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Proposed Plan for Interim Remedial Measures at the 100-DR-1 Operable Unit

Hanford Site
Richland, Washington

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PROPOSED PLAN FOR INTERIM REMEDIAL MEASURES AT THE 100-DR-1 OPERABLE UNIT

Hanford Site, Richland, Washington

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DOE, EPA, AND ECOLOGY ANNOUNCE PROPOSED PLAN

INTRODUCTION

This proposed plan introduces the preferred alternative for addressing contaminated soil and solid waste at the 100-DR-1 Operable Unit, located at the Hanford Site, along the Columbia River. In addition, this plan includes a summary of other alternatives analyzed for the 100-DR-1 Operable Unit. This document is issued by the Washington State Department of Ecology ([Ecology] support agency), the U.S. Environmental Protection Agency ([EPA] lead agency), and the U.S. Department of Energy ([DOE] responsible agency).

Preferred Alternative

The removal, treatment, and disposal is the preferred interim remedial measures alternative for most waste sites in 100-DR-1 Operable Unit. Table 3 indicates (in shaded columns) the preferred interim remedial measures alternative for each 100-DR-1 Operable Unit waste site group.

In order to protect human health and the environment, the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) enables the EPA to respond to potential threats of contamination at sites identified on the *Superfund National Priorities List*. The 100 Areas of the Hanford Site were officially placed on the *National Priorities List* on November 3, 1989, because of soil and groundwater contamination resulting from the past operation of nuclear activities.

The DOE conceived and implemented the Environmental Restoration Program in response to the 100 Areas being placed on the *National Priorities List*. The objective of the Environmental Restoration Program is remediation of the contaminated waste sites in the 100 Areas in accordance with applicable regulations. The Environmental Restoration Program proposes using past-practice waste site and groundwater remediation, along with reactor and facility decontamination and demolition, to prepare the 100 Areas for delisting from the *Superfund National Priorities List*.

Remedial investigations and planning activities for the 100 Areas have been conducted in accordance with the *Hanford Past-Practice Strategy*. The goal of the *Hanford Past-Practice Strategy* is to streamline the remedial action process by emphasizing early action at high-priority sites through expedited response actions and interim remedial measures (IRM). The high priority sites addressed by this proposed plan are identified in Table 1.

This proposed plan is intended to be a fact sheet for public review that summarizes the comparison analysis of different remedial alternatives. This analysis is described in greater detail in the *Focused Feasibility Study* (FFS) *Report* and the following documents. The public is encouraged to review the following documents to gain a comprehensive understanding of the 100-DR-1 Operable Unit:

- *Resource Conservation and Recovery Act Facility Investigation/Corrective Measures Study Work Plan for the 100-DR-1 Operable Unit* (DOE/RL-89-09)
- *Limited Field Investigation Report for the 100-DR-1 Operable Unit* (DOE/RL-89-09)
- *Qualitative Risk Assessment for the 100-DR-1 Source Operable Unit* (WHC-SD-EN-RA-005)

Table 1. History of 100-DR-1 Operable Unit IRM Candidate Sites.

Waste Site Category	Waste Site Group	Waste Site Number	Waste Site Description	Waste Site Use
Soil	Retention Basins	• 116-D-7 • 116-DR-9	Each basin consists of two concrete lined cells. Estimated contaminated soil volume and area for these sites are 386,000 m^3 (505,000 yd^3) and 33,100 m^2 (356,000 ft^2), respectively.	Held cooling water effluent from reactors for cooling/decay before release to the Columbia River; probably received ruptured fuel element waste.
	Process Effluent Trenches	• 116-DR-1 • 116-DR-2	Trenches are unlined earthen structures. Estimated contaminated soil volume and area for these sites are 24,500 m^3 (32,000 yd^3) and 4,200 m^2 (45,000 ft^2), respectively.	Received effluent overflow from retention basins at times of high activity caused by fuel element failure.
	Sludge Trenches	• 107-D • 107-DR	Trenches are unlined earthen structures. Estimated contaminated soil volume and area for these sites are 10,500 m^3 (13,700 yd^3) and 2700 m^2 (29,000 ft^2), respectively.	Received sludge from retention basins when basins were dredged for repairs.
	Fuel Storage Basin Trenches	• 116-D-1A • 116-D-1B	Trenches are unlined earthen structures. Estimated contaminated soil volume and area for these sites are 7,400 m^3 (9,700 yd^3) and 770 m^2 (8,300 ft^2), respectively.	Received contaminated water from 105-D fuel storage basin.
	Pipelines	Process Effluent Pipelines	Subsurface pipelines are approximately 2,100 m (6,900 ft) long, 1.5 m (60 in.) in diameter, and 6 m (20 ft) belowgrade. Estimated contaminated soil volume and area for this site has not been determined.	Transported reactor cooling water effluent, decontamination wastes, and/or reactor confinement seal pit drainage to retention basins and disposal trenches.
	Cribs	• 116-D-2A • 116-D-9	Cribs are unlined earthen structures. Estimated contaminated soil volume and area for these sites are 14 m^3 (18 yd^3) and 10 m^2 (108 ft^2), respectively.	Received liquid effluents from various facilities; disposed effluent to the soil.
Solid Waste	Burial Grounds	• 118-D-4A • 118-D-4B • 118-D-18	Burial grounds are unlined earthen structures. Estimated contaminated soil volume and area for these sites are 5,500 m^3 (7,200 yd^3) and 1,500 m^2 (16,000 ft^2), respectively.	Received radioactive and nonradioactive solid waste.

IRM - interim remedial measure.

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- *100-DR-1 Focused Feasibility Study* (DOE/RL 94-64)
- *100 Areas Feasibility Study, Phases 1 and 2* (DOE/RL-92-11)

These documents are available at the following locations:

- U. S. DOE, Richland Operations
  Administrative Record Center
  2440 Stevens Center Place
  Richland, Washington 99352
- EPA Region 10
  Superfund Record Center
  Park Place Building, 7th Floor
  Seattle, Washington 98101
- Washington State Dept. of Ecology
  Administrative Record
  719 Sleater-Kinney Road S. E.
  Capital Finance Building, Suite 200 Lacey, Washington 98503

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SITE BACKGROUND

The 100-DR-1 Operable Unit is one of three operable units in the 100-D/DR Area at the Hanford Site, and includes liquid and sludge disposal and solid waste sites generally associated with operation of the 100-D and 100-DR reactors. The Operable Unit location is marked 100-D/DR in Figure 1. Groundwater underlying the 100-DR-1 and 100-DR-2 Operable Units is being addressed as part of the 100-HR-3 Operable Unit. The 100-DR-1 Operable Unit encompasses an area of approximately 1.5 km^2 (0.59 mi^2) and addresses potential soil contamination. The 100-DR-1 Operable Unit includes 14 waste sites that have been designated as high priority and that are candidates for Interim Remedial Measures. These sites were identified as a result of remedial investigation activities, an assessment of potential impacts to human health and the environment, and local community concerns. Specifically, these sites pose a potential threat to a section of the Columbia River currently being considered for designation as a wild and scenic river by the United States Congress.[1] The 14 high priority sites are identified in Table 1. The table shows that the sites fall into two waste site categories (contaminated soil sites and solid waste sites) and that they have been further classified into 7 waste site groups (e.g., basins, trenches).

SUMMARY OF SITE RISKS

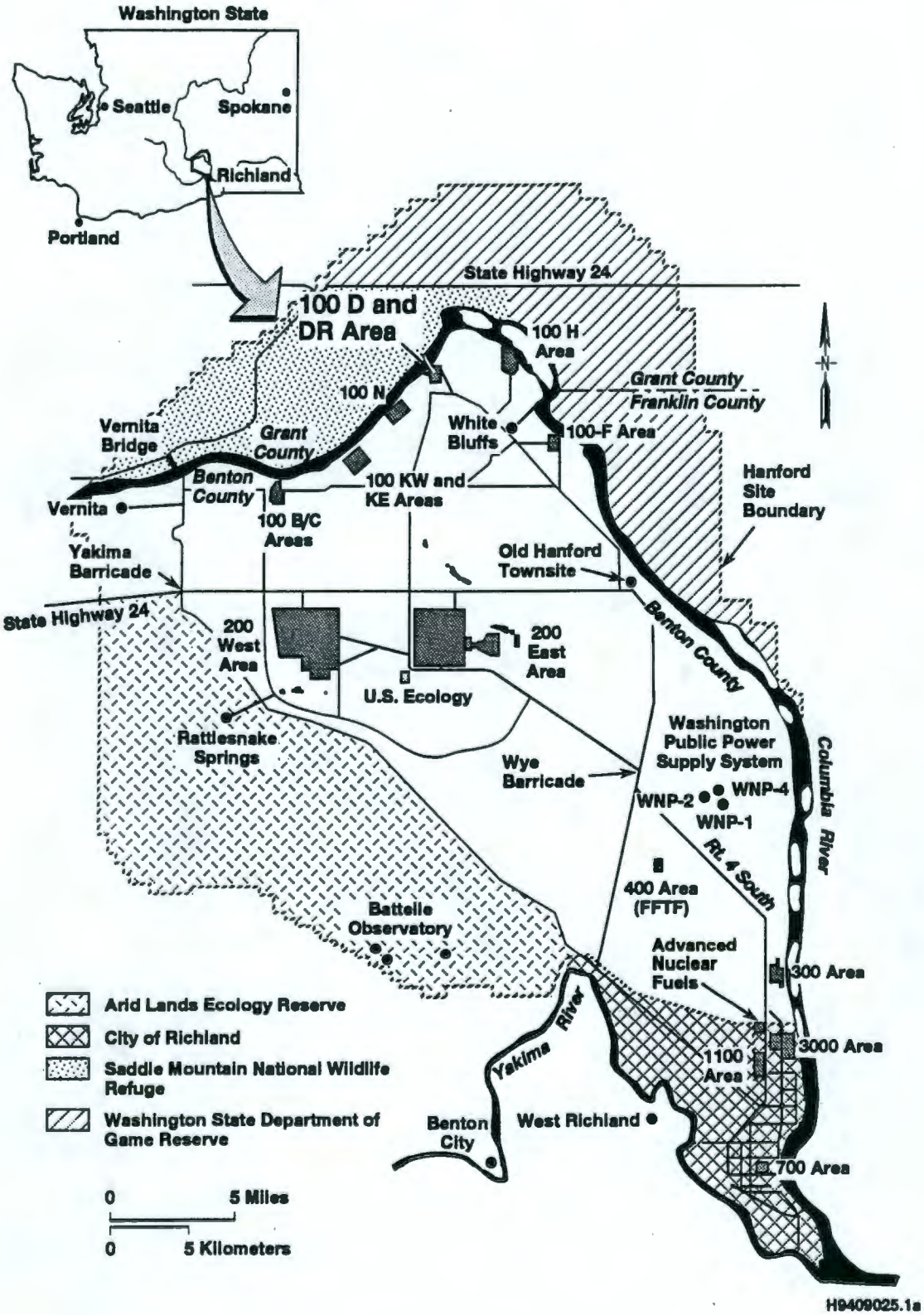
A qualitative risk assessment for the 100-DR-1 Operable Unit was conducted to evaluate potential human health and ecological effects from exposure to contaminated soils/solid waste. In preparing the qualitative risk assessment, assumptions were used that weigh in favor of protecting human health. The results of the risk assessment help determine if any remedial actions are necessary to protect human health or the environment. The goal of the qualitative risk assessment was to identify high-priority sites for expedited response and IRM by estimating a range of risk (low to high) for each chemical at a waste site.

Human Health Risks. The human health evaluation used two hypothetical exposure scenarios, frequent-use and occasional-use, to provide estimates of risk consistent with residential and recreational land use (respectively). The frequent-use scenario assumes a person is exposed to contaminated soil and solid waste every day for one year. The occasional-use scenario assumes a person is exposed to contaminated soil and solid waste for seven days a year. Three pathways were evaluated as the most likely routes of exposure to contaminants for each exposure scenario. These included soil ingestion; fugitive dust inhalation; and external radiation exposure from contaminated soils. The pathway found to contribute the most to the estimated risk at the 100-DR-1 Operable Unit was external radiation exposure from soils. The human health evaluation considered the carcinogenic and noncarcinogenic effects of each contaminant. The qualitative risk estimate for carcinogens is the estimated risk of developing cancer over an individual's lifetime, also referred to as lifetime incremental cancer risk (ICR).

- High ICR > = 1 in 100
- Medium ICR = 1 in 100 to 1 in 10,000
- Low ICR = 1 in 10,000 to 1 in 1,000,000
- Very low ICR < = 1 in 1,000,000.

[1] "Hanford Reach," *Columbia River Comprehensive River Conservation Study and Environmental Impact Statement*, Final Draft, June 1994, Volumes I & II

Figure 1. Operable Unit Locations.



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Risk estimates for noncarcinogens are not usually quantified, but they are reported as having the potential to affect human health. Therefore, for noncarcinogens, a hazard quotient greater than 1 indicates that an adverse toxic effect in humans could occur.

If the calculated lifetime ICR is low or very low, a remedial action is usually not warranted. It was concluded that the contaminants that posed the greatest potential risk of causing cancer and other adverse human health effects were radionuclides in an occasional-use exposure scenario.

Ecological Risk. In addition to the human health evaluation, an ecological evaluation was conducted. This evaluation estimated the risk from contaminants in the 100-DR-1 Operable Unit to selected ecological receptors. An ecological hazard quotient was calculated estimating risk in a manner similar to the hazard quotient, but for an ecological receptor exposed to both carcinogenic and/or noncarcinogenic contamination. An ecological hazard quotient above 1 indicated that an adverse effect in the ecological receptor could occur. Table 2 presents a summary of the risks to human health and ecological receptors for the IRM candidate sites. It was determined, for those sites that exceeded an ecological hazard quotient of 1, all of the dose was from ^{90}Sr. Estimates of risk for the future-use scenarios used concentrations of radionuclides decayed to the year 2018. A detailed description of the assumptions and methods used for the qualitative risk assessment can be found in the *100-DR-1 Source Operable Unit Qualitative Risk Assessment*.

The EPA, DOE, and Ecology believe that a combination of removal, treatment, and disposal technologies would significantly reduce the potential threats to human health and the environment. The suggested remedial actions described in this proposed plan are designed to reduce the likelihood of exposure to site contaminants and ensure that contaminants are not transported to the groundwater. Actual or threatened releases of hazardous substances from this operable unit, if not addressed by implementing the remedial action selected by this proposed plan, may present a current or potential threat to public health, welfare, or the environment. The preferred alternative would reduce excess lifetime ICR to an individual from a particular waste site to within acceptable levels (i.e., 1 in 10,000 to 1 in 1,000,000) for the hypothetical occasional-use scenario.

SCOPE AND ROLE OF INTERIM REMEDIAL MEASURES

Contamination present in the soil of the 100-DR-1 Operable Unit represents a potential threat to future occasional users and to current ecology in the 100-D/DR Area. The contaminated sites have been designated as high-priority sites in the *100-DR-1 Source Operable Unit Limited Field Investigation* for IRM.

The low-priority sites in the *100-DR-1 Source Operable Unit Limited Field Investigation* have been deferred (Table 1) but will be addressed in the *100 Areas Aggregate Remedial Investigation/ Feasibility Study*. The study will also address final remedy selection for high priority sites to determine what additional actions (if any) are required to delist the 100 Areas.

The following are low-priority sites at the 100-DR-1 Operable Unit:

- Waste Acid Reservoir
- Septic Tanks
- Septic Tank Tile Field
- Fuel Oil Tank Pipeline
- Fuel Oil Tank Fuel Oil Tanks
- 105-D Reactor Building
- 126-D-1 Ash Disposal Basin
- Salt Dissolving Pit
- Electrical Facilities
- 1714-D Solvent Storage
- 1715-D Oil and Paint Storage
- 1716-D Gas Station
- 1722 Equipment Development
- 1724-D2A Underwater Test Facility
- 183-D Filter Plant
- 185-D Thermal Hydraulics Laboratory

The intent of an IRM is to expedite the response to soil and solid waste contamination posing a potential threat to human health and the environment. It is assumed that IRM would be applied until the year 2018. After the year 2018, the final site remedy determined in the *100 Areas Aggregate Remedial Investigation and Feasibility Study* would be implemented, if different than the selected IRM.

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Table 2. Summary of Risks for 100-DR-1 Operable Unit IRM Candidate Sites.

Waste Site	Waste Site Group	Waste Site Number	Qualitative Risk Assessment		Contaminants of Concern
			Human Health[b]	EHQ > 1[a]	
Soil	Retention Basins	116-D-7	High	Yes	^{14}C, ^{60}Co, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{3}H, $^{239/240}Pu$, ^{90}Sr, chromium (VI)
		116-DR-9	High	Yes	^{14}C, ^{60}Co, ^{137}Cs, $^{152/154}Eu$, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{228}Th, arsenic, cadmium, chromium (VI)
	Process Effluent Trenches	116-DR-1	Medium	No	^{137}Cs, ^{152}Eu, $^{239/240}Pu$, cadmium, chromium (VI)
		116-DR-2	Medium	No	^{137}Cs, ^{152}Eu, $^{239/240}Pu$, cadmium, chromium (VI)
	Sludge Trenches	107-D	High	No	^{14}C, ^{137}Cs, ^{60}Co, $^{152/154}Eu$, ^{238}Pu, $^{239/240}Pu$, ^{90}Sr, arsenic, cadmium, chromium (VI), lead
		107-DR	High	Yes	^{14}C, ^{137}Cs, ^{60}Co, $^{152/154}Eu$, 238Pu, $^{239/240}Pu$, ^{90}Sr, arsenic, cadmium, chromium (VI), lead
	Fuel Storage Basin Trenches	116-D-1A	Medium	No	^{137}Cs, ^{152}Eu, $^{239/240}Pu$, ^{226}Ra, ^{22}Na, cadmium, chromium (VI), lead
		116-D-1B	Medium	No	^{137}Cs, ^{152}Eu, $^{239/240}Pu$, chromium (VI), lead
	Pipelines	Process Effluent Pipelines	Medium	[b]	^{60}Co, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{155}Eu, ^{63}Ni, ^{238}Pu, $^{239/240}Pu$, ^{90}Sr
	Cribs	116-D-2A	Low	No	^{226}Ra
		116-D-9	Medium	[b]	None
Solid Waste	Burial Grounds	118-D-4A	[b]	[b]	^{14}C, ^{137}Cs, ^{60}Co, $^{152/154}Eu$, ^{3}H, ^{63}Ni, ^{90}Sr, cadmium, lead, mercury
		118-D-4B	[b]	[b]	^{14}C, ^{137}Cs, ^{60}Co, $^{152/154}Eu$, ^{3}H, ^{63}Ni, ^{90}Sr, cadmium, lead, mercury
		118-D-18	[b]	[b]	^{14}C, ^{137}Cs, ^{60}Co, $^{152/154}Eu$, ^{3}H, ^{63}Ni, ^{90}Sr, cadmium, lead, mercury

IRM - Interim remedial measures.

[a] Environmental hazard quotient (EQH) calculated by the qualitative ecological risk assessment.

[b] Human health risk, using a recreational use scenario, is based upon the ICR grouped into the following risk categories: high (ICR > 1 in 100); medium (ICR = 1 in 10,000 to 1 in 100); low (ICR = 1 in 1,000,000 to 1 in 10,000); and very low (ICR > 1 in 1,000,000).

[c] Not rated by the qualitative risk assessment.

KEY:

c	=	carbon	Ni	=	nickel
Co	=	cobalt	Pu	=	plutonium
Cs	=	cesium	Ra	=	radon
Eu	=	Europium	Sr	=	strontium
H	=	Tritium	Th	=	thorium
Na	=	sodium			

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The DOE, EPA, and Ecology propose to remove, treat, and dispose of soil contamination from the 100-DR-1 Operable Unit as an IRM. The potential threat to human health and the environment in the 100-D/DR Area would be eliminated by the physical removal of the contamination.

The DOE, EPA, and Ecology encourage you to comment during the public comment period on all of the interim remedial measures alternatives described in this proposed plan. The DOE, EPA and Ecology may modify the preferred alternative or select another response action presented in this plan and the 100-DR-1 *Focused Feasibility Study* based on new information or public comments.

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SUMMARY OF ALTERNATIVES

A total of 23 remedial alternatives were considered for the remediation of contaminated soil and solid waste at the 100-DR-1 Operable Unit. Elements of the alternatives are presented in Table 3. Table 4 presents the estimated duration for each alternative, and Table 5 provides the estimated cost for each alternative. A summary of remedial alternatives is provided in Table 6 for each of the two waste site categories (soil and solid waste). The alternatives for the soil sites are designated with a SS prefix while the solid waste sites are designated with a SW prefix. The contaminated soil sites consist of retention basins, trenches, pipelines, and cribs. The contaminated solid waste sites are burial grounds. The specific details of each remedial alternative can be found in the *100-DR-1 Focused Feasibility Study Report*.

No Interim Action Alternatives (SS-1 and SW-1). The "no interim action" alternative applies to both contaminated soil and solid waste sites. This alternative serves as a baseline for evaluating remedial actions and represents a hypothetical scenario where no additional restrictions, controls, or active remedial measures other than those currently existing are applied to a waste site. Contamination would be allowed to diminish naturally.

Institutional Controls Alternatives (SS-2 and SW-2). These alternatives apply to contaminated soil and solid waste sites and involve the following:

- Deed restrictions
- Groundwater surveillance monitoring.

Deed restrictions would consist of limitations on certain types of land-uses (e.g., prohibit well drilling) at an individual waste site. Groundwater surveillance monitoring for the 100-DR-1 Operable Unit is currently (and would continue to be) conducted as part of the 100-HR-3 Operable Unit. Monitoring would identify potential impacts to the groundwater underlying the waste site. These institutional controls would limit exposure to human health and the environment and would protect groundwater.

Containment Alternatives (SS-3 and SW-3). These alternatives apply to contaminated soil and solid waste sites and would involve the following:

- Deed restrictions
- Groundwater surveillance monitoring
- Surface water controls
- Installation of a modified RCRA barrier.

As described in the Institutional Controls Alternatives, deed restrictions and groundwater surveillance monitoring would be implemented along with surface water controls during and after installation of a modified RCRA barrier, if required. Surface water controls (e.g., drainage channels and culverts) would be implemented to control the run-on and runoff of surface water. This would reduce the potential for infiltration through the contaminated soils and solid waste and prevent the spread of contamination. The modified barrier would consist of layers of clean soil and natural grasses underlain by layers of sand, gravel, and asphalt. The effective or constraining layer that would prevent infiltration of water is the asphalt layer. The barrier would prevent contact with the contaminated media, and protect groundwater by minimizing the spread of contamination through erosion and infiltration. Fencing around a contaminated area for the purpose of limiting access would be included with any type of physical barrier. Risk to human and ecological receptors would be reduced at the waste site by eliminating exposure pathways through construction of a physical barrier inhibiting contact with the contaminants and protecting groundwater.

Removal/Disposal Alternatives (SS-4 and SW-4). These alternatives apply to contaminated soil and solid waste sites and involve the following:

- Removal of contaminated media
- Disposal at the Environmental Restoration Disposal Facility (ERDF).

Under these alternatives, the contaminated media would be excavated, transported to, and disposed of at the ERDF or another appropriate onsite facility. As the soil and/or solid waste is excavated, it would be visually characterized and segregated before transportation to the ERDF. Excavation would continue until all contaminated media exceeding a

Table 3. Summary of Components for 100-DR-1 Operable Unit Remedial Alternatives.

Technology	Retention Basins 116-D-7 116-DR-9		Pipelines 100-D/DR			Process Effluent Trenches 116-DR-1 116-DR-2			Sludge Trenches 107-D 107-DR			Cribs 116-D-2A 116-D-9			Fuel Storage Basin Trenches 116-D-1A 116D-1B		Burial Grounds 118-D-4A 118-D-4B 118-D-18			
	Alt SS4	Alt SS10	Alt SS3	Alt SS4	Alt SS8B	Alt SS4	Alt SS8A	Alt SS10	Alt SS4	Alt SS8A	Alt SS10	Alt SS4	Alt SS8A	Alt SS10	Alt SS4	Alt SS10	Alt SW3	Alt SW4	Alt SW7	Alt SW9
No Interim Action																				
Access Restrictions			•		•		•			•			•				•		•	
Removal	•	•		•		•		•	•		•	•		•	•	•		•		•
Soil Washing		•						•			•			•		•				
Thermal Desorption		•						•			•			•		•				•
Compaction																			•	•
Disposal	•	•		•		•		•	•		•	•		•	•	•		•		•
RCRA Barrier			•		•												•		•	
Surface Water Controls			•		•		•			•			•				•		•	
Grouting					•															
In Situ Vitrification							•			•			•							

RCRA = *Resource Conservation and Recovery Act of 1976*

Table 4. Summary of Estimated Durations for 100-DR-1 Operable Unit Remedial Alternatives.

Site	Containment	Removal/ Disposal	In Situ Treatment	Removal/ Treatment/ Disposal
	Duration (years)	Duration (years)	Duration (years)	Duration (years)
116-D-7	N/A	1.2	N/A	2.1
107 D/DR Sludge Trenches				
#1	N/A	0.1	0.4	0.1
#2	N/A	0.1	0.4	0.1
#3	N/A	1.0	0.4	0.1
#4	N/A	0.1	0.3	0.1
#5	N/A	0.1	0.3	0.1
116-DR-9	N/A	1.4	N/A	3.2
116-D-1A	N/A	0.2	N/A	0.3
116-D-1B	N/A	0.1	N/A	0.1
116-DR-1/2	N/A	0.4	3.1	0.5
116-D-2A	N/A	0.1	0.1	0.1
116-D-9	N/A	N/A	N/A	N/A
100-D/DR Pipeline	1.6	1.0	0.1	N/A
116-D-5	0.1	0.1	N/A	0.1
116-DR-5	N/A	N/A	N/A	N/A
118-D-4A	0.1	0.1	0.1	0.1
118-D-4B	0.1	0.1	0.1	0.1
118-D-18	0.1	0.1	0.1	0.1

N/A = not applicable (See *100-DR-1 Focused Feasibility Study*).

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Table 5. Summary of Estimated Costs for 100-DR-1 Operable Unit Remedial Alternatives.

Site	Containment			Removal/ Disposal			In Situ Treatment			Removal/ Treatment/Disposal		
	Capital ($ million)	O&M	Present Worth ($ million)	Capital ($ million)	O&M*	Present Worth ($ million)	Capital ($ million)	O&M ($ million)	Present Worth ($ million)	Capital ($ million)	O&M ($ million)	Present Worth ($ million)
116-D-7	N/A	N/A	N/A	81.5	-	76.8	N/A	N/A	N/A	82.30	12.60	87.70
107 D/DR Sludge												
Trenches												
#1	N/A	N/A	N/A	1.69	-	1.61	3.53	2.24	5.49	2.08	0.27	2.24
#2	N/A	N/A	N/A	1.75	-	1.67	3.61	2.29	5.63	2.13	0.28	2.30
#3	N/A	N/A	N/A	1.72	-	1.64	3.58	2.27	5.57	2.11	0.27	2.28
#4	N/A	N/A	N/A	1.27	-	1.22	2.63	1.56	4.00	1.68	0.19	1.79
#5	N/A	N/A	N/A	1.31	-	1.25	2.85	1.78	4.42	1.72	0.21	1.84
116-DR-9	N/A	N/A	N/A	102	-	96	N/A	N/A	N/A	100.20	24.50	114.00
116-D-1A	N/A	N/A	N/A	4.69	-	4.47	N/A	N/A	N/A	4.88	0.95	5.57
116-D-1B	N/A	N/A	N/A	1.95	-	1.86	N/A	N/A	N/A	2.29	0.41	2.58
116-DR-1/2		N/A	N/A	13.90	-	13.3	31	23	48.80	13.70	3.48	16.30
116-D-2A	N/A	N/A	N/A	0.28	-	0.27	0.60	0.09	0.66	0.71	0.01	0.70
116-D-9	Institutional Controls proposed at site											
100 D/DR Pipeline	32.3	14.8	38.1	9.03	-	8.61	3.68	0.00	3.51	N/A	N/A	N/A
116-D-5	0.62	0.22	0.71	0.52	-	0.50	N/A	N/A	N/A	0.94	0.01	0.92
116-DR-5	Institutional Controls proposed at site											
118-D-4A	1.22	0.51	1.45	2.50	-	2.38	1.43	0.58	1.69	2.51	0.14	2.53
118-D-4B	0.70	0.29	0.83	0.43	-	0.42	0.82	0.32	0.96	0.92	0.02	0.91
118-D-18	0.75	0.27	0.87	0.57	-	0.55	0.88	0.30	1	1.02	0.03	1.02

N/A - not applicable (See *100-DR-1 Focused Feasibility Study*).
*No cost.

Table 6. Comparative Analysis Summary for 100-DR-1 Operable Unit.

Evaluation Criteria	Waste Site Groups	Retention Basins 116-D-7		Retention Basins 116-DR-9		Process Effluent Trenches 116-DR-1, 2			Sludge Trenches 107-D/DR (1)			Sludge Trenches 107-D/DR (2)			Sludge Trenches 107-D/DR (3)			Sludge Trenches 107-D/DR (4)			Sludge Trenches 107-D/DR (5)			Fuel Storage Basin Trenches 116-D-1A		Fuel Storage Basin Trenches 116-D-1B	
	Alternatives[b]	SS-4	SS-10	SS-4	SS-10	SS-4	SS-8A	SS-10	SS-4	SS-8A	SS-10	SS-4	SS-8A	SS-10	SS-4	SS-8A	SS-10	SS-4	SS-8A	SS-10	SS-4	SS-8A	SS-10	SS-4	SS-10	SS-4	SS-10
Overall Protection of Human Health and Environment		Better	Best	Better	Best	Good	Better	Better	Good	Better	Better	Good	Better	Better	Good	Better	Better	Good	Better	Better	Good	Better	Better	Good	Better	Good	Good	Better
Compliance with ARAR		Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best
Long-Term Effectiveness and Permanence		Best	Best	Best	Best	Best	Good	Better	Best	Good	Better	Best	Good	Better	Best	Good	Better	Best	Good	Better	Best	Good	Better	Better	Better	Better	Better
Reduction of Toxicity, Mobility, and Volume		Good	Better	Good	Better	Better	Better	Good	Good	Best	Better	Good	Best	Better	Good	Best	Better	Good	Best	Better	Good	Best	Better	Good	Better	Good	Better
Short-Term Effectiveness		Better	Good	Better	Good	Good	Better	Better	Better	Best	Good	Better	Best	Good	Better	Best	Good	Better	Best	Good	Better	Best	Good	Good	Better	Good	Better
Implementability		Good	Better	Good	Better	Better	Better	Good	Best	Good	Better	Best	Good	Better	Best	Good	Better	Best	Good	Better	Best	Good	Better	Good	Better	Good	Better
Present Worth ($ millions)		76.8	87.7	96.0	114.0	13.3	48.8	16.3	1.61	5.49	2.24	1.67	5.63	2.23	1.64	5.57	2.28	1.22	4.0	1.79	1.25	4.42	1.84	4.47	5.57	1.86	2.58

Evaluation Criteria	Waste Site Groups	Pluto Crib 116-D-2A			Pipelines 100-D/DR			Burial Grounds 118-D-4A				Burial Grounds 118-D-4B				Burial Grounds 18			
	Alternatives[b]	SS-4	SS-8A	SS-10	SS-3	SS-4	SS-8B	SW-3	SW-4	SW-7	SW-9	SW-3	SW-4	SW-7	SW-9	SW-3	SW-4	SW-7	SW-9
Overall Protection of Human Health and Environment		Good	Better	Better	Better	Better	Good	Better	Better	Good	Best	Better	Better	Good	Best	Better	Better	Good	Best
Compliance with ARAR		Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best
Long-Term Effectiveness and Permanence		Better	Good	Better	Better	Better	Good	Better	Better	Good	Better	Better	Better	Good	Better	Better	Better	Good	Better
Reduction of Toxicity, Mobility, and Volume		Better	Better	Good	Better	Good	Better	Better	Good	Best	Better	Better	Good	Best	Better	Better	Good	Best	Better
Short-Term Effectiveness		Good	Better	Better	Better	Better	Good	Best	Good	Better	Better	Best	Good	Better	Better	Best	Good	Better	Better
Implementability		Better	Better	Good	Better	Good	Better	Best	Better	Better	Good	Best	Better	Better	Good	Best	Better	Better	Good
Present Worth ($ millions)		0.267	0.661	0.692	38.1	8.61	3.51	1.45	2.38	1.69	2.53	0.832	0.415	0.962	0.907	0.866	0.547	1.0	1.02

Key: Best, Better, Good, Fair, Poor

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ARAR - applicable or relevant and appropriate requirement

[a]Comparative Analysis Summary is based on Tables 6-1 through 6-7 in the *100-DR-1 FFS Focused Feasibility Study Report*. Comparisons are made between relevant alternatives for each individual waste site group only.

[b]Alternatives are summarized as follows:

- SS-3/SW-3 Containment
- SS-4/SW-4 Removal and disposal
- SW-7 In situ treatment of solid waste
- SS-8A In situ treatment of soils (except pielines)
- SS-8B In situ treatment of soils (pipelines)
- SW-9 Removal, treatment and disposal of solid waste
- SS-10 Removal, treatment and disposal of soil

predetermined concentration that protects groundwater are removed. Excavation may extend to the water table, if necessary. Imported clean soil would be use to backfill the site and the site would be contoured to approximately original conditions. Risk to human health or the environment at the site would be eliminated by the physical removal of the contaminants.

In Situ Treatment Alternative (SW-7). This alternative applies to contaminated solid waste sites and involves the following:

- Deed restrictions
- Groundwater surveillance monitoring
- Surface water controls
- Dynamic compaction
- Installation of a modified RCRA barrier.

As described in the Institutional Control and Containment Alternatives, deed restrictions, groundwater surveillance monitoring, and surface water controls would be implemented during and after dynamic compaction of the solid waste sites. Dynamic compaction of the solid waste would also result in deep densification of the soils. Following dynamic compaction, a modified RCRA barrier would be constructed (as described in the Containment Alternatives) if required. Risk to human health or the environment would be reduced by eliminating exposure pathways through the construction of a physical barrier that would inhibit contact with the contaminants and protect the groundwater.

In Situ Treatment Alternative (SS-8A). This alternative applies to contaminated soil sites and involves the following:

- Deed restrictions
- Groundwater surveillance monitoring
- Surface water control
- In situ vitrification.

Deed restrictions, groundwater surveillance monitoring, and surface water controls would be implemented as described in the Institutional Control and Containment Alternatives during and after the in situ vitrification process. The contaminated soil would be vitrified in place and covered with a minimum of 1 m (3.3 ft) of clean soil. The risk to human health or the environment at the waste sites would be reduced through the solidification of the contaminated soils and the addition of clean cover. Protection of groundwater would also be achieved through the use of a soil cover, minimizing the spread of contamination through erosion and infiltration.

In Situ Treatment Alternative (SS-8B). This alternative applies to contaminated soil sites and involves the following:

- Deed restrictions
- Groundwater surveillance monitoring
- Surface water control
- Void grouting
- Installation of a modified RCRA barrier, if required.

Under this alternative, deed restrictions, groundwater surveillance monitoring, and surface water controls would be implemented as described in the Institutional Controls and Containment Alternatives during and after void grouting. Buried pipelines would be pressure-injected in place with grout, which would immobilize contamination inside the pipeline. A modified RCRA barrier would then be installed over the backfilled site (as described in the Containment Alternatives) to control migration of uncontained contamination to the groundwater. Risk would be reduced at the waste site by immobilizing potential contamination present in the pipeline through encapsulation. In addition, risk to human health or the environment would be further reduced by eliminating exposure pathways through construction of a physical barrier that would inhibit contact with contaminants and protect groundwater.

Removal/Treatment/Disposal Alternative (SW-9). This alternative applies to contaminated solid waste sites and involves the following:

- Removal of the contaminated solid waste
- Thermal desorption
- Dynamic compaction
- Disposal at the ERDF.

Under this alternative, the contaminated solid waste would be removed as described in the Removal/Disposal Alternatives. The organically contaminated solid waste, if present, would be treated by thermal desorption, then recombined with the remaining contaminated solid waste. If appropriate, some of the solid waste would be dynamically compacted to reduce volume before disposal.

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Disposal would occur at the ERDF or another appropriate onsite disposal facility as described in the Removal/Disposal Alternatives. Risk to human health or the environment at the site would be eliminated by the physical removal of the contaminants.

Removal/Treatment/Disposal Alternative (SS-10). This alternative applies to the contaminated soil sites and involves the following:

- Removal of the contaminated soil
- Thermal desorption
- Soil washing
- Disposal at the ERDF.

Under this alternative, the contaminated soils would be excavated as described in the Removal/Disposal Alternatives. Organically contaminated soils, if present, would be treated by thermal desorption, then recombined with the remaining contaminated soils. Soil washing, which reduces the volume of contaminants, may then be implemented (if appropriate).

Imported clean soil and washed soils determined to be clean would be used to fill excavations to near original conditions. Excavated or treated contaminated soil and/or solid waste would be transported to and disposed at the ERDF or another appropriate onsite disposal facility. Risk to human health or the environment at the site would be eliminated by the physical removal of the contaminants.

PREFERRED INTERIM REMEDIAL ALTERNATIVES

Detailed and comparative analysis of the alternatives in the focused feasibility study report determined that the removal, treatment, and disposal alternatives (SS-10 and SW-9) are both technically feasible and cost effective. However, the cost effectiveness of these alternatives is based on assumed disposal costs that involve a high degree of uncertainty. If disposal costs were to change, then the preferred alternatives would be reviewed accordingly.

These alternatives protect human health and the environment in both the short and long term. By removing the contaminated soil and solid waste from the waste sites, all applicable or relevant and appropriate requirements would be met. Although other alternatives evaluated in the focused feasibility study may also achieve these goals, these alternatives address only the mobility of contaminants while the removal, treatment, and disposal alternatives also reduce toxicity and the volume of contaminated waste to the maximum extent. The removal, treatment, and disposal alternative remains implementable and cost effective if allowances are made for uncertainty in the conditions existing at specific waste sites. Table 3 indicates (in the shaded columns) the preferred alternative for each 100-DR-1 Operable Unit waste site group.

Soil Waste Sites. The preferred alternative for soil waste sites is excavation and removal of contaminated soil waste, treatment of contaminated soils to reduce volume or toxicity (if appropriate), then disposal of the remaining contaminated fraction in the ERDF or another appropriate onsite disposal facility. Treatment at individual waste sites would include soil washing to address radionuclide contamination (unless waste site-specific conditions make soil washing inappropriate). If organics are present, thermal desorption would be used to remove organic contaminants. Organic contaminants in general are not considered in the conceptual models for the waste site groups, but may be present at some individual waste sites. The applicability of each treatment will be determined on a case-by-case basis for each waste site.

Soil Washing. Soil washing is a means for reducing contaminated soil/solid waste volume by concentrating contaminants in the fine soil fractions; the clean cobble and gravel fraction is then used as fill. Although bench-scale treatability tests in the 100 Areas have shown soil washing to be effective, there are limits to the application of this treatment process. Soil washing is a desirable treatment when significant volume reduction can be achieved. To achieve significant volume reduction, contamination in the coarse soil fractions after soil washing must be below cleanup levels. When any of the following conditions exist, soil washing is the most effective method for meeting cleanup and volume-reduction goals.

- Concentrations of strong bonding contaminants in the soil (all particle sizes), such as ^{137}Cs, are below twice the cleanup level.

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- Concentrations of strong bonding contaminants, such as ^{137}Cs, are below cleanup levels in the coarse soil fractions.

- The bulk of the radionuclide contamination is concentrated in the fine soil fraction.

- Most of the soil is fine-grained, providing a sufficient surface for concentration of contaminants.

When any of these conditions exist, soil washing may reduce the level of contamination in the coarse soil fractions below cleanup levels and, therefore, waste volume reduction would be achieved.

When contamination in the coarse soil fraction can be reduced below cleanup levels, the resulting volume reduction may still be insufficient to implement soil washing. For example, the cost of soil washing may exceed the cost of disposing the entire waste volume without treatment when reduction of waste volume by treatment does not offset the costs of soil washing. The ability to achieve sufficient volume reduction may result from the total volume of waste at a particular site or the soil particle size distribution.

- Volume reduction is proportional to total waste volume. For large sites, the volume of clean gravels resulting from soil washing would also be large.

- When the coarse soil fraction is a large percentage of the soil, the volume of clean gravels resulting from treatment would be large.

In addition, volume-reduction potential from soil washing has been shown to be a function of the choice of soil washing methods (e.g., wet sieving, scrubbing, and grinding) that can be performed at varying levels of cost. Achieving volume-reduction goals at some sites may be technically feasible but not cost effective. Specific conditions that enhance the applicability of soil washing that may exist at specific 100-DR-1 Operable Unit waste sites are identified below. If these conditions are found to exist during remedial design and implementation, soil washing would likely be chosen as a treatment alternative. The treated contaminated soil would then be disposed of in the ERDF or another appropriate onsite disposal facility after volume reduction.

A design investigation would be conducted during remedy design to determine the site-specific conditions applicable to soil washing. If all identified criteria are met for implementation of soil washing at a specific waste site, a bench-scale treatability test would be conducted to determine final design parameters for the soil washing system. The bench-scale treatability test would also identify any unforeseen problems or site conditions that may alter the treatment selection.

Thermal Desorption. If organic compounds are found, thermal desorption would be used to reduce toxicity and meet ERDF waste acceptance criteria. Thermal desorption involves heating the soil to evaporate volatile organic compounds. Organic compounds are not generally present in the 100-DR-1 Operable Unit waste sites but may be present at some individual sites. Thermal desorption would be used as part of specific waste site remedy, if soil samples confirm the presence of organic compounds above ERDF waste acceptance criteria. The presence of organics and the need for thermal desorption would be determined on a site-specific basis during remedy design.

Solid Waste Sites. The preferred alternative for solid waste sites is excavation, treatment of contaminated solid waste to reduce volume or toxicity (as appropriate), and disposal of the remaining contaminated fraction in the ERDF or another appropriate onsite disposal facility. Treatment would consist of thermal desorption to remove organic contaminants if organics are present. Organic contaminants are not in the general conceptual models for the waste site groups but could be present at some individual waste sites. The applicability of each treatment method will be determined for each individual waste site.

EVALUATION OF ALTERNATIVES

Each of the 100-DR-1 Operable Unit remedial alternatives were evaluated in detail to determine the preferred remedy for each of the waste site groups. The first seven of nine criteria established by CERCLA were used to evaluate the remedial alternatives in the detailed and comparative analyses process. The last two criteria, state acceptance and community acceptance, will be evaluated following comment on this proposed plan and the interim record of decision. The nine criteria encompass statutory requirements and include other technical,

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economic, and practical factors that assist in gauging the overall feasibility and acceptability of the cleanup alternatives.

Overall Protection of Human Health and the Environment. The preferred alternatives would provide the most protection of human health and the environment from soil and solid waste contamination. The preferred alternatives would physically remove treated waste from the site, thus eliminating risk.

Compliance with Applicable or Relevant and Appropriate Requirements. All the remedial alternatives would comply with applicable or relevant and appropriate requirements in federal and state environmental statutes.

Long-Term Effectiveness and Permanence. The removal/disposal alternatives would be the most effective and permanent treatment in the long term. These alternatives would reduce the magnitude of risk. The preferred alternatives would reduce risk, but the treatment process would not be as permanent as vitrification.

Reduction of Toxicity, Mobility, or Volume. The in situ vitrification alternatives would be the most effective in reducing mobility and, to some extent, volume. The preferred alternatives would not control mobility, but would result in the reduction of volume.

Short-Term Effectiveness. The removal/disposal and in situ vitrification alternatives would be the most effective in the short-term. The preferred alternatives treatment processes may create adverse impacts during construction and operation.

Implementability. The containment alternatives would be the most implementable for the solid waste sites. While the removal/disposal alternatives would be the most implementable for the soil sites, the preferred alternatives would be implementable for either soil or solid waste sites.

Cost. The removal/disposal alternatives would be the most cost effective for both the soil and solid waste sites. However, as the cost of disposal increases, so does the effectiveness of the preferred alternatives. Also, if disposal costs remain as assumed, the preferred alternatives would allow for removal and disposal without treatment. Thus, the preferred alternatives may be altered to be equal in cost to the removal/disposal alternatives.

A summary of this analysis is provided in Table 4.

SCHEDULE OF FUTURE ACTIVITIES

The following activities for interim remedial action are planned for the 100-DR-1 Operable Unit:

- During the period of ? to ? the public will have the opportunity to comment and question, both in writing and during an open public meeting on ? on the proposed plan for the 100-DR-1 Operable Unit.

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CERCLA EVALUATION CRITERIA

Overall Protection of Human Health and the Environment addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure route are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Compliance with Applicable or Relevant and Appropriate Requirements addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements in federal and state environmental statutes, or provide grounds for invoking a waiver of the requirements.

Long-Term Effectiveness and Permanence refers to the magnitude of residual risk and the ability of a remedy to maintain reliable protection of human health and the environment after remedial action objectives have been met.

Reduction of Toxicity, Mobility, or Volume Through Treatment evaluates the anticipated performance of the treatment technologies that may be employed in a remedy.

Short-Term Effectiveness refers to the speed with which the remedy achieves protection, as well as the potential of the remedy to create adverse impacts on human health and the environment that may result during the construction and implementation period.

Implementability refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the selected solution.

Cost evaluates capital, operation, and maintenance costs for each remedial alternative by performing present-worth cost analyses.

State Acceptance indicates whether the state concurs with, opposes, or has no comment on the preferred alternative based on review of the remedial investigation and focused feasibility study reports and proposed plan.

Community Acceptance is an assessment of the general public response to the proposed plan following a review of the public comments received on the focused feasibility study report and the proposed plan during the public comment period and open community meeting(s).

GLOSSARY

Applicable or Relevant and Appropriate Requirements - These ensure compliance with all substantitive elements of federal laws and more stringent state laws that apply or are determined to be relevant and appropriate.

Comprehensive Environmental Response, Compensation, and Liability Act of 1986 - A federal law that establishes a program that enables the EPA to identify abandoned hazardous waste sites, ensures they are cleaned up, and allows other government entities to evaluate damages to natural resources.

Contaminants of Potential Concern - Constituents that must be addressed by remedial action.

Dynamic Compaction - A weight for use in tamping (compacting) that is attached to a crane and dropped from a predetermined height onto the area to be compacted to cause deep densification of the soils.

Environmental Restoration Disposal Facility - A disposal facility plan, which is currently in the process of being implemented, for contaminated soils and solid waste.

Expedited Response Action - A response action that could be taken to address contamination problems.

Focused Feasibility Study - An evaluation of a limited number of alternatives that are focused to the scope of planned response action.

Groundwater - Underground water that fills the spaces between particles of soil, sand, gravel, or openings in rocks to the point of saturation.

Hazard Quotient - The ratio of exposure to toxicity for noncancer end points. When the hazard quotient exceeds 1.0, a possible health risk is assumed to exist.

In Situ - This refers to an operation or process that is being conducted in place.

In Situ Vitrification - A thermal treatment process that converts soil and other material into stable glass or glass-like crystalline substances that stabilize the contaminants in place.

Interim Record of Decision - The formal document in which the lead agency sets forth the selected IRM and the reasons for its selection.

Interim Remedial Measure - A remedial measure (IRM) that is taken at a site to address one or more of the site problems but not necessarily all of the site problems. The IRM is based on a limited field investigation/focused feasibility study and is selected in an interim record of decision.

Limited Field Investigation - This is an investigation selected to assess the applicability of the IRM for reducing human health and environmental risks through groundwater sample collection and analysis.

Operable Unit - A subset of a larger Superfund site which is typically the subject of an investigation and remedial action.

Qualitative Risk Assessment - An evaluation of risk for a predefined set of human and environmental exposure scenarios that assists Tri-Party Agreement signatories in making defensible decisions on the necessity of IRM.

Remedial Investigation - An in-depth study that involves gathering the data necessary to determine the nature and extent of contamination.

Superfund National Priorities List - A list of high-priority hazardous waste sites in the country that are eligible for investigation and cleanup under the Superfund program.

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