DOE/EIS - 0286F

Final Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement Richland, Washington

Summary

U.S. Department of Energy
Richland Operations Office
Richland, Washington

January 2004

Cover Photographs:

1. Hanford workers preparing to retrieve and repackage TRU waste drums
2. Drums of transuranic waste in a retrievable storage trench
3. A partial aerial view of Hanford's Low Level Burial Grounds
4. Waste Receiving and Processing Facility inspection and repackaging glove boxes
5. Hanford's Mixed Low-Level Waste disposal facility
6. Placing TRU waste into a TRUPACT shipping container for shipment to the Waste Isolation Pilot Plant

RESPONSIBLE AGENCY: **COVER SHEET**

U.S. Department of Energy, Richland Operations Office

TITLE:

Final Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Richland, Benton County, Washington (DOE/EIS-0286F)

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ABSTRACT:

The Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement (HSW EIS) provides environmental and technical information concerning U.S. Department of Energy (DOE) proposed waste management practices at the Hanford Site. The HSW EIS updates analyses of environmental consequences from previous documents and provides evaluations for activities that may be implemented consistent with the Waste Management Programmatic Environmental Impact Statement (WM PEIS) Records of Decision (RODs). Waste types considered in the HSW EIS include operational low-level radioactive waste (LLW), mixed low-level waste (MLLW), immobilized low-activity waste (ILAW), and transuranic (TRU) waste (including TRU mixed waste). MLLW contains chemically hazardous components in addition to radionuclides. Alternatives for management of these wastes at the Hanford Site, including the alternative of No Action, are analyzed in detail. The LLW, MLLW, and TRU waste alternatives are evaluated for a range of waste volumes, representing quantities of waste that could be managed at the Hanford Site. A single maximum forecast volume is evaluated for ILAW. The No Action Alternative considers continuation of ongoing waste management practices at the Hanford Site and ceasing some operations when the limits of existing capabilities are reached. The No Action Alternative provides for continued storage of some waste types. The other alternatives evaluate expanded waste management practices including treatment and disposal of most wastes. The potential environmental consequences of the alternatives are generally similar. The major differences occur with respect to the consequences of disposal versus continued storage and with respect to the range of waste volumes managed under the alternatives. DOE's preferred alternative is to dispose of LLW, MLLW, and ILAW in a single, modular, lined facility near PUREX on Hanford's Central Plateau; to treat MLLW using a combination of onsite and offsite facilities; and to certify TRU waste onsite using a combination of existing, upgraded, and mobile facilities. DOE issued the Notice of Intent to prepare the HSW EIS on October 27, 1997, and held public meetings during the scoping period that extended through January 30, 1998. In April 2002, DOE issued the initial draft of the EIS. During the public comment period that extended from May through August 2002, DOE received numerous comments from regulators, tribal nations, and other stakeholders. In March 2003, DOE issued a revised draft of the HSW EIS to address those comments, and to incorporate disposal of ILAW and other alternatives that had been under consideration since the first draft was published. Comments on the revised draft were received from April 11 through June 11, 2003. This final EIS responds to comments on the revised draft and includes updated analyses to incorporate information developed since the revised draft was published. DOE will publish the ROD(s) in the *Federal Register* no sooner than 30 days after publication of the Environmental Protection Agency's Notice of Availability of the final HSW EIS.

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Summary

This *Final Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement* (HSW EIS) covers three primary aspects of waste management at Hanford – waste treatment, storage, and disposal. It also addresses four types of waste – low-level (radioactive) waste (LLW), mixed (radioactive and chemically hazardous) low-level waste (MLLW), transuranic (TRU) waste (including TRU mixed waste), and certain wastes from the Hanford tank waste treatment plant (WTP), including immobilized low-activity waste (ILAW) and melters used to vitrify the tank waste. This EIS was prepared to help us answer the question: how should we manage the waste we have now and will have in the future? It analyzes the potential impacts of the LLW, MLLW, TRU waste, WTP melters, and ILAW we currently have in storage, will generate, or expect to receive at Hanford. The HSW EIS is intended to help us determine what specific facilities we will continue to use, modify, or construct to manage these wastes (Figure S.1). Because radioactive and chemically hazardous waste management is a technically complex and challenging subject, we have made every effort to minimize the use of acronyms, use more commonly understood words, and provide the "big picture" in this summary. An acronym list, glossary of terms, and units of measure conversion table are provided in the reader's guide in Volume I of this EIS.

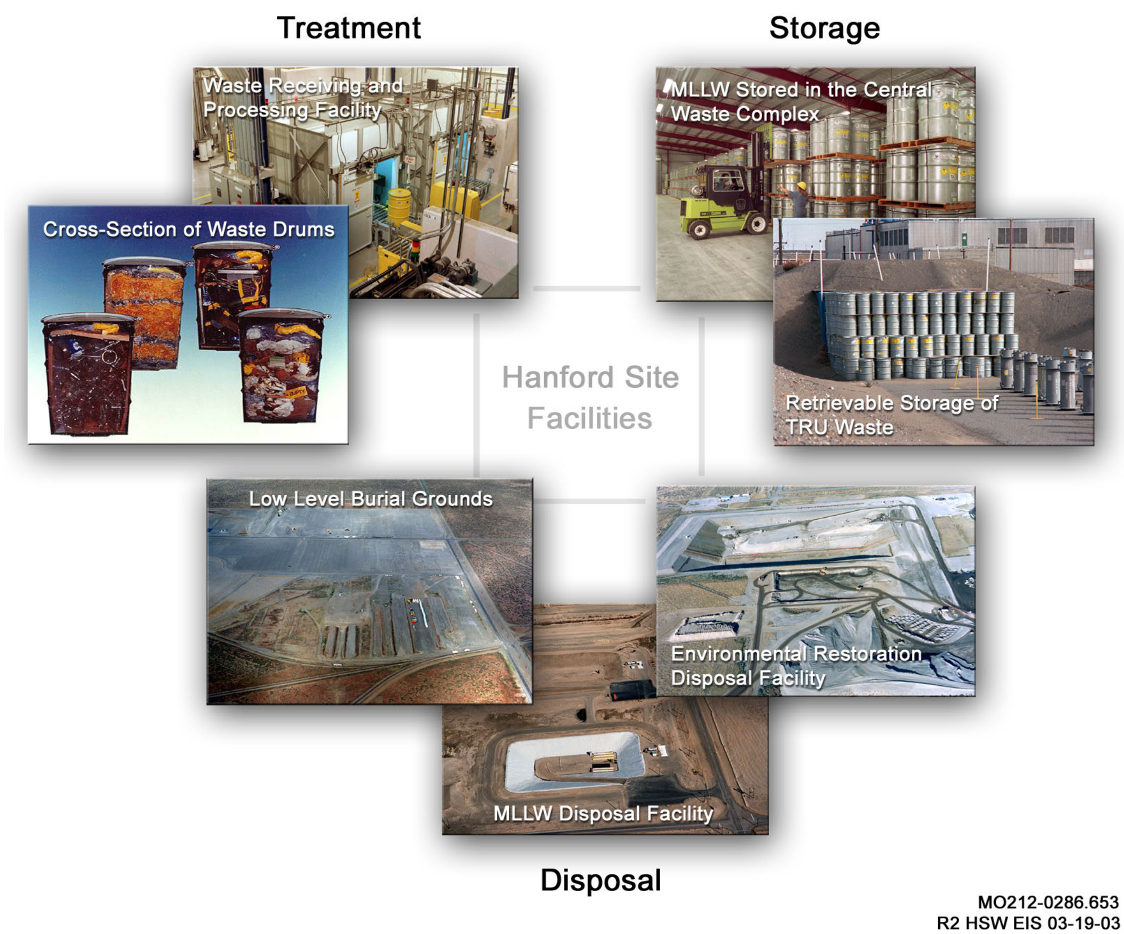

Figure S.1. Hanford Site Treatment, Storage, and Disposal Facilities

We have a number of reasons for preparing this HSW EIS. Foremost is our need to treat and dispose of the waste we are generating from ongoing Hanford cleanup operations, including some of our own buried waste. We also support cleanup and closure of other U.S. Department of Energy (DOE) sites across the country. Just as we were during the days of nuclear weapons production, Hanford is connected to and dependent on other sites. For example, Hanford plans to send its high-level waste (HLW) and spent nuclear fuel (SNF) to a national geologic repository. DOE is now preparing an application to the Nuclear Regulatory Commission to obtain a license to proceed with constructing a repository for disposal of SNF and HLW at Yucca Mountain in Nevada. In addition, we have begun sending our TRU waste to the Waste Isolation Pilot Plant (WIPP) in New Mexico and have sent all of our usable uranium to the Portsmouth Site in Ohio.

Hanford has historically received LLW, MLLW, and TRU waste from offsite sources. The *Waste Management Programmatic Environmental Impact Statement* (WM PEIS) Record of Decision issued in February 2000 designated Hanford as one of the sites for treatment of MLLW and disposal of LLW and MLLW from other sites within the DOE complex that do not have those capabilities (65 FR 10061). We are currently accepting LLW from various DOE sites and MLLW from the U.S. Navy. Hanford has received TRU waste from other sites for certification and eventual transport to the Waste Isolation Pilot Plant. This HSW EIS considers three waste volume scenarios, one of which consists of "Hanford Only" waste, and two that include additional offsite waste volumes. It analyzes the potential environmental impacts associated with various alternatives for storing, treating, transporting, and disposing of both existing and forecast waste at Hanford, as well as waste generated offsite.

Solid radioactive waste activities at Hanford have been evaluated in a number of previous National Environmental Policy Act (NEPA) (42 USC 4321) documents. This HSW EIS updates the evaluations of a number of waste management options, including whether to build new facilities, or to modify existing structures, to treat waste. We also evaluate alternative sizes and designs of disposal facilities, including the use of lined or unlined trenches for disposal of LLW. In addition, if combined-use disposal facilities for more than one waste type are determined to be operationally and environmentally desirable, we considered alternative locations for such facilities. We have used the detailed analysis performed within this HSW EIS combined with previous analyses from other NEPA documents, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC 9601) decision documents, and other DOE sources to show how the HSW EIS alternatives fit into the overall Hanford cleanup.

Although we understand that some readers would prefer the HSW EIS to include more detailed information found in other documents, we believe that the readability of this document is enhanced by not repeating all of those discussions here. We have provided hard copies, Web links, and compact disks (CDs) for readers interested in the other analyses referred to, or incorporated by reference in, this HSW EIS. Material incorporated by reference is briefly summarized. All references cited in this EIS are available in the DOE public reading rooms in Washington, D.C., and at Washington State University, Tri-Cities Campus, in Richland, Washington. If you are having difficulty obtaining a specific reference, please contact the HSW EIS document manager identified on the cover sheet for assistance.

S.1 Purpose and Need for Agency Action

We need to provide capabilities to manage existing and anticipated quantities of LLW, MLLW, TRU waste, ILAW, and WTP melters at the Hanford Site. These capabilities are needed to protect human health and the environment by enabling us to clean up Hanford and assist other DOE sites in completing their cleanup programs. Our proposed actions will allow us to comply with local, state, and federal laws, such as the Washington State Dangerous Waste Regulations (WAC 173-303) and the Resource Conservation and Recovery Act (RCRA) (42 USC 6901), as well as to meet other obligations such as the Hanford Federal Facility Agreement and Consent Order, also referred to as the Tri-Party Agreement, or TPA (Ecology et al. 1989).

To address our anticipated needs for waste management capabilities, we propose to

- continue to operate and modernize our existing radioactive waste treatment, storage, and disposal facilities
- develop additional capabilities to treat MLLW for disposal at Hanford and to certify TRU waste for disposal at the Waste Isolation Pilot Plant in New Mexico
- construct additional disposal capacity for LLW, MLLW, ILAW, and WTP melters[a]
- close onsite disposal facilities at the end of their useful life and provide for post-closure stewardship of disposal sites.

Alternatives for accomplishing DOE's proposed actions, along with an analysis of potential environmental impacts, are detailed in this HSW EIS. A No Action Alternative is also evaluated as required by NEPA. Through this analysis, we will have the foundation to make decisions regarding waste management at Hanford, including decisions concerning the use, modification, and construction of facilities.

S.2 Background

The Hanford Site (Figure S.2) was established in 1943 as part of the World War II nuclear weapons production effort called the Manhattan Project. Through the 1980s, DOE produced plutonium in nine nuclear reactors along the Columbia River. In 1988, we stopped plutonium production and shifted our mission to cleanup, research, and waste management. Throughout this timeframe radioactive waste management has been an ongoing component of Hanford Site operations.

(a) On July 3, 2003, parts of DOE Order 435.1 dealing with the procedures for determining waste incidental to reprocessing were declared invalid by the U.S. District Court for the District of Idaho in Natural Resources Defense Council v. DOE, No. 01-413-S-BLW. The District Court's ruling is currently on appeal to the U.S. Court of Appeals for the Ninth Circuit. The ultimate outcome of this matter, and its impact or applicability to wastes addressed in this EIS, are uncertain. While this EIS evaluates the disposal, at Hanford, of ILAW and melter wastes meeting Hanford Site Solid Waste Acceptance Criteria, DOE would only proceed with disposal of these wastes if their disposal complies with applicable law.

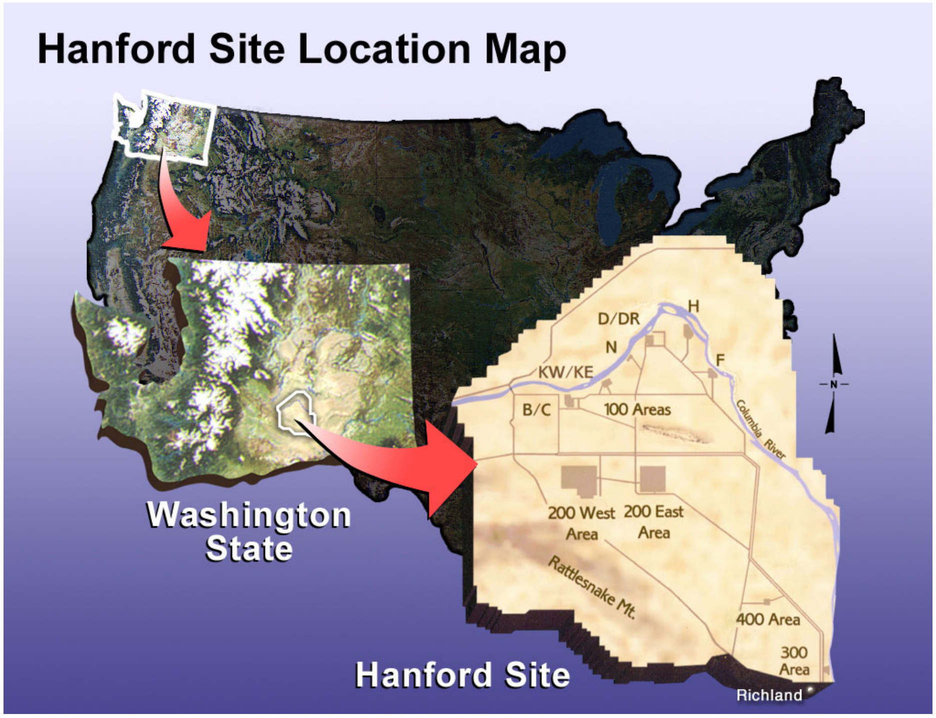

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Figure S.2. Hanford Site Location Map

S.2.1 Hanford Cleanup Progress and New Initiatives

DOE's nationwide cleanup program is an immense and complex effort presenting many technical, financial, political, and regulatory issues. Hanford is a major part of that program. In the last five years, DOE has made substantial progress nationally in systematically defining the scope, schedules, and life-cycle costs to meet this challenge as well as in creating an environment for further reform of the cleanup program by accelerating cleanup and risk-reduction actions, improving schedules and cost efficiencies, and closing sites. At Hanford, we have made significant progress in our cleanup mission. We have

- cleaned up over 210 contaminated soil and waste sites
- decommissioned over 500 inactive facilities
- placed three production reactors into interim safe storage and have made significant progress at two more reactors
- disposed of over 4 million tons of environmental restoration waste in an approved facility, including over 800,000 tons since the beginning of Fiscal Year (FY) 2002

- stabilized and moved more than 1,500 metric tons of the 2,100 metric tons of production reactor fuel from the K Basins to storage on the Central Plateau during the past 3 years

- shipped nearly 900 metric tons of uranium to an offsite storage facility

- initiated construction of the waste treatment plant for Hanford's tank waste

- continued treatment and disposal of MLLW in permitted facilities, including the treatment of over 550 cubic meters and the disposal of over 450 cubic meters since the beginning of FY 2002

- continued certification and shipment of TRU waste to the Waste Isolation Pilot Plant

- continued retrieval of TRU waste from the Low Level Burial Grounds (more than 1,400 drums processed to date)

- continued stabilization and packaging of plutonium material, including completion of all plutonium-bearing solutions, plutonium metal, plutonium residues, and significant portions of plutonium polycubes and oxides

- continued treatment of contaminated groundwater—more than 6.7 billion liters of groundwater have been treated to remove substantial amounts of chromium, carbon tetrachloride, uranium, technetium-99, and strontium-90 contamination. In addition, installation of a chromium treatment barrier system in the 100 Area also has been completed

- removed over 187,000 pounds of carbon tetrachloride from the soil by vapor extraction to remediate groundwater contamination, to prevent future groundwater contamination, and to reduce worker exposure.

Although DOE cleanup actions are progressing across the nation and at Hanford, there has been some dissatisfaction with the pace and cost of cleanup. Some felt that cleanup completion was too far in the future, required unrealistic levels of funding, and was slow to reduce near-term risk. To address this concern, DOE initiated actions to reform the cleanup program.

One of those actions was to develop accelerated cleanup plans in consultation with site regulators. The *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE-RL 2002) created six strategic initiatives that we believe can move the completion date of the Hanford cleanup mission from 2070 to 2035, and possibly to 2025. The six initiatives would accelerate 1) River Corridor cleanup, 2) tank waste retrieval, treatment, and closure, 3) nuclear materials stabilization and inventory reduction, 4) waste disposal, 5) Central Plateau cleanup, and 6) groundwater cleanup and protection. We will do this without compromising the quality of the cleanup and in compliance with applicable requirements and cleanup standards.

Each of these initiatives may impact Hanford's Solid Waste Program, but activities included in the strategic initiative to accelerate waste disposal are most relevant to the alternatives analyzed in this HSW EIS. Specific performance milestones within that initiative include the following:

- complete retrieval, designation, and disposal of 15,000 drum-equivalents of suspect TRU waste by September 2006, 4 years early

- complete treatment and disposal of all stored MLLW (about 7000 cubic meters) and newly generated MLLW (forecasted to be about 7000 cubic meters) by September 2008, 4 years early

- complete certification and shipment of all legacy contact-handled TRU waste (about 7500 cubic meters) to the Waste Isolation Pilot Plant by September 2015, 12 years early

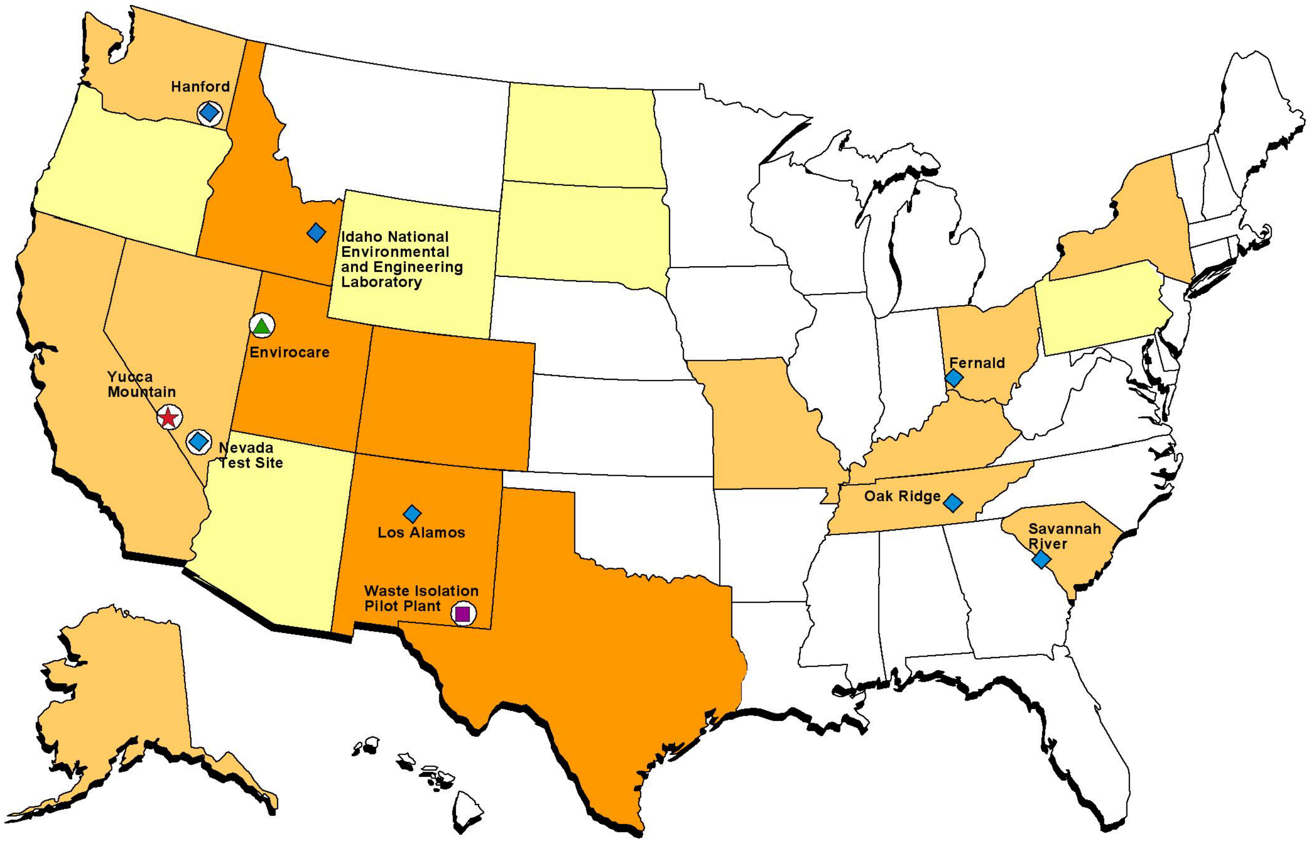
- complete construction and initiate use of lined MLLW/LLW disposal facilities by September 2007.

Some of the acceleration activities described in our performance management plan could be implemented immediately, consistent with existing NEPA documentation. Others could be implemented following completion of this HSW EIS. Still others may require further planning, changes to existing permits or Tri-Party Agreement Milestones, and preparation of additional environmental analyses.

Although our performance management plan targets a cleanup completion date of 2035 or sooner, our current technical baseline of 2046 has not yet been updated to accommodate all of the acceleration initiatives. Therefore, in Volume II, Appendix C of this HSW EIS we have provided our current basis for the waste volume forecasts. We believe these volumes encompass the range of waste volumes that might be received at Hanford from both onsite and offsite sources. Although the acceleration initiatives may impact the timing of actions, it is unlikely that the types of activities and overall waste volumes would change significantly as a result of these initiatives.

S.2.2 Disposition of DOE Waste Across the Nation and at Hanford

Hanford is part of a nationwide complex of DOE sites undergoing cleanup operations and disposing of radioactive waste. Figure S.3 shows the nationwide distribution of states in which one or more types of DOE radioactive waste are, or will be, disposed of, including LLW, MLLW, environmental restoration waste, TRU waste, HLW, SNF, and uranium mill tailings. The following sections describe DOE nation-wide and Hanford Site waste management plans.



Color Key: States where DOE radioactive wastes will remain

- States with Uranium Mill Tailings Remedial Action (UMTRA) sites
- States with past disposal or in-situ treatment of LLW or MLLW wastes at DOE sites
- States with both UMTRA sites and past disposal or in-situ treatment of LLW or MLLW wastes at DOE sites

Legend: Major DOE sites with ongoing radioactive waste disposal operations:

- DOE sites identified for the nationwide disposal of LLW or MLLW
- DOE sites with LLW, MLLW, or environmental restoration disposal cells for disposal of their own wastes
- DOE repository for the disposal of TRU wastes
- DOE geologic repository site for the proposed disposal of HLW and SNF
- Commercial site currently used for the disposal of DOE MLLW

DOE - U.S. Department of Energy
HLW - high-level waste
LLW - low-level waste
MLLW - mixed low-level waste
SNF - spent nuclear fuel
TRU - transuranic

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Figure S.3. States with Radioactive Waste Disposal Activities

Waste Management Programmatic EIS

The WM PEIS (DOE 1997a) was a DOE-wide study examining the potential environmental impacts of managing an estimated 2,000,000 cubic meters of radioactive and hazardous waste from past, present, and reasonably foreseeable DOE activities across the nation. DOE's goal in preparing the WM PEIS was to analyze alternative nationwide strategies to treat, store, and dispose of the waste in a safe, responsible, and efficient manner that minimized the impacts to workers, the public, and the environment. Wastes analyzed in the WM PEIS included MLLW, LLW, TRU waste, HLW, and hazardous waste.

The WM PEIS provides information on the impacts of various alternatives that DOE considered for managing each waste type. In the Records of Decision resulting from the final WM PEIS, DOE decided the following:

- In the Record of Decision for management of LLW and MLLW (65 FR 10061), DOE decided that sites with existing disposal capabilities for LLW and MLLW will continue to dispose of their wastes in their onsite facilities. Sites with LLW disposal capabilities include the Idaho National Engineering and Environmental Laboratory, the Oak Ridge Reservation in Tennessee, the Savannah River Site in South Carolina, the Los Alamos National Laboratory in New Mexico, the Nevada Test Site, and the Hanford Site. MLLW disposal could occur at Hanford, the Nevada Test Site, or commercial facilities.

  The Record of Decision for management of LLW and MLLW identified the Hanford Site and the Nevada Test Site as disposal sites for wastes from sites that do not have disposal capability. The Nevada Test Site is expected to take the bulk of the LLW that would be shipped for disposal from other DOE generators. For example, over the 5-year time period (2002 through 2006) it is estimated that the Nevada Test Site will receive approximately 423,000 cubic meters of LLW. That amount (for just this 5-year period) is more than the entire offsite volume of LLW and MLLW Hanford would receive under the Upper Bound waste volume estimate and over 20 times the amount of offsite waste that Hanford would receive under the Lower Bound waste volume estimate evaluated in this HSW EIS (see Section S.3).

- For management of TRU waste, DOE initially decided that each site would prepare and certify waste generated at that site for disposal at the Waste Isolation Pilot Plant in New Mexico (63 FR 3629). Subsequently, DOE amended this Record of Decision for TRU waste to allow for temporary storage, characterization, and certification of TRU waste from small generator sites at the Savannah River Site and the Hanford Site (65 FR 82985, 66 FR 38646, 67 FR 56989). In the amended Record of Decision, DOE decided that the Hanford Site would receive approximately 170 drums of waste (36 cubic meters) from the Battelle West Jefferson North Site in Ohio and the Energy Technology and Engineering Center in California for processing, certification, and storage pending shipment to the Waste Isolation Pilot Plant for disposal. DOE completed all of the shipments to Hanford from Energy Technology and Engineering Center (ETEC) and some from the Battelle facility. However, on May 9, 2003, the federal district court for the Eastern District of Washington issued a preliminary injunction prohibiting additional shipments from Battelle.

- DOE would continue its current practice of managing non-radioactive hazardous waste at commercial treatment and disposal facilities (63 FR 41810).

What wastes are included in the HSW EIS and how are they defined?

Low-level waste (LLW) is radioactive waste that is not high-level waste, spent nuclear fuel, transuranic waste, or byproduct material (as defined under the Atomic Energy Act of 1954 (42 USC 2011)) or naturally occurring radioactive material. LLW is technically defined not by what it is, but by what it is not. LLW has a wide range of forms, radionuclide concentrations, and hazards. LLW can range from very low to very high radionuclide concentrations, but is generally the kind of waste acceptable for shallow-land disposal.

Mixed low-level waste (MLLW) is LLW that contains both radionuclides subject to the Atomic Energy Act of 1954, and a hazardous chemical component subject to the Resource Conservation and Recovery Act (RCRA) (42 USC 6901) or applicable Washington State Dangerous Waste Regulations.

Immobilized low-activity waste (ILAW) is the solidified low-activity waste from the treatment and immobilization of Hanford tank wastes. Low-activity waste is the waste that remains after separating from high-level waste (HLW) as much of the radioactivity as practicable, and that when solidified may be disposed of as low-level waste in a near-surface facility.

Transuranic (TRU) waste is radioactive waste containing more than 100 nanocuries (3700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for the following:

- high-level radioactive waste
- waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR 191 disposal regulations
- waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61.
- After DOE (2001c).

Hanford's Waste Management Plans

Hanford's waste management challenges are significant, but we are making progress. We have disposition plans for our waste types and materials, which are illustrated in Figure S.4 and discussed by waste type below. The text boxes in this section also highlight which waste types are analyzed in detail in this HSW EIS, and which are not.

High-Level Waste and Spent Nuclear Fuel: We plan to send DOE HLW and SNF to a deep geologic repository. DOE is now preparing a license application to the Nuclear Regulatory Commission

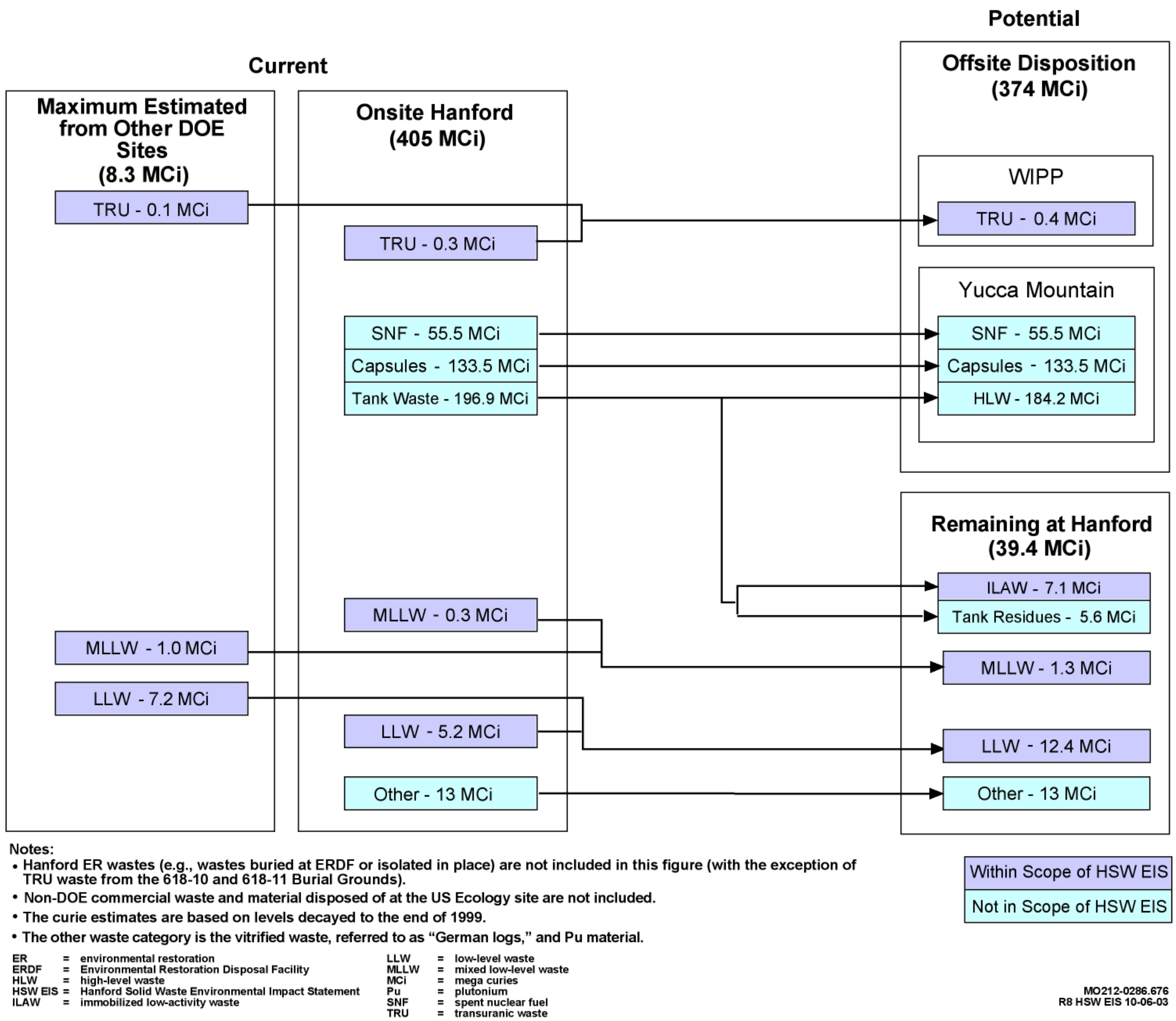

Figure S.4. Waste and Materials Coming to and Leaving Hanford (in megacuries [MCi])

to obtain a license to proceed with constructing a repository for disposal of HLW and SNF at Yucca Mountain in Nevada. Our useable uranium has already been shipped to the Portsmouth Site in Ohio.

Transuranic Waste: TRU waste from DOE sites across the nation is going to the Waste Isolation Pilot Plant in New Mexico, an underground repository that opened in 1999. The Hanford Site, Idaho National Engineering and Environmental Laboratory, Savannah River Site, Los Alamos National Laboratory, and Rocky Flats Environmental Technology Center have shipped TRU waste to the Waste Isolation Pilot Plant.

Hanford has also received some TRU waste from other DOE sites that needed to take advantage of our existing and planned certification and storage capabilities. However, all TRU waste sent to Hanford will eventually be shipped to the Waste Isolation Pilot Plant. Our planned shipments from Hanford to the Waste Isolation Pilot Plant include the following:

- TRU waste stored in the Central Waste Complex or other aboveground Hanford storage units
- TRU waste generated as a result of decommissioning and demolition of facilities such as the Plutonium Finishing Plant
- sludge from the K Basins
- retrievably stored TRU waste currently in the Low Level Burial Grounds
- TRU waste sent to Hanford from other DOE sites to take advantage of existing and planned certification and storage capabilities pending shipment to the Waste Isolation Pilot Plant
- TRU waste retrieved from the 618-10 and 618-11 Burial Grounds
- TRU waste retrieved as a result of other CERCLA remediation decisions.

Low-Level and Mixed Low-Level Waste: We plan to do the following with these waste types:

- Continue to dispose of our own LLW and MLLW onsite
- For the waste generated by environmental restoration activities (e.g., contaminated soils and building demolition debris), continue to dispose of these wastes in the specially designed Environmental Restoration Disposal Facility
- Accept some DOE LLW and MLLW from sites that do not have disposal capability. The Nevada Test Site and commercial disposal facilities, such as Envirocare in Utah, also receive such waste.

The scope of the HSW EIS does not include commercial LLW disposed of on land we lease to the State of Washington. The state permits US Ecology, Inc. to operate a low-level waste burial ground for commercial waste on Hanford's Central Plateau. This operation is independent of our DOE cleanup and waste management operations at Hanford. However, we do consider the US Ecology, Inc. facility in the cumulative impacts analysis in this EIS.

Figure S.5 provides an overview of Hanford's waste and material disposition paths. It provides references to the existing NEPA documentation associated with each waste stream or source, including this HSW EIS.

What waste types are not included in the analysis of HSW EIS alternatives?*

- High-level radioactive waste
- Most liquid wastes
- Spent nuclear fuel
- Naval reactor compartments
- Non-radioactive hazardous wastes
- Most environmental restoration wastes generated as part of the CERCLA process
- Commercial LLW destined for US Ecology

*Although these wastes are not considered in the detailed alternative analyses, they are considered in the cumulative impacts analyses.

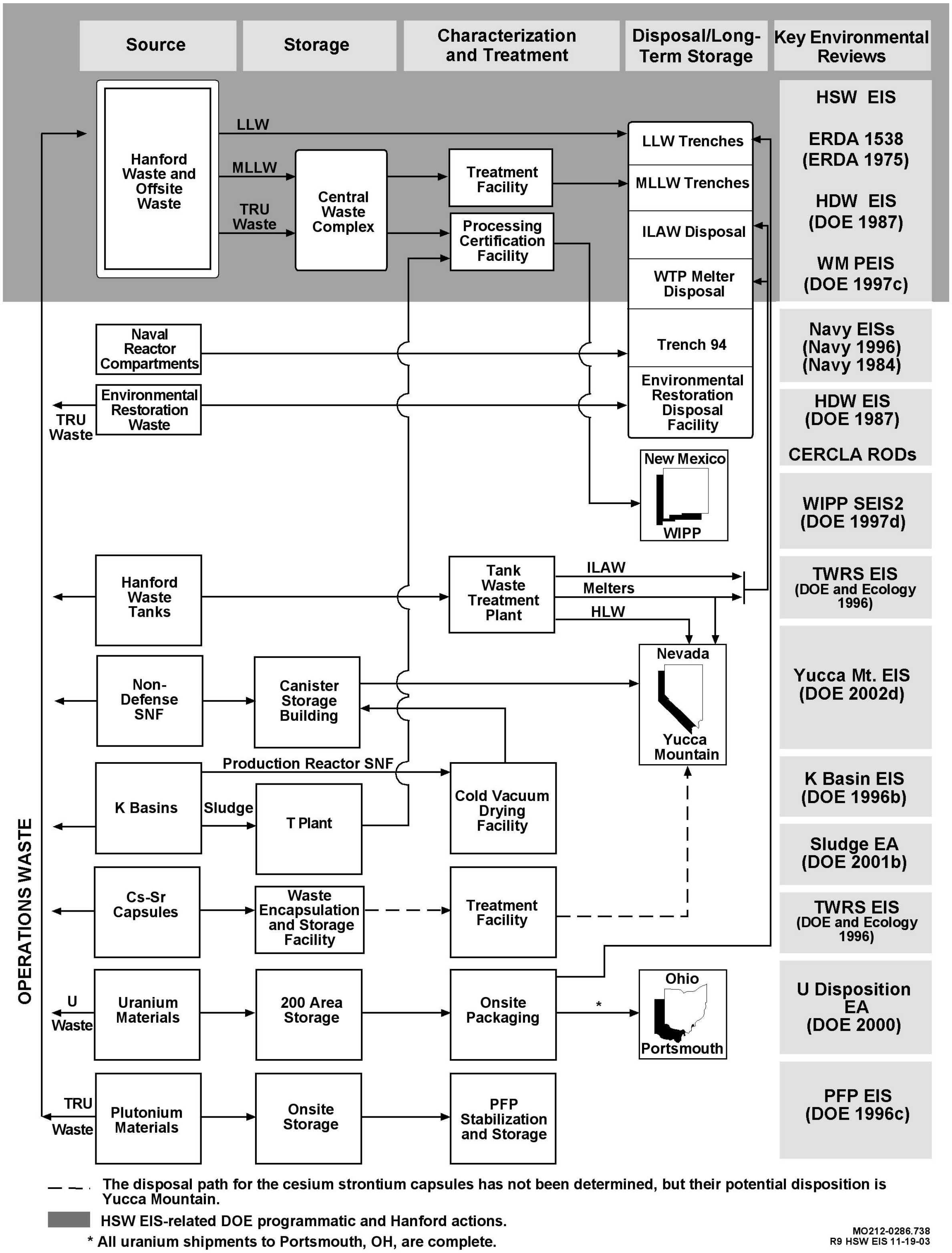

Figure S.5. Relationship of the HSW EIS to Other Key Environmental Reviews

S.2.3 Development of the Final HSW EIS

In April 2002, we issued our first draft of the HSW EIS for public comment. During the public comment period, we received a large number of comments (approximately 3,800) from tribal governments, regulators, stakeholders, and the public. Comments focused predominantly on the following issues:

- importation of waste to the Hanford Site from other locations and the impact that waste would have on the environment

- how Hanford cleanup plans are affected by this EIS

- disposal facility design and long-term performance: there were numerous concerns regarding the use of unlined trenches for disposal of LLW, as well as concerns about contamination of groundwater and ultimately the Columbia River

- whether the document adequately analyzed the cumulative impacts of waste coming from offsite along with the wastes that are already there

- scope of the transportation analysis

- technical content and scope of the HSW EIS: comments 1) pointed out perceived omissions or inaccuracies in the HSW EIS technical analyses, alternatives, and scope of the EIS, and 2) requested evaluation of additional alternatives for waste treatment and disposal, including alternative disposal facility designs

- why all other waste types at Hanford were not specifically analyzed, including disposal of the ILAW.

We prepared a revised draft of the HSW EIS to address these comments and give the public the information needed to better understand the decisions we still need to make. That draft was issued in March 2003 for public comment and incorporated substantial changes that responded to the concerns that we heard. Key changes in the revised draft HSW EIS included the following:

- expanding the range and depth of alternatives and supporting analyses to include ILAW disposal and other alternatives that had been proposed after the initial draft was prepared

- providing information describing new DOE plans to accelerate cleanup and how they relate to the HSW EIS

- distinguishing between the Hanford waste volumes and those projected to come from offsite

- providing a fuller description of transporting waste through the states of Washington and Oregon

- providing an expanded discussion on cumulative impacts, including groundwater impacts.

During the public comment period on the revised draft HSW EIS, we received many additional comments from tribal governments, regulators, stakeholders, and the public. We considered each comment in preparing this final HSW EIS. Key comments are summarized and DOE responses are provided in Volume III, Section 2 of this final HSW EIS. Volume IV of this EIS contains all of the individual comments and transcripts of public meetings. Comments on the revised draft HSW EIS focused predominantly on the following issues, a number of which were previously addressed in the revised draft:

- disagreement over the importation of waste to Hanford, including the risk of transporting this waste through the states of Oregon and Washington

- concerns about potential impacts to the groundwater and compliance with groundwater protection standards

- concerns over the scope and alternatives of the HSW EIS, particularly related to uncertainty of chemical inventories in existing buried waste, continued use of unlined trenches, alternative ILAW waste forms, tank residuals, mitigation measures, and cumulative impacts

- health, safety and regulatory concerns regarding long-term impact calculations, modeling approaches, uncertainties, and compliance with NEPA requirements

- public involvement concerns, including the length of time for public comment and DOE's commitment to openness and public involvement during the decision-making process.

In accordance with the Council on Environmental Quality Regulations (40 CFR 1500–1508), we changed the EIS 1) to respond to public comments as appropriate, 2) to correct errors in the revised draft EIS, and 3) to provide clarifying information or improved analyses relevant to the EIS. For example, key changes to the final HSW EIS include:

- The groundwater analyses were revised to reflect disposal of MLLW with high iodine-129 content taking into account higher integrity containment, such as grouting. This reduced the estimated groundwater concentrations of iodine-129 and other radionuclides from disposal of MLLW for all alternatives over the analysis period (Volume I, Section 5.3 and Volume II, Appendix G). It also reduced the potential human health consequences (Volume I, Section 5.11 and Volume II, Appendix F) and potential impacts on ecological resources (Volume I, Section 5.5 and Volume II, Appendix I) from groundwater contamination.

- Additional analyses were prepared to provide further insight into the impacts on groundwater at the disposal facility boundaries (Volume I, Section 5.3 and Volume II, Appendix G). These analyses are presented in response to comments received on the revised draft EIS. They provide information about the differences in radionuclide groundwater concentrations between the facility boundary and the 1-kilometer lines of analysis used for the alternatives evaluation in the EIS. For existing disposal facilities, the estimated maximum concentrations at the LLW management area boundaries over the 10,000-year analysis period were a factor of about 2 to 20 higher than those at the 1-kilometer distance. For proposed new waste disposal facilities, the corresponding concentrations at the LLW management area or new disposal facility boundaries were about a factor of 1 to 6 higher than at the 1-kilometer distance. For the DOE preferred alternative (see Section S.7.2), constituents migrating from new waste disposal facilities would not exceed benchmark drinking water standards at the facility boundaries. For existing disposal facilities, and for new disposal facilities in other alternatives, benchmark drinking water standards could potentially be exceeded at the disposal facility boundaries in some cases.

- Additional groundwater analyses were prepared to evaluate the long-term effect of the Modified RCRA Subtitle C barrier (Volume I, Section 5.3 and Volume II, Appendix G). Three scenarios are presented as sensitivity analyses in response to comments received on the revised draft EIS: 1) no barrier is assumed to be present, 2) the barrier functions as designed for 500 years, then gradually degrades over the next 500 years, and 3) the barrier functions as designed for the entire 10,000-year period of analysis. The estimated maximum potential radionuclide concentrations in groundwater for scenarios 1 and 2 were similar, although the peaks for scenario 2 were delayed by several hundred years compared with scenario 1, corresponding to the assumed effective life of the barrier in scenario 2. The potential maximum groundwater concentrations in scenario 3 were less than 10% of those in the other two, but the levels persisted for a much longer period of time, reflecting the reduced water infiltration rate through the intact barrier for scenario 3.

- Additional groundwater analyses were prepared to provide further insight into the potential impacts of varying technetium-99 content in the ILAW waste stream (Volume I, Section 5.3). The revised draft HSW EIS analyses assumed the majority of the estimated tank inventory of technetium-99 would be disposed of in ILAW, whereas a lower quantity would be disposed of in ILAW if the tank waste were treated to separate part of the technetium-99 for disposal with HLW. The higher ILAW inventory assumed for the revised draft HSW EIS analyses would result in estimated technetium-99 groundwater concentrations that are about a factor of 4 to 5 higher than if the separation process were implemented to reduce the quantity of technetium-99 in ILAW. The final HSW EIS provides additional analysis based on disposal of ILAW containing reduced quantities of technetium-99. The estimated groundwater concentrations of technetium-99 from ILAW disposal would not be expected to exceed benchmark public drinking water standards at 1 km from the disposal facility, or at the disposal facility boundary, for either Tc-99 inventory in the HSW EIS preferred alternative. Groundwater concentrations of Tc-99 could potentially exceed the benchmark drinking water standard at the disposal facility boundary for other alternatives, depending on the disposal facility location and configuration.

- The groundwater analyses were expanded to include estimated concentrations of hazardous chemicals in groundwater from waste disposed of before 1988 (Volume I, Section 5.3 and Volume II, Appendix G). This information was added in response to comments on the revised draft EIS. The analyses show these chemicals are unlikely to present a substantial risk to humans or ecological resources.

- The cumulative impacts on groundwater were expanded to include an estimated inventory of iodine-129 expected to remain in all waste sites at Hanford over the long term (Volume I, Section 5.14.3 and Volume II, Appendix L). This change had a small effect on estimated long-term consequences of using groundwater beneath the Hanford Site.

- In response to comments, the transportation analysis was revised to include nationwide transport of LLW, MLLW, and TRU waste to and from Hanford, using updated highway routing information and 2000 Census data (Volume I, Section 5.8 and Volume II, Appendix H). This provided additional information related to consequences of transportation, but did not substantially change the transportation consequences identified in the revised draft EIS.

- The discussion of DOE's preferred alternative in the revised draft EIS was updated to identify a proposed location for the new combined-use disposal facility (Section S.7.2).

S.3 Waste Volumes Analyzed

In this final HSW EIS we address LLW, MLLW, WTP melters, ILAW, and TRU waste. Radioactive waste may also be classified as either contact-handled or remote-handled (see text box). This HSW EIS does not reevaluate alternatives for waste types that have been, or will be, addressed by separate NEPA reviews or other appropriate documentation. For example, wastes that have been the subject of previous NEPA evaluations include Hanford's tank waste (DOE and Ecology 1996), naval reactor compartments (Navy 1984, 1996), and spent nuclear fuel (DOE 1996a). An EIS for closure of Hanford's single-shell tanks is in preparation (68 FR 1052). Environmental restoration wastes from other Hanford cleanup projects are being addressed under the CERCLA process. Commercial LLW disposed of at the US Ecology site is the subject of a separate Washington State Environmental Policy Act EIS (WDOH and Ecology 2000).

What is the difference between contact-handled and remote-handled waste?

Contact-handled waste containers produce radiation dose rates less than or equal to 200 millirem per hour at the container surface. Remote-handled waste containers produce dose rates greater than 200 millirem per hour at the container surface. Contact-handled containers can be safely handled by direct contact using appropriate health and safety measures. Remote-handled containers require special handling or shielding during waste management operations.

Unless stated otherwise, environmental consequences in the HSW EIS have been evaluated for three waste volumes: a Hanford Only, a Lower Bound, and an Upper Bound waste volume. Because of uncertainty about future waste receipts, these alternative waste volume scenarios were evaluated to encompass the range of quantities that might be generated at Hanford or received from other sites.

- The **Hanford Only** waste volume consists of: 1) the forecast volumes of LLW, MLLW, and TRU waste from Hanford Site generators, 2) the forecast ILAW and WTP melter volumes from treatment of Hanford tank waste, 3) existing onsite inventories of waste that are already in storage, and 4) waste that has previously been disposed of in the LLBGs.

- The **Lower Bound** waste volume consists of: 1) the Hanford Only waste volume, and 2) additional volumes of LLW and MLLW that are currently forecast for shipment to Hanford from offsite facilities. The Lower Bound volume for TRU waste is not substantially greater than the Hanford Only volume, and is not analyzed separately in all cases.

- The **Upper Bound** waste volume consists of 1) the Lower Bound waste volume, and 2) estimates of additional LLW, MLLW, and TRU waste volumes that may be received from other sites consistent with the WM PEIS decisions and the "Western Hub" proposal for management of TRU waste, as discussed in Volume I, Section 5.8.

The Hanford Only waste volume was included so the incremental impacts of managing all offsite waste can be clearly evaluated. The bases for waste volumes evaluated in the HSW EIS are discussed further in Volume I, Section 3.3 and Volume II, Appendix C. The three volumes by waste type are illustrated in Figure S.6.

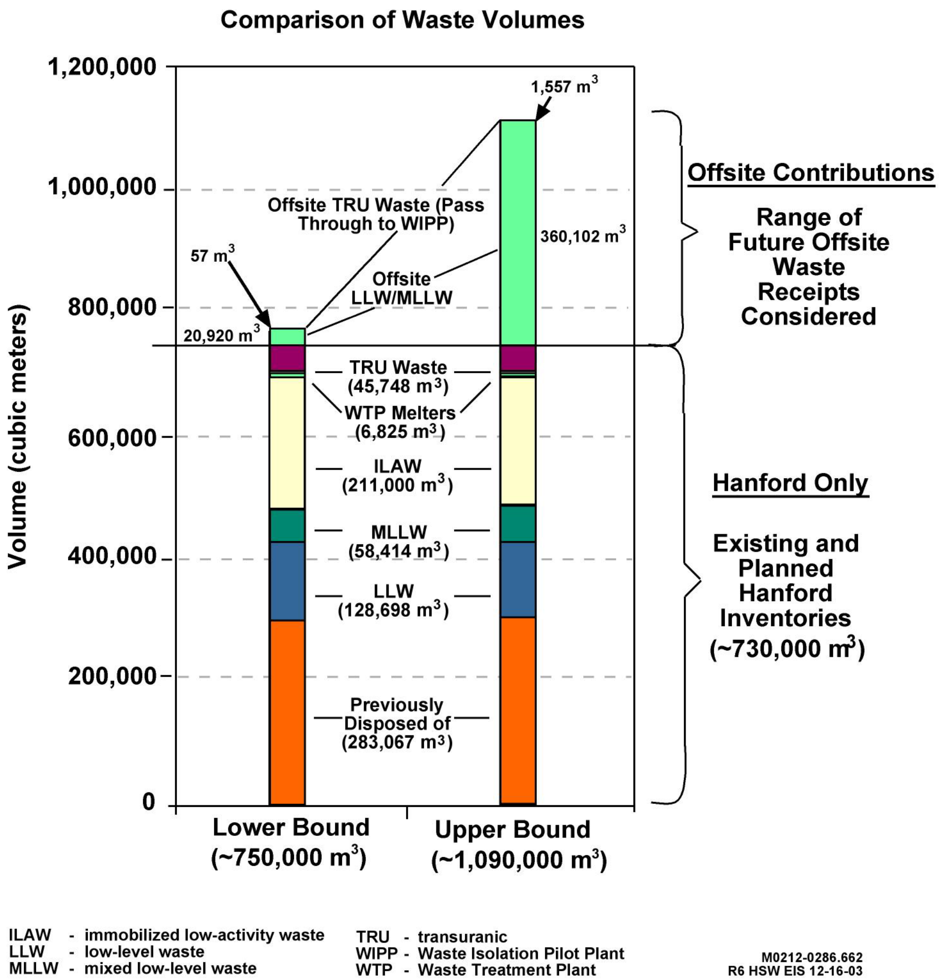

Figure S.6. Range of Waste Volumes Considered in the HSW EIS

The Hanford Only waste volume does not include waste disposed of in older burial grounds, environmental restoration waste disposed of in the Environmental Restoration Disposal Facility, decommissioned Naval reactor compartments, or commercial waste disposed of in the US Ecology facility. This is because the operation, cleanup, and closure of these facilities and areas are the subject of other decision documents. However, those wastes are considered as part of cumulative impacts in this HSW EIS (see Volume I, Section 5.14 and Volume II, Appendix L).

S.4 Waste Management Activities and Facilities

In 1999, we selected a land-use plan in the Record of Decision (64 FR 61615) for the *Final Hanford Comprehensive Land-Use Plan EIS* (DOE 1999). The plan divided the site into five geographical areas: the Wahluke Slope, the Columbia River Corridor, the Central Plateau, the Fitzner/Eberhardt Arid Lands Ecology Reserve, and other areas (Figure S.7). The Comprehensive Land-Use Plan EIS Record of Decision designates the Central Plateau as an Industrial-Exclusive zone, specifically for waste management operations and similar industrial facilities.

The Solid Waste Program activities at Hanford (located on the Central Plateau) include storage, treatment, and disposal of LLW and MLLW, as well as storage and processing of TRU waste and disposal of ILAW and WTP melters. To fully understand the scope of this HSW EIS, it is important to understand the pieces of this complex program. Figure S.8 illustrates the approximate locations of current and proposed treatment, storage, and disposal facilities on Hanford's Central Plateau.

The Hanford Solid Waste Program has three major functions: treatment, storage, and disposal of radioactive and chemically hazardous radioactive mixed waste. Solid radioactive waste from onsite and offsite generators is stored until it can be transferred to an appropriate treatment or disposal facility. Treatment of solid radioactive wastes may include size reduction, stabilization, encapsulation, and/or destruction or neutralization of non-radioactive waste constituents. We also use the term processing to encompass the concepts of waste characterization, certification, and treatment. Solid waste disposal facilities at Hanford currently accept LLW and MLLW and, in the future, would also accept ILAW and WTP melters that meet Hanford's waste acceptance criteria. TRU waste will continue to be processed and stored pending disposal at the Waste Isolation Pilot Plant in New Mexico.

S.4.1 Radioactive Waste Storage

Waste is often stored prior to treatment or disposal. The specific storage methods we use depend on the chemical, radioactive, and physical characteristics of the waste. We store waste in both aboveground and belowground facilities. Our primary waste storage facility is the Central Waste Complex (Figure S.9), a group of enclosed metal buildings on concrete pads. Some waste is also stored outdoors in the Central Waste Complex on concrete pads if the outer containers are corrosion-resistant and suitable for such storage.

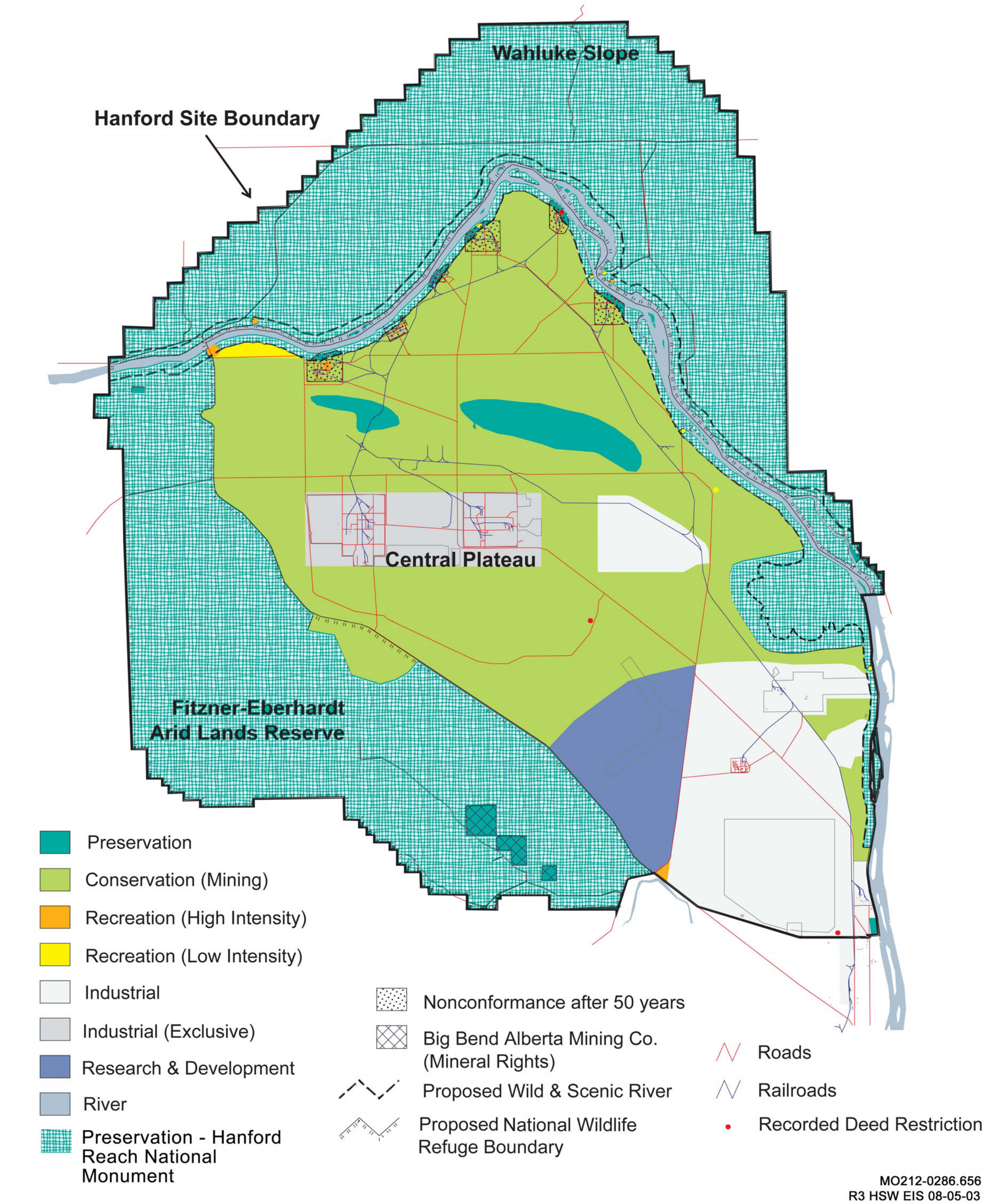

Figure S.7. Hanford's Land-Use Plan

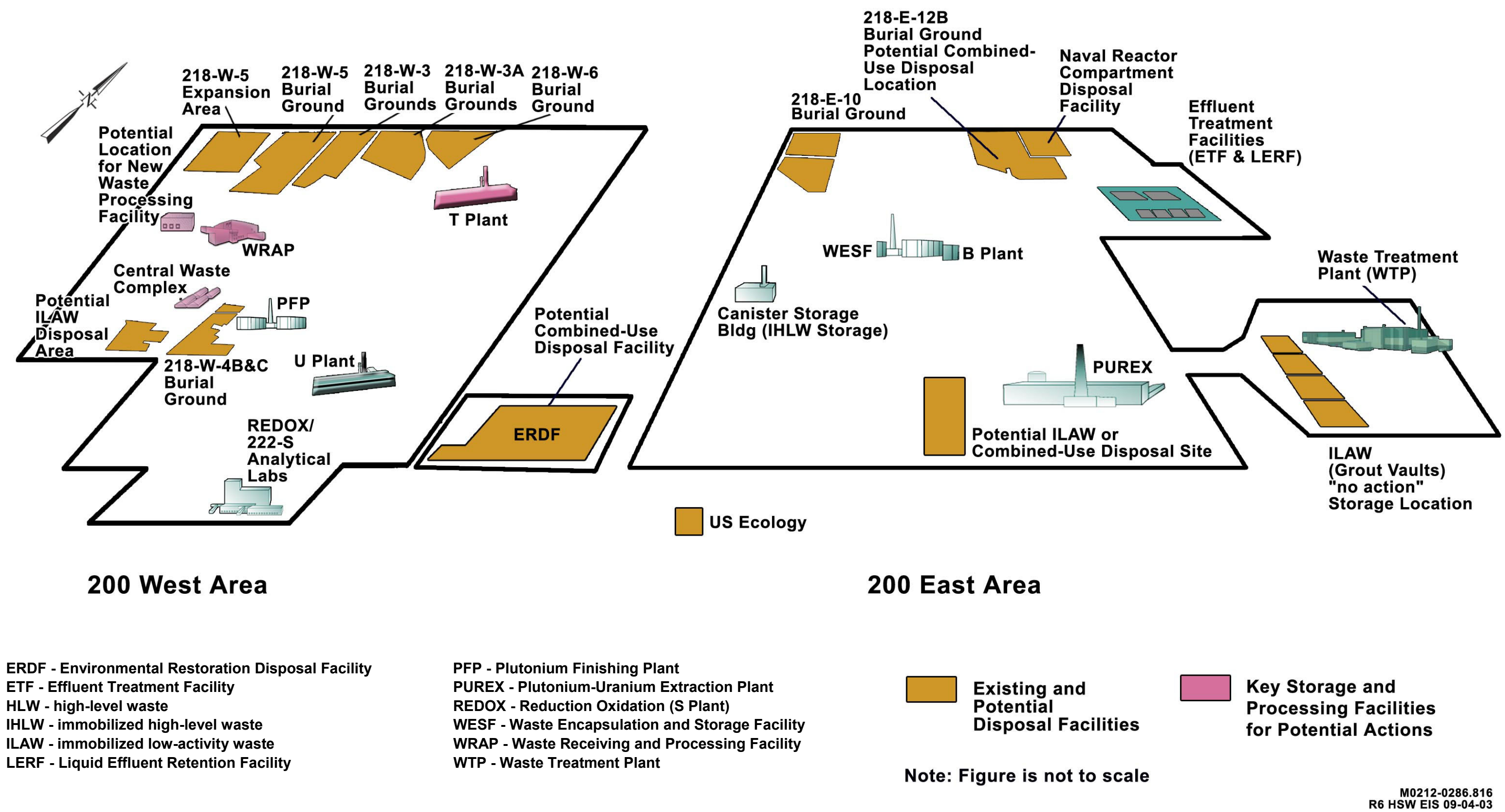

Figure S.8. Hanford's Waste Management Operations

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Figure S.9. Aerial View of the Central Waste Complex

The T Plant Complex and Waste Receiving and Processing Facility also have waste storage capabilities. The T Plant Complex will be used to store K Basin sludge and perhaps other remote-handled waste. We are also considering storage of ILAW in existing lined vaults in the 200 East Area.

Hanford has limited ability to treat MLLW, so we need facilities in which to store this waste until we obtain the capability to treat it. The primary storage facility we now use is the Central Waste Complex, which is constructed to meet RCRA and state environmental regulations for storage of mixed waste.

Transuranic waste was not defined as a separate waste type until 1970. Beginning in 1970, waste suspected of containing transuranic radionuclides was stored in the Low Level Burial Grounds in trenches or in caissons (underground structures intended for storage of some higher activity wastes). This waste is referred to as "suspect" TRU waste because only some of the stored waste contains TRU radionuclides at concentrations that meet the current definition of TRU waste. Since 1985, TRU waste typically has been stored in surface facilities, such as the Central Waste Complex or the T Plant Complex, until it can be sent to the Waste Isolation Pilot Plant.

This HSW EIS addresses storage, processing, certification, and transportation of TRU waste. DOE has addressed retrieval of Hanford's TRU waste in previous NEPA documents (DOE 1987, DOE 2002a) and may conduct further NEPA review as appropriate before implementing additional retrieval decisions.

S.4.2 Radioactive Waste Treatment and Processing

Waste treatment is often necessary for safe, efficient storage and disposal of waste. We use treatment processes to change the physical, chemical, or biological characteristics of waste, to reduce its volume, or to prepare it for disposal.

Treatment is not required for most kinds of LLW. However, we treat some LLW to meet specific disposal facility waste acceptance criteria. One type of LLW, called "Category 3 LLW," contains higher concentrations of radionuclides that contribute to potential long-term risks. This waste would be grouted in the trench or placed in high integrity containers to reduce the mobility of those radionuclides.

MLLW requires treatment to specific standards defined by RCRA and state regulations before it can be disposed of. Because we have limited capability to treat MLLW at Hanford, we have contracted with offsite RCRA-permitted commercial facilities to begin treating limited quantities of stored contact-handled MLLW. These contracts provide for the stabilization of inorganic solids, encapsulation of debris waste, and thermal treatment. One of the challenges facing all DOE sites is that commercial treatment capabilities and capacities are limited. In addition to the treatment standards defined by RCRA and state regulations, we also intend to perform additional treatment of MLLW that contains high concentrations of long-lived mobile radionuclides (similar to the Category 3 LLW discussed previously). The 200 Area Effluent Treatment Facility treats our liquid wastes, including leachate collected from the MLLW trenches.

TRU waste requires processing before it can be sent to the Waste Isolation Pilot Plant for disposal. Processing includes activities such as repackaging, characterization, and certification that the waste meets the Waste Isolation Pilot Plant waste acceptance criteria. Under current plans, we will manage contact-handled and remote-handled TRU wastes differently. Most newly generated and retrievably stored contact-handled TRU waste would be sent to Hanford's Waste Receiving and Processing Facility for processing and certification. Remote-handled TRU waste and oversized containers of TRU waste would continue to be stored at the T Plant Complex, the Central Waste Complex, and the Low Level Burial Grounds until we develop processing and certification capabilities for those wastes. We anticipate that the Waste Isolation Pilot Plant will be able to begin receiving remote-handled TRU waste by about 2006.

S.4.3 Radioactive Waste Disposal

The final step in the waste management process is disposal. Some types of waste can be disposed of safely in existing facilities using conventional methods, such as shallow-land burial. In response to comments, we are considering moving exclusively to shallow-land burial of LLW and MLLW in lined disposal facilities with leachate collection systems. We now dispose of LLW and treated MLLW in Hanford's Low Level Burial Grounds and are considering onsite disposal of ILAW and WTP melters that meet onsite waste acceptance criteria. The decision on a specific location would be supported by the analyses in this EIS. We will continue to ship TRU waste to the Waste Isolation Pilot Plant for disposal, and we plan to ship SNF and HLW from the underground storage tanks to a repository designed for those types of waste.

The Low Level Burial Grounds have formed the foundation of Hanford's Solid Waste Program. Each burial ground consists of a series of trenches on the Central Plateau. There are six Low Level Burial Grounds in the 200 West Area and two in the 200 East Area. Figure S.10 illustrates disposal of LLW within Hanford's Low Level Burial Grounds.

Figure S.10. Hanford's Low Level Burial Grounds

Most of Hanford's Low Level Burial Grounds contain LLW; however, one Low Level Burial Ground in the 200 West Area contains two trenches permitted under RCRA and state regulations for disposal of MLLW. The MLLW trenches (Figure S.11) are constructed with a low-permeability liner and a system for collecting water that drains through the waste disposal area. The collected liquids, referred to as leachate, are shipped to the Effluent Treatment Facility and converted to a solid form suitable for disposal.

The Environmental Restoration Disposal Facility is located in the center of the Hanford Site between the 200 East and 200 West Areas. It is a RCRA-compliant large-scale landfill, authorized by the U.S. Environmental Protection Agency (EPA) under CERCLA. The facility is designed to receive and isolate LLW and MLLW generated from Hanford's environmental restoration activities. The Environmental Restoration Disposal Facility currently has four disposal cells and is being expanded further. The cells are lined and have leachate collection systems. This HSW EIS analyzes whether we should use the Environmental Restoration Disposal Facility location not only for environmental restoration waste but for other wastes (such as LLW, MLLW, WTP melters, and ILAW) as well.

Figure S.11. Mixed Low-Level Waste Disposal Trench

The Waste Isolation Pilot Plant in New Mexico is DOE's underground repository for disposal of TRU waste. We began shipping TRU waste from Hanford to the Waste Isolation Pilot Plant in the summer of 2000, made several more shipments through 2002, and substantially increased shipments in 2003 (Figure S.12). Disposal of TRU waste was evaluated in previous EISs and is not reconsidered in this EIS. We currently plan to dispose of both contact- and remote-handled TRU waste at the Waste Isolation Pilot Plant. Because the Waste Isolation Pilot Plant is not yet approved to receive remote-handled TRU waste, we must continue to store these wastes at Hanford. We anticipate that the Waste Isolation Pilot Plant will have the approval needed to begin receiving remote-handled TRU waste by about 2006.

S.4.4 Radioactive Waste Transportation and Emergency Preparedness

About 300 million hazardous material[a] shipments occur in the United States every year (DOT 1998). About 3 million (1 percent) of these involve shipments of radioactive material, including radioactive waste. Currently, less than one percent of these 3 million radioactive material shipments are DOE shipments (NEI 2003).

(a) For the purposes of this transportation discussion, hazardous materials include items that present chemical hazards, radioactive hazards, and physical hazards (e.g., compressed gases).

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Figure S.12. Packaging of TRU Waste for Shipment to Waste Isolation Pilot Plant

The number of DOE radioactive material shipments is expected to increase over the next several years. However, the number of these shipments will continue to be small in comparison to the total number of hazardous material shipments. Volume II, Section H.2.2 discusses the total number of potential shipments to and from Hanford.

The U.S. Department of Transportation regulates shipment of hazardous materials (including radioactive materials), and the Nuclear Regulatory Commission and DOE have additional regulations that govern transportation of radioactive materials. Local, state, tribal, and federal governments and carriers all have responsibility for preparing for and responding to transportation emergencies. Local or tribal personnel typically are the first responders and incident commanders for transportation accidents within their jurisdictions. Although many local governments have special hazardous material response units, most seek state or federal technical assistance during radiological incidents.

S.5 Description of Alternatives

The HSW EIS considers a number of action alternatives and a No Action Alternative. The action alternatives include capabilities for management of wastes evaluated in this HSW EIS. The No Action Alternative is required under NEPA regulations and serves as a baseline against which the action alternatives are compared. Each action alternative is defined by a general waste management activity (storage, treatment, or disposal); a specific waste stream; and a specific design, location, or technical option for the proposed action. For example, an alternative for treatment of MLLW would be to use offsite contracts for thermal treatment of some contact-handled MLLW; or an alternative for disposal of ILAW might be to use a combined-use modular facility located in the 200 East Area. In addition to the alternatives discussed in this section, in Volume I, Section 3.2, we considered a number of other alternatives, but did not evaluate them in detail because DOE determined that they are not reasonable alternatives based on environmental, technical, or fiscal constraints. Volume I, Sections 3.1 and 3.2 describe the HSW EIS alternatives.

Under all alternatives evaluated in this HSW EIS, some waste storage operations (as opposed to waste disposal operations discussed later) would continue at the Central Waste Complex and within the Low Level Burial Grounds. The action alternatives do not require additional storage beyond the current capacity. The No Action Alternative, which evaluates continuation of current waste management practices, would require an expansion of the Central Waste Complex to store wastes that could not be treated or disposed of using existing capabilities.

We would need new capabilities to treat non-conforming LLW (waste that does not meet Hanford's waste acceptance criteria because of its physical or radiological characteristics) and most of Hanford's contact-handled MLLW, which could be accomplished either by constructing onsite facilities or by establishing contracts with offsite treatment facilities. Additional onsite capabilities would be needed to treat the remaining MLLW because some types, including remote-handled MLLW and non-standard containers (such as oversize boxes or large items), cannot be shipped to, or accepted by, commercial facilities. In addition, we would need the capability to process and certify remote-handled TRU waste and non-standard containers because the Waste Receiving and Processing Facility does not have that capability. Existing and new facilities could use various treatment technologies. We identify reasonable treatment technologies and their alternative locations. These action alternatives for treatment and processing are summarized in Figure S.13. In this HSW EIS, we developed alternatives for new or modified facilities that could provide needed capabilities for waste treatment and processing by asking the following questions:

- To treat some MLLW and process some TRU waste, should we modify facilities within the T Plant Complex or construct a new facility?
- To treat the remaining contact-handled MLLW, should we extend existing commercial treatment contracts, establish new contracts, or construct a new onsite treatment facility?
- To process and ship TRU waste to the Waste Isolation Pilot Plant more quickly, should we use mobile processing facilities, also called Accelerated Process Lines, in addition to the existing Waste Receiving and Processing Facility?

In some of the action alternatives, we consider constructing new disposal capacity for LLW and MLLW as well as using existing capacity. We evaluate trenches similar to those used now for disposal of LLW and MLLW at Hanford, new deeper and wider trenches, or expandable disposal facilities. We evaluate separate designs for each waste type and for melters and ILAW from the tank waste treatment plant. We also analyze some alternatives in which we would use a lined modular disposal facility for some or all of the waste streams. In the action alternatives, we would ultimately close the disposal facilities by placing a cap (cover or barrier) over the top of the facility. The cap would consist of soil, sand, gravel, and asphalt to reduce water infiltration and the potential for human, animal, and plant intrusion. Figure S.14 summarizes the various alternatives considered for the disposal of solid radioactive waste in the future.

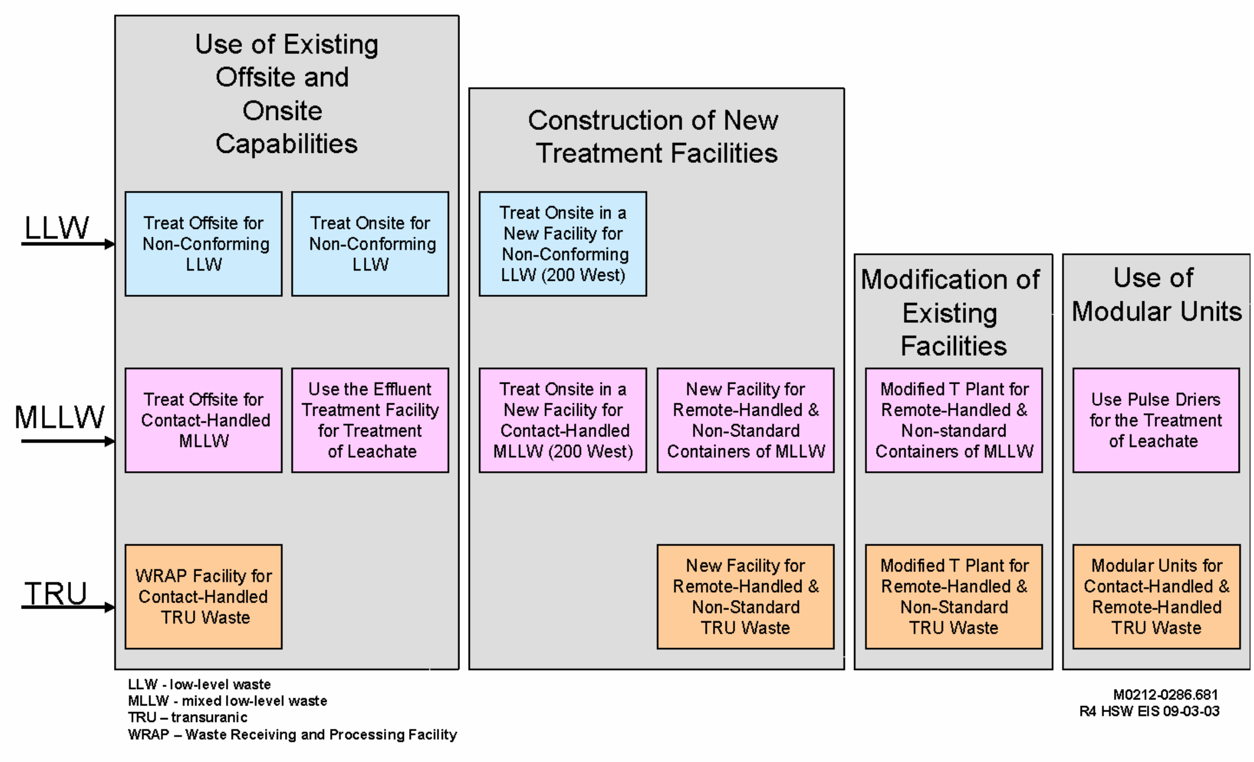

Figure S.13. Solid Waste Treatment Action Alternatives

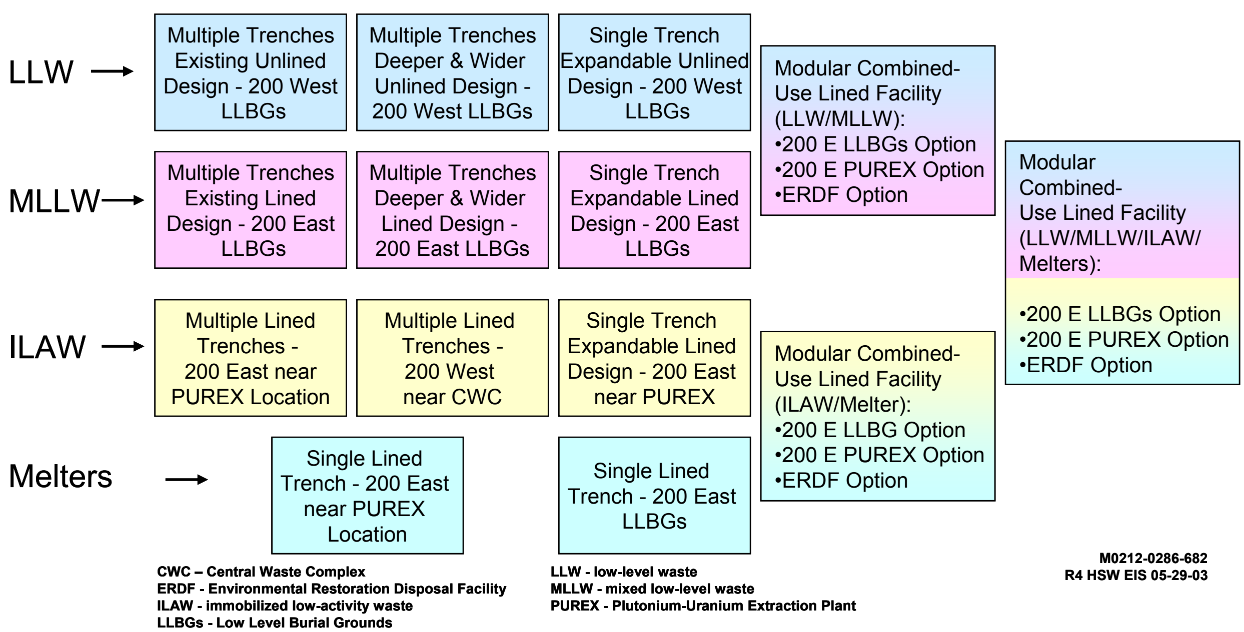

Figure S.14. Solid Waste Disposal Action Alternatives

S.5.1 Grouping of Alternatives

In developing the alternatives for this HSW EIS we recognized that there are a large number of combinations of the various waste streams, their potential waste volumes, and individual options for their storage, treatment, and disposal. To represent these combinations, we have identified five action alternative groups (Alternative Groups A-E) and the No Action Alternative. Within these alternative groups we specified subalternatives for Alternative Groups D and E, which consist of different potential locations for the disposal facilities within the 200 East and 200 West Areas. With the exception of the No Action Alternative, each alternative is consistent with the WM PEIS Records of Decision. Figure S.15 illustrates our approach for defining these five action alternative groups.

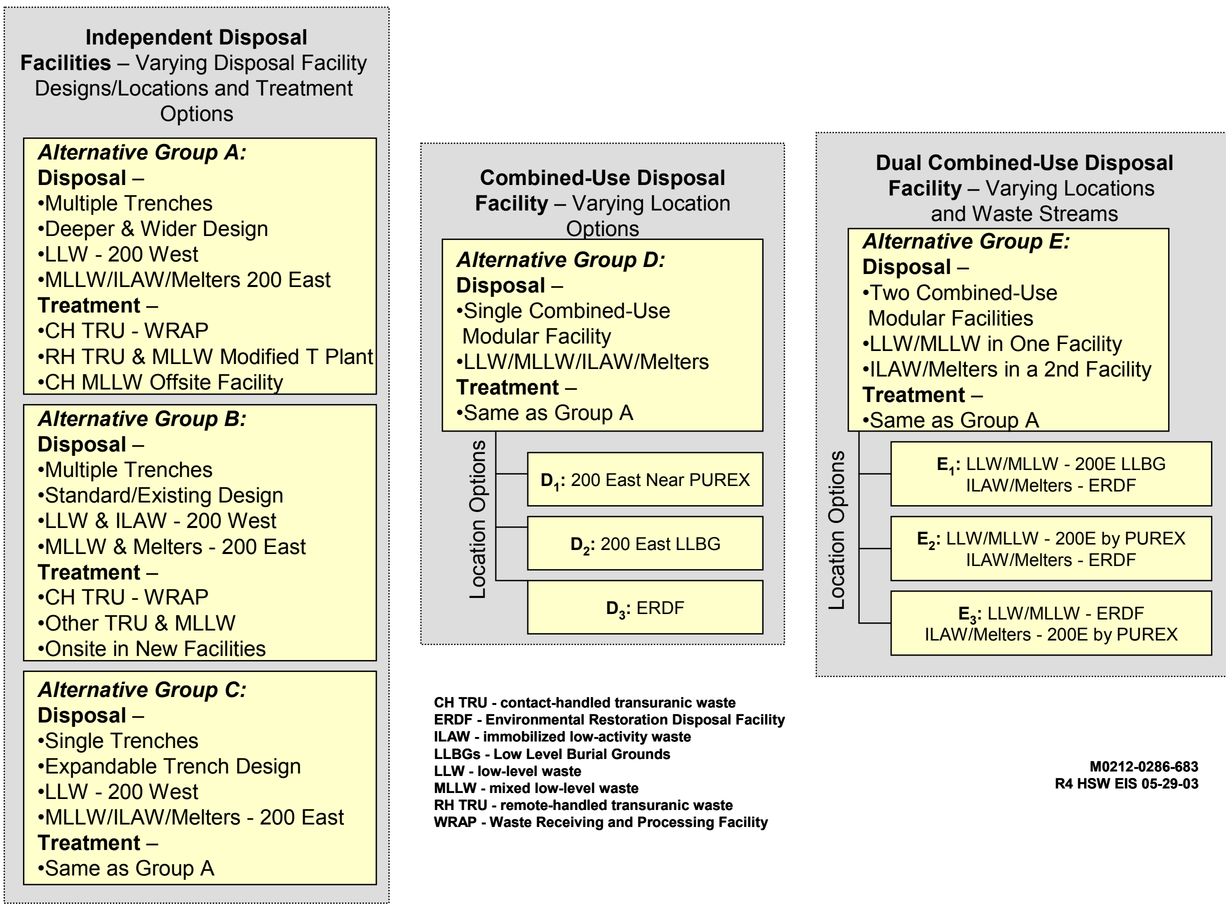

Figure S.15. Development of Action Alternative Groups

No Action Alternative: Under the No Action Alternative, we would continue ongoing waste management activities, and would implement previous NEPA Records of Decision and other decisions for existing facilities and operations. This is the more traditional "no action" alternative, where the EIS assumes there is no change from existing operations. For example, Hanford would continue to dispose of LLW within the Low Level Burial Grounds. The No Action Alternative would also require an expansion of the Central Waste Complex to store wastes that could not be treated or disposed of using existing capabilities. The No Action Alternative was evaluated for both the Hanford Only and Lower Bound Waste Volumes as discussed in Section S.3.

Action Alternatives: The action alternative groups analyzed in this EIS are described in the following paragraphs. All of the action alternatives assume continued use of existing waste management capabilities and facilities, such as the Waste Receiving and Processing Facility to process and certify contact-handled TRU waste, or existing disposal facilities until new facilities can be opened. Alternatives for development of new waste management capabilities needed at Hanford are encompassed within the alternative groups described in this section. The Action Alternatives were evaluated for the Hanford Only, Lower Bound, and Upper Bound waste volumes discussed in Section S.3.

Alternative Group A – *Disposal by Waste Type in Larger Disposal Facilities – Onsite and Offsite Treatment*: New LLW and MLLW disposal trenches would be deeper and wider than those currently in use, and facilities for disposal of MLLW, ILAW, and WTP melters would include liners and leachate collection systems. Different waste types would not be disposed of together. New LLW disposal facilities would be located in the 200 West Area and new MLLW, ILAW, and WTP melter disposal facilities would be located in the 200 East Area. T Plant would be modified to provide processing capabilities for remote-handled TRU waste and TRU waste in non-standard containers, as well as treatment capabilities for remote-handled MLLW and MLLW in non-standard containers. Treatment of most contact-handled MLLW would be provided at offsite facilities.

Alternative Group B – *Disposal by Waste Type in Existing Design Disposal Trenches – Onsite Treatment*: Disposal trenches would be of the same design as those currently in use. Different waste types would not be disposed of together. New LLW and ILAW disposal facilities would be located in the 200 West Area and new MLLW and WTP melter disposal facilities would be located in the 200 East Area. A new facility would be built to provide processing capabilities for remote-handled TRU waste and TRU waste in non-standard containers, as well as treatment capabilities for remote-handled MLLW, most contact-handled MLLW, and MLLW in non-standard containers.

Alternative Group C – *Disposal by Waste Type in Expandable Design Facility – Onsite and Offsite Treatment*: A single, expandable disposal facility (similar to the Environmental Restoration Disposal Facility) would be used for each waste type. Different waste types would not be disposed of together. New LLW disposal facilities would be located in the 200 West Area, and new MLLW, ILAW, and WTP melter disposal facilities would be located in the 200 East Area. Treatment alternatives would be the same as those described in Alternative Group A.

Alternative Group D – *Single Combined-Use Disposal Facility – Onsite and Offsite Treatment*: LLW, MLLW, ILAW, and WTP melters would be disposed of in a single combined-use facility. Disposal would occur at one of three locations: near the Plutonium-Uranium Extraction (PUREX) Plant (D_1), in the 200 East Area Low Level Burial Grounds (D_2), or at the Environmental Restoration Disposal Facility (D_3). Treatment alternatives would be the same as those described in Alternative Group A.

Alternative Group E – *Dual Combined-Use Disposal Facilities – Onsite and Offsite Treatment*: LLW and MLLW would be disposed of in a single facility; ILAW and WTP melters would be disposed of in a separate single facility. Disposal would occur at some combination of locations as shown in Table S.1. Treatment alternatives would be the same as those described in Alternative Group A.

Table S.1. Alternative Group E – Options for Dual Combined-Use Disposal Facilities

Options	**Disposal Facility Location**		
	At ERDF	**200 East LLBG**	**200 East Near PUREX**
E_1	WTP Melter & ILAW	LLW & MLLW	—
E_2	WTP Melter & ILAW	—	LLW & MLLW
E_3	LLW & MLLW	—	WTP Melter & ILAW

S.6 Comparison of Environmental Consequences

The following sections summarize the results of the environmental analyses presented in this final HSW EIS. They include a high-level comparison of the potential environmental consequences of the various alternative groups (Section S.6.1). They also discuss the results of our cumulative impacts analysis (Section S.6.2), uncertainties (Section S.6.3), potential mitigation measures (Section S.6.4), and long-term stewardship plans (Section S.6.5).

S.6.1 Environmental Impacts of Alternatives

We have examined the potential environmental impacts of implementing each of the alternative groups. For some consequences, such as long-term effects of waste disposal on groundwater and the Columbia River, the evaluation period extends well beyond the end of the site operations. For many of the resources, minimal impacts would be expected to occur as a result of implementing any of the alternatives, and differences among the alternative groups are also small. However, for some resources, noticeable differences in impacts among the alternative groups do exist. These differences are summarized in the following sections, and they are described in more detail in Volume I, Section 3.4 and Section 5 of this HSW EIS.

Table S.2 provides a summary comparison of the range of potential environmental consequences of our alternatives during operations for the projected waste volumes. Table S.3 provides a summary comparison of the potential long-term (10,000-year) impacts associated with our alternatives.

What is meant by the term "conservative" in the HSW EIS?

As used in this EIS, the term "conservative" refers to assumptions used in the various environmental consequence analyses that tend to bound, maximize, or overestimate the potential impacts. Such assumptions are typically used when specific information regarding an activity is not available or is at a conceptual stage of development. These assumptions are used to ensure that we have not underestimated the effects of our proposed actions on human health or the environment.

Table S.2. Summary Comparison of Potential Impacts Among the Alternatives During Operational Period (Present to 2046)

Alternative Groups A-E - Hanford Only to Upper Bound Waste Volume [(a)]															
No Action Alternative - Hanford Only to Lower Bound Waste Volume [(b)]															
Alternative	Facility Operations – Direct Radiation and Emissions to Atmosphere						Transportation					Shrub-Steppe Habitat Disturbed, ha	Geologic Resources Committed (sand, gravel, silt/loam, and basalt), millions of $m^{3(g)}$	Diesel Fuel Committed Thousands of m^3	Cost in Billions of 2002 Dollars
	Normal Operations				Fatalities from Operational Accident Having Largest Consequences: Beyond-Design-Basis Earthquake at CWC[(c)]		Incident-Free	# Accidents/# Fatalities from Accidents							
	Chances of Latent Cancer Fatality: Lifetime Exposure of Maximally Exposed Individual		Latent Cancer Fatalities (LCFs) Among Population within 80 km Lifetime Exposure	Latent Cancer Fatalities (LCFs) from Collective Radiation Exposure of Workers			Onsite, from Offsite, for Offsite Treatment, & TRU Waste to WIPP: Includes Transport-Crew, Public, and Non-Involved Workers, Fatalities[(f)]	Onsite, from Offsite, for Offsite Treat-ment, and TRU Waste to WIPP[(d)]	LLW, MLLW & TRU Waste Within Oregon State Only[(d)]	LLW, MLLW & TRU Waste Within Wash. State Only[(d)]	TRU Waste to WIPP				
	Public	Non-Involved Workers			Public	Non-Involved Workers[(e)]									
Group A	<1/million	<1/million	0 (<0.001)	0 (<0.5)	30	1	6-9	23/1-75/3	1/0-5/0	0/0-2/0	17/1	32	4.0-4.2	133 - 134	3.7-4.0
Group B	<1/million	<1/million	0 (<0.001)	0 (<0.5)	30	1	6-10	22/1-74/2	1/0-5/0	0/0-2/0	17/1	0	4.4-4.9	137 - 141	3.8-4.2
Group C	<1/million	<1/million	0 (<0.001)	0 (<0.5)	30	1	6-9	23/1-75/3	1/0-5/0	0/0-2/0	17/1	14	3.7-4.0	66 - 67	3.5-3.9
Group D_1	<1/million	<1/million	0 (<0.001)	0 (<0.5)	30	1	6-9	23/1-75/3	1/0-5/0	0/0-2/0	17/1	19 - 25	3.7-3.9	66 - 67	3.2-3.5
Group D_2	<1/million	<1/million	0 (<0.001)	0 (<0.5)	30	1	6-9	23/1-75/3	1/0-5/0	0/0-2/0	17/1	0	3.9-4.0	66 - 67	3.2-3.5
Group D_3	<1/million	<1/million	0 (<0.001)	0 (<0.5)	30	1	6-9	23/1-75/3	1/0-5/0	0/0-2/0	17/1	0	3.7-3.9	66 - 67	3.2-3.5
Group E_1	<1/million	<1/million	0 (<0.001)	0 (<0.5)	30	1	6-9	23/1-75/3	1/0-5/0	0/0-2/0	17/1	0	3.7-3.8	66 - 67	3.4-3.8
Group E_2	<1/million	<1/million	0 (<0.001)	0 (<0.5)	30	1	6-9	23/1-75/3	1/0-5/0	0/0-2/0	17/1	5 - 11	3.7-3.8	66 - 67	3.4-3.8
Group E_3	<1/million	<1/million	0 (<0.001)	0 (<0.5)	30	1	6-9	23/1-75/3	1/0-5/0	0/0-2/0	17/1	14	3.7-3.8	66 - 67	3.4-3.8
No Action	<1/million	<1/million	0 (<0.001)	1 (0.5)	30	1	2-2	10/0-13/0	1/0-1/0	0/0-0/0	8/0	10	2.7	189	3.5-3.5
See footnotes for this table on the next page.															

Footnotes for Table S.2

(a) For the action alternative groups, values represent the range for the Hanford Only to Upper Bound waste volume. Where a single value is given, the value applies to both Hanford Only and Upper Bound waste volumes. Values for health effects are rounded to the nearest whole number; values less than 0.5 are presented as zero.

(b) For the No Action Alternative, values represent the range for the Hanford Only to Lower Bound waste volume. Where a single value is given, the value applies to both Hanford Only and Lower Bound waste volumes. Values for health effects are rounded to the nearest whole number; values less than 0.5 are presented as zero.

(c) Unlike the action alternative groups where the risk of this accident would be over about 43 years, risk for the No Action Alternative would continue as long as waste is stored in CWC.

(d) Values are for Lower to Upper Bound waste volumes. The first value applies to the accidents and fatalities for the Lower Bound waste volume; the second value applies to the Upper Bound waste volume.

(e) The value shown is the probability of an LCF based on the estimated dose from the accident – the number of such non-involved workers is unknown, but likely would range from none to no more than 5. For the “involved” worker(s) that might be in a CWC building during such an event the consequences could range from none to several fatalities from collapse of the building.

(f) Consists of inferred fatalities from radiation exposure and vehicular emissions. In the final HSW EIS all offsite transport is addressed, including transport of TRU waste to WIPP and the entire transportation route for offsite waste sent to Hanford.

(g) As a result of refined calculations of resource needs based on the Technical Information Document (FH 2004), the need for gravel and sand, silt/loam, and basalt for action alternative groups increased by factors of approximately 1.8, 2.6, and 1.2, respectively, over those reported in the DEIS.

Table S.3. Summary Comparison of Hypothetical Impacts Among the Alternatives Over the Long-Term (up to 10,000 years)

Alternative Groups A-E - Hanford Only to Upper Bound Waste Volume [a] No Action Alternative - Hanford Only to Lower Bound Waste Volume [b]											
Alternative	Additional Land Permanently Committed to Disposal, ha	Exposure to Radionuclides Via Groundwater Pathway: Maximum Annual Drinking Water Dose, millirem[e, g]		Maximum Chances in a Million of Fatality (LCF) to Lifetime Onsite Resident Gardener[e, g]		Maximum Chances in a Million of Fatality (LCF) for Lifetime Onsite Resident Gardener with Sauna/Sweat Lodge[e, g]		Fatalities (LCFs) in Populations over 10,000 years[d]		Waste Site Intruder Maximum Risk of Fatality at 100 Years After Closure[e]	
		200 Areas[f]	Near River	200 Areas[f]	Near River	200 Areas[f]	Near River	Tri-Cities	Portland	Drilling	Excavation[h]
Group A	38-47	0.4	0.05	60	6	3000	200	0	0	4 in 100	Not Applicable
Group B	56-80	0.4	0.04	50-60	6-7	7000-8000	200-300	0	0	4 in 100	Not Applicable
Group C	20-29	0.4	0.04-0.05	60	6-7	3000	200	0	0	4 in 100	Not Applicable
Group D_1	19-25	0.2	0.05	20-30	7-8	2000	200	0	0	4 in 100	Not Applicable
Group D_2	19-25	0.2	0.06	30	8-9	4000	200	0	0	4 in 100	Not Applicable
Group D_3	19-25	0.3-0.4	0.05	50	6-7	3000-4000	200	0	0	4 in 100	Not Applicable
Group E_1	19-25	0.2	0.06	30	8-9	3000	200	0	0	4 in 100	Not Applicable
Group E_2	19-25	0.2	0.04	30	5	3000	200	0	0	4 in 100	Not Applicable
Group E_3	19-25	0.3-0.4	0.04	50	6	2000	200	0	0	4 in 100	Not Applicable
No Action	86-95[c]	0.4-0.5	0.04	50-140	5	10,000-20,000	600	0	0	4 in 100	Likely Fatality

(a) Where a single value is given it is essentially the same for the Hanford Only and Upper Bound waste volumes.
(b) Where a single value is given it is essentially the same for the Hanford Only and Lower Bound waste volumes.
(c) Includes additional land for long-term storage of waste that cannot be treated or processed for disposal.
(d) Zero inferred latent cancer fatalities. Assumed populations; Tri-Cities – 125,407; Portland – 538,180.
(e) Risk value given assumes that the event takes place; i.e., active institutional controls are not maintained after 100 years.
(f) Results presented are for a location within the 200 Areas having the highest radionuclide concentrations along a line of analysis 1-km downgradient from HSW disposal facilities. Sensitivity cases were also evaluated to determine the relationship of concentrations at the 1-km location to those at the waste management area or facility boundaries. The results of those analyses are presented in Volume I, Section 5.3.
(g) Differences in impacts compared with those presented in the revised draft EIS reflect additional mitigation to reduce the release and transport of contaminants resulting from assumed disposal of some forecast MLLW using higher integrity containment, such as HICs, macroencapsulation, and in-trench grouting.
(h) Excavation is not considered to be a reasonably foreseeable scenario for the action alternative groups because the depth of the barrier placed over disposal facilities at closure is greater than the depth of a typical basement excavation for a residence. The dose estimated for this scenario in the No Action Alternative likely would lead to fatality.

We made a number of conservative assumptions in our analysis that were intended to maximize, or overestimate, the potential impacts. One of these assumptions is that active institutional controls would end 100 years after site closure. Without active institutional controls, the analysis assumes that disposal facility caps would not be maintained and would degrade over time, maintenance and monitoring activities would not be performed, and there would be no long-term credit taken for the presence of liners in preventing release of contamination from the disposal facilities. Those assumptions increased the potential long-term impacts, and they are considered to be conservative because many engineered structures and administrative or institutional controls have remained in place for several hundreds of years (Europe is replete with examples of both).

Although we have used these assumptions in our analysis, the federal government fully intends to maintain institutional controls and continue long-term stewardship, mitigation, maintenance, and monitoring activities for as long as necessary. Based on comments received, we have provided additional analyses in this final HSW EIS regarding the potential variation in the environmental impacts under continued active maintenance and control measures. For example, if protective barriers over the disposal facilities are assumed to function as designed for the entire 10,000-year period of analysis, the estimated peak concentrations of contaminants in groundwater are lower, but persist over a much longer time, compared with the cases in which the barrier is assumed to be absent or effective for only a limited time (see Volume I, Section 5.3.5 of the final HSW EIS). These differences occur because of the reduced water infiltration rate through an intact barrier.

Land Use: We prepared an estimate of the total amount of land committed to waste management for each alternative group. All proposed waste management facilities would be located within, and consistent with, the Hanford Comprehensive Land-Use Plan EIS Industrial-Exclusive land-use designation (DOE 1999). Disposal facilities would permanently commit land areas to that use, whereas storage and treatment facilities are typically removed after their useful life ends. Incremental increases in long-term land use are summarized in the following section and in Table S.3; the analyses for land use can be found in Volume I, Section 5.1.

Land permanently committed to waste disposal includes about 130 hectares occupied by waste previously disposed of in the Low Level Burial Grounds. Disposal of the forecast Hanford Only waste volume would increase the 200 Area land permanently committed from a low of 19 additional hectares under Alternative Groups D and E, to a maximum of 56 additional hectares for Alternative Group B. Therefore, disposal of forecast Hanford waste represents a 15- to 43-percent increase over land currently occupied in the Low Level Burial Grounds.

Disposal of the forecast Upper Bound waste volume would increase the 200 Area land permanently committed from a low of 25 additional hectares under Alternative Groups D and E (6 hectares greater than for the Hanford Only waste volume) to a maximum of 80 additional hectares under Alternative Group B (24 hectares greater than for the Hanford Only waste volume). Therefore, disposal of waste from other sites at the Upper Bound waste volume would increase the land area required by 4 to 13 percent over that needed for existing and forecast Hanford waste.

Under the No Action Alternative, up to an additional 28 hectares would be permanently committed for disposal facilities, and up to 66 additional hectares would be committed for long-term storage of wastes that could not be processed for disposal.

Land occupied by existing treatment and storage facilities amounts to 127 hectares, which would not require expansion under any of the action alternatives except Alternative Group B. Construction of a new waste processing facility would add 4 hectares to the total for that alternative group. At most, total land use for solid waste operations, including treatment, storage, and disposal facilities, would be about 4 percent of the 200 Area Industrial-Exclusive zone.

Transportation: We described the potential nationwide impacts of shipping solid waste from other sites to Hanford and shipping TRU waste from Hanford to the Waste Isolation Pilot Plant through the assumed end of waste management operations in 2046. We also evaluated the impacts of shipments within the Hanford Site of LLW, MLLW, TRU waste, ILAW, and WTP melters to onsite treatment and disposal facilities; shipments of some Hanford MLLW to offsite treatment facilities; and shipments of construction and capping materials to Hanford. In response to comments received during public review, we also highlighted transportation impacts within the states of Washington and Oregon. Routes that are anticipated to be used for transport of LLW, MLLW, and TRU waste to and from various sites around the nation are shown in Figure S.16. Three routes through Washington and Oregon were analyzed (see Figure S.17).

Information on the transportation analyses can be found in Volume I, Section 5.8 and Volume II, Appendix H. Comparisons of the HSW EIS transportation impacts to those from previous DOE analyses (DOE 1997a, DOE 1997b) are presented in Volume II, Appendix H. Although updated methods and assumptions were used in the HSW EIS, the results of the analyses were similar to those published previously.

From the analyses, we estimated 2 latent cancer fatalities (LCFs) from incident-free transportation activities in the No Action Alternative for the Hanford Only or Lower Bound waste volumes. In the action alternatives, 6 LCFs were estimated for the Hanford Only waste volume, and 9 to 10 LCFs were estimated for the Upper Bound waste volume. For the Hanford Only and Lower Bound waste volumes, the potential LCFs would be associated principally with the transport of Hanford's TRU waste to WIPP, which accounts for about 95% of the potential LCFs. The potential LCFs are also associated with TRU waste being shipped to Hanford. The incremental impacts for the Upper Bound waste volume were primarily due to LLW and MLLW shipments to Hanford.

In the No Action Alternative, including the transport of TRU waste to WIPP, 10 to 13 accidents with no fatalities were estimated for the Hanford Only and Lower Bound waste volumes, respectively. For the other alternatives, the Lower Bound waste volume resulted in an estimated 22 to 23 accidents and 1 potential fatality. For the Upper Bound waste volume, 74 to 75 accidents were estimated with the possibility of 2 to 3 fatalities.

Figure S.16. Analyzed Transportation Routes of Radioactive Waste Through the United States

Figure S.17. Analyzed Transportation Routes of Radioactive Waste Through Oregon and Washington

The transport of TRU waste to WIPP for Alternative Groups A through E might result in 17 traffic accidents with 1 fatality; and the No Action Alternative might result in 8 traffic accidents with no fatalities. Results for the No Action Alternative are lower because waste that could not be certified for disposal at WIPP was assumed to remain in storage at Hanford or where it is currently located.

The impacts through 2046 in Oregon and Washington from incident-free transport of waste to or from the Hanford Site (either the Hanford Only or Upper Bound waste volumes) were estimated to result in one fatality within the two states. Within Oregon and Washington (including the Hanford Site), we estimated the number of potential traffic accidents would range from a low of 1 for the Hanford Only waste volume to a high of 7 for the Upper Bound waste volume, with the possibility of one associated traffic fatality.

Although transportation of waste from other sites to Hanford for disposal or temporary storage might result in potential impacts, the sites at which those wastes were generated would not have capabilities to manage them. Those sites would ultimately need to ship their wastes to another facility, either Hanford or elsewhere, and similar impacts would be likely to occur for transportation to any potential receiving site. In all of the waste volume scenarios, transportation of Hanford's TRU waste to WIPP accounts for a substantial fraction of the estimated impacts.

Air Quality and Noise: Air quality impacts are based on estimated concentrations of particulate matter, sulfur dioxide, carbon monoxide, and nitrogen dioxide at points of public occupancy for comparison with state and federal air quality standards. Air quality standards are not exceeded under any of the alternatives over the range of waste volumes. In addition to the analysis of air quality, we also assessed construction noise. Because all alternatives would involve essentially the same activities, noise levels produced by those activities at any given point in time would be essentially the same. Moreover, noise was not considered to be an important impact element because of distance to public receptors and the ability of wildlife to acclimate to, or move away from, noise sources. Analyses for air quality and noise impacts appear in Volume I, Sections 5.2 and 5.9, respectively.

Ecological Resources: Potential impacts on ecological resources are small among the alternative groups and the No Action Alternative; we do not expect them to be important discriminators in the selection process. However, development of new disposal facilities at the location near PUREX could result in the loss of shrub-steppe habitat, which may represent a discriminating ecological resource impact for the alternative groups (A, C, D_1, E_2, and E_3) including that option. If this location were selected, mitigation measures would be expected in accordance with our biological resources management program as described in the *Hanford Site Biological Resources Management Plan* (DOE-RL 2001) and the *Hanford Site Biological Resources Mitigation Strategy* (DOE-RL 2003b). Potential impacts on terrestrial biota were based on appropriate seasonally adjusted surveys. Potential impacts on aquatic and riparian biota near and in the Columbia River were based on an ecological risk assessment of potential future releases from waste sites through groundwater to the river. Exposures of aquatic and riparian biota to radiological and chemical materials from future contaminant releases are well below levels expected to cause any discernible impacts. The risk to threatened and endangered species is likewise negligible for all the alternative groups. Analyses for ecological resources appear in Volume I, Section 5.5, and Volume II, Appendix I. More detailed information can be found in Section 5 where the specific potential impacts of each alternative group are discussed. More detailed information on potential mitigation measures can be found in Section 5.18 and other places.

Cultural, Aesthetic, and Scenic Resources: The principal potential for impacts on cultural resources would be associated with disturbance of the surface and near-surface portions of the proposed Area C borrow pit site (Figure S.18). Although it is possible that we might find archeological sites in Area C, a recent field reconnaissance failed to reveal any sites or artifacts on the surface. In the event that artifacts of possible cultural significance were found, construction would be halted until a professional evaluation was made. Borrow material requirements are similar for all action alternatives; therefore, it

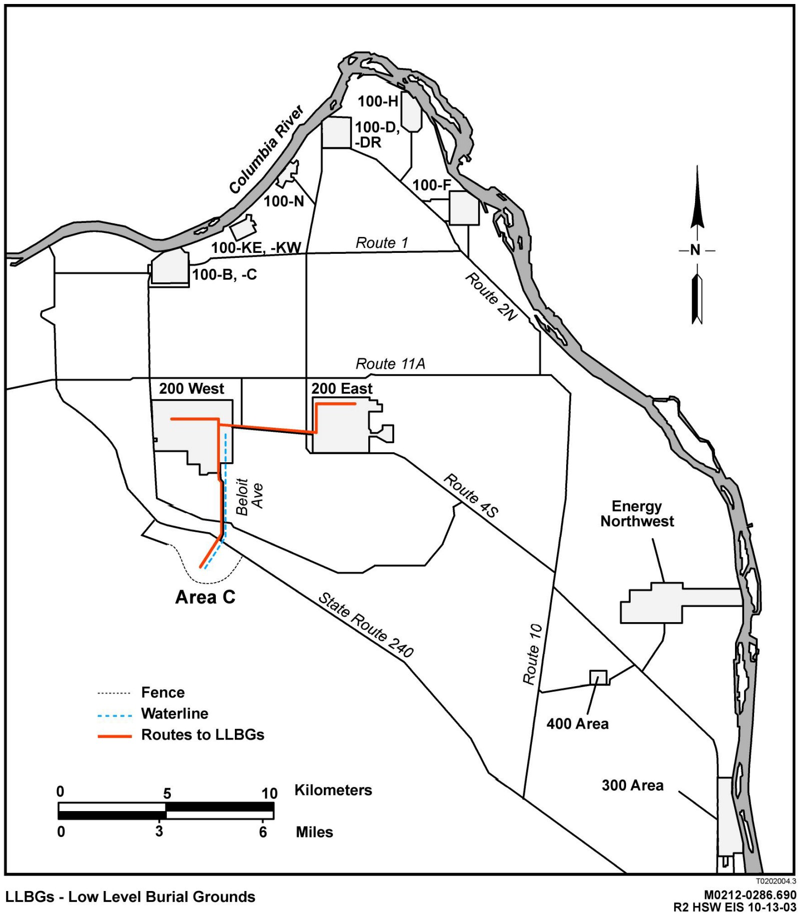

Figure S.18. Area C Location Relative to the 200 East and 200 West Burial Grounds

would be unlikely that impacts to cultural resources would be important discriminators among the alternative groups. The evaluation of cultural resource impacts appears in Volume I, Section 5.7.

Potential impacts on aesthetic and scenic resources would result principally from excavation at Area C for borrow materials, or from construction of waste management facilities within the 200 Area Industrial-Exclusive zone. Potential impacts on aesthetic and scenic resources are expected to be minimal because these activities occur within previously disturbed areas adjacent to other industrial facilities, the locations are relatively remote from publicly accessible areas, and most of the activities occur over a relatively short term. After the end of active waste management operations, borrow areas, disposal facilities, and sites for other decommissioned facilities would be restored to a naturally vegetated state. These activities would be similar for all alternative groups and waste volumes; therefore, no particular distinction was made among any of the alternative groups for impacts on aesthetic and scenic resources. Aesthetic and scenic resource impacts are discussed in Volume I, Section 5.12.

Socioeconomics and Environmental Justice: Implementation of any of the alternative groups or the No Action Alternative, for any of the waste volumes evaluated, would involve a relatively small work force relative to expected regional employment over the operational period. Waste management activities would have minimal and barely differentiable impacts on local socioeconomic infrastructure, including housing, schools, medical support, traffic, and environmental justice impacts. Analyses of socioeconomic and environmental justice impacts appear in Volume I, Sections 5.6 and 5.13, respectively.

Geological and Non-Renewable Resources: Although large quantities of gravel, silt/loam, and basalt would be needed in the construction of waste disposal facility barriers upon closure, these resources are readily available at the proposed Area C borrow pit site. The quantities of these resources range from a low of 2.7 million cubic meters for the No Action Alternative to a high of 4.9 million cubic meters for Alternative Group B. Disposal of the Upper Bound waste volume would increase the requirements for geologic resources by 4 to 15 percent relative to the Hanford Only waste volume, depending on the disposal facility configuration for a particular alternative group. Analyses for geological resource use are presented in Volume I, Section 5.4.

In addition to geologic resources, the consumption of fossil fuels (diesel, gasoline, and propane) has been estimated for all the alternative groups. Alternative Groups A and B have noticeably higher fossil fuel demands than the other alternative groups because of additional construction and the operation of new onsite treatment facilities. Disposal of the Upper Bound waste volume would increase the requirements for fossil fuels by 5 to 12 percent relative to the Hanford Only waste volume, depending on the alternative. Analyses for fossil fuels and other resource use appear in Volume I, Section 5.10.

Cost: The costs associated with waste management operations through 2046 ranged from $3.2 billion to $4.2 billion in 2002 dollars (Table S.2). In general, Alternative Groups C, D, and E were associated with the lowest costs because of their more efficient disposal facility configurations and because of the reduced cost of treating some Hanford waste at offsite facilities compared with constructing new onsite treatment capability. Relative to the Hanford Only waste volume, the incremental costs of managing offsite waste added 1 to 2 percent to the total cost for the Lower Bound waste volume and 10 to 11 percent to the total cost for the Upper Bound waste volume in all alternatives. The cost analysis for HSW EIS alternatives is presented in Volume I, Section 3.6. For perspective, the estimated total costs associated with the HSW EIS waste management alternatives through 2046 are less than two times the FY 2003 budget for the Hanford Site. Therefore, the incremental costs of managing offsite waste are unlikely to influence the progress of other Hanford Site cleanup programs over the long term. The cost analysis appears in Volume I, Section 3.6 of this HSW EIS.

Water Quality: For the HSW EIS, groundwater quality was evaluated by estimating the maximum combined concentrations of radionuclides or chemicals in predicted plumes along several lines of analysis downgradient (toward the river) from existing or proposed solid waste disposal facilities. These lines of analysis were positioned at a distance of 1 kilometer from disposal facilities in order to capture the combined contributions from multiple disposal facilities located in different areas of the Hanford Central Plateau, as illustrated in Figure S.19. Most of the 1-kilometer lines of analysis fall within, or near the boundary of, the 200 Area Industrial-Exclusive zone. In addition, groundwater quality was evaluated at a line of analysis along the Columbia River, which is also illustrated in Figure S.19. Surface water quality was evaluated by determining the rates at which constituents in groundwater enter the Columbia River. Additional quantitative evaluations were prepared for disposal facilities in Alternative Group D, which includes DOE's preferred alternative (Section S.7.2), to estimate the groundwater concentrations about 100 m downgradient from existing LLW management area boundaries, or from proposed new disposal

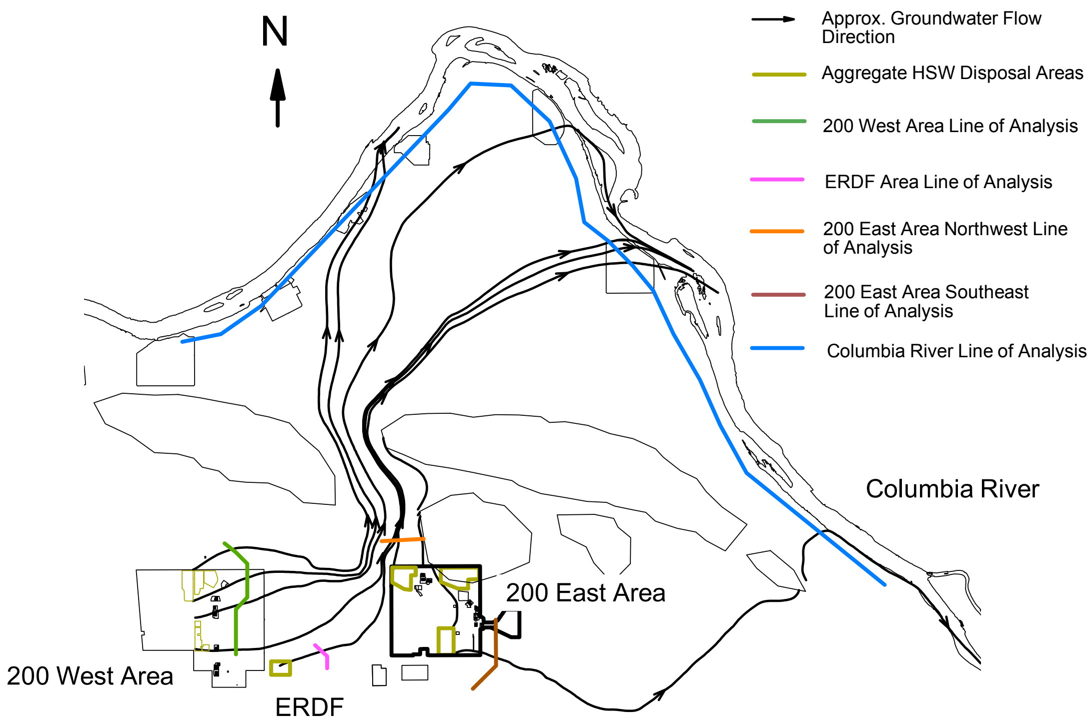

Figure S.19. Lines of Analysis for Estimating Maximum Annual Drinking Water Dose

facility boundaries. Based on those analyses, a qualitative assessment was performed for the other alternatives. The water quality analyses are presented in Volume I, Section 5.3 and Volume II, Appendix G.

One measure of water quality for purposes of comparing the alternatives is taken as the annual dose to an individual from drinking 2 liters per day of groundwater from hypothetical wells located along the lines of analysis described previously. As a benchmark, the estimated doses from disposal of wastes in the HSW EIS alternatives are compared with the 4 millirem-per-year standard for public drinking water systems operated by DOE (DOE 1993), although groundwater beneath the Hanford Site is not currently used as a source for public drinking water. Estimated peak doses from drinking groundwater containing combined radionuclide concentrations at 1 kilometer from the Hanford solid waste disposal facilities, for any of the alternatives and waste volumes disposed of, would fall below 1 millirem per year over the 10,000-year period of analysis. The corresponding doses estimated adjacent to the Columbia River would be less than 0.1 millirem per year for the period of analysis. Most of the variation in groundwater radionuclide concentrations among the alternatives resulted from proposed locations and configurations for new disposal facilities; differences between the Hanford Only and Upper Bound waste volumes were minimal. Doses from using Columbia River water downstream from Hanford would be substantially lower than those estimated for groundwater use, and are expected to be far below state and federal public drinking water standards. The doses to individuals and populations from various uses of groundwater are discussed in Volume I, Section 5.11 and Volume II, Appendix F.

For Alternative Group D, the doses from radionuclides in groundwater 100 m from LLW management areas or new disposal facility boundaries would not exceed the 4-millirem-per-year benchmark DOE standard in any of the sub-alternatives (D_1, D_2, or D_3) for the individual waste categories described in Volume I, Section 5.3.2. Based on the results for Alternative D in Volume I, Section 5.3.6.4 and a qualitative evaluation for the other HSW EIS alternatives in Section 5.3.6.5, the 4-millirem-per-year benchmark standard could potentially be exceeded at new disposal facility boundaries for other alternatives, depending on the location and configuration of those facilities.

Based on these analyses, all alternatives and waste volumes analyzed in this EIS would meet the DOE four millirem-per-year benchmark public drinking water dose at the 1-kilometer lines of analysis and at locations near the Columbia River (see Volume I, Section 3.4.3 and Section 5.11.2.1). To put these results into perspective, the average dose to individuals in the United States from naturally occurring background sources is about 300 millirem per year. By the time waste constituents are predicted to reach groundwater in the action alternatives (hundreds of years), the waste constituents would only minimally contribute to existing plumes at those locations because by then, existing groundwater contaminant plumes would have essentially migrated out of the areas potentially affected by disposal facilities considered in the HSW EIS.

In addition to the DOE dose standard, we also compared potential radionuclide and chemical concentrations in groundwater to the 40 CFR 141 maximum contaminant levels for public drinking water systems as benchmark standards. Those analyses are presented in Volume I, Section 5.3 and Volume II, Appendix G.

Under all alternative groups and the No Action Alternative, the highest potential impacts to groundwater quality were estimated from releases of long-lived technetium-99, iodine-129, and uranium isotopes. Using the sum-of-fractions method, the total concentrations of technetium-99 and iodine-129 when combined would reach a maximum of 69 percent of the drinking water standard in the 200 Areas for Alternative Groups D_3 and E_3 at the ERDF 1-kilometer line of analysis for the Upper Bound waste volume in about the year 3900 A.D. Combined technetium-99 and iodine-129 concentrations would be even further below benchmark standards by the time they reached the Columbia River line of analysis for all alternative groups and the No Action Alternative. For the No Action Alternative, uranium concentrations reached up to about 5 percent of the benchmark standard at the 200 East Area line of analysis about 10,000 years after closure. None of the alternatives would result in concentrations of uranium exceeding 0.3 percent of the benchmark standard at the river line of analysis. As in the dose evaluation, most variation in groundwater radionuclide concentrations among the alternatives resulted from different proposed configurations and locations for new disposal facilities, and there were essentially no differences between the Hanford Only and Upper Bound waste volumes.

For Alternative Group D_1, constituents migrating from new waste disposal facilities would not exceed maximum contaminant levels in groundwater at the disposal facility boundary. For existing disposal facilities and for new disposal facilities in other alternatives, the benchmark drinking water standards could potentially be exceeded at the disposal facility boundaries in some cases.

A screening evaluation of hazardous chemicals potentially disposed of before October 1987 in the Low Level Burial Grounds did not identify any chemicals that would be likely to exceed the 40 CFR 141 maximum contaminant levels over the period of analysis. Wastes containing hazardous chemicals disposed of after October 1987 would have been treated according to regulatory requirements, and are not expected to present a substantial risk for groundwater contamination.

Human Health –Operational Period (present to 2046): We compared potential impacts on the public from the routine atmospheric releases of radioactive materials or chemicals during operations in various alternative groups. Airborne emissions from routine operations would be very small and would not be expected to result in any additional latent cancer fatalities in the exposed population. We also compared potential radiological impacts to workers (both non-involved workers and occupational radiation workers). The No Action Alternative would result in the highest collective worker dose, followed by Alternative Group B, with the remaining groups resulting in very similar collective doses. At the highest collective worker dose (873 person-rem), which results from the No Action Alternative, one additional latent cancer fatality might be estimated (0.52 calculated). No latent cancer fatalities would be expected among workers for the action alternative groups.

We do not expect that occupational injuries as a result of accidents or routine occupational radiation exposure would result in fatalities among workers involved in waste management operations. Some reportable and lost workday accidents of an industrial nature would be expected based on Hanford Site labor statistics (see Table S.2). The potential radiological impacts of accidents vary greatly depending on the circumstances of the events analyzed, but did not differ by alternative or waste volume. The human health impact evaluations for both routine operations and accidents are presented in Volume I, Section 5.11, and are described in more detail in Volume II, Appendix F.

Human Health – Post Closure Period: As stated previously, we made a number of conservative assumptions in our analysis that tend to maximize the estimated potential long-term impacts. These assumptions include such things as the absence of active institutional controls 100 years after site closure and the eventual degradation of disposal facility barriers. Although we have used these assumptions in our analysis, the federal government intends to maintain institutional controls and continue long-term stewardship, maintenance, and monitoring activities for as long as necessary. In the case of intruder scenarios (for example, unauthorized use of, or entry into, an area), the consequences are essentially the same for all alternative groups, and although they do not discriminate among alternatives, they are potential impacts. Because of these potential impacts, we would employ mitigation techniques such as maintaining institutional controls and stewardship activities for the alternatives selected in subsequent Records of Decision. The post-closure human health impact evaluations are presented in Volume I, Section 5.11 and Volume II, Appendix F.

Potential impacts on the public in the long term are expressed in terms of the annual dose hypothetical gardeners might receive at different locations, if they were to reside on the Hanford Site, drill a well into a contaminated aquifer, and use the well water for both domestic and irrigation purposes. Plots of the annual doses over time to the hypothetical resident gardeners at several locations are provided in Volume I, Section 3.4. There are differences in the annual doses over time as a function of the specific alternatives, location, and construction details; however, the maximum doses for all alternatives are less than 25 millirem per year, which is the DOE limit for all pathways (DOE 2001b). For perspective, 25 millirem per year is 8 percent of the typical annual dose received from naturally occurring sources.

To account for the possibility that the hypothetical resident had a sauna, or in the case of a Native American, a sweat lodge, the annual dose to such an individual as a function of time was also estimated. Plots of the annual doses for this scenario are again compared among the alternatives in Volume I, Section 3.4. The much higher potential doses associated with the sauna/sweat lodge scenario are attributable to inhalation of radionuclides (primarily uranium) released as a result of elevated water temperatures used in saunas or sweat lodges. For all alternatives, the estimated annual dose is at or less than 4 millirem for the first 1,000 years. Late in the 10,000-year period there is an increase in the risk of a latent cancer fatality due primarily to the arrival of uranium in groundwater. For a hypothetical 70-year residency at locations on the Central Plateau, the risk of latent cancer fatality for the sauna/sweat lodge scenario would range from up to about 8 in 10,000 for the action alternatives to 200 in 10,000 for the No Action Alternative. For a location near the river, the corresponding risk would range from up to 3 in 10,000 for the action alternatives to 6 in 10,000 for the No Action Alternative. For perspective, the risk of a latent cancer fatality over 70 years from the naturally occurring potassium-40 in the adult male body would be about 8 in 10,000. As noted in Section S.5.1, the use of conservative, or bounding, assumptions strongly influences these results, and the estimated potential impacts and risk would be much lower if credit were taken for continued effectiveness of barriers that would be installed and maintained over waste disposal sites.

Under all of the alternatives, radionuclide or hazardous chemical exposures to populations using Columbia River water downstream from the Hanford Site would be well below those from which we would expect any health effects. As noted in the groundwater quality analyses, the estimated doses and risks for all post-closure scenarios varied somewhat with assumptions related to disposal facility location and configuration, but within each alternative, they were not substantially different for the Hanford Only and Upper Bound waste volumes.

S.6.2 Cumulative Impacts

The cumulative impact discussion in this final HSW EIS has been expanded in response to comments, especially in the areas of potential groundwater impacts and human health impacts resulting from use of surface- or groundwater. The cumulative impacts analysis addresses past, present, and reasonably fore-seeable future actions. Examples of current and future actions at Hanford include preparation for and disposal of tank waste, CERCLA remediation projects, decontamination and decommissioning of the Hanford reactors and chemical processing facilities, operation of a commercial LLW disposal site by US Ecology, Inc., and operation of the Columbia Generating Station by Energy Northwest. We evaluated cumulative impacts regarding worker health and safety; public health (for atmospheric, surface water, and groundwater pathways); land use; air quality; and ecological, cultural, and socioeconomic resources. For most resource and potential impact areas, the combined effects of actions proposed in the HSW EIS would be a small addition to the effects of other past, present, and future actions.

Because of public interest in cumulative impacts associated with contamination of groundwater and the Columbia River, these impacts are presented here in more detail. Cumulative impacts on groundwater and the Columbia River are examined in the context of existing sources of contamination in the soil, vadose zone, and groundwater. Groundwater beneath the operational areas, and in plumes from the Central Plateau moving towards the Columbia River, is contaminated with hazardous chemicals and radionuclides from past liquid disposal practices and unplanned releases. Mobile radionuclides leached from wastes in the environment could eventually be transported through the vadose zone to groundwater.

Although groundwater beneath the Hanford Site is not used as a source of public drinking water today, nor is it expected to be in the foreseeable future, we evaluated a scenario in which an individual in the future is assumed to drill a well through the vadose zone to groundwater and use the groundwater as a source of drinking and irrigation water. To understand cumulative Hanford groundwater impacts, we analyzed the annual dose from radionuclides to an individual drinking 2 liters of that water per day. The annual dose was also estimated for an individual drinking 2 liters per day of water taken from the Columbia River at the City of Richland pump house. We took into account all wastes disposed of on the Hanford Site since the beginning of operations and waste forecasted to be disposed of through the end of site operations. Radionuclide releases from these wastes and their transport through groundwater to the Columbia River were modeled using the System Assessment Capability (SAC) software (Kincaid et al. 2000) and Hanford-specific hydrological data.

This analysis includes the contribution to cumulative impacts of the long-lived mobile radionuclides technetium-99, iodine-129, and isotopes of uranium, which would dominate the long-term risks associated with groundwater contamination. Other radionuclides were eliminated from consideration because their lower mobility, short half-lives, or low inventories would reduce their potential to contribute substantially to the overall risk. DOE is continuing to refine the inventory that would remain at Hanford following site closure, as well as the computer models, to provide more precise estimates under our Waste Management Program. If further analyses (such as disposal facility performance assessments) show the potential for adverse cumulative groundwater impacts, DOE would implement appropriate mitigation measures to prevent such cumulative impacts from occurring. Potential mitigation measures could include treating waste by such methods as macroencapsulation, grouting, placing it in more robust containers, or limiting the amount of waste in a specific disposal facility.

The approach taken by the SAC is consistent with the methods, characteristics, and controls associated with a composite analysis as described by the Columbia River Comprehensive Impact Assessment team (DOE-RL 1998). The SAC was applied in this HSW EIS to examine the cumulative dose from technetium-99, iodine-129, and uranium associated with all wastes expected to remain at Hanford after closure of the site; and to provide an overall (cumulative impacts) perspective regarding the contribution of solid waste from implementing the HSW EIS alternatives. Results of these analyses are provided in Volume I, Section 5.14 and Volume II, Appendix L.

Using SAC, we can conclude that the potential dose over the next 500 years from groundwater contamination by technetium-99, iodine-129, and uranium would be dominated by the existing groundwater plumes and past releases to the vadose zone from liquid waste disposal sites (for example, cribs, ponds, and ditches). In some locations, groundwater concentrations of constituents from those releases currently exceed benchmark drinking water standards (see Volume I, Section 4.5.3.2). Releases of contaminants from solid waste would begin to have noticeable contributions between the years 3,000 and 5,000 A.D.

and decline thereafter, with contributions from tank residuals causing a later secondary peak. Long-term releases from solid wastes, including ILAW, would appear during the last several thousand years of the 10,000-year post-closure analysis. Figure S.20 illustrates these results.

Action alternatives analyzed in this EIS would not cause the dose from drinking groundwater at 1 km from the disposal facilities to exceed the DOE 4-mrem-per-year benchmark public drinking water limit (see Volume I, Section 5.11.2.1). Analysis of the preferred alternative (see Section S.7.2) also indicated the dose from drinking groundwater at the disposal facility boundary would not exceed the DOE limit (see Volume I, Section 5.11.2.1.4). By the time the waste constituents from the action alternatives are predicted to reach groundwater (hundreds of years) the waste constituents would not superimpose on existing plumes and would not exceed the benchmark dose, because the existing groundwater contaminant plumes will have migrated out of the unconfined aquifer by then.

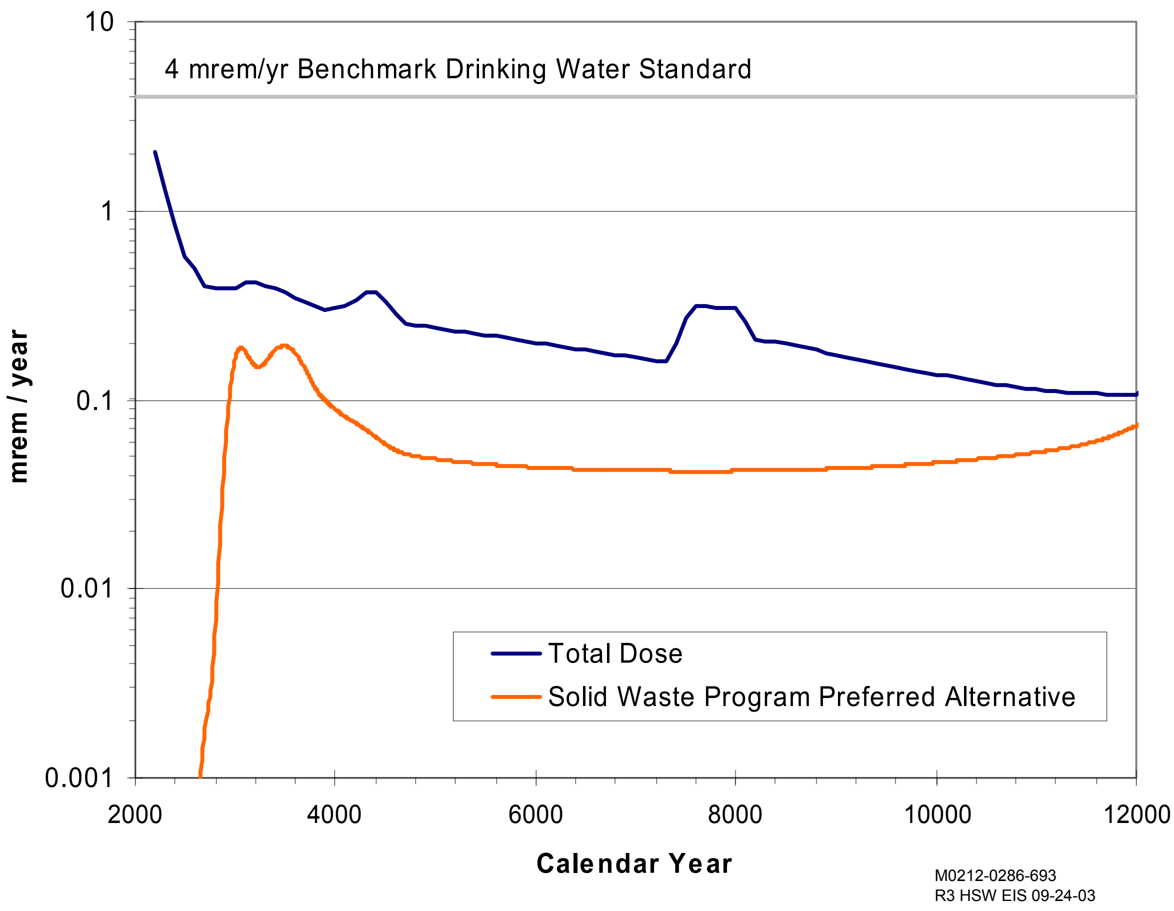

Figure S.20. Hypothetical Drinking Water Dose in Groundwater 1 km Southeast of the 200 East Area from All Hanford Sources

The contribution of solid waste from the HSW EIS preferred alternative is also shown in Figure S.20. Differences in the two curves, especially the slopes between 8,000 and 12,000 A.D., are attributed to different distribution coefficients used in the simulation of uranium in HSW EIS alternatives and in the SAC cumulative assessment. Values assigned to the HSW EIS alternatives are more conservative and thus exhibit earlier release (hence the upward slope of the curve) while values assigned in the cumulative assessment are median values designed to assess the central tendency of contaminant migration. The contribution to the total hypothetical drinking water dose from solid waste is increasing in the last few thousand years in the HSW EIS preferred alternative simulation because of a growing contribution from uranium; however, the uranium contribution is delayed beyond 10,000 years in the SAC simulation of cumulative impact.

SAC was also employed to evaluate the relative role in overall release of different waste types, including solid waste, past liquid discharges, past tank leaks, future tank losses, tank residuals, unplanned releases, and facilities (including canyon buildings). The variability in the results is due to variability in assumptions concerning the inventory, release, and transport of contaminants. In the simulation, the contribution to technetium-99 from solid waste releases to groundwater would amount to approximately 20 percent of the cumulative release from all Hanford sources. For iodine-129, releases from solid waste to groundwater would be approximately 25 percent of the cumulative release from all Hanford sources. For uranium, contributions from solid waste are much lower. The majority of the technetium-99, iodine-129, and uranium releases from wastes (other than ILAW) were estimated to occur from liquid discharge sites used in the past (for example, cribs, ponds, and ditches), from unplanned releases on the Central Plateau (including past tank leaks), and from off-plateau waste sites. Annual doses would be approximately one-hundred thousand times lower at the City of Richland pumping station compared with those predicted at the 200 East Area.

S.6.3 Uncertainties

Even with the knowledge gained over the past decade in addressing our environmental cleanup challenges, there still are many unknowns. Waste site inventories, both in terms of chemical and radioactive contaminants, are not well known for many of the older solid and liquid wastes sites present on the Central Plateau. Although the overall quantities of radionuclides generated at the Hanford Site are relatively well known, the actual amounts in specific waste sites are more uncertain. For example, the inventory of iodine-129 in the solid waste, vadose zone, and groundwater is uncertain by up to a factor of two, and thus, so are the associated cumulative impacts. Because of this and other uncertainties, the HSW EIS analysis typically uses conservative assumptions, which tend to overestimate the potential impacts.

Overall, the largest uncertainties in the HSW EIS analyses surround the actual volumes of waste we must treat, store, and dispose of and their associated levels of contaminants. To deal with this uncertainty we took the approach of using a range of potential waste volumes, with the Upper Bound waste volume being a very conservative (larger than expected) estimate of the maximum expected volume of waste to be managed at Hanford.

Another set of uncertainties results from our use of the various models and modeling techniques. For example, the science of modeling waste movement in the vadose zone and groundwater is continually developing, as is our knowledge base. The SAC is an example of a good, but still emerging, tool. Because we are uncertain about the nature and extent of some of the sources and types of contaminants, the SAC model was designed to accommodate a range of input assumptions. For example, the inventory of iodine-129 in the solid waste, vadose zone and groundwater is uncertain by up to a factor of two, and thus, so are the associated cumulative effects. Variability with regard to individual behavior and exposure affects uncertainty in the estimated dose even more. Because of these uncertainties, the HSW EIS analysis typically uses conservative assumptions, which tends to overestimate the potential impacts. See Volume I, Section 3.5 for additional discussion of uncertainties.

S.6.4 Mitigation

We have identified measures DOE could take to avoid or reduce environmental impacts that might occur as a result of the Hanford Solid Waste Program. The text box on the following page provides a brief list of potential mitigation measures that could be pursued (see Volume I, Section 5.18). Many of the activities described in the listing are incorporated into existing waste management practices and requirements and would be a part of normal operations considered in the HSW EIS alternatives. For example, to avoid loss of cultural resources, we would conduct cultural resource surveys before constructing solid waste management facilities. If we discovered cultural resources, we would confer with the State Historic Preservation Officer and Tribal governments (as applicable) in evaluating the find and determining appropriate management actions. In addition, if mature shrub-steppe habitat needs to be removed to construct a solid waste management facility, we could mitigate the habitat loss by revegetating or protecting other parcels of land.

In addition, we will continue to evaluate additional measures to improve the long-term performance of the disposal facilities and to reduce performance uncertainties. These measures include barriers or waste form technologies (e.g., macroencapsulation) to limit releases and transport of radionuclides, actions to restrict public access, and more protective designs during operations.

Besides identifying specific mitigation actions, the alternatives evaluated in this HSW EIS incorporate various mitigation features as part of the alternatives, such as use of a combined-use lined modular disposal facility, which would be considered an action to minimize the amount of land used. In addition, for the final HSW EIS, we have accounted for additional confinement of high iodine-129 content MLLW in the groundwater analyses for all of the action alternatives. This action is another illustration where mitigation actions and assumptions have been directly incorporated into the alternatives.

What are some of our potential mitigation measures?

- Continue implementing DOE's pollution prevention/waste minimization program.
- Perform cultural and biological surveys prior to construction.
- Implement guidelines (such as the replacement of shrub-steppe community disturbed by construction or capping activities) consistent with the *Hanford Site Biological Resources Management Plan* (DOE-RL 2001) and the *Hanford Site Biological Resources Mitigation Strategy* (DOE-RL 2003b).
- Continue to implement the "As-Low-As-Reasonably-Achievable" principle during operations and construction.
- Continue safety training to help protect workers and prepare for possible emergencies and accidents.
- Perform large movements of construction and capping materials during low traffic times.
- Implement resource management plans identified by the *Hanford Comprehensive Land-Use Plan* as mitigation action plans.
- Construct new facilities and trenches in areas that have already been disturbed. This would minimize the chances of encountering items of cultural significance or disturbing items of cultural significance that have not been disturbed. It would also minimize the impacts to animals, plants, and ecosystems.
- Construct final closure barriers that would allow the growth or re-growth of shrub-steppe habitat on them.
- Plan construction activities to avoid nesting seasons.
- Reuse top soil removed during construction of disposal trenches for construction of final closure caps to the extent possible.
- Install and use rain curtains in operating trenches. This would prevent some of the rainwater and snow melt from coming into contact with waste already in place. This, in turn, would reduce the amount of waste that could leach into the rainwater, reduce the amount of contaminated rainwater (leachate) that would have to be treated, and reduce the amount of leachate that could possibly reach the vadose zone or groundwater.
- Use soil fixants and wind speed limits to minimize dust generated during construction activities, waste disposal, and final closure activities.
- Treat and dispose of MLLW to RCRA land disposal restriction standards as quickly as possible to minimize the risk from accidents and exposure to workers from aboveground storage.
- Certify and ship transuranic waste in storage as quickly as possible to minimize the risk from accidents and exposure to workers from aboveground storage.
- Keep areas around facilities and trenches clear of combustible material to limit impacts from wildfires.
- Keep trenches clear of deep-rooted plants and burrowing animals to minimize the potential for spreading contamination.
- Provide additional waste treatment prior to disposal.

S.6.5 Long-Term Stewardship and Post Closure

Cleanup plans and decisions strive to achieve an appropriate balance among contaminant reduction, use of engineered barriers, and reliance on institutional controls. Decisions are influenced by several factors:

- risks to members of the public, workers, and the environment
- legal and regulatory requirements
- technical and institutional capabilities and limitations
- current state of scientific knowledge
- values and preferences of interested and affected parties
- costs and budgetary considerations
- impacts on, and activities at, other sites.

Reliance on institutional controls after contaminants have been reduced and engineered barriers have been put in place is referred to as long-term stewardship. Specific long-term stewardship activities depend on the specific hazards that remain and how those hazards must be controlled. Long-term stewardship activities are intended to continue isolating hazards from people and the environment.

DOE does not rely solely on long-term stewardship to protect people and the environment. As indicated in the DOE-sponsored report *Long-Term Institutional Management of U. S. Department of Energy Legacy Waste Sites* (National Research Council 2000), "contaminant reduction is preferred to contaminant isolation and the imposition of stewardship measures." Contaminant reduction is a large part of the ongoing cleanup efforts at Hanford. The long-term stewardship plan for the Hanford Site was approved in August 2003 (DOE-RL 2003a).

What are typical long-term stewardship activities?

- monitoring to verify the integrity of barriers placed over disposal sites
- maintaining barriers to ensure their continued integrity
- monitoring groundwater and the vadose zone to determine whether systems to contain hazards are working
- monitoring for surface contamination
- monitoring animals, plants, and ecosystems
- performing groundwater pump-and-treatment operations
- installing and maintaining fences and other barriers
- posting warning signs
- establishing easements and deed restrictions
- establishing zoning and land-use restrictions
- maintaining records on cleanup activities, remaining hazards, and locations of the hazards
- maintaining necessary infrastructure (e.g., utilities, roads, communication systems).

S.7 Major Conclusions

Our analysis demonstrates that implementing any of the action alternatives (to operate existing and new facilities for the safe treatment, storage, and disposal of solid radioactive wastes and then to close those facilities) would not have adverse physical effects on populations using the Columbia River downstream of the Hanford Site. In addition, the disposal of solid waste would make only a small contribution to projected doses for people in the highly unlikely event that they were to drink groundwater from the Hanford Site. However, while also highly unlikely, intruder and resident gardener scenarios incorporating the use of saunas or sweat lodges could result in doses that might be of concern at times after about 8,000 years. Mitigation plans, particularly those related to our long-term stewardship actions, including land-use notices and restrictions as well as active and passive institutional controls, would be used to minimize the risk from possible post-closure intrusion into the waste zones or groundwater resource into the future.

In general, the proposed action would potentially result in small, short-term public health and worker safety impacts due primarily to the transportation of waste, industrial accidents, and occupational exposure to radiation, regardless of the alternative group chosen for implementation. Transportation impacts would be associated largely with non-radiological traffic accidents and vehicle emissions. Industrial accidents would depend for the most part on the volumes of waste to be handled. Occupational exposure to radiation would be well below permissible limits and would not result in any additional latent cancer fatalities. Impacts at the Hanford Site for the operational period are summarized in Table S.2. Impacts are compared among the alternatives in Volume I, Section 3.4 and discussed in further detail in Volume I, Section 5. Volume II contains additional information to support many of these sections.

S.7.1 Major Impact Differences Among the Alternatives

The No Action Alternative does not address the need for final disposition of many of the waste types, leaving large volumes in storage for the foreseeable future. Therefore, the obligation to dispose of these wastes would become the responsibility of future generations. Moreover, the No Action Alternative results in the largest impacts for a number of the environmental resource categories. It uses the most land because of the need to expand storage facilities, such as the Central Waste Complex, for wastes that could not be treated or disposed of under that alternative. It also requires the largest amounts of non-renewable and geologic resources for construction of storage facilities and the barrier over the ILAW disposal facility. The additional construction and long-term storage of waste would also result in the largest occupational radiation exposures and number of industrial accidents. In addition, implementing the No Action Alternative would preclude DOE from eventually meeting its compliance obligations.

After the No Action Alternative, Alternative Group B generally has the next highest potential impacts among the alternatives. As configured, Alternative Group B would be the action alternative with the largest land-use impacts because it involves building new treatment facilities and using the existing (and less efficient) designs for disposal facilities. Based on these considerations, Alternative Group B would result in the highest potential impacts among the action alternative groups in the non-renewable and geologic resources, air quality, worker dose, groundwater quality, and occupational exposure categories. One benefit of Alternative Group B is a reduction in transportation impacts because most MLLW would be treated onsite.

Alternative Groups A and C have more efficient designs for individual disposal cells (for LLW, MLLW, and ILAW) and both would use a combination of existing onsite facilities (including a modified

T Plant) and offsite capabilities for the treatment of waste. These alternative groups have noticeably reduced impacts in a number of environmental categories compared with Alternative Group B. Thus, the use of existing onsite and offsite treatment capabilities appears to result in lower onsite impacts compared with the construction of new onsite treatment facilities. In addition, the use of improved disposal cells compared with existing disposal trench design also results in lower impacts.

Alternative Groups D and E were configured to evaluate the potential impacts and benefits associated with combined-use disposal facilities. In Alternative Group D, we looked at a single combined-use disposal facility for all Hanford solid waste types (LLW, MLLW, ILAW, and WTP melters). In Alternative Group E, we considered two combined-use disposal facilities, one for LLW and MLLW, and a separate facility for ILAW and WTP melters. The waste treatment approach for these alternative groups would be the same as in Alternative Groups A and C. In general, Alternative Groups D and E have noticeably reduced impacts in a number of environmental categories compared with Alternative Groups A, B, and C. Within these two alternative groups we also examine the effect of different locations for combined-use disposal facilities. The differences in impacts among Alternative Groups D and E and their subgroups would generally be small. Thus, the use of combined-use facilities also appears to result in lower impacts compared with those designed for individual waste streams.

S.7.2 DOE Preferred Alternative

Based on the results of the environmental analyses (as presented in Volume I, Section 5 and summarized in Volume I, Section 3.4), cost, and other considerations, DOE has identified its preferred alternative for the HSW EIS. The preferred alternative consists of those actions identified in Alternative Group D_1. The preferred alternative would be implemented for Hanford and offsite waste up to the Upper Bound waste volume. Offsite waste would be managed in the same manner as onsite waste. The preferred alternative would be implemented as follows:

Storage: The Central Waste Complex will continue to be the primary storage facility for LLW, MLLW, and TRU waste. Consistent with previous decisions, TRU waste retrievably stored in the Low Level Burial Grounds would be retrieved for processing and shipment to WIPP. Until the waste is retrieved, it would continue to be stored in the LLBGs. Newly generated mixed TRU waste from onsite and offsite generators would be stored in RCRA-compliant storage facilities such as CWC and T Plant. Newly generated non-mixed TRU waste from onsite and offsite generators would be stored in several places, such as CWC and T Plant, but remote-handled waste could be stored temporarily in the Low Level Burial Grounds. T Plant would be used to store sludge from the K Basins.

Treatment: LLW and MLLW would be treated using a combination of existing capabilities and processes, offsite commercial capabilities, and a modified T Plant. TRU waste would be processed and certified using a combination of the Waste Receiving and Processing Facility, a modified T Plant, and mobile processing facilities.

Disposal: Newly generated LLW, MLLW, ILAW, and WTP melters would be disposed of in a new modular facility near PUREX. This new disposal facility would include a RCRA-compliant liner and a leachate collection/leak detection system. Upon closure, it would be capped with a Modified RCRA

Subtitle C Barrier. Waste previously disposed of in the Low Level Burial Grounds would be similarly capped. Existing disposal capacity in the Low Level Burial Grounds would continue to be used as necessary to meet short-term requirements pending construction and operation of the new disposal facility.

In general, waste management activities outlined in Alternative Group D_1 would be operationally efficient, cost-effective, and environmentally preferable as to many types of potential impacts. The differences in impacts among all alternative groups would be relatively minor. However, Alternative Group D_1 appears to offer a combination of low environmental impacts and low cost. Future waste disposal operations would be combined in a single location that could provide a more unified regulatory pathway to construction, operation, and stewardship.

S.7.3 Areas of Controversy

We acknowledge that areas of controversy exist regarding the proposed action and the analyses in the HSW EIS. We have considered these areas in the development of this final HSW EIS. Issues raised during the public review are addressed in the Comment Response Document, Volume III of this final HSW EIS.

Receipt of Offsite Waste: There are differing points of view about the importation of waste to Hanford from other DOE sites and the additional impact that waste would have on the environment. To clearly communicate the incremental impacts of receiving and managing offsite waste, we analyzed three different waste volumes: Hanford Only, Lower Bound, and Upper Bound. As discussed previously, the additional offsite waste in the Lower Bound and Upper Bound volumes did not substantially increase the impacts that would occur during management of Hanford's waste.

Transportation: Concerns were expressed regarding previous transportation analyses conducted for the Waste Management Programmatic EIS and the desire by members of the public to have the transportation impacts updated as part of the HSW EIS. To address this issue we have included an updated nationwide transportation analysis for both Hanford waste and offsite waste shipments to Hanford using current highway routing information, 2000 census data, and the latest versions of the radiation transportation computer codes. Details of the transportation analysis can be found in the final HSW EIS Volume I, Section 5.8 and Volume II, Appendix H. The results of the new analysis are consistent with the past transportation analysis conducted as part of the WM PEIS (DOE 1997a) and the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b).

Technetium-99 Inventory in ILAW: There are different points of view regarding removal of technetium-99 from Hanford's tank waste. The analysis performed in the revised draft HSW EIS assumed that a maximum quantity of technetium-99 remained in the ILAW waste stream to provide a bounding analysis. In the final HSW EIS, we have also performed an analysis assuming a much lower quantity (approximately one-fourth) of technetium-99 remaining in the ILAW. Details of the analysis can be found in Volume I, Section 5.3 and Volume II, Appendix G. In addition, as indicated in Volume I, Section 1.5.2, DOE is currently preparing a separate EIS that will evaluate alternative treatment processes for some tank waste and disposal of low-activity waste forms other than those considered in this HSW EIS.

Modeling Uncertainties and Evaluation of Long-Term Performance: There are differing points of view regarding the ability to predict groundwater impacts and the use of computer models for accurately predicting groundwater and human health impacts far into the future. We estimated long-term impacts using the best available methodologies, and we identified the uncertainties associated with our models. Some disagreement also exists with our use of bounding assumptions, which predict higher modeled groundwater concentrations than would be likely to occur, potentially masking differences among the alternatives. To address this issue, the final HSW EIS contains supplemental groundwater analysis that was prepared to illustrate how predicted impacts change when varying these assumptions. For example, the groundwater models have been run to explore the effects of maintaining the disposal facility surface barrier over time. DOE believes that the analyses in this final HSW EIS are suitable for purposes of comparing and bounding potential impacts among alternatives.

Lines of Analysis: There are differing points of view about where groundwater impacts should be estimated. It has been suggested that analysis at the disposal facility boundaries is needed. The lines of analysis used in the HSW EIS alternative assessments were located along lines approximately 1 kilometer downgradient from aggregate Hanford solid waste disposal facilities within the 200 East, 200 West, and the ERDF areas. Another line of analysis was located near the Columbia River downgradient from all disposal facilities. These lines of analysis downgradient from the overall waste disposal facilities in each area are not meant to represent points of compliance but rather common locations to facilitate a more complete comparison of long-term impacts from the various waste management configurations and locations defined for each alternative. In the final HSW EIS, we have included quantitative modeling information at the boundary of the possible new combined-use disposal facility locations in alternative Group D (which includes DOE's preferred alternative), and at the boundaries of the existing LLW management areas. This information is based on a more detailed modeling approach similar to that needed to support the new disposal facility permitting process (see Volume I, Section 5.3 and Volume II, Appendix G). Based on these analyses, a qualitative assessment was performed for the other action alternative groups.

Cumulative Impacts: There are differing points of view regarding how best to assess cumulative impacts on the Hanford Site. For example, a number of public comments expressed concern about the SAC computer model's ability to predict the long-term consequences of waste disposal. Because the Hanford Site cleanup is a technically complex and long-term program, with associated uncertainties both in terms of final cleanup end states and modeling techniques, cumulative impact analyses will necessarily reflect those same uncertainties. The final HSW EIS discussion of cumulative impacts was expanded to include additional constituents (notably iodine-129) and to more clearly show the contribution to long-term impacts from waste considered in the HSW EIS alternatives relative to those from other Hanford sources (see Volume I, Section 5.14 and Volume II, Appendix L).

Land Use: There are differing points of view about actions on the Hanford Site that use additional land for waste management activities. For example, a number of public comments expressed concern about using more land at Hanford for disposal of waste from offsite generators.

S.7.4 Future Activities

In conjunction with the preferred alternatives to modify T Plant, construct new disposal facilities, and close the disposal facilities once they are no longed needed, the following activities would be conducted:

- We would finalize the design features for new disposal facilities to support completion of the performance assessment process and to support an application to the State of Washington for a permit to construct, operate, and close such a facility.

- We would also finalize the design features, MLLW treatment processes, and TRU waste certification systems for the modified T Plant to support the application to the State of Washington for a permit to modify and operate such a facility.

- In accordance with the Tri-Party Agreement we would prepare and submit applicable permit modifications/closure plans to the State of Washington for the closure of existing Low Level Burial Grounds.

- We would identify and develop applicable mitigation plans and measures associated with long-term stewardship, disposal site closure, and groundwater protection.

- We would continue to develop and implement our groundwater protection program, including further development of our modeling and analysis tools needed to comprehensively predict future groundwater conditions from the full set of Hanford sources.

S.8 Public Interaction Process

This section provides a brief summary of our public interaction process that has led to the development of the final HSW EIS.

S.8.1 Scoping Process

Initial Scoping for the HSW EIS: To determine the scope of the issues to be addressed in the HSW EIS, we issued a Notice of Intent (62 FR 55615) to prepare this EIS in 1997. We requested comments and recommendations from interested parties on the range of actions, alternatives, and impacts we should consider and we held public scoping meetings. We received both oral and written comments. In response to these comments, along with subsequent DOE-wide decisions reflected in the WM PEIS Records of Decision, we restructured and revised some of our alternatives and projected waste volumes from those originally presented in the 1997 Notice of Intent for the HSW EIS. This scoping process and the other key events that have led to the preparation of the final HSW EIS are illustrated in Figure S.21.

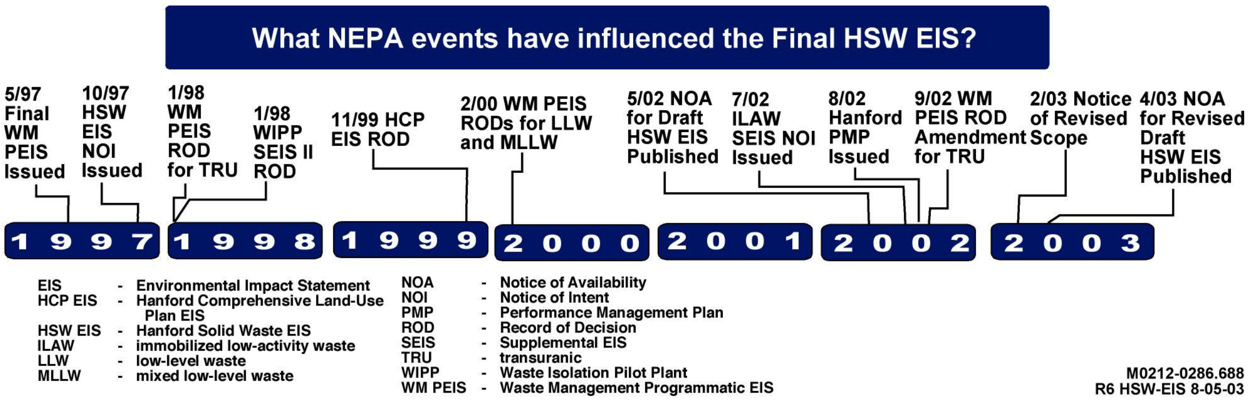

Figure S.21. Final HSW EIS Development Timeline

Scoping for ILAW Disposal Alternatives: On July 8, 2002, DOE published a Notice of Intent in the *Federal Register* announcing our plan to prepare the Tank Waste Remediation System (TWRS) Supplemental EIS for the disposal of ILAW (67 FR 45104). During the scoping period, we invited interested parties to submit comments or suggestions concerning the scope of the issues, alternatives, and environmental impacts to be analyzed in a TWRS Supplemental EIS and we held a public scoping meeting in Richland, Washington. One of the concerns was that disposal of ILAW at Hanford should be considered with disposal of other similar radioactive wastes, such as LLW and MLLW, and should be included in the HSW EIS. In response to this concern we decided to include the ILAW analysis in the HSW EIS. Consequently, all topics that were originally identified in the Notice of Intent for consideration in a TWRS Supplemental EIS are now included in the final HSW EIS, and all comments on ILAW generated during the scoping phase of the TWRS Supplemental EIS are addressed in Volume II, Appendix A of the HSW EIS. DOE published a Notice of Revised Scope in the *Federal Register* on February 12, 2003 (68 FR 7110).

S.8.2 Comments on the First Draft of the HSW EIS

As a result of our public involvement activities on the first draft of the HSW EIS (DOE 2002c), we received approximately 3,800 comments. In Section S.2 of this summary, we briefly listed key concerns expressed during the public review, and we described how those comments influenced the development of both the revised draft of the HSW EIS and this final HSW EIS.

We also prepared a Comment Response Document (Volume III of the revised draft HSW EIS) that provided responses to the public comments on the first draft of the HSW EIS. In addition, in the Comment Response Document for the first draft, we provided summary responses to a number of common issues and questions.

S.8.3 Comments on the Revised Draft of the HSW EIS

As a result of our public involvement activities on the revised draft of the HSW EIS (DOE 2003), we received approximately 1,600 comments. In Section S.2 of this summary, we briefly listed the key concerns from the second round of public review, and we described how those comments influenced development of the final HSW EIS. This final HSW EIS incorporates various changes to discussions that appeared in the revised draft HSW EIS, and it provides additional details and supplemental analyses concerning potential environmental impacts. Throughout Volumes I and II of this final HSW EIS, DOE has indicated these changes with "change bars" in the margins of the affected pages. These revisions are not a result of any significant new circumstances or information that became available since publication of the revised draft HSW EIS.

We have also prepared a new Comment Response Document (Volume III of this final HSW EIS) to provide responses to the public comments on the revised draft HSW EIS. In addition, in this Comment Response Document, we provide summary responses to a number of common issues and questions. We describe our role in managing Hanford's cleanup and waste management operations. We also provide additional details on the relationship between this HSW EIS and other NEPA documents, including the Waste Management Programmatic EIS, our approach to defining the scope of the HSW EIS, the analysis of the impacts of offsite waste (including transportation issues), and our approach to understanding cumulative impacts. We also respond to the concerns over the technical content and scope of the HSW EIS, including depth of analysis, disposal facility design details and alternatives, and long-term performance, particularly with respect to the groundwater. The complete text of written comments received and oral comments provided in public meetings during the comment period for the revised draft HSW EIS are reproduced in Volume IV of this final HSW EIS.

Thirty or more days after the Notice of Availability of the final HSW EIS, DOE will issue one or more Records of Decision. We will describe the substance of the decision, the alternatives considered in reaching our decision, and the environmentally preferable alternative. We will also identify and discuss any additional factors we used to make our decision and any mitigating actions we would undertake to avoid or minimize adverse environmental consequences from the actions we decide to implement. If required, we will prepare a Mitigation Action Plan to establish our specific mitigation commitments.

S.9 References

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