses a proactive approach to protecting groundwater through the performance assessment process. Disposal facility performance assessments are routinely reviewed to ensure that facilities meet requirements established in DOE Orders 435.1, *Radioactive Waste Management*, and 5400.5, *Radiation Protection of the Public and the Environment*. Changes in disposal facility waste acceptance criteria could be enforced, if a review indicated that groundwater contamination might exceed applicable requirements. As a result, some waste could require further treatment prior to disposal, additional confinement (such as disposal in high-integrity containers), or the development and use of better long-term performing waste forms. Waste that does not meet the waste acceptance criteria for immediate disposal could be stored until another treatment or disposition method was found.

Most Tank Closure alternatives would employ landfill closure of the tank farms, which would include placing an engineered surface barrier (either the modified Resource Conservation and Recovery Act [RCRA] Subtitle C barrier or the Hanford barrier design) over the tank farms to minimize water infiltration through the residual tank waste inventories and its subsequent transport through the vadose zone. The surface barrier would be monitored and maintained during a 100-year postclosure care period to ensure its structural integrity. For those Tank Closure alternatives that would employ clean closure of the tank farms, the impacts were analyzed without assessment of such barriers. In addition, engineered surface barriers would be constructed for FFTF entombment and closure of waste management disposal facilities such as one or more IDFs and the RPPDF. The analysis of the Hanford barrier, designed to be a more robust surface barrier, under Tank Closure Alternative 5, is a potential mitigating measure that could be incorporated into all alternatives for closure of tank farms, cribs and trenches (ditches), and waste management disposal facilities, depending on its performance compared to the RCRA Subtitle C barrier design.

The engineered surface barriers that would be constructed for in-place closure of the tank farms, FFTF entombment, or closure of the waste management disposal facilities would have an extensive groundwater monitoring network of observation wells to detect contaminant releases. Given that releases of contaminants from the closed disposal facilities or tank farms would occur hundreds or thousands of years into the future, groundwater quality monitoring systems may need to remain in place far beyond the 30- or 100-year periods assumed under current regulations and incorporated into these alternatives. Should the monitoring system detect releases that could lead to significant deterioration of groundwater quality, DOE could implement one or more of the following mitigation measures:

- The same types of technologies that could be implemented to address existing groundwater contamination could be implemented to remediate potential future groundwater contamination under any *TC & WM EIS* alternative.

- The same technologies and actions described under the clean closure alternatives for tank, ancillary equipment, and contaminated soil removal could be implemented to remove the source(s) of all or part of the exceedances on a location-by-location basis.

- Surface controls (e.g., hydraulic barriers, water run-on and runoff management systems, and leachate collection systems) implemented to limit and control infiltration through engineered barriers could be replaced by more robust and effective systems and/or subsurface contaminant migration control systems (e.g., grout curtains, chemical barriers, or sequestering-agent injection).

- Postclosure care, associated administrative controls, and monitoring and maintenance of the closure systems (e.g., groundwater monitoring, restricting access to the surface of the sites, and routine repair of remediation systems, including surface barrier lobes), which are assumed to end after 100 years, could be extended and/or implemented to restrict access to groundwater by future site users.

Of particular interest when considering long-term impacts on groundwater, and as discussed in detail in Chapter 5, are hydrogen-3 (tritium), iodine-129, technetium-99, chromium, nitrate, uranium-238, and total uranium. Collectively, these constituent of potential concern (COPCs) account for essentially 100 percent of the risk and hazard drivers when analyzing long-term groundwater impacts for the *TC & WM EIS* alternatives. Tritium is a short-lived radionuclide (e.g., half-life of 12.7 years) that is projected to sufficiently decay below benchmark concentrations before reaching the Columbia River. Iodine-129, technetium-99, chromium, and nitrate are referred to as conservative tracers due to their mobility and because they are long-lived or persistent in the environment. Under the clean-closure Tank Closure Alternatives 6A and 6B, the peak concentrations at the Core Zone Boundary for conservative tracers was projected to have occurred during the past-practice period due to past leaks from SST farms and discharges to cribs and trenches (ditches). Under all other Tank Closure alternatives, the peak concentration at the Core Zone Boundary would occur shortly after the post–administrative control period ends, when any residual waste in the SSTs or DSTs would be released into the vadose zone. The end of the post–administrative control period ranges from calendar year 2107 under Tank Closure Alternative 1 to calendar year 2193 under Tank Closure Alternative 2A. Uranium-238 and total uranium are characterized with limited mobility and are projected to reach peak concentrations at the Core Zone Boundary at a much later date than the other more-mobile COPCs (i.e., after calendar year 5000).

Under the FFTF Decommissioning alternatives, tritium and technetium-99 are the risk drivers; however, neither of these COPCs are projected to exceed benchmark concentrations within the 400-Area Property Protected Area or at the Columbia River.

The same COPCs as discussed above for Tank Closure alternatives are also the risk and hazard drivers for the Waste Management action alternatives. However, the performance of an IDF in the 200-East Area (IDF-East), an IDF in the 200-West Area (IDF-West) under Waste Management Alternative 3, and the RPPDF and their related impacts on groundwater are largely influenced by waste form performance and the partitioning of COPCs between the various waste forms. Generally, ILAW (e.g., vitrified waste) are superior-performing waste forms compared to supplemental treatment and secondary waste forms. Major contributing factors to the groundwater-related impacts of the Waste Management alternatives are the disposal of offsite waste from other DOE facilities. Under the Waste Management action alternatives, iodine-129 and technetium-99 from an IDF would result in the majority of impacts when compared with other *TC & WM EIS* sources (e.g., Tank Closure and FFTF Decommissioning action alternatives).

This *TC & WM EIS* shows that receipt of offsite waste streams that contain specific amounts of certain isotopes, specifically iodine-129 and technetium-99, could cause an adverse impact on the environment. As evaluated in this EIS, 15 curies of iodine-129 from offsite waste streams show impacts above the MCLs, regardless of whether this waste stream is disposed of in the 200-East Area under Waste

Management Alternative 2 or in the 200-West Area under Waste Management Alternative 3. The technetium-99 inventory of 1,790 curies evaluated in this EIS from offsite waste streams shows impacts that are less significant than those of iodine-129. However, when the impacts of technetium-99 from past leaks and cribs and trenches (ditches) are combined, DOE believes it may not be prudent to add significant additional technetium-99 to the existing environment. Therefore, one means of mitigating this impact would be for DOE to limit disposal of offsite waste streams containing iodine-129 or technetium-99 at Hanford.

Appendix D provides detailed discussion and assumptions regarding the partitioning of COPCs between the various waste form products. One of the assumptions of the *TC & WM EIS* analysis is that approximately 20 percent of iodine-129 would be captured in primary waste forms (e.g., ILAW, bulk vitrification, or steam reforming waste forms), with the balance due to volatization recovered in secondary waste forms. The only exception would be under Tank Closure Alternatives 3B, 4, and 5, where cast stone would capture a higher percentage of iodine-129 due to the nonthermal nature of this treatment technology. Iodine-129, as mentioned above, is one of the conservative tracers with a half-life of approximately 17 million years and is projected to exceed benchmark concentrations. As such, reasonable mitigation measures could be considered that would recycle secondary waste streams into the primary waste stream feeds within the WTP to increase iodine-129 capture in ILAW and bulk vitrification, which are considered more stable waste forms than those associated with secondary waste. The current WTP design supports the ability to recycle. For example, one method would involve the recycling of iodine within the WTP by capturing it in the submerged bed scrubber and returning it to pretreatment. This recycling could theoretically concentrate the iodine in the feed stream, which, in turn, could put more iodine in a specific volume of glass product. Also, the development of more robust, longer-performing waste forms, particularly with regard to cast stone, steam reforming, and grouted secondary waste, could be pursued.

Another assumption detailed in Appendix D of this *TC & WM EIS* is partitioning of technetium-99 in IHLW, ILAW, and supplemental treatment primary waste forms. Without technetium-99 removal as a pretreatment step in WTP, the analysis assumes that roughly 97 to 98 percent of the technetium-99 from treated tank waste would be captured in ILAW or supplemental treatment waste products, 1 to 2 percent would be captured in secondary waste forms, and less than 1 percent would be captured in IHLW. The further partitioning of technetium-99 among ILAW and supplement treatment waste forms would be generally proportional to the volume of waste that would be treated in each of the facilities. For example, under Tank Closure Alternative 3A, technetium-99 was assumed to partition at 28 percent, 38 percent, and 32 percent between ILAW, the 200-East Area Bulk Vitrification Facility, and the 200-West Area Bulk Vitrification Facility, respectively. However, under Tank Closure Alternative 2B, where technetium-99 removal would be incorporated as a pretreatment step in WTP, 97.5 percent of technetium-99 is expected to be captured in IHLW and only 1 percent in ILAW. In addition, under Tank Closure Alternative 3B, where technetium-99 removal would be employed in the WTP, 99 percent of the technetium-99 in the waste treated in the 200-East Area would be incorporated in IHLW. Similar to iodine-129 above, technetium-99 is a conservative tracer with a long half-life (211,000 years) and is projected to exceed benchmark concentrations. Potential mitigation measures that could be considered include technetium-99 removal as a pretreatment option in the WTP. Also, the development of more robust, longer-performing waste forms, particularly for supplemental treatment technologies and grouted secondary waste, could be pursued.

7.1.7 Ecological Resources

The short-term impacts on ecological resources would largely depend on the amount of new land disturbance that would occur under each *TC & WM EIS* alternative and would potentially upset terrestrial habitats and threatened and endangered species. Disturbance of new land could be minimized by employing the same mitigation measures discussed in Section 7.1.1.

Ecological resources in the Industrial-Exclusive Zone of the Central Plateau have been adversely affected from previous disturbances of the area and from the 24 Command Fire (see Chapter 3, Section 3.2.7). However, the fire did not affect the 200-East Area. New facility construction under the Tank Closure and Waste Management alternatives would impact sagebrush habitat to varying degrees depending on the alternative. Chapter 4, Sections 4.1.7 and 4.3.7, discuss the total area of sagebrush habitat that would be affected under each alternative. This loss may be subject to compensatory mitigation at a ratio of 1:1 to 3:1, as prescribed in the *Hanford Site Biological Resources Management Plan* (DOE 2001) and the *Hanford Site Biological Resources Mitigation Strategy* (DOE 2003a). In addition, some habitats and species that have repopulated the burned areas could also be subject to mitigation under existing biological conditions and current mitigation guidelines. Within the Central Plateau, several state-listed, special status species of plant and wildlife have been observed or have the potential for inhabiting the areas of disturbance. The noted species include two state watch plant species; the stalked-pod milkvetch and crouching milkvetch, which would not require mitigation, although they could be considered in project planning. Other, more protected species that are considered Level III resources under the *Hanford Site Biological Resources Management Plan* (DOE 2001) would potentially require active mitigation (e.g. Piper's daisy [state sensitive], loggerhead shrike and northern sagebrush lizard [Federal species of concern and state candidates], and black-tailed jackrabbit, sage sparrow, striped whipsnake, and sage thrasher [state candidates]. No significant ecological impacts, and therefore no mitigation, is expected to occur in the 400 Area under any of the FFTF Decommissioning alternatives.

The extent of ecological impacts on Borrow Area C would depend on the amount of geologic materials that would need to be mined to support backfilling needs, construction of new facilities, and construction of engineered surface barriers. The maximum impacts would occur under the Tank Closure alternatives that involve clean closure of the tanks, cribs, and trenches, and under Disposal Groups 2 and 3 for the Waste Management action alternatives (where one or two IDFs and the RPPDF would be sized for the largest capacities). Vegetation communities located within Borrow Area C include cheatgrass/bluegrass and needle-and-thread grass/Indian ricegrass. The latter represents an unusual and relatively pristine community type at Hanford and is more highly valued. In addition to Piper's daisy, stalked-pod milkvetch, and crouching milkvetch, which are also found in the Central Plateau as discussed above, the long-billed curlew (state monitor) has been identified in Borrow Area C.

Biological surveys of areas potentially affected under the action alternatives have been completed (Sackschewsky 2003a, 2003b). While current biological conditions and mitigation guidelines are appropriate for determining mitigation requirements for near-term impacts, they are not suitable for judging long-term mitigation requirements because habitats and species assemblages may change over time. Consequently, actual mitigation requirements for later activities that would occur under the alternatives considered would depend on the results of field surveys conducted just prior to initiating ground-disturbing activities and the mitigation guidelines in effect at Hanford at that time.

In addition to preparing a comprehensive mitigation action plan to address the impacts on Level III resources (Piper's daisy, black-tailed jackrabbit, loggerhead shrike, and sage sparrow) and sagebrush habitat, the following mitigation measures could also be implemented to minimize short-term impacts on terrestrial resources and threatened and endangered species:

- Conduct proper maintenance of heavy equipment and clearly mark construction zones to prevent intrusion into sensitive areas or outside work areas.
- Implement noise reduction measures, as discussed in Section 7.1.3.
- Implement spill prevention and control plans, as discussed in Section 7.1.6.

- Avoid, to the maximum extent possible, disturbance of the needle-and-thread grass/Indian ricegrass communities in Borrow Area C.
- Perform land-disturbing activities at times that avoid animal breeding and nesting periods.

The long-term impacts on ecological receptors from air emissions and groundwater are correlated to the amount and timing of air emissions and releases of contaminants to the vadose zone and underlying aquifers. As discussed in Chapter 5, radiological COPCs from air emissions are not projected to be a risk to ecological receptors. Groundwater impacts at the Columbia River for nonradiological and radiological COPCs are also not projected to be a significant risk; however, a slightly elevated risk exists for chromium on aquatic biota at the Columbia River under most Tank Closure and Waste Management alternatives. In some cases, moderate risks for nonradiological COPCs from air emissions are projected. The majority of impacts are associated with mercury and xylene under the Tank Closure alternatives and with xylene under the FFTF Decommissioning and Waste Management alternatives. However, as presented in Appendix D and for conservative analysis, the mercury inventory was assumed both to be captured in waste forms and be emitted into the air. The assumption for most action alternatives that essentially 100 percent of the mercury inventory should be included in air emission analysis (i.e., almost 100 percent of the mercury inventory was assumed to be captured in waste form products) suggests that the risk from mercury is conservatively overstated. Implementing any of the mitigation measures discussed in Sections 7.1.4 and 7.1.6, which would reduce air and groundwater impacts, would also serve to reduce impacts on ecological receptors. Other mitigation measures could include performing periodic ecological surveys to monitor trends in terrestrial, riparian, and aquatic populations.

7.1.8 Cultural and Paleontological Resources

Although no alternative is expected to impact any prehistoric or other significant cultural resource, the potential for inadvertent discovery of prehistoric resources exists. Avoidance of identified resources would be the primary form of mitigation wherever practical. To avoid loss of cultural resources during new facility construction, cultural resource surveys have been and may be conducted in areas of interest. An archaeological monitor could be assigned onsite during ground-disturbing activities of any highly sensitive areas to ensure that, whenever possible, construction impacts would be limited to the project area. If any cultural resources were discovered during construction, construction would be halted, and procedures set forth in the *Hanford Cultural Resources Management Plan* (DOE 2003b) would be implemented.

The construction of new facilities in the Central Plateau would increase the industrial profile of the area from higher elevations. Likewise, excavation of Borrow Area C would alter the view of this area from higher elevations, such as Rattlesnake Mountain, which is of cultural interest to local American Indian tribes. The consolidation of existing activities/facilities and the removal of unnecessary facilities/infrastructure on Rattlesnake Mountain would tend to improve the visual profile of the mountain, allow restoration of the natural habitat, and enhance tribal religious and cultural experiences. The restoration of land used for *TC & WM EIS* activities as well as restoration of Borrow Area C in accordance with the appropriate resource management plans, such as a final adopted version of the *Draft Industrial Mineral Resources Management Plan* (Reidel, Hathaway, and Gano 2001), would lessen these visual impacts. DOE will continue its ongoing practice of consulting with American Indian tribes concerning potential impacts that may affect traditional cultural properties, including visual impacts. Where needed, measures to avoid or minimize these impacts would be developed and implemented in coordination with area tribes.

7.1.9 Socioeconomics

The potential exists for substantial impacts on regional socioeconomic conditions under all of the *TC & WM EIS* alternatives. Under the Tank Closure No Action Alternative, termination of WTP construction would lead to a noticeable and immediate short-term effect on the regional economy due to loss of employment and revenue. This loss of jobs could not be easily mitigated, as workers with certain skill sets could find it difficult to find comparable employment in the region. In contrast, implementation of any of the action alternatives would significantly increase the demand for professional, skilled, and unskilled labor. This would affect the regional economy, demographic characteristics, and housing and community services in the socioeconomic region of influence for the foreseeable future. Construction activities would cause short-term spikes in employment and demands on the regional economy. These short-term spikes could place a strain on the availability of housing and cause large upward and downward swings in housing prices. These spikes could also strain local school districts and other public services. Secondary effects on housing and community services would be somewhat mitigated by the fact that the spike in employment would be associated with construction. The long duration of some alternatives during the operations phase would lead to a more stable, long-term demand on regional socioeconomics. Data indicate that vacant permanent housing for sale and rent in the region may be insufficient to meet the demand under some action alternatives (see Chapter 3, Section 3.2.9.3, and Chapter 4, Sections 4.1.9, 4.2.9, and 4.3.9). It is anticipated that additional demand would stimulate construction of permanent and other forms of housing to meet the influx of construction workers, thereby producing a positive effect on the regional economy. Similarly, the direct and indirect income associated with procurement of equipment and supplies for completion of the WTP and associated new facility construction would be another economic benefit. Nevertheless, school enrollments associated with the influx of construction and operations workers and their families are expected to increase, and utility, community safety, and police and fire services may need to be expanded to meet demand.

Careful scheduling of activities, particularly during the construction phases, could reduce the severity of short-term spikes. Certain facilities could be built in sequence, rather than concurrently, although this could cause some small delays in initiation or completion of the projects and increases in project cost.

Implementing any action alternatives could impact local transportation infrastructure, especially during commuting periods. The local transportation system has additional capacity during noncommuting periods, but has no additional capacity during the morning and evening peaks (see Chapter 4, Sections 4.1.9, 4.2.9, and 4.3.9). As also described in these subsections, employee commuter traffic and truck traffic would peak at various times depending on the nature and intensity of the activities being conducted under each alternative. This combined effect would decrease the available capacity of site access roads during the morning and evening rush hours. Possible measures that could be used to mitigate traffic volume impacts are physical improvements to local and onsite roads to increase capacity, including construction of additional vehicle lanes throughout road segments; construction of passing lanes in certain locations; or realignment of roadways to reduce points of congestion. Employee programs that provide flexible hours or staggered work shifts to reduce peak traffic volumes also could reduce local transportation impacts. In addition, employee programs and incentives encouraging ridesharing could be established, and existing bus and/or vanpool programs could be expanded. Under Washington State law, Benton and Franklin Counties and the cities of Kennewick, Pasco, Richland, and West Richland must adopt commute trip reduction program plans for major employers. The intent of the commute trip reduction plan is to reduce commutes by workers from their homes to major work sites during the peak period of 6:00 A.M. to 9:00 A.M. on weekdays. Construction work sites are generally excluded under the law, provided the construction duration is less than 2 years. The ongoing construction of the Hanford WTP would likely not be exempt. The current anticipated deadline for the Tri-Cities commute trip reduction plan is February 2009, and the ordinance deadline is September 2009 (BFCOG 2006:2-5, 2-6).

Transport of geologic materials from Borrow Area C across State Route 240 to the 200 Areas presents a particular concern for its potential to cause traffic congestion and accidents and may require specific mitigation measures. Safety measures could include dust control; restrictions on crossings to non-shift-change hours; signs and warning lights along State Route 240 to the north, south, and well in advance of the crossing; and a traffic control light at the crossing itself.

7.1.10 Public and Occupational Health and Safety

Current and anticipated design, construction, and operation of waste treatment and disposal facilities could incorporate the best available technology and engineering controls to limit the discharge of potentially hazardous materials to the environment. The peak annual dose for the maximally exposed individual for both the onsite and offsite receptor for the air pathway was projected to be well below the regulatory limit of 10 millirem per year (DOE Order 5400.5) under all alternatives analyzed.

Although below any regulatory limits, the peak years for radiological impacts on the public coincide with the year of strontium and cesium processing. One option for mitigating this impact could be to alter the treatment strategy by distributing the treatment of strontium and cesium capsules over a longer period of time or by incorporating more aggressive air pollution control technology designed to target cesium and strontium emissions.

Workers would receive radiological doses under the *TC & WM EIS* alternatives. For all work activities involving radiation, the principle of maintaining doses as low as is reasonably achievable (ALARA) would be followed. This principle would involve formal analysis by workers, supervisors, and radiation and/or chemical protection personnel of the work in a hazardous environment to reduce exposure of workers to the lowest practicable level. Examples of ALARA measures could include minimizing time spent in the field of radiation, maximizing distances from sources of radiation, using shielding whenever possible, and/or reducing the radiation source. Mitigation measures also would be used to protect workers from radiological and chemical exposure hazards during construction, operation, and demolition activities. These mitigation measures would be derived from formal radiation protection programs and chemical hazards management programs. Examples of specific measures could include personal protective equipment (e.g., Tyvek suits, face masks), shielding (e.g., earth berms, concrete walls, steel plates, lead bricks), remotely operated robotic machinery, training, and spreading the work across a larger number of workers. All activities that affect the handling, treatment, storage, or disposal of radioactive waste would be performed within the limits of a DOE-approved safety basis. The safety basis would be established by evaluating potential accidents and defining appropriate controls to ensure that accident impacts are below required levels.

The regulatory limit for a worker dose is 5,000 millirem per year (10 CFR 835). The recommended DOE Administrative Control Level for a worker dose is 500 millirem per year (DOE Standard 1098-99). The analysis for worker dose presented in Chapter 4, Sections 4.1.10, 4.2.10, and 4.3.10, calculated an aggregated average dose for a full-time equivalent (FTE) worker over all activities included under each alternative. For example, an average annual dose reported to be 500 millirem per year would indicate that, unless mitigation measures were taken, a portion of an alternative's activities would exceed DOE's Administrative Control Level and a portion would be below this level. For Tank Closure Alternatives 4 and 6B, the average annual dose would exceed 500 millirem per year without mitigation measures. For Tank Closure Alternative 6A, the average annual dose would approach 500 millirem per year. The high average FTE worker dose experienced in these cases would be primarily due to the exhumation of tank farms and underlying radiologically contaminated soils. In these cases, a comprehensive evaluation of worker exposures may be warranted and, whenever possible, applicable ALARA techniques or other mitigation measures similar to those discussed above may be necessary to ensure the worker dose is reduced and maintained below 500 millirem per year. For all other *TC & WM EIS* alternatives, the FTE worker dose would be sufficiently low that the probability of any worker dose exceeding 500 millirem per year would be low.

Long-term impacts on human health were analyzed using a variety of receptors and receptor locations, as discussed in Chapter 5 and detailed further in Appendix K. In summary, the offsite receptor locations are the Columbia River itself and downstream population centers. One receptor is an American Indian hunter-gatherer, who, like the population centers, would consume water from the Columbia River. In contrast, the onsite receptors (i.e., the drinking-water well user, resident farmer, and American Indian resident farmer) would directly consume groundwater for drinking water, and, in some cases, would use groundwater to irrigate crops. The exposure scenarios for onsite receptors involve several locations within the Core Zone Boundary and the nearshore of the Columbia River. The COPCs that are drivers for groundwater impacts, briefly discussed in Section 7.1.6, are also the drivers for human health impacts.

Because of the substantial dilution that would take place as groundwater seeps into the Columbia River, impacts on downstream population centers and the American Indian hunter-gatherer, both of whom would use surface water as a source of drinking water or might consume fish from the Colombia River, would be negligible compared to background exposures. However, impacts on any receptor that consumes groundwater as a drinking water source and uses groundwater to irrigate crops within the Core Zone Boundary would exceed dose standards and Hazard Indices for either one or multiple COPCs. These impacts on receptors at onsite locations could not be directly mitigable because the underlying assumption is that access to the site and its groundwater resources would be attainable at some future date after all institutional controls are no longer in force. However, implementing any of the mitigation measures discussed in Section 7.1.4, which would reduce groundwater impacts, may also reduce impacts on human health.

All shipments of radioactive or hazardous materials on public roads would be performed within applicable regulatory requirements that address the following:

- Waste packaging in containers certified for use in waste transport.
- Training and licensing requirements for transporters.
- Notification of potentially affected organizations.

Potential mitigation measures to reduce impacts on workers and the public could include packaging the waste to reduce radiation doses below regulatory limits, selecting transportation routes to minimize exposure to populations along the route, and scheduling transport to avoid high traffic times and locations. The latter could also reduce congestion and transportation delays; thereby, reducing radiation exposure and the potential for traffic accidents.

7.1.11 Waste Management

This *TC & WM EIS* analyzes the construction, operation, and closure of permanent disposal facilities to support the disposal of the waste that would be generated under each of the Tank Closure, FFTF Decommissioning, and Waste Management alternatives. These permanent disposal facilities would include IDF-East, IDF-West, and the RPPDF, which would be located in an area between the 200-East and 200-West Areas. A more-detailed description of the IDF and RPPDF disposal facilities is provided in Chapter 2 and Appendix E. This *TC & WM EIS* analyzes several configurations of the IDF and RPPDF, depending on the size and length of operations required; these configurations are referred to as disposal groups. A disposal group is designed to conservatively provide disposal capacity to multiple Tank Closure alternatives; thus, under some Tank Closure alternatives, the full capacity of the disposal facilities, as analyzed in this EIS, may not be used. Chapter 2 provides a more-detailed description of the disposal groups, how they were determined, and which Tank Closure alternatives would be supported. Furthermore, the continued use of LLBG trenches 31 and 34 until filled to capacity could mitigate the amount of space required in an IDF or the RPPDF.

Permanent disposal facilities (i.e., one or two IDFs and the RPPDF) would be constructed with an RCRA-compliant liner and leachate collection system to manage infiltration and prevent the release of contaminants into the vadose zone. Each permanent disposal area would be closed and covered with an engineered modified RCRA Subtitle C barrier. Tank Closure Alternative 5 analyzes the emplacement of a more robust Hanford barrier design, which may further mitigate infiltration of surface water and extend the lifetime of the structural integrity of the barrier. These engineered surface barriers constructed for in-place closure of the tank farms, entombment of the FFTF, or closure of the waste management disposal facilities could have an extensive groundwater monitoring network of observation wells to detect contaminant releases.

With the exception of the Tank Closure No Action Alternative, all of the Tank Closure alternatives would generate HLW. Under Tank Closure Alternative 6A, all tank waste would be treated and formed into IHLW in the WTP. Under Tank Closure Alternatives 6A, 6B, and 6C all treated tank waste would be managed as HLW. In addition to the IHLW, HLW melters taken out of service would be generated over time from WTP operations and would require disposal. The amount of treated tank waste managed as HLW under Tank Closure Alternatives 6A, 6B, and 6C would represent a significant increase in waste volume managed as HLW by a factor of at least 14 times more than other action alternatives. In these alternatives, the treated tank waste would be stored on site. To mitigate potential impacts from storing large quantities of HLW, waste management areas could be modified as necessary. The increase in volume of waste managed as HLW under Tank Closure Alternatives 6A, 6B, and 6C would also result in a corresponding reduction in the volume of glass ILAW that would require onsite disposal in an IDF.

Sulfate removal is a WTP pretreatment step analyzed under Tank Closure Alternative 5. Sulfate removal has the potential to mitigate impacts on the waste management system (see Appendix E, Section E.1.2.3.9). This technology would remove sulfates from the tank waste stream, thereby reducing corrosivity and potentially extending melter life. This may lead to a reduction in melters taken out of service that would otherwise require disposal. The removal of sulfates may also enable increased waste loading from 14 weight-percent sodium oxide loading to 20 weight-percent sodium oxide loading, thereby potentially reducing the number of IHLW and/or ILAW canisters that would be produced (CEES 2007). However, a grouted sulfate waste form would be generated that would require disposal in an IDF.

DOE has a longstanding policy to minimize waste generation. DOE is implementing Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, by conducting its environmental, transportation, and energy-related activities under the law in an environmentally, economically and fiscally sound, integrated, continuously improving, efficient, and sustainable manner. Hanford has a pollution prevention program that was formalized in the *Hanford Site Waste Minimization and Pollution Prevention Awareness Program Plan* (DOE 1999b). Program components include waste minimization, recycling, source reduction, and buying practices that prefer products made from recycled materials. Implementation of the pollution prevention and waste minimization plans could minimize the generation of secondary wastes.

7.1.12 Alternative Combinations

Generally, potential mitigation measures for each resource area would remain the same regardless of the selected combination of alternatives; therefore, additional discussion of mitigation measures across the three alternative combinations would be unnecessarily redundant. However, wherever appropriate in the previous subsections of Section 7.1, mitigation measures may be specifically discussed for a particular alternative (e.g., Tank Closure), when analysis suggests an impact may need more emphasis. The alternative combinations and their affects on short-term impacts are discussed in more detail in Chapter 4, Section 4.4.

7.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Unavoidable adverse environmental impacts are those that would occur after implementation of all feasible mitigation measures, including those design elements incorporated in and analyzed under the individual *TC & WM EIS* alternatives. Implementing any of the alternatives considered in this

TC & WM EIS would result in unavoidable adverse impacts on the human environment. A summary discussion of these impacts is included in this section; however, a more-detailed impacts discussion can be found for each resource area in the appropriate sections in Chapter 4 for short-term impacts and Chapter 5 for long-term impacts.

Unavoidable adverse environmental impacts may occur in either the short or long term. For analysis purposes in this EIS, "short-term" refers to the complete project life cycle under each alternative during which construction, operations, decommissioning, deactivation, and closure activities would take place. All of the *TC & WM EIS* alternatives require either a 100-year postclosure care period or storage of HLW for a significant period of time, either of which would contribute very little to impacts. Thus, the most significant unavoidable adverse environmental impacts would occur in the earlier years of the short-term timeframes for the *TC & WM EIS* alternatives, during which all construction, operations, and deactivation activities would be completed and only postclosure care or storage activities would remain. A Tank Closure, FFTF Decommissioning, and Waste Management alternative would be implemented concurrently as an alternative combination, so while short-term impacts may end for one *TC & WM EIS* alternative, they may continue for another.

"Long-term" refers to the timeframe that extends beyond conclusion of the short-term project life cycle period for each alternative. For any viable alternative, it is expected that an increase in short-term adverse impacts would lead to an overall decrease in long-term adverse impacts (see Section 7.4).

7.2.1 Land Resources

Construction, consolidation, operations, maintenance and deactivation of new or existing facilities would be required to support the action alternatives and would result in short-term adverse impacts on land and visual resources, including the development or use of undisturbed land. Visual impacts from existing structures and maintenance activities on Rattlesnake and Gable Mountains and land use for construction of new facilities are considered a short-term impact because, after a facility's mission has been completed, it would be deactivated and demolished and vegetation and habitat would be re-established to recreate the natural condition. Many of the facilities currently reside on or would be constructed on land that has been disturbed; thus, while this would be considered a short-term commitment of land, it would not necessarily be considered an adverse impact. With the exception of the FFTF Decommissioning alternatives, the IHLW Interim Storage Modules constructed under Tank Closure Alternative 6A, and Borrow Area C, new and existing facilities would be situated in the *Hanford Comprehensive Land-Use Plan EIS* Industrial-Exclusive designated area. This area has been set aside for waste management activities. FFTF decommissioning activities would take place within the 400 Area Property Protected Area, which is in the *Hanford Comprehensive Land-Use Plan EIS* Industrial-Exclusive designated area (DOE 1999a). Borrow Area C is located at the end of Beloit Avenue, just south of Route 240. Other land resource impacts are presented and discussed in Chapter 4, Sections 4.1.1, 4.2.1, and 4.3.1.

The amount of new land disturbance required for construction of facilities to support the Tank Closure alternatives ranges from 3.2 hectares (8 acres) under Alternative 2B to 184 hectares (454.8 acres) under Alternative 6A. Under Tank Closure Alternatives 6A, 6B, and 6C, where all tank waste would be managed as HLW and would require substantial facility storage space, the disturbance of new land would be very high compared to the remainder of the Tank Closure alternatives. The Tank Closure No Action Alternative would terminate construction of the WTP and the Canister Storage Building and would not require any new disturbance of land. New land disturbance would not be necessary under any of the FFTF Decommissioning alternatives. The Waste Management No Action Alternative would not disturb any new land areas and would only utilize existing disposal facilities. The amount of new land disturbance for the Waste Management action alternatives ranges from 64 hectares (158 acres) under Alternative 2, Disposal Group 1 to 253 hectares (624 acres) under Alternative 3, Disposal Group 3. All newly disturbed land under the Tank Closure alternatives would be used to construct treatment and storage facilities; as such, this disturbance would be considered a short-term adverse impact. The vast majority of newly disturbed land under the Waste Management alternatives would be used for construction of permanent disposal facilities, which would be considered a long-term impact. Less than 1 percent of the new land disturbed under the Waste Management alternatives, or 0.4 hectares (1 acre), would be used for construction of new treatment facilities.

Borrow Area C is the designated source for the geologic materials that would be used for construction, operation, deactivation, and closure activities. Geologic materials from Borrow Area C would be used for concrete and grout, backfill, and construction of engineered barriers. The unavoidable adverse impacts would be the aerial extent of land disturbance and the mining of geologic materials to a maximum depth of 6 meters (15 feet) in some locations. Despite any restoration efforts, the land contours and visual references would be unavoidably altered for the long term; however, the potential use of the land would remain as Conservation (Mining), as designated by the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a). Borrow Area C land disturbance required to support tank closure would range from 2 hectares (5 acres) under the Tank Closure No Action Alternative to 568 hectares (1,405 acres) under Tank Closure Alternative 6A, Option Case. The FFTF Decommissioning No Action Alternative would not require any geologic materials, but FFTF Decommissioning Alternative 3 would disturb up to 3 hectares (8 acres) of Borrow Area C. Geologic materials would not be required under the Waste Management No Action Alternative, but Waste Management Alternative 2, Disposal Groups 2 and 3, would disturb up to 158 hectares (392 acres) of Borrow Area C. The aerial extent of land disturbance impacts would be commensurate with the total amount of geologic resources consumed, as discussed in more detail in Section 7.2.4.

7.2.2 Infrastructure

Implementation of the *TC & WM EIS* alternatives would not adversely affect the current infrastructure's long-term ability to provide energy, fuel, or water resources to support future actions. In the short term, under Tank Closure Alternative 6A, Base and Option Cases, which would vitrify all tank waste in WTP HLW melters, demand was projected to exceed the peak electrical capacity of Hanford's electrical power distribution system. Even though the available peak capacity was not projected to be exceeded under other tank closure activities, electrical consumption is expected to remain near Hanford's peak capacity for the duration of the WTP operations analyzed under each alternative. However, this short-term adverse impact on electrical distribution can be mitigated, as discussed in Section 7.1.2.

7.2.3 Noise and Vibration

Increases in noise levels would be relatively low outside of immediate areas of construction; however, the combination of construction noise and associated human activity would likely displace small numbers of animals surrounding the work areas. Heavy diesel equipment used for construction under most of the alternatives is expected to result in the highest noise levels. The most obvious reaction of wildlife would be a startle or fright response resulting from transient, unexpected noise. Such noise could cause animals to flee the area. Lower, more constant noise levels may cause wildlife to temporarily avoid the construction zone. None of the construction activities are located near residential areas. Noise impacts would be considered a short-term impact that would be experienced mainly during the construction phases of an alternative. Noise impacts are presented and discussed in Chapter 4, Sections 4.1.3, 4.2.3, and 4.3.3.

7.2.4 Air Quality

Implementation of the *TC & WM EIS* alternatives would cause unavoidable adverse impacts on air quality for various criteria and toxic chemical constituents. The peak impact for criteria pollutants is expected to occur during construction activities. For select Tank Closure alternatives, unmitigated air quality could exceed standards for particulate matter, and in some cases, carbon monoxide. The FFTF Decommissioning alternatives were not projected to exceed standards for criteria pollutants. All Waste Management alternatives were projected to exceed standards for particulate matter.

The peak impacts for toxic pollutants are expected to occur during routine waste retrieval, waste treatment, and supporting facility operations. All toxic air pollutants were projected to be below acceptable source impact levels.

Even after employing the best available technology and management practices to bring air contaminants down to acceptable levels, complete elimination of criteria and toxic air pollutants would not be possible and some unavoidable adverse impacts would still occur. Nonradiological air quality impacts are presented and discussed in Chapter 4, Sections 4.1.4, 4.2.4, and 4.3.4.

In addition to nonradiological air pollutants, unavoidable adverse impacts on air quality would occur as a result of radiological emissions. Unavoidable impacts due to radiological air emissions are discussed in Section 7.2.7.

7.2.5 Geology and Soils

Large volumes of geologic resource materials would be required for construction of facilities, backfilling excavations, construction of engineered barriers for closure of tank systems, entombment of facilities, and closure of landfill disposal sites. Such geologic resource materials would include rock, gravel, sand, clays, and soil. Under Tank Closure Alternatives 3A, 4, and 5, when bulk vitrification is employed as a supplemental treatment option, geologic resources would also be consumed. Section 7.4 and Chapter 4, Sections 4.1.5, 4.2.5, and 4.3.5, discuss impacts on geology and soils resources in more detail. Borrow Area C is the designated source of geologic materials for the activities discussed in this *TC & WM EIS*. This *TC & WM EIS* assumed that all geologic materials would be supplied from Borrow Area C.

The utilization of geologic materials would be the most significant under Tank Closure Alternatives 6A and 6B and Disposal Groups 2 and 3 under the Waste Management action alternatives, both of which involve clean closure of the SST farms.

7.2.6 Water Resources

Adverse impacts on subsurface soils and groundwater, and subsequently the Columbia River, would be unavoidable over the long term under all of the *TC & WM EIS* alternatives due to historical releases of contaminants and the ongoing presence of onsite disposal areas. The greatest impact on water resources would be experienced under the No Action Alternative for each set of proposed actions, where the storage tanks would be left to degrade over time, leading to the eventual release of untreated tank waste into the subsurface; where the remote-handled special components (RH-SCs) and bulk sodium would not be properly dispositioned; and where construction of modern landfill facilities would not be completed. All of the action alternatives are designed to enhance waste form and disposal area performance. Discussions of the long-term performance assessment, the projected impacts, and whether these impacts would exceed existing health- and risk-based standards are found in Chapter 4, Sections 4.1.6, 4.2.6, and 4.3.6, as well as in Chapter 5.

The unavoidable adverse impacts on groundwater that would be experienced from implementation of any of the *TC & WM EIS* action alternatives would be proportional to the amount of tank waste that would be retrieved for treatment and the performance of the primary and secondary waste forms. Even the high performance of ILAW that would be disposed of on site would eventually leach some COPCs into the subsurface. During any post–administrative control period, the eventual failure of engineered barriers followed by infiltration of water through the permanent disposal facilities or in-place closure of other facilities would facilitate migration of contaminants into the groundwater.

In addition to waste generated under the *TC & WM EIS* alternatives, the onsite non-Comprehensive Environmental Response, Compensation, and Liability Act-generated waste and any offsite waste that would be received and disposed of in an IDF or the RPPDF would contribute to any unavoidable impacts on groundwater.

7.2.7 Ecological Resources

Unavoidable adverse impacts on ecological resources would be commensurate with the amount of new land disturbance that would occur as a result of a particular action, as previously discussed in Section 7.2.1. This would cause short-term unavoidable impacts on the natural habitat in these areas, affecting both plant and wildlife ecosystems. Microbiotic crusts, which are expected to occur only on undisturbed sites within the 200 Areas and Borrow Area C, would be destroyed by new construction and excavation activities. Ground disturbance would also result in the loss of less-mobile species such as small mammals, reptiles, and amphibians. Larger, more-mobile species, including many mammals and birds, would be displaced to similar surrounding habitat. Their ultimate survival would depend on whether the areas into which they moved were at their carrying capacity (i.e., contained the maximum number of individual animals that the habitat is capable of supporting). Over the long term, with the exception of areas used for waste disposal, vegetation and wildlife would be re-established to recreate the natural condition on land disturbed for construction of treatment facilities, including Borrow Area C.

Federally and state-listed threatened or endangered species have not been observed within or in the immediate vicinity of the 200 Areas or Borrow Area C; therefore, long-term impacts on these groups of plants and animals are not expected. However, there are several state-listed species of interest that may be adversely affected in newly disturbed land areas such as the stalked-pod milkvetch, crouching milkvetch, Piper's Daisy, black-tailed jackrabbit, loggerhead shrike, sage sparrow, or the long-billed curlew.

The five ponds associated with the Liquid Effluent Retention Facility and Treated Effluent Disposal Facility, located within and adjacent to the 200-East Area, would receive effluent discharges. These ponds are lined and covered and are generally not accessible to wildlife. Potential long-term indirect impacts on ecological life that depends on Columbia River aquatic resources are discussed in Chapter 4, Sections 4.1.7, 4.2.7, and 4.3.7.

In addition to new land disturbance, air and groundwater impacts over the long term would cause limited unavoidable adverse impacts on ecological receptors. Even after implementation of air pollution technologies, air emissions from facility operations would deposit radiological and nonradiological COPCs into area soils and the Columbia River. Furthermore, under all *TC & WM EIS* alternatives, some COPCs would eventually migrate to and seep into the Columbia River. However, as discussed in Chapter 5, most of these impacts for all *TC & WM EIS* alternatives are not projected to be a risk to ecological receptors. In a few cases, the impacts would represent a very small risk. Implementing the mitigation measures discussed in Section 7.1.7 would further reduce these impacts.

7.2.8 Cultural and Paleontological Resources

None of the *TC & WM EIS* alternatives or ongoing maintenance and operational activities are expected to significantly impact any prehistoric, historic, cultural, paleontological, or visual resources. Given that ground disturbance would be required under most alternatives, the potential for inadvertent discovery of prehistoric resources exists. If discovered, the mitigation steps described in Section 7.1.2 of this chapter would be implemented. Excavation of Borrow Area C would alter the view of this area from higher elevations, such as Rattlesnake Mountain, which is of cultural interest to local American Indians, even after restoration efforts would be completed. The consolidation of existing activities/facilities, removal of unnecessary facilities/infrastructure on Rattlesnake Mountain, and maintenance of firebreaks and access roads on Rattlesnake and Gable Mountains would constitute unavoidable adverse short-term impacts, but over the long term would tend to improve the visual profiles on or from these natural features and allow restoration of natural habitat, thus enhancing tribal religious and cultural experiences.

7.2.9 Socioeconomics

The potential exists for substantial impacts on regional socioeconomic conditions under all of the *TC & WM EIS* alternatives. Under the Tank Closure No Action Alternative, termination of WTP construction would lead to a noticeable and immediate short-term effect on the regional economy due to the loss of employment and revenue. In contrast, implementation of any of the action alternatives would result in a significant increase in demand for professional, skilled, and unskilled labor. This would affect the regional economy, demographic characteristics, and housing and community services in the socioeconomic region of influence for the foreseeable future. Construction activities would cause short-term spikes in employment and demands on the regional economy. These short-term spikes could strain the availability of housing and cause large upward and downward swings in housing prices. These spikes could also cause strains on local school districts and other public services. Additionally, the influx of people to the region would strain the local transportation system. These unavoidable impacts could not be easily mitigated; however, implementing the mitigation measures discussed in Section 7.1.9 of this chapter could reduce their effect on the region.

7.2.10 Public and Occupational Health and Safety

Normal facility operations and deactivation, including some closure activities, would result in unavoidable radiation exposure to workers and the general public. The general public would be exposed to radiation from facility air emissions. Impacts on the general population and maximally exposed individuals are discussed in Chapter 4, Sections 4.1.10, 4.2.10, and 4.3.10. Workers would be exposed to radiation from routine operations dealing with the processing of radiological wastes. Workers would have the highest levels of exposure due to proximity and length of exposure, but doses would be administratively controlled to ensure radiation exposure levels would not exceed occupational health and safety standards. In addition to radiological exposures, workers would be exposed to chemical hazards and would also experience injuries, possibly even fatalities, while performing routine work-related tasks. With the exception of Tank Closure Alternative 6A, Base and Option Cases, where there would be about three projected fatalities, projected fatalities for routine work-related incidents were calculated to be less than one under all other *TC & WM EIS* alternatives. Work-related accidents are discussed in Chapter 4, Sections 4.1.15, 4.2.15, and 4.3.15.

The risk from transportation of radioactive materials is categorized as either radiological impacts or nonradiological impacts. Radiological impacts are those associated with the accidental release of radioactive materials or the effects from low levels of radiation emitted during normal, or incident-free, transportation. Nonradiological impacts are those associated with transportation itself, regardless of the nature of the cargo being transported, such as accidents resulting in death or injury when there is no release of radioactive material. Shipping packages containing radioactive materials emit low levels of radiation during incident-free transportation. The amount of radiation emitted depends on the kind and amounts of materials being transported. U.S. Department of Transportation regulations require that shipping packages containing radioactive materials have sufficient radiation shielding to limit the radiation to an acceptable level of 10 millirem per hour at 2 meters (6.6 feet) from the transporter. Incident-free exposure and accident-related fatalities while shipping both radiological waste and nonradiological materials are discussed in Chapter 4, Sections 4.1.12, 4.2.12, and 4.3.12.

Even after implementing all of the potential mitigation measures discussed in Section 7.1.6 in order to reduce groundwater impacts, some unavoidable impacts would still occur on the groundwater, as discussed in Section 7.2.6. Likewise, any impact on groundwater, even if below benchmark concentrations, would result in some impacts on human health even if these impacts were acceptable from a dose perspective or negligible when compared to background exposures.

7.2.11 Waste Management

Secondary waste, including LLW, MLLW, and hazardous waste, would be an unavoidable byproduct generated during construction, operations, deactivation, and closure activities. Examples of secondary waste include personal protective equipment, rags, tools, filters, and empty containers. This secondary waste would be in addition to the primary waste forms produced as a result of tank waste treatment or FFTF decommissioning activities. Secondary waste generation would be greatest during the operations and deactivation phases of each alternative. Secondary waste would be managed, treated, and/or stored for eventual recycling or disposal in accordance with applicable Federal and State of Washington regulations. Waste management impacts are discussed in Chapter 4, Sections 4.1.14, 4.2.14, and 4.3.14.

Primary waste is generally not considered an unavoidable adverse environmental impact because this waste already exists in one form or another and, consequently, would require management and disposal. However, depending on the treatment method implemented, the volumes of primary waste may increase. This could result from the addition of binding agents (e.g., glass formers and/or grout), treatment by acid wash, or WTP and/or Preprocessing Facility (PPF) melters taken out of service. The increased volumes of waste would lead to a larger demand for landfill space. The increase in landfill loading would be considered an unavoidable consequence, although not necessarily an adverse consequence, because the overall performance of the final waste form would be enhanced.

7.2.12 Alternative Combinations

For comparison purposes, three alternative combinations were selected for discussion in this section. A summary of overall projected unavoidable adverse impacts for these alternative combinations is presented in Table 7–2. A detailed discussion of short-term impacts under the alternative combinations is presented in Chapter 4, Section 4.4. Long-term impacts under the alternative combinations are presented in Chapter 5, Section 5.4.

Alternative Combination 1, which represents all the No Action Alternatives, would have the least unavoidable impacts on most resource areas in the short term, but conversely would also have the greatest overall adverse impacts on the environment over the long term. Until construction of the WTP and Canister Storage Building could be terminated under the Tank Closure No Action Alternative, some land disturbance and mining of geologic materials would occur in Borrow Area C. This would result in relatively small, but unavoidable short-term impacts on land, noise, air, and ecological resources. Approximately 2 hectares (5 acres) of new land disturbance would take place solely in Borrow Area C. Because of the limited disturbance of land in Borrow Area C, it is expected that native vegetation and natural species habitat would reclaim the disturbed areas relatively quickly, especially after restoration efforts are completed. Noise impacts would remain in the general vicinity of construction zones, but were not projected to exceed guidelines at receptor locations. Air quality would be adversely affected, with the possibility that particulate matter could exceed existing standards. Noise and air impacts would end with the cessation of construction activities. Over the long term, untreated tank waste would eventually be released from all the tank systems, migrate through the subsurface into groundwater, and unavoidably and adversely impact the Columbia River and the Hanford Reach ecosystem.

Alternative Combination 2 represents a midrange set of alternatives. The majority of short-term impacts would be experienced between 2006 and 2051, after which most activities would have been completed and the 100-year administrative monitoring period for this set of alternatives would collectively begin. In the short term, 66 hectares (163 acres) of new land would be disturbed in the 200 Areas, disrupting mostly sagebrush habitat and potentially several species of interest. In Borrow Area C, 139 hectares (344 acres) of new land would be permanently disturbed, altering the aesthetic quality of this area from several vantage points. Most of the 6.4 million cubic meters (8.4 million cubic yards) of geologic resources utilized would come from Borrow Area C. Electricity demand for WTP operations would approach site capacities and would need to be sustained for as long as the WTP was operating. Noise and air impacts would not necessarily increase in acuity, but the effects would be experienced over a prolonged period of time, compared to Alternative Combination 1. Particulate matter could exceed air quality standards at times. Vitrification of tank waste would eliminate the threat of untreated tank waste being released into the subsurface, but subsequent burial in an onsite disposal facility would be an unavoidable consequence of such treatment. As a result of tank waste treatment, secondary waste and ILAW glass melters taken out of service would be generated, thereby increasing the need for onsite disposal capacity. The transportation risk assessment projected two fatalities from radiological doses to workers and three fatalities due to nonradiological accidents. The majority of projected transportation risks are associated with the receipt of offsite LLW and MLLW from other DOE facilities, an activity that is not associated with tank closure.

Alternative Combination 3 represents the set of alternatives that would produce the greatest impacts on most resource areas; therefore, it most closely resembles a scenario where the maximum reasonably foreseeable unavoidable consequences occur in the short term. The duration of short-term impacts resulting from construction, operations, and deactivation would be extended through 2101. Unavoidable impacts on land and ecological resources would be similar to those under Alternative Combination 2, but would be magnified. New land disturbance would increase to 340 hectares (841 acres) in the 200 Areas and to 401 hectares (991 acres) in Borrow Area C. Geologic material consumption would increase to 18.8 million cubic meters (24.6 million cubic yards). Depending on the timing of construction activities, particulate matter and carbon monoxide emissions could exceed air quality standards. The management of all treated tank waste as HLW would balance the reduction in necessary onsite LLW disposal capacity with an increase in demand for onsite HLW storage facilities. Secondary waste would be generated in greater quantities due to the significant increase in waste treatment associated with clean closure of the tank systems. WTP LAW melters taken out of service would be managed as HLW and would not require onsite disposal, but would be replaced with PPF melters taken out of service that would be disposed of on site. Transportation risks would increase for tank closure activities, but the majority of the projected risk would still be from receipt of offsite LLW and MLLW. The projected transportation related fatalities associated with radiological doses would be two workers; for nonradiological accidents, the projected fatalities would be four.

Table 7–2. Unavoidable Adverse Environmental Impacts for Alternative Combinations

Resource Area	Alternative Combination 1	Alternative Combination 2	Alternative Combination 3
Land	2 hectares of new land would be disturbed in Borrow Area C only.	66 hectares of new land would be disturbed within the 200 Areas. 139 hectares would be disturbed in Borrow Area C.	340 hectares of new land would be disturbed within the 200 Areas. 400 hectares would be disturbed in Borrow Area C.
Infrastructure	Demand would remain well below capacities; therefore, no adverse impacts would be experienced.	Demand would remain well below capacities, except electrical demand would be approximately 68 percent of site capacities during WTP operations. This impact would not be permanent, but would require infrastructure upgrades or supplemental electrical supply to prevent a potential disruption in the local electrical supply grid.	Demand would remain well below capacities, except electrical demand would be approximately 72 percent of site capacities during WTP operations. This impact would not be permanent, but would require infrastructure upgrades or supplemental electrical supply to prevent a potential disruption in the local electrical supply grid.
Noise and Vibration	Increases in noise levels would be relatively low outside immediate areas of construction and would be barely discernible at the Hanford site boundaries. All combinations of alternatives at the site boundaries are projected to be below the Washington State standard daytime maximum noise level limitation of 60 dBA for industrial sources impacting residential receptors. Noise levels are expected to be the highest during the construction phase. Since the activities for each scoping area of the *TC & WM EIS* (tank closure, FFTF decommissioning, and waste management) occur in different geographic areas, the impacts on noise levels would not be additive.		
Air Quality	Particulate matter emissions may require additional analysis or engineering controls.	Particulate matter emissions may require additional analysis or engineering controls.	Particulate matter and carbon monoxide emissions may require additional analysis or engineering controls.
Geology and Soils	99,030 cubic meters of geologic resources would be consumed for partial construction of the WTP and Canister Storage Building until terminated.	6,435,000 cubic meters of geologic resources would be consumed.	18,780,000 cubic meters of geologic resources would be consumed.

Table 7–2. Unavoidable Adverse Environmental Impacts for Alternative Combinations *(continued)*

Resource Area	Alternative Combination 1	Alternative Combination 2	Alternative Combination 3
Water	All tank waste would eventually leak into the subsurface, adversely affecting groundwater quality and the Columbia River. The majority of long-term impacts would be from the eventual release of tank waste. Tank Closure Alternative 1 would account for more than 99 percent of impacts on groundwater under this alternative combination.	All tank waste would be vitrified in the WTP and disposed of in 200 Area disposal facilities or stored on site until disposition decisions are made and implemented. Some leaching of contaminants would occur prior to decay. The majority of long-term impacts would be from tank farm sources for hydrogen-3 (tritium), uranium-238, chromium, nitrate, and total uranium. The largest contributors for iodine-129 and technetium-99 are waste management sources, particularly offsite waste disposed of at the 200-East Area IDF.	All tank waste would be vitrified and managed as HLW, requiring long-term, onsite storage in aboveground HLW storage facilities. PPF glass and deep soil removal would be disposed of in 200 Area disposal facilities. Some leaching of contaminants would occur prior to decay, although less than under Alternative Combination 2, due to aboveground storage of vitrified tank waste. Long-term impacts would be similar to those under Alternative Combination 2.
Ecology	Negligible ecological impacts would occur to grasslands and state-listed species within Borrow Area C. However, long-term impacts could occur along the Columbia River due to release of untreated tank waste. Negligible ecological long-term impacts would occur from air emissions. Due to unmitigated release of tank waste into the subsurface, impacts on ecological resources in the Columbia River might occur from migration of contaminants through groundwater.	Grassland and sagebrush habitat would be adversely impacted along with several state-listed species. Some long-term impacts would occur to ecological resources from air emissions associated mainly with WTP operations. Although less, but more prolonged than under Alternative Combination 1, impacts on ecological resources in the Columbia River might occur from releases from tank farm sources and waste management sources into the groundwater. Overall, ecological resource impacts would be the greatest, although very low, under this alternative combination.	Grassland and sagebrush habitat would be adversely impacted along with several state-listed species. This alternative combination's impact would be greatest due to the length of short-term activities and the amount of new land disturbance when compared to Alternative Combination 2. Some long-term impacts would occur to ecological resources from air emissions associated with WTP, PPF, and clean closure operations. Overall, long-term impacts of groundwater would be similar to those under Alternative Combination 2, although somewhat less due to disposal of more treated tank waste off site as HLW.
Cultural and Paleontological	No impacts are expected to occur for this alternative combination.	Excavation of Borrow Area C would alter the view of this area from higher elevations, such as Rattlesnake Mountain, which is of cultural interest to local American Indians, even after completion of restoration efforts.	

Table 7–2. Unavoidable Adverse Environmental Impacts for Alternative Combinations *(continued)*

Resource Area	Alternative Combination 1	Alternative Combination 2	Alternative Combination 3
Socioeconomic	With the termination of WTP construction, the loss of jobs in the short term would negatively impact the local economy and could possibly suppress growth within the ROI. At its peak and prior to terminating construction, the workforce would be approximately 1,850 FTEs and would represent 1.5 percent of the projected 2008 labor force within the ROI.	Significant growth in the workforce would be necessary and would fuel regional growth. The peak workforce would represent approximately four to five times the peak workforce that would be experienced under Alternative Combination 1, although the peak would occur around 2040. The number of daily commuter vehicles would correlate with the increase in the workforce and could affect commute times.	Major growth in the workforce would be necessary and would fuel regional growth. The peak workforce would represent approximately seven times the peak workforce that would be experienced under Alternative Combination 1, although the peak would occur around 2021. The number of daily commuter vehicles would correlate with the increase in the workforce and could affect commute times.
Public and Occupational Health and Safety	Normal facility operations and deactivation, including some closure activities, would result in unavoidable radiation exposure to workers and the general public: the total estimated latent cancer fatalities to workers would be less than one person. Any increase in transportation risks would be negligible because they would be limited to continued operation of the low-level radioactive waste burial grounds and because no tank waste would be treated and/or transported. No fatalities were projected. Comparatively, this alternative combination would lead to the maximum potential for long-term impacts on the public due to unmitigated releases of radiological contaminants from the storage tanks. Impacts to groundwater from releases of tank inventories within the Core Zone Boundary would potentially increase risks to onsite receptors that attempt to use groundwater as a source of drinking water or for irrigation of crops. Negligible impacts on downstream populations are projected.	Normal facility operations and deactivation, including some closure activities would result in unavoidable radiation exposure to workers and the general public: the total estimated latent cancer fatalities to workers would be 9 persons. The majority of transportation risks would be associated with receipt of offsite waste. Impacts to groundwater within the Core Zone Boundary from waste management areas would potentially increase risks to onsite receptors that attempt to use groundwater as a source of drinking water or for irrigation of crops. Negligible impacts on downstream populations are projected.	Normal facility operations and deactivation, including some closure activities would result in unavoidable radiation exposure to workers and the general public: the total estimated latent cancer fatalities to workers would be increased to 53 persons due to activities associated with clean closure of the storage tanks. The majority of transportation risks would be associated with the receipt of offsite waste, with a minor increase due to the local transportation of additional waste for achieving clean closure of the tanks. Comparatively, this alternative combination would have a lower potential for long-term impacts on the public due to the management of treated tank waste as HLW. Although less than Alternative Combination 2, impacts on groundwater within the Core Zone Boundary and waste management areas would potentially increase risks to onsite receptors that attempt to use groundwater as a source of drinking water or for irrigation of crops. Negligible impacts on downstream populations are projected.

Table 7–2. Unavoidable Adverse Environmental Impacts for Alternative Combinations *(continued)*

Resource Areas	Alternative Combination 1	Alternative Combination 2	Alternative Combination 3
Waste Management	Any increase in secondary waste generation is expected to be negligible during ongoing administrative activities related to maintaining existing tank systems. In time, as efforts to maintain existing tank systems would likely intensify, the rate of secondary waste generation would also increase.	Secondary waste generation and low-activity waste melters taken out of service from WTP operations are projected.	All tank waste would be managed as HLW; a possible long-term consequence would be the requirement for long-term care and management of large quantities of HLW in onsite, aboveground storage facilities. Increased secondary waste generation and PPF melters taken out of service are projected due to the operation of the PPF for clean closure activities. WTP melters taken out of service would also be managed as HLW.

Note: To convert hectares to acres, multiply by 2.471; cubic meters to cubic yards, by 1.308.

Key: dBA=decibels A-weighted; FFTF=Fast Flux Test Facility; FTE=full-time equivalent; HLW=high-level radioactive waste; IDF=Integrated Disposal Facility; PPF=Preprocessing Facility; ROI=region of influence; *TC & WM EIS*=*Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*; WTP=Waste Treatment Plant.

7.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

This section describes the major irreversible and irretrievable commitments of resources that have been identified under each alternative considered in this *TC & WM EIS*. A commitment of resources is irreversible when primary or secondary impacts limit future options for a resource. An irretrievable commitment refers to the use or consumption of resources that is neither renewable nor recoverable for future use. In general, the commitment of capital, land, energy, labor, and materials during implementation of the activities in support of the Tank Closure, FFTF Decommissioning, and Waste Management alternatives would be irreversible or irretrievable. This section discusses the commitments of major resources that would result from implementation of the proposed actions and alternatives for four categories: land, materials, utilities, and labor.

Implementation of any of the alternatives considered in this *TC & WM EIS*, including the No Action Alternatives, would entail the irreversible and irretrievable commitment of land; construction materials (e.g., steel, concrete), chemicals, and geologic resources; utility resources (electricity, fossil fuels, and water); and labor. These resources would be committed over the entire life cycle of the alternatives described in this *TC & WM EIS* and would essentially be unrecoverable. The life cycle of an alternative includes construction, operation, decommissioning, and closure of facilities used to accomplish the objectives included in the scope of this *TC & WM EIS*.

7.3.1 Tank Closure Alternatives

Implementation of the Tank Closure No Action Alternative would continue both ongoing partial construction of new facilities and routine tank operations until these activities are terminated, followed by administrative controls for 100 years. Implementation of Tank Closure Alternatives 2 through 6C would specifically require construction, operation, and deactivation of new facilities to support tank waste retrieval, treatment, and disposal and SST system closure. For some facilities, construction of multiple replacements would be necessary because the life cycle of a particular alternative would exceed the design life of the facility.

7.3.1.1 Land Resources

The irreversible and irretrievable commitment of land resources (see Table 7–3) would occur from land use commitments for construction of new facilities on undisturbed land, for the permanent in-place closure of existing facilities and for borrow areas that would be used to supply geologic materials (e.g., sand, gravel, and soil).

Land use commitments for the Tank Closure No Action Alternative represent the area currently occupied by the SST farms and the B and T cribs and trenches (ditches) that would not be closed. Under Tank Closure Alternatives 2A through 5 and 6C, land use commitments would include new treatment and storage facilities constructed on undisturbed land. Under Tank Closure Alternative 2A, land use commitments would also include the SST tank farms and cribs and trenches (ditches), where waste would be left in place. Under Tank Closure Alternatives 2B through 5 and 6C, land use commitments would also include those areas where engineered barriers would be placed over the SST farms and cribs and trenches (ditches). Under Tank Closure Alternatives 6A and 6B, clean closure of the SST farms would be achieved, thereby eliminating the need for engineered barriers. However, management and subsequent storage of all tank waste as IHLW under these alternatives would require a substantial amount of land until permanent waste disposition could be realized. Tank Closure Alternatives 6A and 6B, Base Cases, however, would still require the emplacement of an engineered barrier over the cribs and trenches (ditches). Tank Closure Alternative 6A and 6B Option Cases would achieve clean closure of the SST farms and the B and T cribs and trenches (ditches).

New disturbance of land for construction of facilities would be considered an irreversible impact. The in-place closure of SST farms and cribs and trenches (ditches), with or without the emplacement of engineered barriers, would be considered an irreversible and irretrievable commitment of land. Section 7.4 discusses the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity.

Construction of new facilities, emplacement of engineered surface barriers, and/or partial or complete clean closure of the SST system would require relatively large volumes of geologic materials from Borrow Area C for backfilling of excavations. While this land would not be irreversibly or irretrievably committed to some use, the area would be irreversibly altered. The consumption of geologic materials including soil, gravel, sand, and rock/basalt is covered in Section 7.3.1.2 below.

The estimated areas of land that may be permanently committed or newly disturbed while supporting the Tank Closure alternatives are presented in Table 7–3. With the exception of Borrow Area C and the construction of IHLW Interim Storage Modules under Tank Closure Alternative 6A, all land commitments would be within the Central Plateau (200 Areas). This area has been designated by the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a) for Industrial-Exclusive use and has been set aside for *TC & WM EIS* activities. For a detailed discussion of land-use impacts of construction of new and existing facilities and Borrow Area C operations under the Tank Closure alternatives, see Chapter 4, Section 4.1.1. Table 7–3 may differ from the presentation analysis in Chapter 4, Section 4.1.1, because Table 7–3 does not include committed land for construction of new facilities where the land is known to have already been disturbed.

Table 7–3. Irreversible and Irretrievable Commitment of Land Resources for Tank Closure Alternatives[a]

Alternative	Land Resource (hectares)	
	Permanently Committed and Newly Disturbed Land[b]	**Borrow Area C (Disturbed Land)**
1	17	2
2A	33	27
2B	108	95
3A	110	101
3B	111	94
3C	111	94
4	86	102
5	111	118
6A-Base Case	209	492
6A-Option Case	184	568
6B-Base Case	126	239
6B-Option Case	100	316
6C	153	104

[a] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure. Does not include land area already committed for construction of the original WTP.

[b] This includes (1) land area where facilities would be closed in place or where engineered barriers would be constructed; (2) new disturbance of land for facility construction; or (3) new disturbance of land for construction of engineered barriers beyond the boundary of the barrier itself.

Note: To convert hectares to acres, multiply by 2.471.

Source: SAIC 2007a, 2008.

7.3.1.2 Material Resources

The irreversible and irretrievable commitment of material resources would include process chemicals used during operations of facilities, materials used for construction that cannot be recovered or recycled, materials that would be rendered radioactive and could not be decontaminated, raw materials consumed or reduced to unrecoverable waste forms, and geologic borrow materials. Project demands for primary material resources resulting from implementation of each of the Tank Closure alternatives are shown in Table 7–4 for construction and Table 7–5 for nonconstruction-related activities.

Principal construction materials would include steel, asphalt, and concrete and grout constituents such as cement, gravel and sand. Although other materials including wood, plastics, and other metals would be used, these quantities are not considered a primary demand. Concrete, steel, and other materials incorporated into the framework of new facilities such as the WTP and supplemental treatment facilities would be irretrievably lost, whether or not operations would result in direct contamination of the materials. Cement would be used to formulate concrete for construction of new facilities and in the grouting of SSTs and ancillary equipment in the tank farms. Concrete would be manufactured in batch plants located throughout the 200 Areas. The management of all tank waste as IHLW under Tank Closure Alternatives 6A and 6B would require construction of additional IHLW shipping/transfer facilities and interim storage facilities, as well as ILAW storage facilities, which would increase the steel, asphalt, and concrete commitments. Significant quantities of grout would be utilized under Tank Closure Alternatives 2B through 6C to fill the SSTs in place or the ancillary equipment associated with the tank system and/or cribs and trenches (ditches). The Tank Closure No Action Alternative and Alternative 2A would not utilize comparable amounts of grout because the SSTs would not be closed under these alternatives.

Geologic materials would include sand, gravel, soil, and rock mined from Borrow Area C for the construction of engineered barriers and for specification and nonspecification backfill (e.g., other borrow materials). Specification backfill has been designated for construction of the WTP due to the sensitivity of the melters to facility settling. Under the appropriate alternatives, nonspecification backfill would be used to replenish voids resulting from excavation and removal of the SST farms and cribs and trenches (ditches). For example, Tank Closure Alternatives 6A and 6B, where deep soil removal would be required for the tank systems and/or cribs and trenches (ditches), would require a notable increase in soil commitments (shown under 'other borrow materials' in Table 7–4) for backfilling the excavation. In addition, construction of shipping/transfer facilities and interim storage facilities under Tank Closure Alternative 6A to manage the additional IHLW that would be produced specifically requires 'rock' as a backfill for facility construction. With the exception of the Tank Closure No Action Alternative, Alternative 2A, and the Alternative 6A and 6B Option Cases, engineered barriers would be constructed and emplaced. The Tank Closure Alternative 6A and 6B, Base Cases, would not require engineered barriers for the SST farms; however, these alternatives would still require placement of engineered barriers over the cribs and trenches (ditches).

The consumption of various materials would be necessary to support nonconstruction-related activities for the Tank Closure alternatives. For the Tank Closure No Action Alternative, there would be no retrieval or treatment of tank waste; therefore, the consumption of materials would be below notable quantities. The WTP, which would be required under Tank Closure Alternatives 2A through 6C, as well as the PPF, which would be required under Tank Closure Alternatives 4, 6A, and 6B, would utilize glass formers for the vitrification of tank waste into a high-performance waste form. The operations of the WTP low activity waste melters would require the use of ion exchange resins to remove cesium-137 from the waste feed prior to treatment, except under Tank Closure Alternative 6A where all tank waste would be treated as HLW. To achieve 99.9 percent tank waste retrieval under Tank Closure Alternatives 4, 6A, and 6B, chemical washing would be employed, requiring the use of miscellaneous retrieval chemicals (e.g., oxalic acid). The consumption of nitric acid (3 percent and 57 percent solution) and caustics (50 percent solution) would support operation of the PPF under Tank Closure Alternatives 4, 6A, and 6B. Tank Closure Alternatives 3A through 5 would separate transuranic (TRU) waste from other tank waste using dedicated contract-handled- and remote-handled-Mixed TRU Waste Facilities. The TRU waste processing facilities required for these alternatives would use appreciable quantities of sorbent materials and sodium hydroxide.

The various supplemental treatment technologies (bulk vitrification, cast stone, steam reforming, and sulfate removal) would all consume additional materials to expedite treatment of tank waste. The bulk vitrification technology, implemented under Tank Closure Alternatives 3A, 4, and 5, would utilize soil and sand as an insulator in the large bulk vitrification containers during the melt process. The cast stone technology, implemented under Tank Closure Alternatives 3B, 4, and 5, would utilize fly ash, slag, and cement to encapsulate the waste feed and produce a solid waste form. The steam reforming technology, implemented under Tank Closure Alternative 3C, would consume sucrose (sugar), kaolin clay, iron oxide, oxygen, and nitrogen as chemical additives at various stages of the treatment process. Finally, sulfate removal, implemented under Tank Closure Alternative 5, would consume nitric acid (12.2 molar), strontium nitrate (41.5 weight-percent), sodium hydroxide (30 weight-percent), and grout. The chemicals would be used to react and precipitate sulfates from the waste feed, and the grout would be used to stabilize the sulfate precipitate after it is removed from the waste stream. Appendix E provides a more-detailed analysis of the operations and chemical uses for each of the tank waste treatment technologies.

Table 7–4. Irreversible and Irretrievable Commitment of Construction Materials for Tank Closure Alternatives[a, b]

Resource (×1,000)	Tank Closure Alternative												
	1	2A	2B	3A	3B	3C	4	5	6A-Base Case	6A-Option Case	6B-Base Case	6B-Option Case	6C
Construction Materials (metric tons)													
Steel	4	78	70	69	68	75	168	63	1,940	2,440	530	1,030	140
Asphalt	0	4	5	1	5	5	5	0	240	240	5	5	5
Concrete (cubic meters)[c]													
Cement	8	146	97	94	94	95	120	88	2,550	2,580	340	369	190
Sand	16	297	196	188	188	192	240	178	5,070	5,130	675	732	378
Gravel	21	388	255	246	245	251	312	233	6,610	6,690	876	952	494
Fly ash	0	0	0	0	0	0	0	0	0	0	0	0	0
Grout (cubic meters)[c]													
Cement	0	0.01	13	13	13	13	20	13	28	93	28	93	13
Sand	0	0.05	774	774	774	774	661	772	116	384	116	384	774
Fly ash	0	0.04	166	166	166	166	182	163	140	463	140	463	166
Bentonite clay	0	0	6	6	6	6	7	6	7	9	7	9	6
Water reducing agent	0	0	0.22	0.22	0.22	0.22	0.19	0.22	0.04	0.14	0.04	0.14	0.22
Engineered Barrier (cubic meters)													
Sand (cubic meters)	0	0	1,060	1,060	1,060	1,060	591	1,760	317	0	317	0	1,060
Gravel (cubic meters)	0	0	253	253	253	253	141	421	76	0	76	0	253
Soil (cubic meters)	0	0	850	850	850	850	475	1,416	255	0	255	0	850
Asphalt (cubic meters)	0	0	138	138	138	138	77	230	41	0	41	0	138
Other Borrow Material (cubic meters)													
Rock (cubic meters)	0	10	13	13	13	13	13	10	671	671	13	13	13
Sand (cubic meters)	0.19	1	4	4	4	4	4	4	1	1	1	1	4
Gravel (cubic meters)	0.25	6	8	8	8	8	11	8	11	11	9	9	8
Soil (cubic meters)	0.17	1	529	529	529	529	1,740	1	8,300	12,100	8,300	12,100	529
Specification Backfill (cubic meters)	55	549	254	220	220	220	220	220	1,019	1,019	254	254	254

[a] Resources listed are calculated as total life-cycle requirements for construction related activities.
[b] Values presented in this table are in thousands, multiply by 1,000 to obtain actual value of resource commitment.
[c] Concrete and grout are presented as premixed constituents.
Note: To convert cubic meters to cubic yards, multiply by 1.308.
Source: SAIC 2007a, 2008.

Table 7–5. Irreversible and Irretrievable Commitment of Nonconstruction Materials for Tank Closure Alternatives[a, b]

Resource (×1,000)	Tank Closure Alternative												
	1	2A	2B	3A	3B	3C	4	5	6A-Base Case	6A-Option Case	6B-Base Case	6B-Option Case	6C
Materials													
Glass formers (metric tons)[c]	0	190	190	190	190	190	191	171	194	264	194	264	190
Ion exchange resins (liters)[d]	0	1,580	2,440	1,590	1,590	1,590	1,960	1,600	0	0	2,440	2,440	2,440
Retrieval chemicals, e.g., oxalic acid (liters)[e]	0	0	0	0	0	0	189,000	0	244,000	244,000	189,000	189,000	0
Nitric acid 3 percent and 57 percent solution (liters)[e]	0	0	0	0	0	0	5,680	0	1,790	62,700	1,790	62,700	0
Caustic 50 percent solution (liters)[e]	0	0	0	0	0	0	2,430	0	61	2,120	61	2,120	0
Sorbent (liters)	0	0	0	984	984	984	1,010	894	0	0	0	0	0
Sodium hydroxide (kilograms)	0	0	0	22	22	22	22	22	0	0	0	0	0
Soil (cubic meters)[f]	0	0	0	187	0	0	63	63	0	0	0	0	0
Sand (cubic meters)[f]	0	0	0	148	0	0	50	50	0	0	0	0	0
Fly ash (cubic meters)[g]	0	0	0	0	233	0	149	149	0	0	0	0	0
Slag (cubic meters)[g]	0	0	0	0	233	0	149	149	0	0	0	0	0
Cement (cubic meters)[g]	0	0	0	0	28	0	18	18	0	0	0	0	0
Sucrose (metric tons)[h]	0	0	0	0	0	1,130	0	0	0	0	0	0	0
Kaolin clay (metric tons)[h]	0	0	0	0	0	207	0	0	0	0	0	0	0
Oxygen (metric tons)[h]	0	0	0	0	0	1,070	0	0	0	0	0	0	0
Nitrogen (metric tons)[h]	0	0	0	0	0	460	0	0	0	0	0	0	0
Nitric acid (12.2 Molar (liters)[i]	0	0	0	0	0	0	0	91,600	0	0	0	0	0
Strontium nitrate (41.5 percent-weight) (liters)[i]	0	0	0	0	0	0	0	42,800	0	0	0	0	0
Grout mix (kilograms)[i]	0	0	0	0	0	0	0	28,000	0	0	0	0	0
Sodium hydroxide (30 percent-weight) (liters)	0	0	0	0	0	0	0	3,800	0	0	0	0	0

[a] Resources listed are calculated as total life-cycle requirements for nonconstruction-related activities.
[b] Values presented in this table are in thousands, multiply by 1,000 to obtain actual value of resource commitment.
[c] WTP and PPF utilize glass formers for vitrification process. These values do not include materials for processing cesium and strontium capsules. The values under Tank Closure Alternatives 3A through 5 do not reflect a reduction due to treatment of some tank waste using supplemental treatment.
[d] Cesium removal retreatment.
[e] Chemical washing needed to achieve 99.9 percent retrieval of tank waste.
[f] Bulk vitrification insulating materials.
[g] Cast stone materials.
[h] Stream reforming materials (table does not include small amount of iron oxide that would also be consumed by this process).
[i] Sulfate removal materials.

Note: To convert liters to gallons, multiply by 0.26417; cubic meters to cubic yards, by 1.308; kilograms to pounds, by 2.2046.

Key: PPF=Preprocessing Facility; WTP=Waste Treatment Plant.

Source: SAIC 2007a, 2008.

7.3.1.3 Utility Resources

Key utility infrastructure resources would include the projected activity demands for water, electricity, and fuel over the life cycle of each Tank Closure alternative. Projected demands for key utility infrastructure resources that would result from implementation of each of the Tank Closure alternatives are shown in Table 7–6.

Table 7–6. Utility Resource Commitments for Tank Closure Alternatives[a, b]

	Resource (×1,000,000)			
			Fuel	
Alternative	Water (liters)	Electricity (kilowatt-hours)	Diesel (liters)	Gasoline (liters)
1	3,300	115	36	5
2A	208,000	35,600	4,950	221
2B	86,300	17,900	4,040	156
3A	77,000	14,100	1,860	116
3B	77,000	12,100	1,860	116
3C	77,300	20,100	1,980	116
4	82,200	14,800	2,050	133
5	92,500	12,200	4,110	124
6A-Base Case	644,000	186,000	23,100	723
6A-Option Case	644,000	188,000	23,200	720
6B-Base Case	92,600	21,100	4,360	216
6B-Option Case	92,800	23,800	4,440	212
6C	86,300	17,900	4,040	156

[a] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.

[b] Values presented in this table are in millions, multiply by 1,000,000 to obtain actual value of resource commitment.

Note: To convert liters to gallons, multiply by 0.26417.

Source: SAIC 2007a, 2008.

Water would be required during construction for soil compaction, dust control, and possibly for work surface and equipment washdown. Concrete and grout would be produced in onsite batch plants that would require large volumes of water. During operations, water would be required to support process makeup requirements and facility cooling, as well as for the potable and sanitary needs of the operations workforce and other uses. Water would also be consumed during facility deactivation activities to stabilize and partially decontaminate waste retrieval, treatment, and disposal facilities.

Energy expended would be in the form of electricity for construction equipment and facility operations and fuel for equipment, vehicles, and process operations. The energy required to support the activities under each alternative would be a large fraction of the total energy used at Hanford. The high demand for electricity for Tank Closure Alternatives 2A through 6C would largely be attributed to operation of the WTP and PPF melters, as well as the bulk vitrification or steam reforming supplemental treatment processes implemented under Tank Closure Alternatives 3A, 3C, 4, and 5. Electricity and fuels would be purchased from commercial sources.

For a detailed discussion of the impacts on the existing infrastructure from implementing the Tank Closure alternatives, see Chapter 4, Section 4.1.2.

7.3.1.4 Labor Resources

Labor associated with the Tank Closure alternatives would be required over the entire life cycle of the alternatives, although more labor resources would be required during the construction and operation phases. Under Tank Closure Alternative 6A, the treatment and management of all tank waste as HLW and the duration of all life-cycle phases of this alternative (156 years) would require a substantially larger commitment of labor. The labor requirements for all of the Tank Closure alternatives are shown in Table 7–7. These labor requirements have the potential to generate economic impacts that may affect the need for housing units and public services and local transportation in the region. For a detailed analysis of the labor impacts associated with the Tank Closure alternatives, see Chapter 4, Section 4.1.9.

Table 7–7. Labor Resource Commitments for Tank Closure Alternatives[a]

Alternative	Labor Hours	Labor (FTEs)
1	16,300,000	8,160
2A	704,000,000	352,000
2B	394,000,000	197,000
3A	357,000,000	178,000
3B	352,000,000	176,000
3C	365,000,000	183,000
4	455,000,000	227,000
5	333,000,000	166,000
6A-Base Case	2,550,000,000	1,270,000
6A-Option Case	2,620,000,000	1,310,000
6B-Base Case	520,000,000	260,000
6B-Option Case	577,000,000	288,000
6C	395,000,000	198,000

[a] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.

Note: To convert FTE to labor hours, multiply by 2,000.

Key: FTE=full-time equivalent.

Source: SAIC 2007a, 2008.

7.3.2 FFTF Decommissioning Alternatives

Implementation of the FFTF Decommissioning No Action Alternative would involve completion of deactivation activities and site monitoring under administrative controls for 100 years. The deactivation activities would include removal and storage of the four FFTF RH-SCs and bulk sodium. A complete description of the four FFTF RH-SCs is provided in Appendix E, Section E.2.3. FFTF Decommissioning Alternative 2 would involve demolition of structures to grade and entombment in-place. FFTF Decommissioning Alternative 3 would involve complete removal of all above- and below-grade structures. Both FFTF Decommissioning Alternatives 2 and 3 would require disposition of the four RH-SCs in an RTP at either Hanford or INL, as well as bulk sodium processing in a new Sodium Reaction Facility (SRF) at Hanford or in the existing Sodium Processing Facility (SPF) at INL. As a result of the proposed locations of these facilities at either Hanford or INL, FFTF Decommissioning Alternatives 2 and 3 have four different scenarios depending on the potential location combinations.

7.3.2.1 Land Resources

The irreversible and irretrievable commitment of land resources (see Table 7–8) would occur from land use commitments for construction of new facilities on undisturbed land, for the permanent in-place closure of existing facilities and for borrow areas that would be used to supply geologic materials (e.g., sand, gravel, and soil).

FFTF is located in Hanford's 400 Area. None of the FFTF Decommissioning alternatives involve new disturbance of land for construction of an RTP at Hanford or INL, the construction of an SRF at Hanford, or the construction of as SPF at INL. Construction of these facilities would be within existing buildings or on disturbed land. Land area where engineered barriers would be placed over the Reactor Containment Building (RCB) and buildings 491E and 491W would be considered an irreversible and irretrievable commitment of land as a permanent waste management area. Section 7.4 discusses the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity.

The construction of new facilities, backfilling of sub-grade void spaces, and emplacement of engineered surface barriers would require relatively large volumes of geologic materials from Borrow Area C. While this land would not be irreversibly or irretrievably committed to some use, the area would be irreversibly altered. The consumption of geologic materials including soil, gravel, sand, and rock/basalt is covered in Section 7.3.2.2.

The estimated areas of land that may permanently be committed or newly disturbed while supporting the FFTF Decommissioning alternatives are presented in Table 7–8. With the exception of Borrow Area C, all land use would occur within the FFTF Property Protected Area (e.g., 400 Area). For a detailed discussion of land use impacts of construction of new and existing facilities and Borrow Area C operations under the FFTF Decommissioning alternatives, see Chapter 4, Section 4.2.1. Table 7–8 may differ from the presentation of analysis in Chapter 4, Section 4.2.1, because Table 7–8 does not include committed land for construction of new facilities where the land is known to have already been disturbed.

7.3.2.2 Material Resources

The irreversible and irretrievable commitment of material resources would include process chemicals used during operations of facilities, construction materials that would not be recovered or recycled, materials that would be rendered radioactive and could not be decontaminated, raw materials consumed or reduced to unrecoverable waste forms, and geologic borrow materials. Project demands for primary material resources resulting from implementation of each of the FFTF Decommissioning alternatives are shown in Table 7–9. The commitment of material resources would be for the entire life cycle of each FFTF Decommissioning alternative including construction, operations, deactivation and closure.

Table 7–8. Irreversible and Irretrievable Commitment of Land Resources for FFTF Decommissioning Alternatives[a]

Alternative (with Options)	Land Resource (hectares)	
	Permanently Committed and Newly Disturbed Land[b]	Borrow Area C (Disturbed Land)
1–No Action	18	0
2–Hanford RTP and SRF	0.7	2.8
2–Hanford RTP and Idaho SPF	0.7	2.8
2–Idaho RTP and Hanford SRF	0.7	2.8
2–Idaho RTP and SPF	0.7	2.8
3–Hanford RTP and SRF	0	3.2
3–Hanford RTP and Idaho SPF	0	3.2
3–Idaho RTP and Hanford SRF	0	3.2
3–Idaho RTP and SPF	0	3.2

[a] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.

[b] This includes (1) land area where facilities would be closed in place or where engineered barriers would be constructed; (2) new disturbance of land for facility construction; or (3) new disturbance of land for construction of engineered barriers beyond the boundary of the barrier itself.

Note: To convert hectares to acres, multiply by 2.47.

Key: FFTF=Fast Flux Test Facility; RTP=Remote Treatment Project; SPF=Sodium Processing Facility; SRF=Sodium Reaction Facility.

Source: SAIC 2007b, 2008.

Regardless of whether the SRF is built at Hanford or INL's SPF is reactivated, modified, and used, some nitrogen would be necessary for the operation of either bulk sodium processing facility. Principal construction materials would include steel and concrete and grout constituents such as cement, gravel, and sand. Although other materials including wood, plastics, and other metals would be used, the use of these materials would be minor. For practical purposes, concrete, steel, and other materials incorporated into the framework of new facilities such as the RTP and SRF at Hanford would be irretrievably lost, regardless of whether or not operations would result in the direct contamination of the materials. In general, the RTP and SRF would be of comparable size and complexity; therefore, similar quantities of construction materials would be required for their respective construction.

Geologic materials including sand, gravel, and soil would be mined from Borrow Area C for the construction of engineered barriers and for nonspecification backfill, as presented in Table 7–9 under 'Other Borrow Materials.' The amount of nonspecification backfill required for filling sub-grade void spaces would be higher under FFTF Decommissioning Alternative 3, where the structures would be completely removed. For all of the FFTF Decommissioning Alternative 2 scenarios, entombment would require the construction of an engineered barrier.

Table 7–9. Irreversible and Irretrievable Commitment of Materials for FFTF Decommissioning Alternatives[a, b]

Resource (×1,000)	Alternative								
	1	2–Entombment (with Options)				3–Removal (with Options)			
	No Action	Hanford RTP and SRF	Hanford RTP and Idaho SPF	Idaho RTP and Hanford SRF	Idaho RTP and SPF	Hanford RTP and SRF	Hanford RTP and Idaho SPF	Idaho RTP and Hanford SRF	Idaho RTP and SPF
Process Chemicals (metric tons)									
Nitrogen	0.14	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045
Construction Materials (metric tons)									
Steel	0	1	1	1	1	1	1	1	1
Asphalt	0	0	0	0	0	0	0	0	0
Concrete (cubic meters)[c]									
Cement	0	1	1	1	1	1	1	1	1
Sand	0	1	1	1	1	1	1	1	1
Gravel	0	2	2	2	2	2	2	2	2
Fly Ash	0	0	0	0	0	0	0	0	0
Grout (cubic meters)[c]									
Cement	0	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Sand	0	23	23	23	23	23	23	23	23
Fly Ash	0	12	12	12	12	12	12	12	12
Bentonite Clay	0	0	0	0	0	0	0	0	0
Water Reducing Agent	0	0	0	0	0	0	0	0	0
Engineered Barrier (cubic meters)									
Sand	0	9	9	9	9	0	0	0	0
Gravel	0	2	2	2	2	0	0	0	0
Soil	0	7	7	7	7	0	0	0	0
Asphalt	0	1	1	1	1	0	0	0	0
Other Borrow Material (cubic meters)									
Rock	0	0	0	0	0	0	0	0	0
Sand	0	0	0	0	0	0	0	0	0
Gravel	0	2	1	1	1	2	1	1	1
Soil	0	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Specification Backfill	0	80	80	80	80	120	120	120	120

[a] Values presented in this table are in thousands, multiply by 1,000 to obtain actual value of resource commitment.

[b] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.

[c] Concrete and grout are presented as pre-mixed constituents.

Note: To convert cubic meters to cubic yards, multiply by 1.308.

Key: FFTF=Fast Flux Test Facility; RTP=Remote Treatment Project; SPF=Sodium Processing Facility; SRF=Sodium Reaction Facility.

Source: SAIC 2007b, 2008.

7.3.2.3 Utility Resources

Key utility infrastructure resources would include projected activity demands for water, electricity, and fuel over the life cycle considered for each FFTF Decommissioning alternative. Projected demands for key utility infrastructure resources resulting from implementation of each of the FFTF Decommissioning alternatives are shown in Table 7–10.

Table 7–10. Utility Resource Commitments for FFTF Decommissioning Alternatives[a, b]

Alternatives	Resources (×1,000)			
			Fuel	
	Water (liters)	Electricity (kilowatt-hours)	Diesel (liters)	Gasoline (liters)
1–No Action	7,980,000	600,000	0	114
2–Hanford RTP and SRF	31,100	4,530	5,350	872
2–Hanford RTP and Idaho SPF	30,900	4,530	4,380	466
2–Idaho RTP and Hanford SRF	31,100	4,530	5,360	871
2–Idaho RTP and SPF	30,900	4,530	4,390	465
3–Hanford RTP and SRF	30,400	7,720	5,090	880
3–Hanford RTP and Idaho SPF	30,100	7,710	4,120	474
3–Idaho RTP and Hanford SRF	30,300	7,720	5,090	879
3–Idaho RTP and SPF	30,100	7,710	4,120	474

[a] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.

[b] Values presented in this table are in thousands, multiply by 1,000 to obtain actual value of resource commitment.

Note: To convert liters to gallons, multiply by 0.26417.

Key: FFTF=Fast Flux Test Facility; RTP=Remote Treatment Project; SPF=Sodium Processing Facility; SRF=Sodium Reaction Facility.

Source: SAIC 2007b, 2008.

The consumption of water and electricity under the FFTF Decommissioning No Action Alternative would be relatively high compared to the action alternatives due to the long-term management requirements for 100 years of administrative controls. Conversely, to effect entombment or complete removal under FFTF Decommissioning Alternatives 2 and 3, fuel consumption would increase. Essentially, the differences in utility consumption between FFTF Decommissioning Alternatives 2 and 3 are negligible.

For a detailed discussion of impacts on the existing infrastructure from implementing the FFTF Decommissioning alternatives, see Chapter 4, Section 4.2.2.

7.3.2.4 Labor Resources

Labor requirements associated with the FFTF Decommissioning alternatives would be required over the entire life cycle of each alternative. The FFTF Decommissioning No Action Alternative would require less labor, but labor would be extended over a long period of time. FFTF Decommissioning Alternatives 2 and 3 would require much more short-term labor to achieve either entombment or removal of the FFTF structures. To achieve removal under FFTF Decommissioning Alternative 3, a slight increase in construction labor would be required compared to FFTF Decommissioning Alternative 2. These labor requirements are shown in Table 7–11. Labor requirements have the potential to generate economic impacts that may affect the need for housing units and public services and local transportation in the region. For a detailed analysis of the labor impacts associated with the FFTF Decommissioning alternatives, see Chapter 4, Section 4.2.9.

Table 7–11. Labor Resource Commitments for FFTF Decommissioning Alternatives[a]

Alternative	Labor Hours	Labor (FTEs)
1–No Action	41,600	21
2–Hanford RTP and SRF	1,860,000	929
2–Hanford RTP and Idaho SPF	1,540,000	772
2–Idaho RTP and Hanford SRF	1,810,000	906
2–Idaho RTP and SPF	1,500,000	749
3–Hanford RTP and SRF	2,000,000	999
3–Hanford RTP and Idaho SPF	1,680,000	976
3–Idaho RTP and Hanford SRF	1,950,000	842
3–Idaho RTP and SPF	1,640,000	819

[a] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.

Note: To convert FTE to labor hours, multiply by 2,000.

Key: FFTF=Fast Flux Test Facility; FTE=full-time equivalent; RTP=Remote Treatment Project; SPF=Sodium Processing Facility; SRF=Sodium Reaction Facility.

Source: SAIC 2007b, 2008.

7.3.3 Waste Management Alternatives

Expansion of Hanford's waste disposal capacity would be necessary to support implementation of the Tank Closure, FFTF Decommissioning, and Waste Management alternatives, as well as to receive and dispose of offsite waste. The Waste Management No Action Alternative would not expand the current disposal capacity at Hanford. Burial in LLBG trenches 31 and 34 would continue until 2035, followed by 100 years of administrative controls. Construction of IDF-East would also be terminated by backfilling of the site with native soils. Under Waste Management Alternatives 2 and 3, disposal groups were developed to support particular Tank Closure alternatives based on size and operational timeframe needs. Three disposal groups were developed as a subset of both Waste Management Alternatives 2 and 3; all involve construction, operation, deactivation, closure, and postoperational monitoring of additional disposal facilities (e.g., one or two IDFs and the RPPDF). Additionally, Waste Management Alternatives 2 and 3 would require new facility construction, operation, and deactivation to expand the T Plant, Waste Receiving and Processing Facility (WRAP), and storage capacities for processing and handling TRU waste, LLW, and MLLW.

7.3.3.1 Land Resources

The irreversible and irretrievable commitment of land resources (see Table 7–12) would occur from land use commitments for construction of new facilities on undisturbed land, for areas of permanent land disposal facilities, and for borrow areas that would be used to supply geologic materials. Geologic materials (e.g., sand, gravel, soil, and rock) would be used to construct disposal areas and to emplace engineered barriers over disposal areas.

The Waste Management No Action Alternative would not require construction of any new facilities or disposal facilities. In addition, construction of IDF-East would cease without burial of waste and would be backfilled with native soils. Waste Management Alternatives 2 and 3 would require expansion or new construction of the T Plant, WRAP, and waste processing and storage facilities within the 200-West Area. The only new disturbance of land that would be required under both Waste Management Alternatives 2 and 3 would be the construction of a portion of the WRAP TRU Remote-Handled Processing Facility in the 200-West Area. Waste Management Alternatives 2 and 3 would also involve construction of additional disposal facilities, IDF-East for Waste Management Alternative 2 and two IDFs, IDF-East and IDF-West, for Waste Management Alternative 3. The RPPDF would be situated between 200-East and 200-West Areas regardless of the alternative selected.

Table 7–12. Irreversible and Irretrievable Commitment of Land Resources for Waste Management Alternatives[a]

Alternative	Land Resource (hectares)	
	Permanently Committed and Newly Disturbed Land[b]	Borrow Area C (Disturbed Land)
1–No Action	0	0
2–Disposal Group 1	64	42
2–Disposal Group 2	247	159
2–Disposal Group 3	247	159
3–Disposal Group 1	77	37
3–Disposal Group 2	253	157
3–Disposal Group 3	253	157

[a] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.

[b] This includes (1) land area where facilities would be closed in place or where engineered barriers would be constructed; (2) new disturbance of land for facility construction; or (3) new disturbance of land for construction of engineered barriers beyond the boundary of the barrier itself.

Note: To convert hectares to acres, multiply by 2.471.

Source: SAIC 2007c, 2008.

New disturbance of land for construction of facilities would be considered an irreversible impact. Land used for permanent disposal facilities is considered an irreversible and irretrievable commitment of land. Section 7.4 discusses the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity.

The construction of new facilities and emplacement of engineered surface barriers over disposal areas would require relatively large volumes of geologic materials from Borrow Area C. While this land would not be irreversibly or irretrievably committed to some use, the area would be irreversibly altered. The consumption of geologic materials including soil, gravel, sand, and rock/basalt is covered in Section 7.3.3.2.

The estimated areas of land that may be permanently committed or newly disturbed while supporting the Waste Management alternatives are presented in Table 7–12. With the exception of Borrow Area C, all land use would occur within the Central Plateau. For a detailed discussion of land use impacts of construction of new and existing facilities and Borrow Area C operations under the Waste Management alternatives, see Chapter 4, Section 4.3.1. Table 7–12 may differ from the presentation of analysis in Chapter 4, Section 4.3.1, because Table 7–12 does not included committed land for construction of new facilities where the land is known to have already been disturbed.

7.3.3.2 Material Resources

The irreversible and irretrievable commitment of material resources would include process chemicals used during operations of facilities, construction materials that could not be recovered or recycled, materials that would be rendered radioactive and could not be decontaminated, raw materials consumed or reduced to unrecoverable waste forms, and geologic borrow materials. Projected demands for primary material resources resulting from implementation of each of the Waste Management alternatives are shown in Table 7–13. The commitment of material resources would be for the entire life cycle of each Waste Management alternative including construction, operations, deactivation, and closure.

Geologic materials would include sand, gravel, and soil mined from Borrow Area C for the construction of disposal areas and engineered barriers for one or two IDFs and the RPPDF, as presented in Table 7–13 under 'Other Borrow Materials.' The gravel listed under 'Other Borrow Materials' would be used to construct a drain layer as part of the disposal area liners. For Disposal Groups 2 and 3 under both Waste Management action alternatives, the aggregate size of the IDF(s) and RPPDF would increase significantly to accommodate clean closure of the tank farms and cribs and trenches (ditches), resulting in a proportional increase in the consumption of geologic resources necessary to construct the engineered barriers.

Nitrogen would be used for operation of the expanded WRAP. Principal construction materials would include steel and concrete and grout constituents such as cement, gravel, and sand. Although other materials including wood, plastics, and other metals would be used, the use of these materials would be minor. For practical purposes, concrete, steel, and other materials incorporated into the framework of new facilities such as the T Plant, WRAP, and waste storage facilities would be irretrievably lost, regardless of whether or not operations would result in direct contamination of the materials.

Table 7–13. Irreversible and Irretrievable Commitment of Materials for Waste Management Alternatives[a, b]

Resource (×1,000)	Waste Management Alternative						
	1	2–200-East Area IDF Only			3–200-East and 200-West Area IDFs		
	No Action	Disposal Group 1	Disposal Group 2	Disposal Group 3	Disposal Group 1	Disposal Group 2	Disposal Group 3
Process Chemicals (metric tons)							
Nitrogen	0	1	1	1	1	1	1
Construction Materials (metric tons)							
Steel	2	8	8	8	8	8	8
Asphalt	0	0	0	0	0	0	0
Concrete (cubic meters)[c]							
Cement	1	4	4	4	4	4	4
Sand	3	9	9	9	9	9	9
Gravel	4	11	11	11	11	11	11
Fly ash	0	0	0	0	0	0	0
Grout (cubic meters)[c]							
Cement	0	0	0	0	0	0	0
Sand	0	0	0	0	0	0	0
Gravel	0	0	0	0	0	0	0
Fly ash	0	0	0	0	0	0	0
Bentonite clay	2	5	20	20	5	20	20
Water reducing agent	0	0	0	0	0	0	0
Engineered Barrier (cubic meters)							
Sand	0	814	3,150	3,150	599	3,070	3,070
Gravel	0	195	755	755	195	755	755
Soil	0	651	2,520	2,520	649	2,520	2,520
Asphalt	0	98	377	377	101	382	382
Other Borrow Material (cubic meters)							
Rock	0	0	0	0	0	0	0
Sand	0	0	0	0	0	0	0
Gravel	0.034	209	808	808	208	809	809
Soil	0	0	0	0	0	0	0

a Values presented in this table are in thousands, multiply by 1,000 to obtain actual value of resource commitment.
b Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.
c Concrete and grout are presented as pre-mixed constituents.
Note: To convert cubic meters to cubic yards, multiply by 1.308.
Key: IDF= Integrated Disposal Facility.
Source: SAIC 2007c, 2008.

7.3.3.3 Utility Resources

Key utility infrastructure resources include projected activity demands for water, electricity, and fuel over the life cycle considered for each Waste Management alternative and respective disposal group. Projected demands for key utility infrastructure resources resulting from implementation of each of the Waste Management alternatives are shown in Table 7–14.

Table 7–14. Utility Resource Commitments for Waste Management Alternatives[a, b]

Alternative	Resource (×1,000)			
			Fuel	
	Water (liters)	Electricity (kilowatt-hours)	Diesel (liters)	Gasoline (liters)
1–No Action	35,700	5,630	13,900	1,230
2–Disposal Group 1	3,050,000	556,000	257,000	21,700
2–Disposal Group 2	21,200,000	556,000	1,460,000	83,100
2–Disposal Group 3	37,200,000	556,000	2,220,000	109,000
3–Disposal Group 1	3,040,000	556,000	257,000	21,200
3–Disposal Group 2	21,100,000	566,000	1,460,000	83,100
3–Disposal Group 3	36,900,000	566,000	2,220,000	109,000

[a] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.

[b] Values presented in this table are in thousands; multiply by 1,000 to obtain actual value of resource commitment.

Note: To convert liters to gallons, multiply by 0.26417.

Source: SAIC 2007c, 2008.

The consumption of utility resources under the Waste Management No Action Alternative would be relatively low compared to the action alternatives as new waste processing, storage, and disposal facilities would not be constructed. Disposal Group 1 under both Waste Management action alternatives would involve increased consumption of utility resources. Compared to Disposal Group 1, consumption of water and fuel would increase significantly for Disposal Groups 2 and 3 in proportion to the large increase in disposal area capacities required. Electricity consumption would not increase because it would not be a primary utility necessary for construction and operation of the disposal areas; rather, it would be consumed for operation of the new T Plant, WRAP, and waste storage facilities that would be implemented regardless of the disposal group selected.

For a detailed discussion of impacts on the existing infrastructure from implementing the Waste Management alternatives, see Chapter 4, Section 4.3.2.

7.3.3.4 Labor Resources

Labor associated with the Waste Management alternatives would be required over the entire life cycle of the alternatives. The Waste Management No Action Alternative would require less labor, due to the lack of additional waste processing, storage, and disposal facilities to be constructed and operated. The labor requirements would be proportionally influenced by the size of the disposal areas and the length of operation. The difference in labor requirements between Waste Management Alternatives 2 and 3, where the only difference is the locations of the disposal areas, would be very minor. The labor requirements for the Waste Management Alternatives are shown in Table 7–15. Labor requirements have the potential to generate economic impacts that may affect the need for housing units and public services and local transportation in the region. For a detailed analysis of the labor impacts associated with the Waste Management alternatives, see Chapter 4, Section 4.3.9.

Table 7–15. Labor Resource Commitments for Waste Management Alternatives[a]

Alternative	Labor Hours	Labor (FTEs)
1–No Action	1,000,000	502
2–Disposal Group 1	57,700,000	28,900
2–Disposal Group 2	166,000,000	82,800
2–Disposal Group 3	242,000,000	121,000
3–Disposal Group 1	59,000,000	29,500
3–Disposal Group 2	167,000,000	83,400
3–Disposal Group 3	243,000,000	122,000

[a] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.

Note: To convert FTE to labor hours, multiply by 2,000.
Key: FTE=full-time equivalent.
Source: SAIC 2007c, 2008.

7.3.4 Alternative Combinations

For comparison purposes, three alternative combinations were selected. The alternative combinations are described in detail in Chapter 4, Section 4.4. The combined irreversible and irretrievable commitments of resources for these alternative combinations are discussed below.

7.3.4.1 Land Resources

The irreversible and irretrievable commitment of land resources would occur from land use commitments for construction of new facilities, for areas of permanent disposal and for borrow areas used to supply geologic materials (e.g. sand, gravel, soil, and rock). The estimated areas of land that may be permanently committed or newly disturbed while supporting the representative alternative combinations are presented in Table 7–16. The values presented in Table 7–16 do not include the commitment of land for construction of new facilities where the land is known to have already been disturbed.

Table 7–16. Irreversible and Irretrievable Commitment of Land Resources for Alternative Combinations[a]

Alternative Combination	Land Resources (hectares)	
	Permanently Committed and Newly Disturbed Land[b]	Borrow Area C (Disturbed Land)
1	35	2
2	173	140
3	373	401

[a] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.

[b] This includes (1) land area where facilities would be closed in place or where engineered barriers would be constructed; (2) new disturbance of land for facility construction; or (3) new disturbance of land for construction of engineered barriers beyond the boundary of the barrier itself.

Notes: To convert hectares to acres, multiply by 2.471.
Source: SAIC 2007a, 2007b, 2007c, 2008.

7.3.4.2 Material Resources

The irreversible and irretrievable commitment of material resources would include process chemicals used during operations of facilities, construction materials that cannot be recovered or recycled, materials that would be rendered radioactive and could not be decontaminated, raw materials consumed or reduced to unrecoverable waste forms, and geologic borrow materials. Projected demands for primary material resources resulting from implementation of the representative combination of alternatives are presented in Table 7–17.

Table 7–17. Irreversible and Irretrievable Commitment of Materials for the Alternative Combinations[a, b]

Resources (×1,000)	Alternative Combination		
	1	2	3
Materials			
Glass formers (metric ton)	0	190	194
Ion exchange resins (liter)	0	2,440	2,440
Retrieval chemicals (e.g., oxalic acid) (liter)	0	0	189,000
Nitric acid 3 percent and 57 percent solution (liter)	0	0	1,790
Caustic 50 percent solution (liter)	0	0	61
Nitrogen (metric tons)	0.14	1.05	1.05
Construction Materials (metric tons)			
Steel	6	79	539
Asphalt	0	5	5
Concrete (cubic meters)[c]			
Cement	9	102	345
Sand	19	206	685
Gravel	25	268	889
Grout (cubic meters)[c]			
Cement	0	13.2	28.2
Sand	0	797	139
Fly ash	0	178	152
Bentonite clay	2	11	27
Water reducing agent	0	0.22	0.04
Engineered Barriers (cubic meters)			
Sand	0	1,880	3,467
Gravel	0	450	831
Soil	0	1,510	2,775
Asphalt	0	237	418
Other Borrow Materials (cubic meters)			
Rock	0	13	13
Sand	0.19	4	1
Gravel	0.284	218	818
Soil	0.17	529	8,300
Specification backfill	55	262	266

[a] Calculated as total alternative life-cycle requirements encompassing construction operations, deactivation, and closure.

[b] Values presented in this table are in thousands; multiply by 1,000 to obtain actual value of resource commitment.

[c] Concrete and grout are presented as premixed constituents.

Note: To convert liters to gallons, multiply by 0.26417; cubic meters to cubic yards, by 1.308; kilograms to pounds, by 2.2046.

Source: SAIC 2007a, 2007b, 2007c, 2008.

7.3.4.3 Utility Resources

Key utility infrastructure resources would include projected activity demands for water, electricity, and fuel over the life cycle considered for each alternative combination. The irreversible and irretrievable commitments of utility resources that would result from implementation of the representative alternative combinations are presented in Table 7–18.

Table 7–18. Utility Resource Commitments for Alternative Combinations[a, b]

Alternative Combination	Resource (×1,000,000)			
	Water (liters)	Electricity (kilowatt-hours)	Fuel	
			Diesel (liters)	Gasoline (liters)
1	11,300	721	50	6
2	89,400	18,500	4,300	179
3	114,000	21,700	5,825	300

[a] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.

[b] Values presented in this table are in thousands; multiply by 1,000,000 to obtain actual value of resource commitment.

Note: To convert liters to gallons, multiply by 0.26417.

Source: SAIC 2007a, 2007b, 2007c, 2008.

7.3.4.4 Labor Resources

Labor associated with the alternative combinations would be required over the entire life cycle of each combination, although more labor resources would be required during the construction and operation phases. Labor requirements have the potential to generate economic impacts that may affect the need for housing units and public services and local transportation in the region. The labor requirements for the representative alternative combinations are shown in Table 7–19.

Table 7–19. Labor Resource Commitments for Alternative Combinations[a]

Alternative Combination	Labor Hours	Labor (FTEs)
1	17,300,000	8,680
2	454,000,000	227,000
3	688,000,000	344,000

[a] Calculated as total alternative life-cycle requirements encompassing construction, operations, deactivation, and closure.

Note: To convert FTE to labor hours, multiply by 2,000.

Key: FTE=full-time equivalent.

Source: SAIC 2007a, 2007b, 2007c, 2008.

7.4 RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Pursuant to National Environmental Policy Act regulations (40 CFR 1502.16) an EIS must consider the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. Potential short-term impacts related to the Tank Closure, FFTF Decommissioning, and Waste Management alternatives are presented in Chapter 4. For analysis purposes, "short term" refers to the active project phase under each alternative during which construction, operations, deactivation, and closure activities would take place. Short-term timeframes would include any administrative control, postclosure care, or onsite storage activities for treated waste pending final disposition. "Long term" is defined as the timeframe that extends beyond conclusion of the short-term activities proposed under each alternative. Long-term impacts are discussed in Chapter 5.

The objective of any proposed action is to demonstrate and implement the alternative(s) that, on balance, would result in the least overall adverse impact on the environment. For the proposed *TC & WM EIS* action alternatives, an increase in worker and public exposure under controlled circumstances (i.e., tank waste retrieval, treatment, and disposal) and in compliance with applicable legal requirements in the short term would lead to a decrease in exposure of the unprotected public to unmitigated releases of contaminants into the environment over the long-term.

Under certain *TC & WM EIS* alternatives, and in addition to short-term use of the environment, the emplacement of engineered barriers over tank farm systems, cribs and trenches (ditches), the FFTF RCB, and/or permanent waste disposal sites would be considered a long-term use of the environment, and thus, a decrease in long-term productivity for these locations. Short-term and long-term uses of the environment in the broader context would include elements of unavoidable adverse impacts and an irreversible and irretrievable commitment of resources to enhance the long-term productivity of the environment. Previously, unavoidable adverse environmental impacts were discussed in Section 7.2. Irreversible and irretrievable commitments of resources are discussed in Section 7.3.

7.4.1 Tank Closure Alternatives

The short-term durations for each of the Tank Closure alternatives are presented in Table 7–20. The short-term durations are broken into two groups: (1) the construction, operations, and deactivation phase when most activities would take place and (2) the closure phase when administrative controls, postclosure care, and/or long-term storage would be continued. Most impacts and short-term uses of the environment would occur during the construction, operations, and deactivation phase. Under the Tank Closure No Action Alternative and Tank Closure Alternative 2A, administrative controls would be required because tank farm closure would not be achieved. Tank Closure Alternatives 2B through 5 would close the SST farms with emplacement of an engineered barrier followed by postclosure care. Tank Closure Alternatives 6A and 6B, Base Cases, would emplace an engineered barrier over the cribs and trenches (ditches). Tank Closure Alternatives 6A and 6B, Option Cases, would clean-close all tank farms and cribs and trenches (ditches) and, therefore, would not require construction of an engineered barrier and postclosure care. In contrast, Tank Closure Alternative 6C would require an engineered barrier over the tank farms and cribs and trenches (ditches) and, as a result, postclosure care. Tank Closure Alternatives 6A through 6C would manage all tank waste as HLW, which would require construction and operations of long-term, onsite storage facilities.

Table 7–20. Short-Term Life Cycles for Tank Closure Alternatives

Alternative	Construction, Operations, and Deactivation Phase	Closure Phase (Activity Type)[a]
1	2006–2008	2008–2107 (AC)
2A	2006–2094	2094–2193 (AC)
2B	2006–2046	2046–2145 (PM)
3A	2006–2043	2042–2141 (PM)
3B	2006–2043	2042–2141 (PM)
3C	2006–2043	2042–2141 (PM)
4	2006–2045	2045–2144 (PM)
5	2006–2039	2040–2139 (PM)
6A-Base Case	2006–2165	2151–2250 (PM) Until 2262 (ST)
6A-Option Case	2006–2167	Until 2262 (ST)
6B-Base Case	2006–2101	2102–2201 (PM) Until 2199 (ST)
6B-Option Case	2006–2101	Until 2199 (ST)
6C	2006–2046	2046–2145 (PM) Until 2145 (ST)

[a] Activity types: AC=administrative controls; PM=postclosure care and monitoring; ST=onsite storage.

Source: SAIC 2007a, 2008.

Short-term commitments of resources would include the space and materials required to construct new facilities and the commitment of new support facilities, transportation infrastructure, and other resources and materials for waste storage, retrieval, treatment, and disposal, as well as tank closure. Certain resource commitments would be substantially greater under Tank Closure Alternatives 2B through 6C than under the Tank Closure No Action Alternative or Tank Closure Alternative 2A because construction of an engineered surface barrier for landfill closure and/or partial or complete clean closure of the SST system would be required. Tank Closure Alternative 2A would involve a commitment of resources to treat and stabilize the tank waste, but would not follow through with closure of the SST farms. Depending on the alternative, workers, the public, and the environment would be exposed to various amounts of hazardous and radioactive materials over the short term from tank waste retrieval, treatment, and disposal activities and from SST system closure operations.

Table 7–21 presents the amounts of land that would be committed in the short term to accomplish the objectives of each Tank Closure alternative. This area includes land for existing facilities and for new facilities that would be constructed to support a particular alternative. The land use amounts are presented as aggregate values over the entire short-term life cycles of the alternatives; however, in practice, most facilities would operate at various timeframes. Table 7–21 also presents the long-term land commitments that would continue indefinitely for each alternative, including all permanent disposition areas where engineered barriers would preclude the use of the site for other productive purposes and all areas where tank farms and cribs and trenches (ditches) would not be closed under certain alternatives. Borrow Area C is not included in the short-term commitments of land. Excavation activities conducted at Borrow Area C, while taking place in the short-term, can be terminated at any time. The amount of land disturbance required at Borrow Area C to support each Tank Closure alternative was previously discussed in Section 7.3.1.1.

Table 7–21. Short- and Long-Term Commitments of Land for Tank Closure Alternatives

Alternative	Land Commitment (hectares)	
	Short-Term[a]	Long-Term[b]
1	0	17
2A	32	17
2B	16	84
3A	17	84
3B	19	84
3C	18	84
4	18	61
5	20	84
6A-Base Case	210	25
6A-Option Case	210	0
6B-Base Case	117	25
6B-Option Case	117	0
6C	61	84

[a] Short-term includes entire life cycle of the construction, operations, deactivation and closure phases. Alternative 1, No Action, short-term use does not include partial construction of the Waste Treatment Plant because this action has already been initiated.

[b] Long-term is the period following completion of all alternatives' scheduled activities. Long-term use for Alternatives 1 through 3C, 5, and 6C represent the footprints of the SST tank farms and B and T cribs and trenches (ditches) with or without engineered barriers, as applicable. Alternative 4 does not include the BX and SX tank farms. Alternatives 6A and 6B, Base Case only represent the footprints of the B and T cribs and trenches (ditches). Alternatives 6A and 6B, Option Case indicate clean closure of all tank farms and cribs and trenches (ditches).

Note: To convert hectares to acres, multiply by 2.471.

Source: SAIC 2007a, 2008.

Although this EIS considers only facility deactivation and not decontamination and decommissioning of waste treatment, storage, or disposal facilities, DOE could decontaminate and decommission major facilities at the end of their life cycle and restore adjacent area brownfield sites, which would then be available for future industrial use. However, it would be unlikely for any of the facility sites to be restored to their original predevelopment states or natural, terrestrial habitats.

The Tank Closure No Action Alternative would likely incur additional and indefinite commitments of land over the long term, when degradation of tank farms would lead to eventual release of unmitigated contaminants into the subsurface environment, potentially impacting the Columbia River. Except for Tank Closure Alternatives 6A and 6B, under which clean closure of all SST farms would occur, as well as Tank Closure Alternative 4, under which clean closure of the BX and SX tank farms would occur, the remaining action alternatives would leave SST system components and residual tank waste (ranging from 0.01 to 10 percent by volume) in place. Any land areas where tank farms would be left in place would represent a long-term commitment of land and terrestrial resources for waste management. In addition, with the exception of Tank Closure Alternatives 6A and 6B, Option Cases, the areas occupied by the cribs and trenches (ditches) would represent a long-term commitment of land. Therefore, these areas would be removed from long-term productivity considerations. However, these areas would likely be reclaimed by native vegetation and wildlife in the absence of human intervention over the very long term following the end of any administrative control or postclosure care period.

Air emissions associated with waste retrieval, treatment, and disposal and SST system closure would introduce small amounts of radiological and nonradiological constituents to the regional airshed around Hanford. Over time, these emissions would result in additional loading and exposure, but would not impact air quality or radiation exposure standards at Hanford to the extent that long-term productivity of the environment would be impaired.

Chemical and radiological contamination of the vadose zone and groundwater below and downgradient of the 200 Areas would occur over time under all of the Tank Closure alternatives due to the release of residual tank contaminants, disposal of treated tank waste, and disposal of contaminated soil. The long-term performance of waste forms and their impacts on the vadose zone and groundwater receptors are discussed in detail in Chapter 5. Depending on the extent and magnitude of resultant groundwater contaminant plumes, it may be necessary to place land use or other institutional controls on the overlying land areas for an indefinite period, thereby reducing the overall long-term productivity of the affected areas.

Radiological and chemical doses to aquatic and terrestrial receptors at seeps along the Columbia River and in the receiving water were evaluated as part of the ecological risk portion of the analysis. Under all scenarios and alternatives, results indicated that calculated absorbed doses to referenced organisms would be below regulatory limits and/or reference standards and, therefore, would likely have no impact on the long-term productivity of the Columbia River ecosystem.

Continued employment, expenditures, and tax revenues generated during implementation of any of the action alternatives would directly benefit local, regional, and state economies over the short term. Local governments investing project-generated tax revenues into infrastructure and other required services could facilitate economic productivity. Nearby townships and geographic provinces have experienced a recent surge in growth, and the availability of employment opportunities would further sustain and foster regional development.

Management and disposal of LLW, MLLW, mixed TRU waste, IHLW, ILAW, and secondary waste generated as a result of waste retrieval, treatment, and disposal and SST system closure would increase energy demand and consume space at treatment, storage, or disposal facilities. Regardless of the location, the land required to meet waste management needs would require a longer-term commitment of terrestrial resources. Primary waste (e.g., IHLW canisters) and HLW melters taken out of service would be stored on site. All treated tank waste under Tank Closure Alternatives 6A, 6B, and 6C would be managed as HLW and require storage at Hanford until disposition decisions are made and implemented.

The short-term use of the environment would be evaluated against the maintenance and enhancement of long-term productivity, as demonstrated by the performance assessment for untreated and treated tank waste forms. When considering the relationship between short-term uses of the environment and maintenance and enhancement of long-term productivity, consideration must be given to similar relationships discussed in Section 7.3.3 for waste management. In a simple sense, the Tank Closure alternatives represent most of the short-term uses of the environment, and most of the resultant long-term commitments from tank closure are represented in the Waste Management alternatives. These actions are mutually dependent on each other.

7.4.2 FFTF Decommissioning Alternatives

The short-term durations for the FFTF Decommissioning alternatives are presented in Table 7–22. The short-term durations are broken into two groups: (1) the construction, operations, and deactivation phase when most activities would take place and (2) the closure phase when administrative controls or postclosure care would need to be continued. Most impacts and short-term uses of the environment would occur during the construction, operations, and deactivation phase. Under the FFTF Decommissioning No Action Alternative, administrative controls would be required to maintain the facility in its existing state for 100 years. FFTF Decommissioning Alternatives 2 and 3 would require 100 years of postclosure care, although this activity would be reduced under FFTF Decommissioning Alternative 3, for which emplacement of an engineered barrier would not be required.

Table 7–22. Short-Term Life Cycles for FFTF Decommissioning Alternatives

Alternatives	Construction, Operations, and Deactivation Phase	Closure Phase (Activity Type)[a]
1	Not Applicable	2008–2107 (AC)
2[b]	2013–2021	2022–2121 (PM)
3[b, c]	2012–2021	2022–2121 (PM)

[a] Activity types: AC=administrative controls; PM=postclosure care and monitoring.
[b] Life-cycle durations are the same for all Hanford and Idaho Options.
[c] Alternative 3 includes a 100-year postclosure care period even though this alternative does not have an engineered barrier.
Key: FFTF=Fast Flux Test Facility.
Source: SAIC 2007b, 2008.

Short-term commitments of resources would include the space and materials required to expand or construct facilities for treatment of the four FFTF RH-SCs and processing of bulk sodium at Hanford or INL. The only facility under the FFTF Decommissioning alternatives that would require new construction is the SRF at Hanford, although construction would still occur within disturbed areas. The RTP at either Hanford or INL or the SPF at INL would be located within or adjacent to existing facilities. Depending on the alternative, workers, the public, and the environment would be exposed to various amounts of hazardous and radioactive materials over the short term from FFTF decommissioning activities such as decontamination, demolition, and excavation.

Table 7–23 presents the amounts of land that would be committed in the short term to accomplish the objectives of each of the FFTF Decommissioning alternatives, including land use at both Hanford and INL locations. Table 7–23 also presents those long-term land commitments that would continue indefinitely for each alternative, including all permanent disposition areas where engineered barriers would preclude the use of the site for other productive purposes, all areas where buildings would not be decommissioned, and all bulk sodium storage areas. Borrow Area C is not included in the short term commitments of land. Excavation activities conducted at Borrow Area C, while taking place in the short term, can be terminated at any time. The amount of land disturbance required at Borrow Area C to support each FFTF Decommissioning alternative was previously discussed in Section 7.3.2.1.

The FFTF Decommissioning No Action Alternative would likely incur additional and indefinite long term commitments of land because, after the end of the 100-year administrative control period, contaminants would be released into the environment. FFTF Decommissioning Alternative 2 would provide for complete removal of some facilities and entombment of other buildings (e.g., the RCB and reactor support buildings 491E and 491W). Long-term commitments of land under FFTF Decommissioning Alternative 2 represent an engineered barrier that would be placed over the RCB and 491E and 491W buildings. Therefore, the FFTF Decommissioning No Action Alternative, and to a lesser extent FFTF Decommissioning Alternative 2, would remove land areas within the 400 Area from long term productivity considerations. However, these areas would likely be reclaimed by native vegetation and wildlife in the absence of human intervention over the very long term following the end of any administrative control or postclosure care period. FFTF Decommissioning Alternative 3 represents removal of all buildings, including the RCB and 491E and 491W buildings, with the exception of the RCB's sub-grade concrete shell. In this case, an engineered barrier would not be constructed; however, a limited-scope postclosure care period would still be necessary, after which the land could be returned to productive use.

Table 7–23. Short- and Long-Term Commitments of Land for FFTF Decommissioning

Alternative (with Options)	Land Commitment (hectares)	
	Short-Term[a]	Long-Term[b]
1–No Action	0	18
2–Hanford RTP and SRF	0.2	0.7
2–Hanford RTP and Idaho SPF	0.1	0.7
2–Idaho RTP and Hanford SRF	0.2	0.7
2–Idaho RTP and SPF	0.1	0.7
3–Hanford RTP and SRF	0.2	0
3–Hanford RTP and Idaho SPF	0.1	0
3–Idaho RTP and Hanford SRF	0.2	0
3–Idaho RTP and SPF	0.1	0

[a] Short-term includes entire life cycle of construction, operations, deactivation and closure phases.

[b] Long-term is after all alternatives' scheduled activities have been completed. Long-term use for Alternative 1, No Action, represents the footprint of the existing FFTF Property Protected Area. Alternative 2 represents the engineered barrier over the FFTF Reactor Containment Building, and support buildings 491E and 491W. Alternative 3 represents removal of all FFTF and associated support structures.

Note: To convert hectares to acres, multiply by 2.471.

Key: FFTF=Fast Flux Test Facility; RTP=Remote Treatment Project; SPF=Sodium Processing Facility; SRF=Sodium Reaction Facility.

Source: SAIC 2007b, 2008.

Air emissions associated with building demolition, closure, and site restoration activities, as well as emissions associated with construction, operations, and deactivation of an RTP and SRF/SPF would introduce small amounts of radiological and nonradiological constituents to the regional airshed around Hanford. If the RTP is constructed at INL and INL's SPF is reactivated and modified for bulk sodium processing, air emissions would contribute to cumulative impacts with air emissions from other sources at INL. Over time, these emissions would result in additional loading and exposure, but would not impact air quality or radiation exposure standards to the extent that long-term productivity of the environment would be impaired at either Hanford or INL.

Chemical and radiological contamination of the vadose zone and groundwater below and downgradient from the 400 Area would occur over time under all but FFTF Decommissioning Alternative 3, where removal of all of the structures would take place. Impacts would be the most significant under the FFTF Decommissioning No Action Alternative. FFTF Decommissioning Alternative 2, where the four FFTF RH-SCs and bulk sodium would be removed, long-term impacts on the vadose zone and groundwater would be reduced. The long-term performance of waste forms and their impacts on the vadose zone and groundwater receptors are discussed in detail in Chapter 5. Depending on the extent and magnitude of resultant groundwater contaminant plumes, it may become necessary for land use or other institutional controls to be placed on the overlying land areas for an indefinite period, thereby reducing overall long-term productivity of the affected areas.

No additional short-term or long-term impacts on ecological receptors were projected to occur as a result of implementing any of the FFTF Decommissioning alternatives.

Any impacts on socioeconomic factors are expected to be negligible in the context of activities occurring across Hanford and would be confined within short-term construction, operations, and deactivation phase, ending no later than 2021 for all alternatives.

Management and disposal of LLW, MLLW, and the secondary waste generated would be required under all FFTF Decommissioning alternatives. The FFTF Decommissioning No Action Alternative would require indefinite storage of the four FFTF RH-SCs within the 400 Area and bulk sodium within the 200-West and 400 Areas, removing these areas from other long-term productive use. Under both action alternatives, the specialized components would be decontaminated and repackaged for disposal in an IDF, and the bulk sodium would be processed to produce a caustic sodium hydroxide solution for treating tank waste in the WTP, thereby, eliminating the requirement for long-term operations and maintenance of storage facilities. FFTF Decommissioning Alternative 2 would result in the entombment of LLW and MLLW within the sub-grade void spaces of the RCB, essentially committing the RCB and buildings 491W and 491E for the long term. Comparatively, FFTF Decommissioning Alternative 3 would extricate all internal reactor core components, demolish all buildings, and dispose of all decommissioning debris as LLW or MLLW in an IDF, potentially enabling future productive use of land in the 400 Area.

Short-term use of the environment for removing and processing the four FFTF RH-SCs and the bulk sodium would be evaluated against the potential adverse impacts on long-term productivity that would result from the eventual release of contaminants into the environment. For the action alternatives, the increase in short-term impacts of removal of all FFTF structures would be evaluated against the emplacement of an engineered barrier and long-term lost productivity of the FFTF land areas. An additional long-term consideration is performance assessment and the effect of additional waste loading on an IDF from the generation of decommissioning waste and secondary waste under the action alternatives.

7.4.3 Waste Management Alternatives

The short-term durations for each of the Waste Management alternatives are presented in Table 7–24. The short-term durations are broken into two groups: (1) the construction, operations, and deactivation phase when most activities would take place and (2) the closure phase when administrative controls or postclosure care would be performed. Most impacts and short-term uses of the environment would occur during the construction, operations, and deactivation phase. All Waste Management alternatives would continue to use LLBG trenches 31 and 34 until filled, before using an IDF or the RPPDF. The Waste Management No Action Alternative would not include construction or operation of any new disposal facilities; however, it would require a 100-year administrative control period after the LLBG trenches become full. Under the remaining Waste Management alternatives and their associated disposal groups, permanent disposal facilities would be constructed in the 200 Areas that ultimately would be closed under engineered barriers followed by postclosure care.

Short-term commitments of resources for the Waste Management action alternatives would include the space and materials required to construct expansion facilities for processing high-dose LLW and MLLW waste in the T Plant; processing, packaging, and certifying TRU waste in WRAP; and storing waste in the Central Waste Complex. Other short-term uses of resources would be limited to those required for constructing and operating the disposal facilities.

Table 7–24. Short-Term Life Cycles for Waste Management Alternatives

Alternative	Construction, Operations, and Deactivation Phase	Closure Phase (Activity Type)[a]
1–No Action	2007–2035	2036–2135 (AC)
2–Disposal Group 1	2006–2052	2053–2152 (PM)
2–Disposal Group 2	2006–2102	2103–2202 (PM)
2–Disposal Group 3	2006–2167	2168–2267 (PM)
3–Disposal Group 1	2006–2052	2053–2152 (PM)
3–Disposal Group 2	2006–2102	2103–2202 (PM)
3–Disposal Group 3	2006–2167	2168–2267 (PM)

[a] Activity types: AC=administrative controls; PM=postclosure care and monitoring.
Source: SAIC 2007c, 2008.

Table 7–25 presents the amounts of land that would be committed in the short term to accomplish the objectives of each of the Waste Management alternatives. This short-term use of land would be for expansion of the T Plant, WRAP, and Central Waste Complex facilities under the action alternatives. Table 7–25 also presents those long-term land commitments that would occur indefinitely under each of the disposal groups for the action alternatives. All areas where permanent disposal facilities would be located would be indefinitely removed from long-term productive use. Under the Waste Management action alternatives, engineered barriers would be constructed over the RPPDF and IDF(s). LLBG trenches 31 and 34 are not included in long-term commitments of land in this *TC & WM EIS*, because this facility is a permitted facility and has already been committed in the long-term. Borrow Area C is not included in the short-term commitments of land. Excavation activities conducted at Borrow Area C, while taking place in the short-term, can be terminated at any time. The amount of land disturbance required at Borrow Area C to support each Waste Management alternative was previously discussed in Section 7.3.3.1.

The waste management disposal groups were developed and the waste disposal facilities (the RPPDF and IDF[s]) were sized to primarily support the Tank Closure alternatives and to accept some offsite waste for disposal. The Waste Management No Action Alternative would only be implemented if the corresponding Tank Closure No Action Alternative were selected for implementation. Under Waste Management Alternative 2, only IDF-East would be constructed. Under Waste Management Alternative 3, disposal capacity would be divided between IDF-East and IDF-West. The RPPDF would be constructed between the 200-East and 200-West Areas, regardless of the action alternative selected. Closure of the RPPDF and IDF(s) would be accomplished with the emplacement of an engineered barrier. Therefore, the land areas associated with each of the permanent waste disposal facilities would be removed from long-term productivity considerations. However, these areas would likely be reclaimed by native vegetation and wildlife in the absence of human intervention over the very long term following the end of any administrative control or postclosure care period.

Air emissions associated with the Waste Management alternatives would introduce small amounts of radiological and nonradiological constituents to the regional airshed around Hanford. Radiological air emissions would result from expanded operations of the T Plant and WRAP. Nonradiological air emissions would be the greatest during initial construction of the waste disposal facilities, and then again during closure of the facilities and the construction of engineered barriers. Over time, these emissions would result in additional loading and exposure, but would not impact air quality or radiation exposure standards at Hanford to the extent that long-term productivity of the environment would be impaired.

Table 7–25. Short- and Long-Term Commitments of Land for Waste Management

Alternative	Land Commitment (hectares)	
	Short-Term Use[a]	Long-Term Use[b]
1–No Action	0	0
2–Disposal Group 1	2.7	64
2–Disposal Group 2	2.7	247
2–Disposal Group 3	2.7	247
3–Disposal Group 1	2.7	77
3–Disposal Group 2	2.7	253
3–Disposal Group 3	2.7	253

[a] Short-term includes the entire life cycle of the construction, operations, deactivation, and closure phases. For Alternatives 2 and 3, the land use requirements for the Waste Receiving and Processing Facility, T Plant, and Central Waste Complex construction and operations would be equivalent. Alternative 1, No Action, short-term use does not include partial construction of the 200-East Area Integrated Disposal Facility because this action has already been initiated.

[b] Long-term represents the permanent disposal sites (e.g., one or both of the Integrated Disposal Facilities and the River Protection Project Disposal Facility) after closure by emplacement of engineered barrier.

Note: To convert hectares to acres, multiply by 2.471.

Source: SAIC 2007c, 2008.

Chemical and radiological contamination of the vadose zone and groundwater below and downgradient of the 200 Areas would occur over time under all of the alternatives from release of contaminants from tank closure waste, FFTF decommissioning waste, and offsite waste disposed of in the LLBGs, IDF(s), and RPPDF. The amounts and timing of contaminants that would leach from the waste disposal sites would largely depend on long-term waste form performance, as dictated by the waste treatment methodologies analyzed for the Tank Closure alternatives. Long-term performance of waste forms and their impacts on the vadose zone and groundwater receptors are discussed in detail in Chapter 5. Depending on the extent and magnitude of resultant groundwater contaminant plumes, it may become necessary for land use or other institutional controls to be placed on the overlying land areas for an indefinite period, thereby reducing overall long-term productivity of the affected areas.

The radiological and chemical doses to aquatic and terrestrial receptors at seeps along the Columbia River and in the receiving water were evaluated as part of the ecological risk portion of the analysis. Under all scenarios and alternatives, results indicated that calculated absorbed doses to referenced organisms would be below regulatory limits and/or reference standards and, therefore, would have no impact on long-term productivity of the Columbia River ecosystem.

Continued employment, expenditures, and tax revenues generated during implementation of any of the action alternatives would directly benefit local, regional, and state economies over the short term. Local governments investing project-generated tax revenues into infrastructure and other required services could facilitate economic productivity. Nearby townships and geographic provinces have experienced a recent surge in growth, and the availability of employment opportunities would further sustain and foster regional development.

In addition to the waste generated under the Tank Closure and FFTF Decommissioning alternatives, discussed in Sections 7.3.1 and 7.3.2 above, some quantities of LLW and MLLW would be generated from expanded T Plant operations and would be disposed of in an IDF. TRU waste processed at the expanded WRAP would be stored on site until it can be transported off site for disposal at the Waste

Isolation Pilot Plant. A certain amount of offsite waste would be received under Waste Management Alternatives 2 and 3 and disposed of in an IDF, a long-term commitment at Hanford that would result in comparable enhancement of long-term productivity at other DOE facilities.

The short-term use of the environment for treating waste would be evaluated against the maintenance and enhancement of long-term productivity, as demonstrated by the performance assessment for the final waste forms that would be disposed of in an IDF and the RPPDF.

7.4.4 Alternative Combinations

For comparison purposes, three alternative combinations were selected. The alternative combinations are described in detail in Chapter 4, Section 4.4. This section discusses the relationship between short-term uses of the environment and maintenance and enhancement of long-term productivity for the alternative combinations.

The short-term durations for three alternative combinations are presented in Table 7–26. The short-term durations are broken into two groups: (1) the construction, operations, and deactivation phase when most activities would take place and (2) the closure phase when administrative controls, postclosure care, and/or long-term storage would be continued. Alternative Combination 1 would terminate the construction of the WTP, Canister Storage Building, and IDF-East. The only activity that would continue would be disposal of waste in LLBG trenches 31 and 34 until 2035, followed by a 100-year administrative control period. Alternative Combination 2 represents an expanded WTP vitrification that would significantly reduce the short-term actions, which would end in 2052. Alternative Combination 3 would extend the short-term activities until 2102 to accommodate clean closure of the SST farms, followed by a 100-year postclosure care and monitoring period.

Table 7–26. Short-Term Life Cycles for Alternative Combinations

Alternative Combination	Alternative	Construction, Operations and Deactivation Phase	Closure Phase (Activity Type)[a]
1	Tank Closure Alternative 1	2006–2008	2008–2107 (AC)
	FFTF Decommissioning Alternative 1	Not Available	2008–2107 (AC)
	Waste Management Alternative 1	2007–2035	2036–2135 (AC)
2	Tank Closure Alternative 2B	2006–2046	2046–2145 (PM)
	FFTF Decommissioning Alternative 2	2013–2021	2022–2121 (PM)
	Waste Management Alternative 2, Disposal Group 1	2006–2052	2053–2152 (PM)
3	Tank Closure Alternative 6B, Base Case	2006–2101	2102–2201 (PM) Until 2199 (ST)
	FFTF Decommissioning Alternative 3	2012–2021	2022–2121 (PM)
	Waste Management Alternative 2, Disposal Group 2	2006–2102	2103–2202 (PM)

[a] Activity types: AC=administrative controls; PM=postclosure care and monitoring, ST=onsite storage.
Key: FFTF=Fast Flux Test Facility.
Source: SAIC 2007a, 2007b, 2007c, 2008.

Table 7–27 presents the amounts of land that would be committed in the short term for each of the three representative alternative combinations, including the land area required for existing facilities and construction of new facilities to support a particular alternative combination. The land use amounts are presented as aggregate values over the entire short-term life cycles of the alternatives; however, in practice, most facilities would operate at various timeframes. Borrow Area C is not included in the short term commitments of land. Excavation activities conducted at Borrow Area C, while taking place in the short-term, can be terminated at any time. The amount of land disturbance required at Borrow Area C to support each alternative combination was previously discussed in Section 7.3.4.1. Table 7–27 also presents those long-term land commitments that would continue indefinitely under the alternatives, including all permanent disposition areas where engineered barriers would preclude the use of the site for other productive purposes and all areas where the tank farms and cribs and trenches (ditches) or facilities within the FFTF Property Protected Area would not be closed under certain alternatives. Alternative Combination 1 would construct or operate no new facilities in the short term; however, it would result in a commitment of 35 hectares (86.5 acres) of land as waste management areas for the SST farms, cribs and trenches (ditches), and FFTF Property Protected Area. Alternative Combination 2 would increase land use in both the short and long terms for construction of new disposal facilities and emplacement of engineered barriers over the SST farms and cribs and trenches (ditches). The increase in long-term commitments of land for Alternative Combination 2 over Alternative Combination 1 would occur due to retrieval, treatment, and disposal of all tank waste. Treating the tank waste and disposing of it in an engineered disposal facility reduce the long-term effects of radiological and chemical contaminants leaching into the subsurface and groundwater. Alternative Combination 3 would further increase both short- and long-term commitments of land. In this case, the increase in short- and long-term use would be due to SST clean closure activities and requirements for deep soil excavation and disposition. Treated tank waste under Alternative Combination 3 would be managed as HLW and stored on site until disposition decisions are made and implemented.

Table 7–27. Short- and Long-Term Commitments of Land for Alternative Combinations

Alternative Combination	Land Commitment (hectares)		
	Alternative	**Short-Term Use[a]**	**Long-Term Use[b]**
1	Tank Closure Alternative 1	0	17
	FFTF Decommissioning Alternative 1	0	18
	Waste Management Alternative 1	0	0
	Total Combined	**0**	**35**
2	Tank Closure Alternative 2B	16	84
	FFTF Decommissioning Alternative 2	0.2	0.7
	Waste Management Alternative 2, Disposal Group 1	2.7	64
	Total Combined	**19**	**152**
3	Tank Closure Alternative 6B, Base Case	117	25
	FFTF Decommissioning Alternative 3	0.2	0
	Waste Management Alternative 2, Disposal Group 2	2.7	253
	Total Combined	**120**	**278**

[a] Short-term includes the entire life cycle of the construction, operations, deactivation, and closure phases.
[b] Long-term is the period following completion of all alternatives' scheduled activities.
Note: To convert hectares to acres, multiply by 2.471.
Key: FFTF=Fast Flux Test Facility.
Source: SAIC 2007a, 2007b, 2007c, 2008.

Resultant long-term impacts of the Alternative Combinations would be associated with water resources, ecological resources, and human health. Long-term impacts on ecological resources would occur from air emissions and groundwater impacts. Human health impacts would occur for a number of receptors in both offsite and onsite locations, and would also depend on the acuity and duration of groundwater impacts due to linkage of exposure pathways to consumption of surface water or the use of groundwater for drinking water or crop irrigation. Thus, groundwater-related ecological resource and human health impacts would correlate strongly with the groundwater impacts. Water resources would be impacted the most under Alternative Combination 1, where unmitigated releases from tank inventories would occur and would cause the majority of long-term impacts. Inevitable releases from tank inventories would overcome groundwater impacts of past practices and tank system leaks. Conversely, impacts of air emissions would be least under Alternative Combination 1 because no new facilities would be constructed or operated.

Under Alternative Combination 2, retrieval and treatment of tank waste in the WTP would have short term impacts on air quality. Air emissions would not be sufficient to produce significant long-term impacts on ecological resources. By the time groundwater reaches and is diluted by the Columbia River, impacts on ecological resources would also be negligible. The majority of impacts on groundwater resources would no longer be from tank inventories, as most of this waste would be immobilized through WTP operations, but rather from past discharges to the cribs and trenches (ditches), past leaks from tank systems, and new waste management areas. Ultimately, Alternative Combination 2 is projected to result in a reduction in concentrations of conservative tracers by one or two orders of magnitude at the Core Zone Boundary versus those that would occur under Alternative Combination 1. However, Alternative Combination 2 would require construction of IDF-East and RPPDF in new locations. The receipt and disposal of offsite wastes in IDF-East would also contribute to eventual groundwater impacts in this area, particularly for iodine-129 and technetium-99.

Under Alternative Combination 3, similar air impacts of tank waste treatment would occur; however, to accomplish excavation and clean closure of the tank farms, air impacts would increase significantly. Still, long-term impacts on ecological resources due to air emissions would be minor. Conversely, long-term groundwater impacts on ecological resources would decrease when compared to those impacts under Alternative Combination 2. Under Alternative Combination 3, the SST farms would be clean-closed and any future releases and contributions of residual tank inventories to groundwater impacts eliminated. Similar to Alternative Combination 2, past discharges to the cribs and trenches (ditches) and past leaks from tank systems would still be the major source of impacts on groundwater. Under Alternative Combination 3, all treated tank waste would be managed as HLW and would be stored in onsite storage facilities. As a result, long-term groundwater impacts would be slightly lower under Alternative Combination 3, but generally similar to those under Alternative Combination 2. Treated tank waste requiring disposal in IDF-East would be reduced; however, there would be an increase in need for onsite storage capacity and in disposal requirements for clean-closure waste in IDF-East and tank debris in the RPPDF. As under Alternative Combination 2, receipt and disposal of offsite waste in IDF-East would contribute to eventual groundwater impacts in this area, particularly related to iodine-129 and technetium-99.

All of the alternative combinations would exceed human health dose standards for one or more COPCs within the Core Zone Boundary if groundwater were used as a source of drinking water and crop irrigation. The impacts on the health of human receptors within the Core Zone Boundary is predicated on the receptor's ability to access groundwater; this ability would be delayed or made more difficult under Alternative Combinations 2 and 3, where engineered barriers would be constructed in various locations. These engineered barriers would be constructed over the tank farms, cribs and trenches (ditches), or permanent disposal areas, as applicable under Alternative Combinations 2 or 3.

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