DEVELOPMENT, REVIEW, AND PUBLICATION OF THE HANFORD SITE SOLID WASTE PROGRAM ENVIRONMENTAL IMPACT STATEMENT

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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 covers four primary aspects of waste management at Hanford – waste treatment, storage, transportation, and disposal. It also addresses four kinds of solid radioactive waste – low-level waste (LLW), mixed (radioactive and chemically hazardous) low-level waste (MLLW), transuranic (TRU) waste (including mixed TRUW), and immobilized low-activity waste (ILAW) from treatment of Hanford's tanks waste. The HSW EIS is intended to help DOE determine what specific Hanford Site facilities will continue to be used, will be modified, or need to be constructed to treat, store, and dispose of these wastes.

Alternatives for accomplishing DOE's proposed action, along with an analysis of potential environmental impacts, are detailed in the HSW EIS. The alternatives considered include a wide range of potential disposal configurations and locations, use of onsite and offsite treatment facilities, and continued use of a number of existing waste management facilities (such as the central waste complex for the storage of MLLW and TRU waste). The alternatives are evaluated for a range of waste volumes, representing quantities of waste that could be managed at the Hanford Site. The No Action Alternative is also evaluated as required by the National Environmental Policy Act (NEPA).

The HSW EIS examines the potential environmental impacts associated with implementing each of the alternatives for storage, treatment, transportation, and disposal of radioactive and mixed waste at Hanford. For purposes of analysis, the various storage, treatment, and disposal alternatives were combined into "alternative groups." The analyses of impacts are provided in the following environmental consequence categories:

- Land Use
- Water Quality
- Geologic Resources
- Ecological Resources
- Socioeconomics
- Cultural Resources Impacts
- Traffic and Transportation
- Noise
- Resource Commitments
- Human Health and Safety
- Aesthetic and Scenic Resources
- Environmental Justice

INTRODUCTION

The need to prepare an EIS for Hanford's Solid Waste program was identified near the end of 1996. Since that time the scoping, drafting, and refinement of the HSW EIS have been ongoing. The following sections provide the purpose and need for this EIS and some of the significant events that have led to the preparation of the final HSW EIS.

Purpose and Need

There are a number of reasons for preparing the HSW EIS. Foremost is the need at the Hanford Site to treat, store, transport, and dispose of the waste that is being generated from ongoing Hanford cleanup operations. In addition, the Hanford Site also supports cleanup and early closure of other DOE sites across the country. The HSW EIS considers the Hanford Only waste volumes, as well as waste volumes that include the acceptance of additional offsite waste. To address the anticipated needs for waste management capabilities at Hanford, DOE proposes to:

- continue to operate the existing treatment, storage, and disposal facilities,
- develop additional capabilities to treat MLLW, 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 tank waste treatment plant melters, and
- close onsite disposal facilities and provide for post-closure stewardship of disposal sites.

Background

Table I provides an overview of the steps taken in scoping and preparing the HSW EIS. The Pacific Northwest National Laboratory (PNNL) conducted the technical analysis and prepared the HSW EIS documentation for DOE. Numerous drafts have been prepared, including two formal drafts that have undergone extensive public review. The final HSW EIS evolved out of these review drafts and the comments received, as well as ongoing DOE initiatives to clean up and close former weapons production sites.

Table I Key Events During the Production of the HSW EIS

Date(s)	**Major Events/Activities**
December 1996	Prepare background information for internal scoping meeting
January 8, 1997	Internal scoping meeting
January – May 1997	Finalize internal scoping meeting minutes Develop draft Notice of Intent (NOI) to issue EIS
May 21, 1997	DOE-RL determination to prepare HSW EIS
June 1997	Draft NOI prepared and finalized Plan public scoping meetings and public information materials (fact sheets, briefings, EIS web site)
October 1997	EIS technical planning (document outline, analysis plan, data needs development) Alternatives development with waste management operations contractor
October 27, 1997	NOI published in *Federal Register*[1]
November 1997	Public scoping meetings
December 1997	Respond to scoping meeting comments Development of technical data and alternatives
September 1998	Regional alternative waste stream volume discussions with DOE-HQ
October – December 1998	Public involvement briefings (Hanford Advisory Board [HAB], tribes) Analysis team begins planning, issue resolution Begin drafting EIS text (other than consequences)
January – May 1999	Consequences Analysis begins Analysis data, Technical Information Document (TID) development and issue resolution Receipt of regional waste stream data from DOE-HQ (May) Coordination with Waste Management Programmatic EIS activities (Governor's meetings, preferences announcement)
June – August 1999	Preliminary analysis data for alternatives received Continue public involvement activities (HAB Briefing) Regional waste stream inventories finalized (August)
September – November 1999	Working draft analysis data received from the waste management operations contractor (September) Analyses data completed Working Draft #1 EIS consequences sections prepared and edited Briefing for Washington Department of Ecology (Ecology)
December 1999 – March 2000	Working Draft #1 EIS submitted for review (December) Resolution of working Draft #1 EIS comments, analysis issues Waste Management Programmatic EIS Records of Decision (RODs) for LLW and MLLW issued (February)[3] Prepare Working Draft #2 EIS (February – March)
April – July 2000	Working Draft #2 EIS submitted for review (April) DOE review of Working Draft #2 EIS (through July)
July – August 2000	Resolution of Working Draft #2 EIS comments Prepare Working Draft #3 EIS
September 2000 – October 2000	Working Draft #3 EIS submitted for review (September 2000) DOE-HQ review of Working Draft #3 EIS (through October)

Date(s)	**Major Events/Activities**
January–December 2001	Resolution of Working Draft #3 EIS issues and comments continue Re-review of Working Draft #3 EIS (February) Discussions related to alternatives and waste inventories DOE-HQ letter to Ecology committing to publication of HSW EIS draft in April 2002 followed by a 60-day public comment period (December 2001)
December 2001	DOE-HQ delegates approval authority for HSW EIS to DOE-RL
January – April 2002	Preparation of draft HSW EIS (Jan – April) Review of draft HSW EIS (Feb – April) DOE-RL approves draft HSW EIS for public review 4/29/02
May – August 2002	Publication and distribution of draft HSW EIS (May 2002) Notice of availability published in *Federal Register* 5/24/02; 90-day public review cycle begins DOE/RL issues accelerated cleanup plan (Hanford Performance Management Plan) for public review – May 1[5] HSW EIS public meetings July – August (La Grande OR, Portland OR, Hood River, OR, Seattle, WA, and Richland, WA) August 22, 2002 – DOE-RL letter to stakeholders committing to additional analysis and public review of "supplementary information" in response to public comments.
September – October 2002	HSW EIS team begins developing additional analysis Preliminary discussions with regulatory agencies regarding scope of HSW EIS analyses and process for finalizing DOE-RL and DOE Office of River Protection (DOE-ORP) preliminary decision to consolidate HSW EIS and ILAW Supplemental EIS – October 25[6]
April 11, 2003	Revised draft HSW EIS is issued for public comment HSW EIS public meetings– May (La Grande OR, Portland OR, Hood River, OR, Seattle, WA, Spokane WA, & Richland, WA)
May 16, 2003	DOE-HQ provides an additional 15 days to the public comment period.
July 8, 2003	DOE-HQ decides to include updated transportation analysis (using actual routes, 2000 census data, and RADTRAN version 5) for all onsite and offsite TRU, LLW, and MLLW shipments
September 1, 2003–Present	DOE-HQ and DOJ mandated reviews (following completion of the new analysis, assembly of the FEIS, and DOE-RL NEPA Panel and Validation reviews)
January 2004	DOE approval of the final HSW EIS
January–February 2004	Publication and distribution
March 2004 or thereafter	Issue ROD(s), Mitigation Action Plan (if required)

SCOPE

The HSW EIS provides environmental and technical information concerning DOE's 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. Figure 1 illustrates the range of waste volumes and types considered in the HSW EIS analyses.

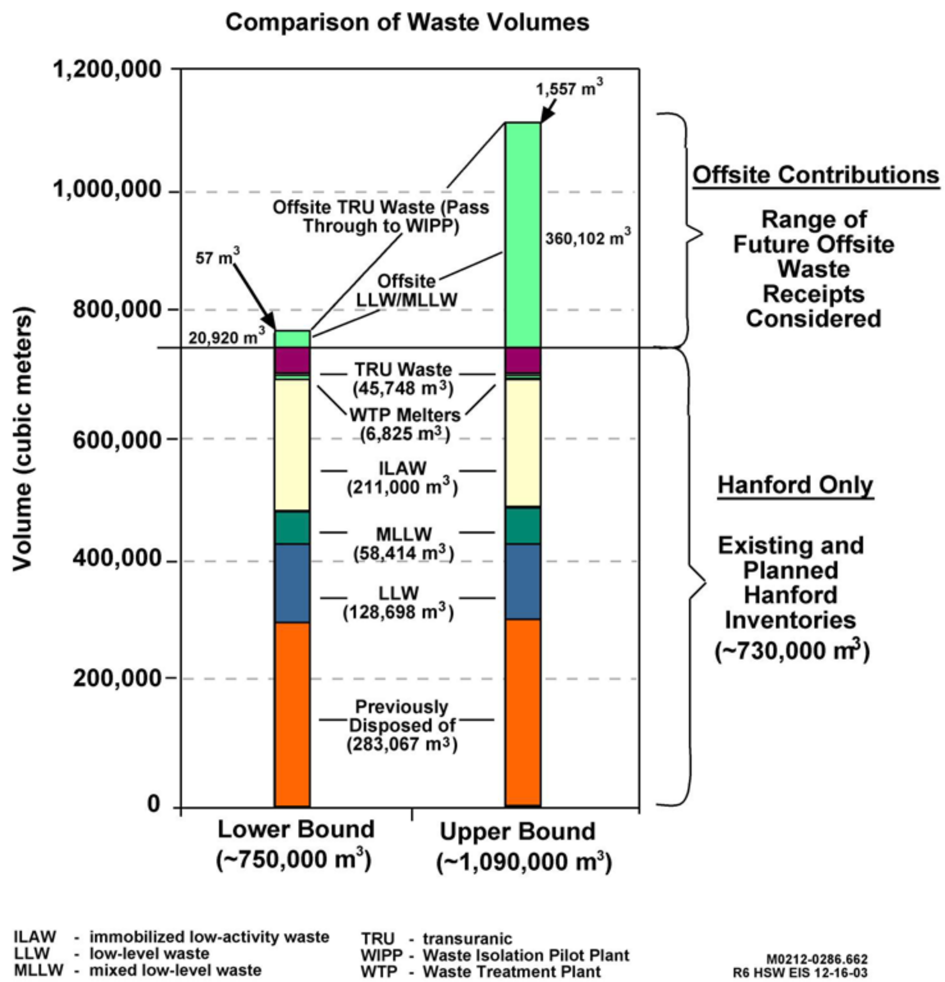

Fig. 1 Range of waste volumes considered in the HSW EIS

The scope of the HSW EIS does not include commercial LLW disposed of on land DOE leases 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 DOE's cleanup and waste management operations at Hanford. However, the HSW EIS does consider the US Ecology, Inc. facility in the cumulative impacts analysis in the EIS. Other waste types outside the scope of the HSW EIS are:

- 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.

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 (HLW), 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 solidified low-activity waste from the treatment and immobilization of Hanford tank wastes. Low-activity waste is the waste that remains after separating from HLW as much of the radioactivity as practicable, and that when solidified may be disposed of as LLW 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.

Fig.2 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 the HSW EIS.

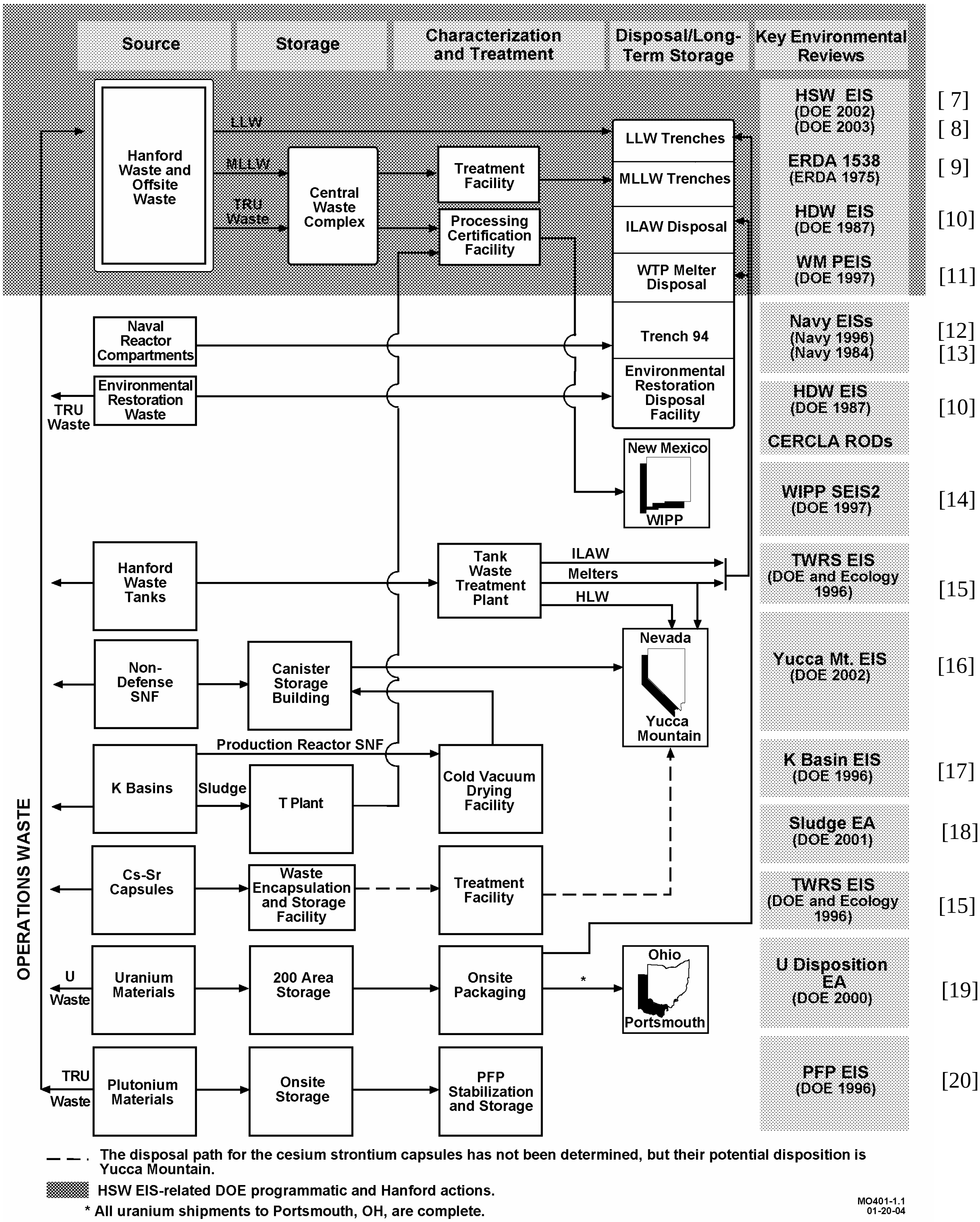

Fig. 2 Relationship of the HSW EIS to other key environmental reviews

DEVELOPMENT OF THE FINAL HSW EIS

In April 2002, DOE issued the first draft of the HSW EIS [7] for public comment. During the public comment period, DOE 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 decisions resulting from 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 were previously disposed of at Hanford
- 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.

DOE prepared a revised draft of the HSW EIS [8] to address these comments and give the public the information needed to better understand the decisions that still need to be made. The revised draft, issued in March 2003 for public comment, incorporated substantial changes that responded to the concerns expressed, as well as incorporating new DOE initiatives for Hanford cleanup. 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 first draft HSW EIS 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, DOE received about 1600 additional comments from tribal governments, regulators, stakeholders, and the public. Each of these comments has been considered in preparing the final HSW EIS. 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.

Consistent with the Council on Environmental Quality Regulations (40 CFR 1500–1508), DOE has prepared the final HSW EIS [21] to respond to public comments as appropriate and to provide clarifying information or improved analyses relevant to the EIS. Those revisions were not a result of any significant new circumstances or information that became available since publication of the revised draft HSW 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. It also reduced the potential human health consequences and potential impacts on ecological resources from groundwater contamination.

- Significant new analyses were prepared to provide further insight into the impacts on groundwater at the disposal facility boundaries. These analyses 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, 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. Three scenarios were 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 percent 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. 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 technetium-99 inventory in the HSW EIS preferred alternative. Groundwater concentrations of technetium-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. 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. 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. 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.

ALTERNATIVES EVALUATED

Alternatives for accomplishing DOE's proposed action, along with an analysis of potential environmental impacts, are detailed in the final HSW EIS. The alternatives considered include a wide range of potential disposal configurations and locations, use of onsite and offsite treatment facilities, and continued use of a number of existing waste management facilities (such as the central waste complex for the storage of MLLW and TRU waste). The alternatives are evaluated for a range of waste volumes, representing quantities of waste that could be managed at the Hanford Site. The No Action Alternative is also evaluated as required by the National Environmental Policy Act (NEPA). For purposes of environmental impacts, various alternatives for waste treatment, storage, and disposal were combined into "alternative groups." Figure 3 illustrates the action alternative groups analyzed in the final HSW EIS.

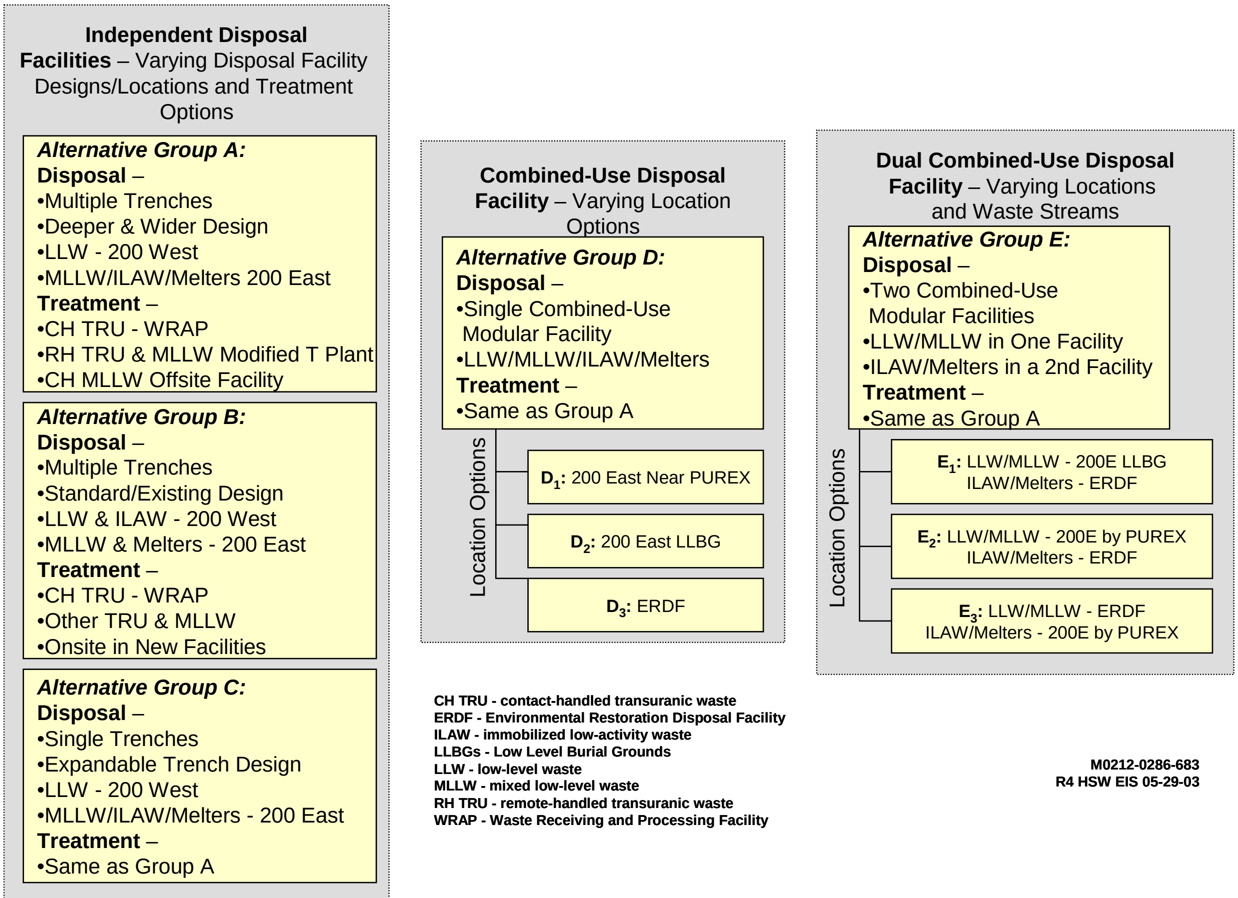

Fig. 3 Development of Action Alternative Groups

ENVIRONMENTAL IMPACT ANALYSIS

The HSW EIS examines the potential environmental impacts associated with implementing each of the alternative groups. The analyses of impacts are provided in the following environmental consequence categories:

- Land Use
- Water Quality
- Geologic Resources
- Ecological Resources
- Socioeconomics
- Cultural Resources Impacts
- Traffic and Transportation
- Noise
- Resource Commitments
- Human Health and Safety
- Aesthetic and Scenic Resources
- Environmental Justice

For some consequences, such as long-term effects of waste disposal on groundwater and the Columbia River, the evaluation period (over 10,000 years) 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 the differences between the alternative groups are also small. However, for some resources, differences in impacts among the alternative groups do exist. 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.

Figure 4 illustrates Hanford's existing treatment, storage, and disposal facilities.

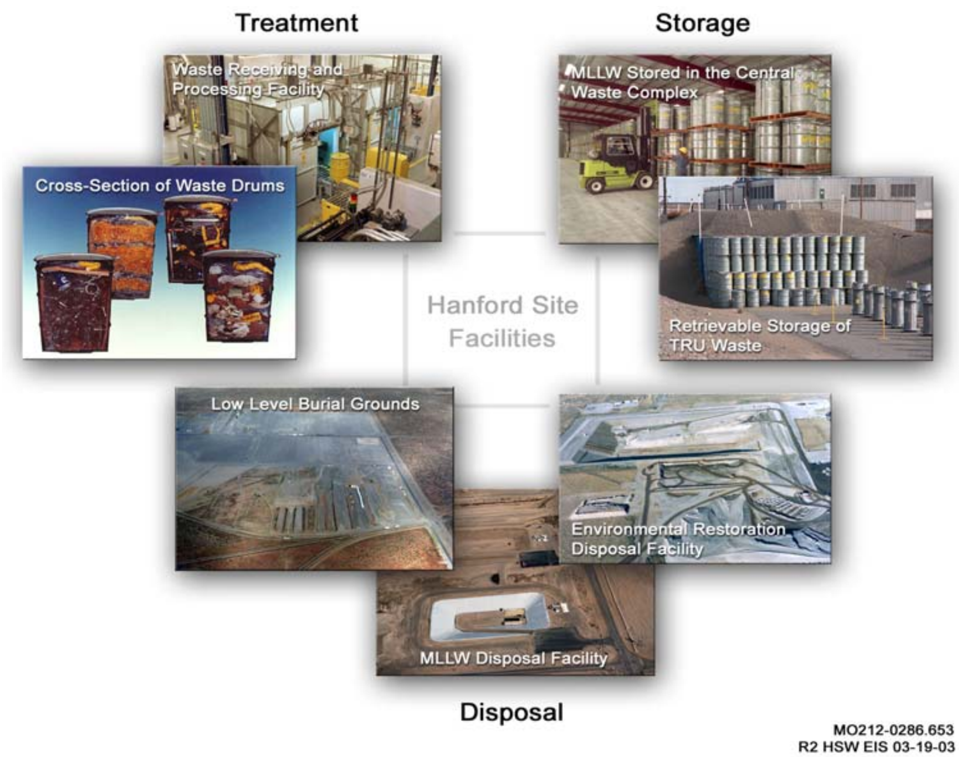

Fig. 4 Hanford site solid waste facilities

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

CONCLUSIONS

DOE's preferred alternative is to phase out existing disposal facilities and to dispose of future LLW, MLLW, and ILAW in a single, modular, lined facility on Hanford's Central Plateau; to treat MLLW using a combination of onsite and offsite facilities; to certify TRU waste onsite using a combination of existing, upgraded, and mobile facilities; and to store waste within the limits of the existing Central Waste Complex.

DOE published the final HSW EIS [21] in January 2004. This major milestone is the culmination of many years of technical work and analysis, the result of two previous drafts submitted for public review, extensive input from the stakeholders, regulators, and the general public, and is supportive of the accelerated cleanup program at Hanford and throughout the entire DOE complex.

Table II 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)]															
	Facility Operations – Direct Radiation and Emissions to Atmosphere						**Transportation**								
	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														
Alternative	**Public**	**Non-Involved Workers**	**Latent Cancer Fatalities (LCFs) Among Population within 80 km Lifetime Exposure**	**Latent Cancer Fatalities (LCFs) from Collective Radiation Exposure of Workers**	**Public**	**Non-Involved Workers[(e)]**	**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**	**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**
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

(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 2003), 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 III 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								Waste Site Intruder Maximum Risk of Fatality at 100 Years After Closure[(e)]	
		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)]			
		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 – 113,000; Portland – 510,000.
(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.

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