DOE/RL-2009-117
Revision 0

Proposed Plan for the Remediation of the 200-CW-5, 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY

Richland Operations Office

P.O. Box 550
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Release Approval Date

Proposed Plan for the Remediation of the 200-CW-5, 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units

U.S. Department of Energy, Richland Operations Office
U.S. Environmental Protection Agency
Washington State Department of Ecology

Central Plateau Remediation at the Department of Energy Hanford Site — July 2011

Public Comment Period
July 5 – August 5, 2011

How You Can Participate:

Read this Proposed Plan and review related documents in the Administrative Record.

Comment on this Proposed Plan by mail, e-mail, or fax on or before August 5, 2011.

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See page 46 for more information about public involvement and contact information.

Inside this Plan

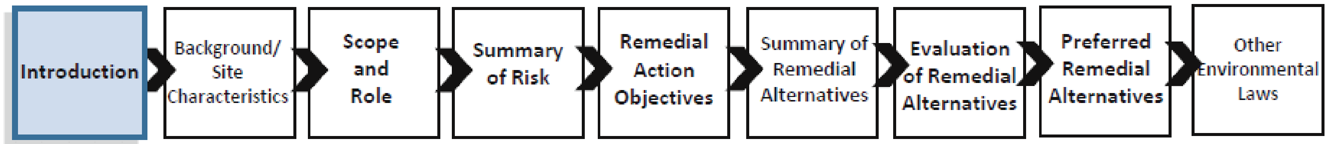
Figure 1. The 200-CW-5, 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units are located within the 200 East Area (foreground) and the 200 West Area (background).

The U.S Department of Energy (DOE) and U.S Environmental Protection Agency (EPA) invite the public and Tribal Nations' comments on this **Proposed Plan** for cleanup of 21 **waste sites** in the central part of the Hanford Site located near Richland, Washington. DOE has completed its investigation of these waste sites through its comprehensive **remedial investigation/feasibility study (RI/FS)** process. DOE is issuing the Proposed Plan for the 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 (200-PW-1,3,6) **Operable Units (OUs)** to summarize and seek public and Tribal Nations input on the cleanup alternatives considered and the preferred alternative proposed for implementation.

The RI/FS concluded that without **remedial action**, contaminants in most of these OUs would exceed risk threshold values for anticipated future industrial land use. The existing contaminant concentrations also exceed acceptable risk levels to human health and the environment.

Public and Tribal Nations input on the Proposed Plan will help DOE and EPA choose the best way to deal with these contaminated sites. Opportunities to provide input include written comments by mail, fax, and e-mail. Comments will be accepted during the 30-day public comment period (see page 46, Community Participation section).

Following consideration of public input on the preferred alternative or other alternatives presented in this Proposed Plan, a **Record of Decision (ROD)** will be issued by DOE and EPA identifying the final alternative selected for implementation. The Proposed Plan is divided into nine sections as shown in the following navigational graphic. The relationship of each section within the document is shown in graphic form.



INTRODUCTION

DOE has completed its investigation and prepared this Proposed Plan, which describes the cleanup alternatives considered and the **preferred alternatives** proposed for the **remediation** of the 200-CW-5 and 200-PW-1,3,6 OU waste sites (Figure 1) and associated pipelines located on the Central Plateau of the Hanford Site near Richland, Washington. These four OUs consist of 21 waste sites that have been grouped together into six waste groups (Z-Ditches, High-Salt, Low-Salt, Settling Tanks, Cesium-137, and Other Sites) based on liquid waste type, primary contaminants, and similarities in the distribution of contaminants in the subsurface. The three government agencies responsible for the cleanup of the 200-CW-5 and 200-PW-1,3,6 OUs are:

- DOE, as the lead agency and the party responsible for conducting the selected cleanup alternative, is required to issue this Proposed Plan to fulfill the public participation requirements under Section 117 (a) of the ***Comprehensive Environmental Response, Compensation, and Liability Act of 1980*** **(CERCLA)** (commonly referred to as "Superfund") and Section 300.430(f) (2) and (3) of the "**National Oil and Hazardous Substances Pollution Contingency Plan" (NCP)**. CERCLA establishes the broad federal authority for conduct of cleanup at Superfund sites, and the NCP defines the requirements and expectations for the cleanup.
- EPA and the Washington State Department of Ecology (Ecology) provide regulatory oversight of the Hanford Site cleanup. EPA is the lead regulatory agency for these OUs. Ecology, the support regulatory agency, will determine if they concur with the preferred alternative after the public comment period on this Proposed Plan.

These agencies are referred to as the Tri-Party agencies under the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989), which is commonly called the **Tri-Party Agreement**.

The preparation of the RI/FS work plan is the first step in the CERCLA decision process. The preparation of the Proposed Plan occurs after the RI/FS reports are finalized and is based on detailed information contained in those reports. The Proposed Plan then goes out for public and Tribal Nation comment.

After Tri-Party agency consideration of the comments received, a ROD will be issued identifying the final cleanup remedies selected for implementation, a responsiveness summary containing agency responses to the comments received during the public comment period will be made available with the ROD.

Interested parties may want to review the RI and FS documents for more comprehensive information. These reports and other supporting information used to evaluate alternatives and develop the preferred alternative are available online in the Hanford Site **Administrative Record**. The Community Involvement section of this Proposed Plan identifies the Administrative Record website and lists the locations of public information repositories.

The preferred alternatives presented for public comment are based on the respective RI and FS reports for the OUs described in this Proposed Plan. The RI and FS findings for the 200-CW-5 OU were published in the following reports:

- DOE/RL-2003-11, *Remedial Investigation Report for the 200-CW-5 U Pond/Z-Ditches Cooling Water Group, the 200-CW-2 S Pond and Ditches Cooling Water Group, the 200-CW-4 T Pond and Ditches Cooling Water Group, and the 200-SC-1 Steam Condensate Group Operable Units.*
- DOE/RL-2004-24, *Feasibility Study for 200-CW-5 Cooling Water Operable Unit*.

The RI and FS findings for 200-PW-1,3,6 OUs were published in these reports:

- DOE/RL-2006-51, *Remedial Investigation Report for the Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit: Includes the 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units.*
- DOE/RL-2007-27, *Feasibility Study for the Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit: Includes the 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units*.

The RI and FS evaluations concluded that without remedial action, most of the waste sites pose a current or potential risk to human health and the environment (plants, animals, or groundwater) via direct contact or contaminant migration into the underlying groundwater. An unrestricted land use scenario is used to provide the basis for determining the need to cleanup these waste sites. Examples of activities of unrestricted land use include an exposure from a driller bringing contaminated drill cuttings to the surface and then a subsistence farmer growing food crops or raising livestock on the cuttings. An industrial worker exposure scenario was used to develop preliminary remediation goals for evaluating the **remedial alternatives** for these waste sites, which is consistent with the industrial land use of the area.

The following remedial action alternatives were evaluated in the feasibility studies:

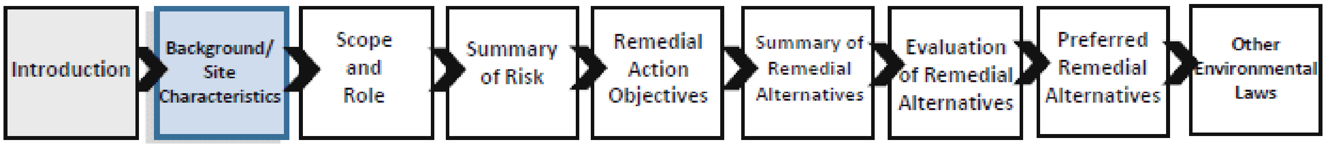
- No Action
- Maintain Existing Soil Cover/Institutional Controls (MESC/IC)
- Engineered Surface Barrier (Barrier)
- In Situ Vitrification (ISV)
- Removal, Treatment, and Disposal (RTD)
- Combinations of several of the above alternatives

Preferred Remedial Alternatives

DOE and EPA are proposing, as part of the preferred alternatives, excavation of contaminated soil and **debris** located at the plutonium-containing (200-PW-1 and 200-PW-6 OUs) and cooling water (200-CW-5 OU) waste sites and disposal of the contaminated soils and debris in approved onsite and offsite disposal facilities. For 200-PW-3 waste sites that primarily contain cesium-137 but do not contain plutonium, maintenance and/or enhancement of the existing soil cover is proposed. Pipelines associated with the waste sites are proposed to be removed. To mitigate the potential for exposure to contamination left in place, IC will be included as part of the preferred alternatives.

All preferred alternatives in this Proposed Plan will be protective of human health and the environment and meet statutory requirements for remedy selection and compliance with **Applicable or Relevant and Appropriate Requirements (ARARs).** ARARs represent the body of federal and state laws (e.g., Model Toxics and Control Act

[MTCA]), regulations, and standards governing environmental protection. The feasibility studies (DOE/RL-2004-24 and DOE/RL-2007-27) describe the potential ARARs.



BACKGROUND/SITE CHARACTERISTICS

This section provides background information on the Hanford Site and the four OUs described in this Proposed Plan. Additional information on previous investigations, contaminant background, and previous public involvement is provided.

Hanford Site Background

The Hanford Site, managed by DOE, encompasses approximately 1,517 km^2 (586 mi^2) in the Columbia Basin of south-central Washington State (Figure 2). In 1942, during World War II, the Hanford Site was selected by the leaders of the Manhattan Project as the site for building the first production-scale nuclear reactors to produce **plutonium** for nuclear weapons. The site was chosen because of its remoteness at the time, the availability of water from the Columbia River, and access to electricity from hydropower plants at the Bonneville and Grand Coulee Dams. The Hanford Site's plutonium production mission continued throughout the Cold War period until the early 1980s.

In July 1989, EPA placed the 100, 200, 300, and 1100 Areas of the Hanford Site (Figure 2) on its **National Priorities List (NPL)** (40 CFR 300, Appendix B, "National Oil and Hazardous Substances Pollution Contingency Plan"). Since that time, the Hanford Site's mission has focused on environmental cleanup. The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States. The list is intended to guide EPA in determining waste sites that warrant further investigation (available at: http://www.epa.gov/superfund/sites/npl/). The Tri-Party Agreement was also signed in 1989, ushering in the cleanup mission for the Hanford Site.

Operable Units Background

This section provides a more detailed description of the 200-CW-5 and 200-PW-1,3,6 OUs, the nature and extent of the contamination, and structures associated with the 21 waste sites comprising the four OUs, which are located in the Inner Area. The Inner Area is located in the central portion of the Hanford Site, as shown in Figure 2.

The 200 Area, which consists of 200 West and 200 East, contains approximately 800 waste sites and includes waste management facilities and inactive irradiated nuclear fuel reprocessing facilities such as the **Plutonium Finishing Plant (PFP)**. Of the four OUs that are the subject of this Proposed Plan, three (200-CW-5, 200-PW-1, and 200-PW-6) are located in the 200 West Area (Figure 3) and one (200-PW-3) is located in the 200 East Area (Figure 4). These waste sites consist of contaminated soils and debris that may require remediation.

The 200-PW-1 and 200-PW-6 OUs in 200 West Area and the 200-PW-3 OU in 200 East Area are associated with subsurface waste handling and disposal sites that were engineered and constructed to dispose of liquid waste into the soil beneath the sites. Pipes conveyed the liquid waste from nuclear processing facilities to the waste sites. At the **cribs, tile field, and French drain**, liquid waste was discharged into a layer of gravel that drained into the underlying soil and may have drained laterally rather than downward.

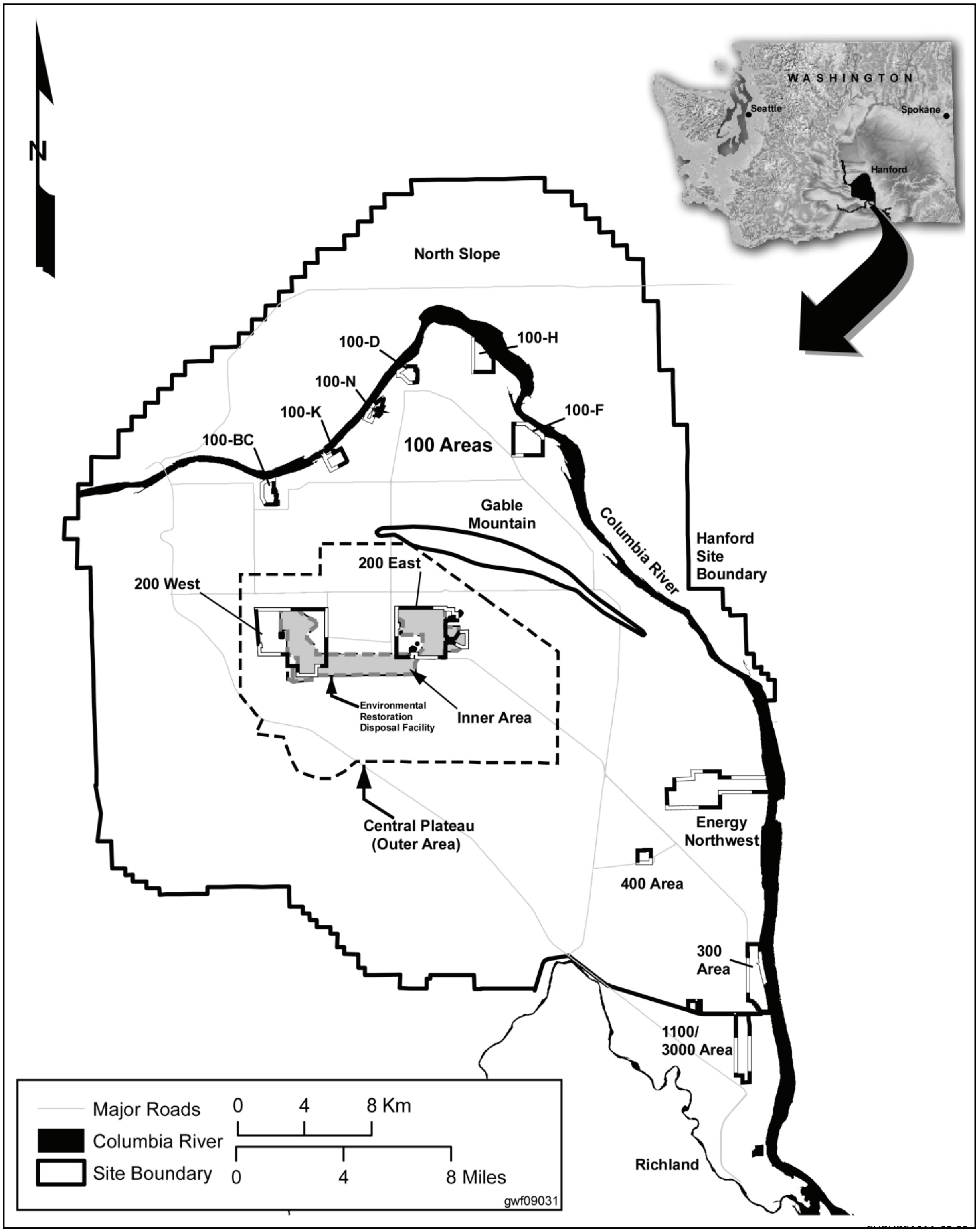


Figure 2. Hanford Site with Inner and Outer Area

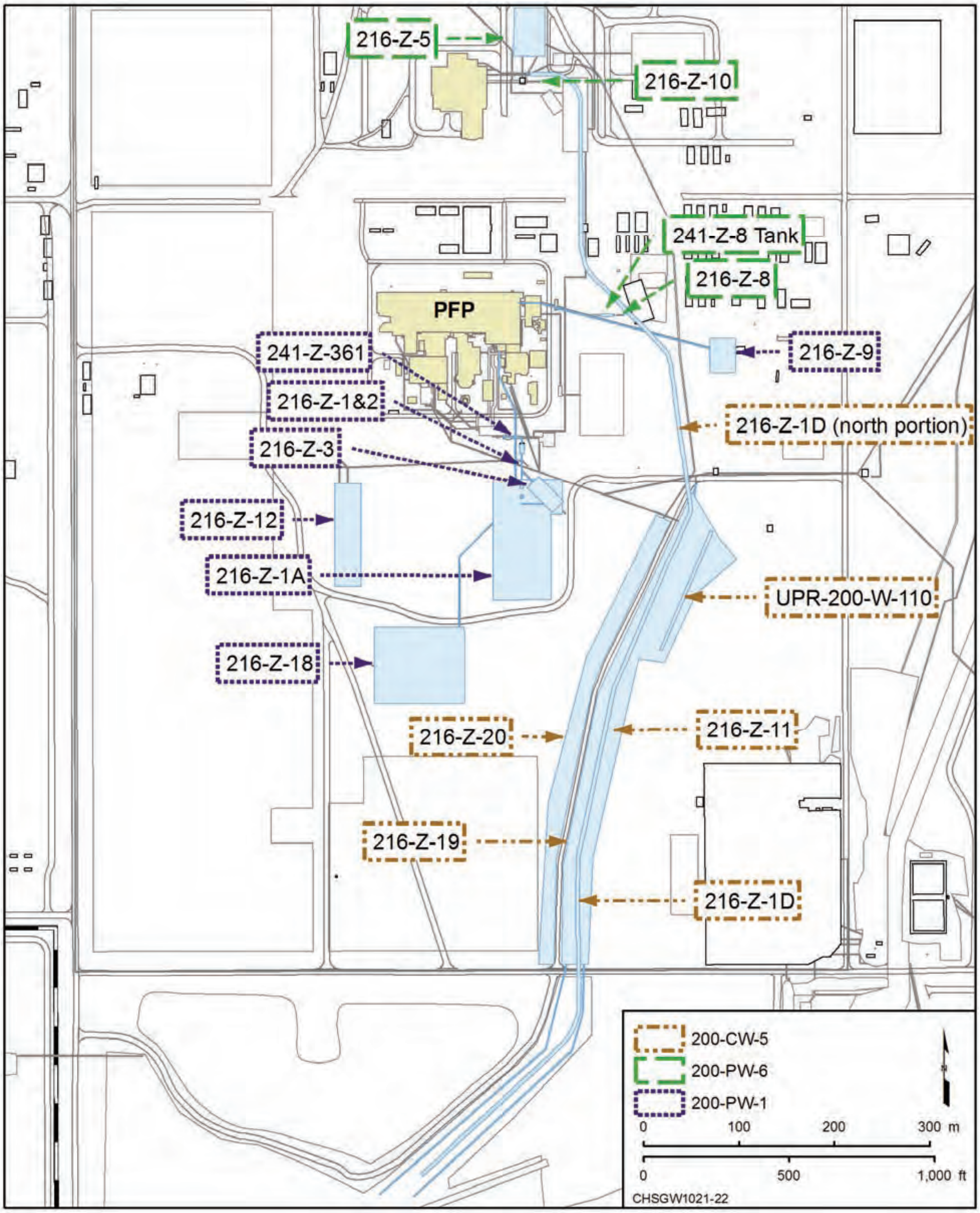


Figure 3. Location of the 200-CW-5, 200-PW-1, and 200-PW-6 OUs Waste Sites in the 200 West Area

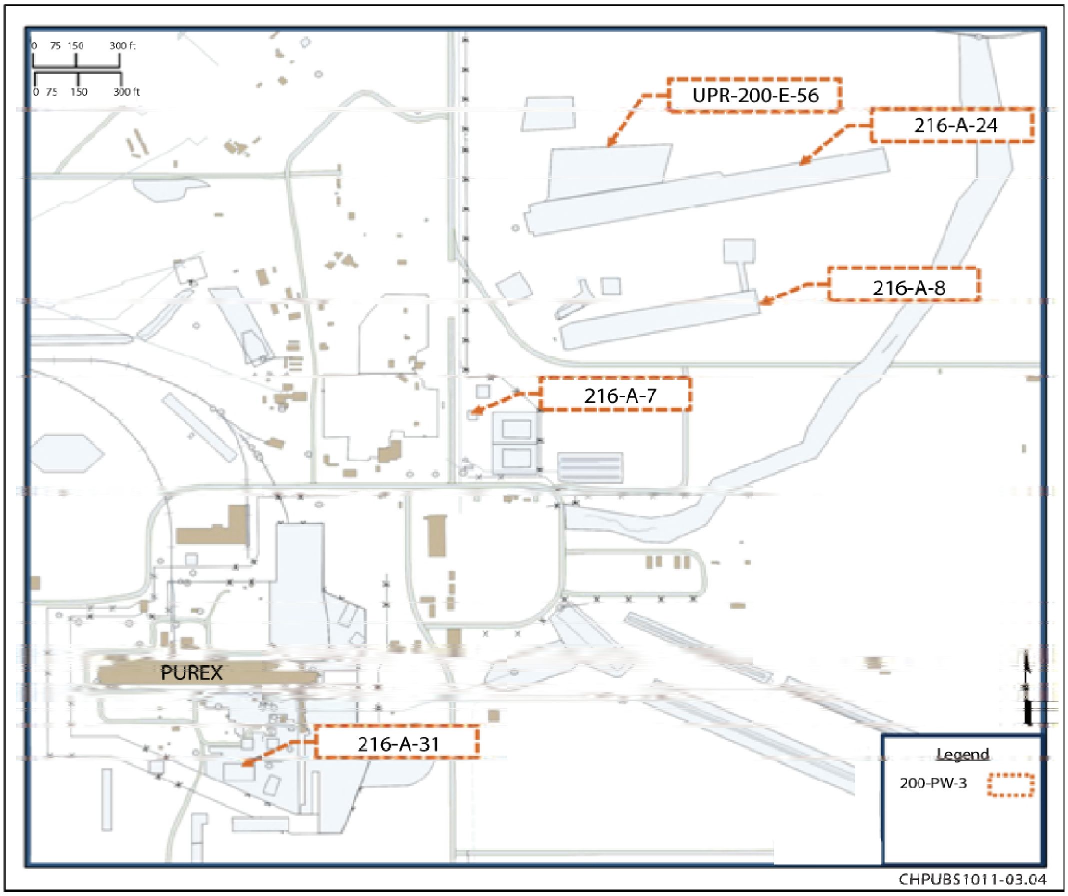


Figure 4. Location of the 200-PW-3 OU Waste Sites in the 200 East Area

The 200-CW-5 OU in the 200 West Area is associated with waste sites that managed cooling water and steam condensate from the PFP. The 200-CW-5 OU consists of shallow, open ditches, called Z-Ditches, which were used for liquid waste disposal; as one ditch was taken out of service, soils excavated for its successor trench were used to backfill the older trench. These ditches are constructed along parallel routes. A tile field (216-Z-20) was constructed as a liquid waste disposal site to replace the initial three ditches. The **Unplanned Release (UPR)** site occurred as a single-use disposal site.

Sources of Contamination

Large volumes of liquid waste were generated from the production of plutonium at various processing and finishing plants in the 200 West and 200 East Areas of the Central Plateau. Process wastewater was discharged to the 200-PW-1,3,6 OU waste sites. The processes were intended to recover as much plutonium as possible prior to discharge of the waste liquids, but the waste streams still contained low levels of plutonium and other contaminants.

Cooling water and steam condensate were discharged to the 200-CW-5 OU waste sites. The cooling water and steam condensate systems were designed to isolate those systems from potential contamination sources, but occasionally became contaminated because of minor leaks due to corrosion pinholes or cracks and process upsets. The process and cooling waters discharged to the 200-CW-5 OU waste sites were disposed of to the ground surface or to the shallow subsurface through ditches or the 216-Z-20 Tile Field, as part of normal operations.

The liquid waste that contained low levels of plutonium and other contaminants discharged to the 200-CW-5 and 200-PW-1,3,6 OU waste sites infiltrated into the ground, contaminating the underlying soil. In addition, soil located adjacent to some of the disposal structures is contaminated due to lateral spreading of the liquid waste. However, most soil contamination associated with these 200-PW-1,3,6 OU waste sites is located beneath the bottom of the waste sites and is deeper than 4.6 m (15 ft) below the existing ground surface (bgs). There are nine waste sites, out of 21, that contain contamination above 4.6 m (15 ft) bgs:

- One within the 200-PW-1 OU (216-Z-1A Tile Field)
- Three within the 200-PW-3 OU (216-A-7 Crib, 216-A-8 Crib, and UPR-200-E-56 Unplanned Release)
- Five within the 200-CW-5 OU (216-Z-1D Ditch, 216-Z-11 Ditch, 216-Z-19 Ditch, 216-Z-20 Tile Field, and UPR-200-W-110 Unplanned Release)

Previous Investigations

The RI for the 200-CW-5 OU (DOE/RL-2003-11) was conducted in accordance with the RI/FS work plan (DOE/RL-99-66, *200-CW-5 U Pond/Z-Ditches Cooling Water Group Operable Unit RI/FS Work Plan*) and associated sampling and analysis plan (DOE/RL-2002-24, *200-CW-5 U Pond/Z-Ditches Cooling Water Group Operable Unit Remedial Investigation Sampling and Analysis Plan*). The RI identified chemical and **radionuclide** contaminants of potential concern that exist in shallow soils near the bottom of the waste sites.

The RI for the 200-PW-1,3,6 OUs (DOE/RL-2006-51) was conducted in accordance with the RI/FS work plan DOE/RL-2001-01, *Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit RI/FS Work Plan: Includes the 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units,* to characterize the nature and extent of chemical and radiological contamination and physical conditions in the **vadose zone** underlying three waste sites: the 216-Z-1A Tile Field, the 216-Z-9 Trench, and the 216-A-8 Crib. The RI summarizes the characterization data for all of the waste sites in the three OUs.

Previous Remediation

Several interim actions have been conducted to mitigate risks posed by the waste sites: (1) a remediation system (i.e., **Soil Vapor Extraction [SVE]**) for carbon tetrachloride was constructed and is in operation, (2) some plutonium-contaminated soils were removed, (3) covers were placed over certain waste units, and (4) remedial technologies were tested at certain waste sites. Each of the interim remedies is briefly summarized below.

- ***Remediation of carbon tetrachloride:*** Groundwater below the 200 West Area is contaminated with carbon tetrachloride and other contaminants from a variety of sources. A remedy for treating the groundwater below these OUs will be addressed through actions for the groundwater OUs. The potential for contamination from the soils in the 200-CW-5 and 200-PW-1,3,6 OUs to migrate to the groundwater and contribute to the existing groundwater contamination was evaluated. Carbon tetrachloride and other volatile contaminants present in the vadose zone were determined to pose a potential threat to groundwater at 200-PW-1 OU, but not at the 200-PW-3, 200-PW-6, or 200-CW-5 OU waste sites. This potential groundwater threat at the 200-PW-1 OU is being addressed by continued use of the existing SVE system.

  Since 1992, under an Expedited Response Action for the 200-PW-1 OU, SVE has been used to minimize the migration of carbon tetrachloride and other volatile organic compounds (VOCs) in the vadose zone away from the 216-Z-9 Trench, the 216-Z-1A Tile Field, and the 216-Z-18 Crib.

  Between April 1991 and September 2009, approximately 81,000 kg (179,000 lb) of carbon tetrachloride were removed by the SVE systems (SGW-44694, *Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Operable Unit Carbon Tetrachloride Site, Fiscal Year 2009*). Remediation using SVE under an expedited response action will continue until it is no longer necessary or is replaced by a component of a final action remedy.

- ***Removal of plutonium-contaminated soils and tank contents:*** From 1976 through 1977, 0.3 m (1 ft) of soil containing about 58 kg (128 lb) of plutonium was removed from the bottom of 216-Z-9 Trench. This action removed roughly half the plutonium mass that had been estimated to be located beneath the trench. In addition, from 1974 through 1975, liquids that could be pumped were removed from the 241-Z-361 and 241-Z-8 Settling Tanks, leaving behind contaminated sludge.
- ***Placement of covers:*** The Z-Ditches were constructed parallel to one another and operated in sequence; therefore, as one ditch was taken out of service, clean soil from the excavation of the new ditch was used to backfill the old ditch. Routine stabilization of these sites has been performed to prevent the spread of surface contamination.
- ***Test project for applicability of remedial technology:*** In 1987, a portion of the 216-Z-12 Crib was vitrified as part of an ISV test project, resulting in the formation of a 408,000 kg (450 ton) block of vitrified contaminated soil.

Previous Public Involvement

The Tribal Nations, the public, and the Hanford Advisory Board (HAB) have been informed of the status of remedial action through regular updates and placement of documents in the Administrative Record. Updates on the performance of the ongoing interim action to address carbon tetrachloride contamination at the 200-PW-1 OU through SVE are one example.

DOE and EPA sought early input from Tribal Nations and the public on the remedial alternatives for these waste sites through a public workshop held in April 2008. Input was also received through HAB meetings and interactions (HAB 207, "Criteria for Development of the Proposed Plan for 200-PW-1, 3, and 6"). The comments received generally expressed a preference for removal of the plutonium-containing waste at the sites, regardless of the risk assessment result. Due to the extremely long half-life of plutonium (approximately 24,100 years) and the concern regarding future risk, a number of comments questioned the protective ability of any remedy that left plutonium in place. Comments suggested such a remedy might not provide the same confidence for protection far into the future as a remedy that included the excavation and disposal of plutonium-contaminated soil.

Previous draft versions of the Proposed Plan for the 200-CW-5 and 200-PW-1,3,6 OUs and the respective RI and FS documents were shared with the Tribal Nations, the public, and the HAB for their consideration and input.

The Tri-Parties' **Community Relations Plan** and its subsequent revisions will serve as the basis for the current and future public involvement efforts for the 200-CW-5 and 200-PW-1,3,6 OUs.

Waste Site/Group Characteristics

A total of 21 waste sites are located within these four OUs. These sites represent the majority of the Hanford Site's plutonium production wastewater sites. Process wastewater, cooling water, and steam condensate that had been contaminated with plutonium was disposed of at these waste sites via discharge to the shallow soil surface. In addition, several sites contain cesium-137 and other contaminants.

Some of the sites include timber- or culvert-supported void spaces. One site has a large void space enclosed by a concrete cover where liquid waste was discharged directly to the soil (Figure 5). Two sites are settling tanks where waste particles (sludge) accumulated before the waste liquids drained to other disposal sites. One site is a reverse well, where the liquid waste was discharged directly into the soil, and the others are UPR sites, where liquid waste drained laterally from an adjacent waste site.

The waste sites have been grouped into six waste groups based on the similar process liquid waste type, primary contaminants, and similarities in the distribution of contaminants in the subsurface (Table 1). The evaluation of remedial alternatives is by waste group rather than by OU because of the similarities. Table 1 also includes the pipelines associated with the six waste groups.

Figure 5. The 216-Z-9 Trench (beneath cover)

Table 1. Summary of Waste Sites Assigned to Each Waste Group

Operable Unit	Waste Site	Waste Group	Primary Contaminants
200-CW-5	216-Z-1D Ditch, North and South 216-Z-11 Ditch 216-Z-19 Ditch 216-Z-20 Tile Field UPR-200-W-110 Unplanned Release 200-W-207-PL (216-Z-19 Ditch)	Z-Ditches	plutonium, americium-241, cesium-137, radium, PCBs
200-PW-1	216-Z-1A Tile Field 216-Z-9-Trench 216-Z-18 Crib 200-W-174-PL and 200-W-206-PL	High-Salt	plutonium, americium-241, carbon tetrachloride, methylene chloride
200-PW-1 200-PW-6	216-Z-1&2 Crib 216-Z-3 Crib 216-Z-12 Crib 216-Z-5 Crib 200-W-208-PL and 200-W-210-PL	Low-Salt	plutonium, americium-241
200-PW-1 200-PW-6	241-Z-361 Settling Tank 241-Z-8 Settling Tank 200-W-205-PL and 200-W-220-PL	Settling Tanks	plutonium, americium-241
200-PW-3*	216-A-7 Crib 216-A-8 Crib 216-A-24 Crib 216-A-31 Crib UPR-200-E-56 Unplanned Release	Cesium-137	cesium-137
200-PW-6	216-Z-8 French Drain 216-Z-10 Injection/Reverse Well	Other Sites	None Identified

* Pipelines associated with 200-PW-3 are part of another OU.

The remainder of this section provides a more detailed description of the nature and extent of the contamination and the unique aspects of each waste group.

Z-Ditches Waste Group (200 CW-5)

200-CW-5 OU contains the Z Ditches Waste Group, which comprises three ditches (216-Z-1D, 216-Z-11, and 216-Z-19); one tile field (216-Z-20); and a UPR site (UPR-200-W-110). These waste sites managed cooling water and steam condensate from the PFP. The PFP received nuclear materials and process streams from Hanford Site operations. The PFP was used to perform americium and plutonium separation and recovery operations.

These operations generated large quantities of cooling water and steam condensate that was discharged to the Z-Ditches for transfer to the 216-U-10 Pond for disposal. The 216-Z-1D Ditch, 216-Z-11 Ditch, 216-Z-19 Ditch, and the 216-Z-20 Tile Field operated sequentially over a 50-year period (1944 through 1995). A cross section of the ditches is shown in Figure 6.

The northern portion of 216-Z-1D, which is 526 m (1,725 ft) long, was abandoned, backfilled, and replaced with a process sewer pipe in 1949. The 216-Z-20 Tile Field consists of a perforated polyvinyl chloride (PVC) pipe set in gravel. The other ditches were open trenches. The ditches and the tile field all had native soil at the base. The ditches have been backfilled; a stabilized cover, which is slightly above the surrounding topography, has been placed over them. The contamination is generally located beneath the bottom of the trenches.

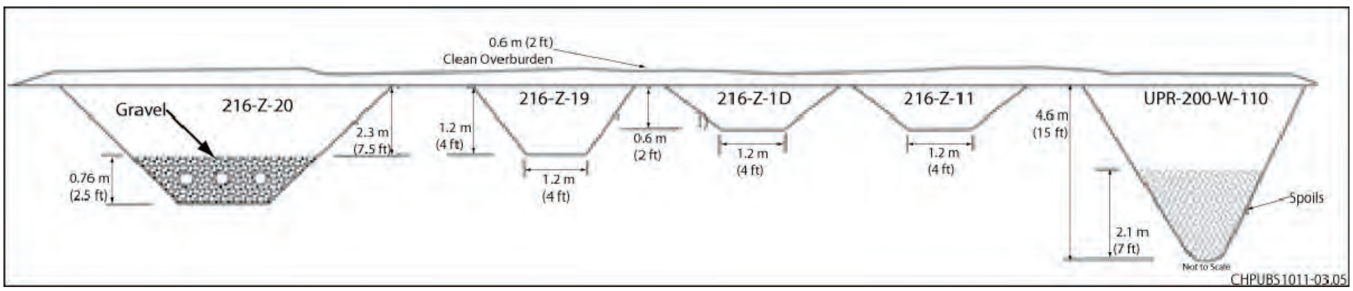


Figure 6. Z-Ditches (Primary COCs are Pu, Am-241, Cs-137, Ra, and PCBs)

UPR-200W-110 is a narrow, one-time use disposal trench located immediately east and parallel to 216-Z-11 Ditch. The trench was used to dispose of spoils containing 216-Z-1D ditch sediments and clean backfill.

The primary Z-Ditch contaminants are radionuclides (americium-241, plutonium-238, plutonium-239/240, cesium-137, and radium-226) and polychlorinated biphenyls (PCBs, also referred to as Aroclor).[1] In general, the highest concentrations of radioactive contaminants are located in shallow soils from approximately 0.6 m (2 ft) bgs to 4.1 m (13.5 ft) bgs at the deepest location. The PCBs were found from 2.1 to 3.0 m (7 to 10 ft) bgs at one location in the 216-Z-11 Ditch. Sampling has confirmed that contamination decreases with depth.

High-Salt Waste Group (200-PW-1)

The three waste sites in the High-Salt Waste Group (the 216-Z-9 Trench, 216-Z-1A Tile Field, and 216-Z-18 Crib) primarily received waste from the **Recovery of Uranium and Plutonium by Extraction (RECUPLEX)** facility or the **Plutonium Reclamation Facility (PRF)** solvent extraction systems used for plutonium recovery. During operation, extensive attempts were made to retain the plutonium in the extraction and reclamation facilities and to keep it from entering the waste streams. The waste streams were acidic and contained plutonium, americium, and a significant volume of organics (primarily carbon tetrachloride).

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[1] Aroclor 1254 and Aroclor 1260 were trade names for PCBs marketed by Monsanto Company from 1930 to 1977.

The 216-Z-9 Trench is a rectangular, enclosed trench with a concrete cover supported by six columns (Figure 7). The 216-Z-1A Tile Field consists of distribution vitrified clay pipes placed in a gravel bed, which was then backfilled (Figure 8). The 216-Z-18 Crib consists of five separate parallel crib structures (Figure 9).

The plutonium and americium radionuclide contamination remains in the subsurface just below the bottom of the waste sites and is concentrated within the upper 6 m (20 ft) of soil, but it has been found to a depth of 27.5 to 30.5 m (90 to 100 ft). However, the concentration of radionuclide contamination generally decreases with depth.

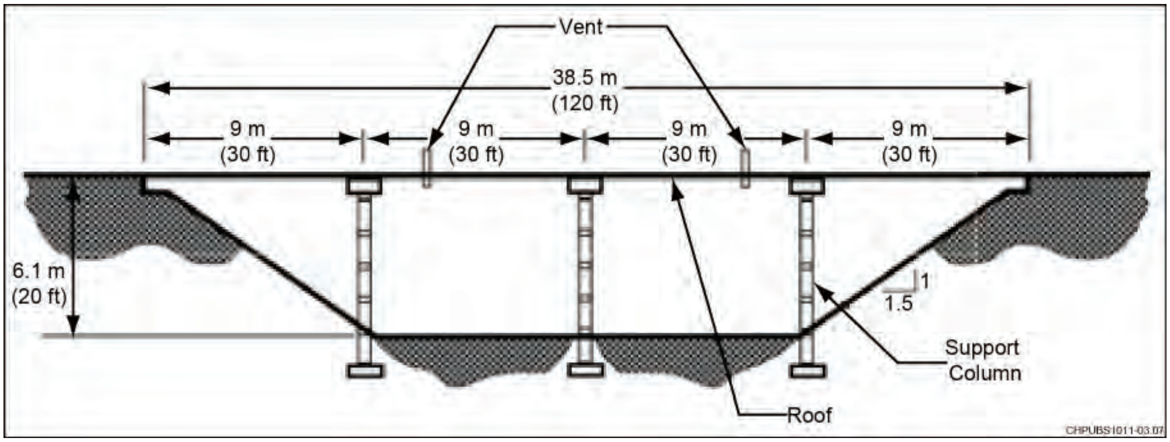


Figure 7. 216-Z-9 Trench (Primary COCs are Pu and Am-241)

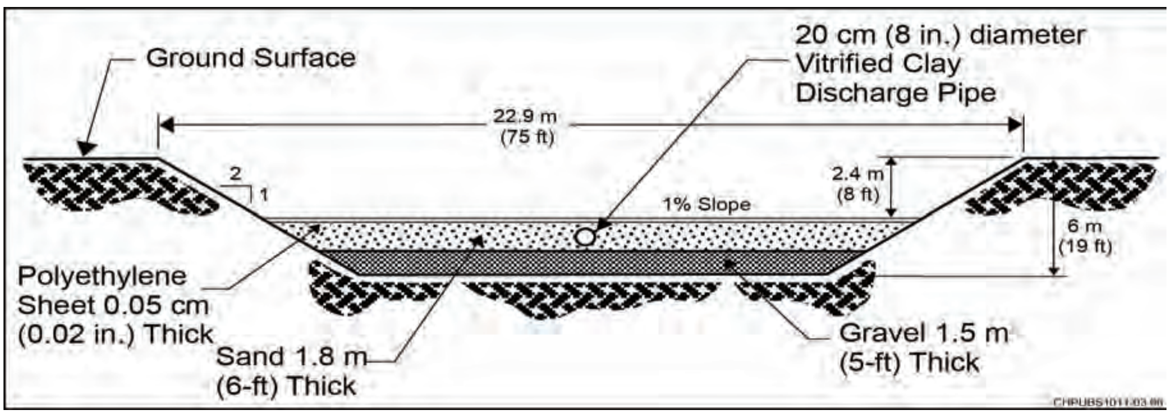


Figure 8. 216-Z-1A Tile Field (Primary COCs are Pu and Am-241)

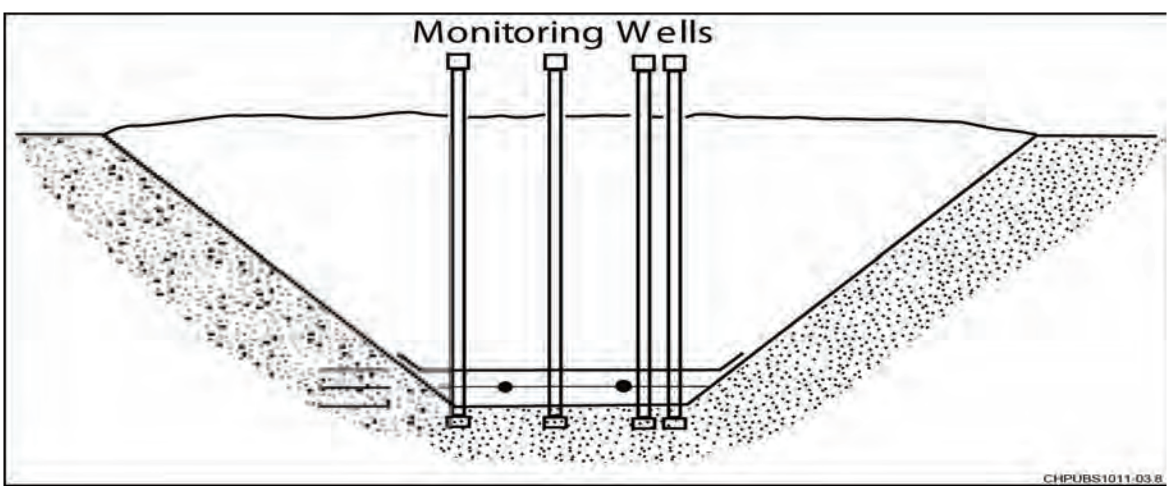


Figure 9. 216-Z-18 Crib (Primary COCs are Pu and Am-241)

Carbon tetrachloride remains in the soil column beneath these waste sites and is known to have contaminated groundwater. Since 1992, SVE has been used to minimize the migration of and recover carbon tetrachloride in the vadose zone at three sites (216-Z-9 Trench, 216-Z-1A Tile Field, and 216-Z-18 Crib).

Low-Salt Waste Group (200-PW-1 and 200-PW-6)

The four waste sites in the Low-Salt Waste Group (216-Z-1&2 Crib, 216-Z-3 Crib, 216-Z-12 Crib, and 216-Z-5 Crib) primarily received neutral to basic aqueous waste streams from the Plutonium Isolation Facility or the PFP Complex.

The waste primarily contained plutonium and americium, with negligible amounts of organics. This aqueous waste, referred to as low-salt waste, was primarily a dilute sodium fluoride and sodium nitrate solution when it was discharged to the cribs. The waste streams were routed through the 241-Z-361 Settling Tank prior to discharge to the cribs.

The 216-Z-1&2 Cribs consist of two open-bottom square wooden boxes set in excavations (Figure 10). The 216-Z-3 Crib consists of three long perforated corrugated metal culverts laid horizontally end to end (Figure 11). The 216-Z-12 Crib is rectangular with a perforated pipe that runs the length of the crib (Figure 12). The 216-Z-5 Crib consists of two, in-line, interconnected deep wooden sump boxes (Figure 13).

The contamination at the Low-Salt Waste Group remains near the bottom of the waste sites. Contaminant concentrations decrease rapidly with depth below the base of the waste site and radionuclide concentrations fall to levels associated with unrestricted use within 1.2 m (4 ft) below the bottom of the waste site or 7.6 m (25 ft) bgs.

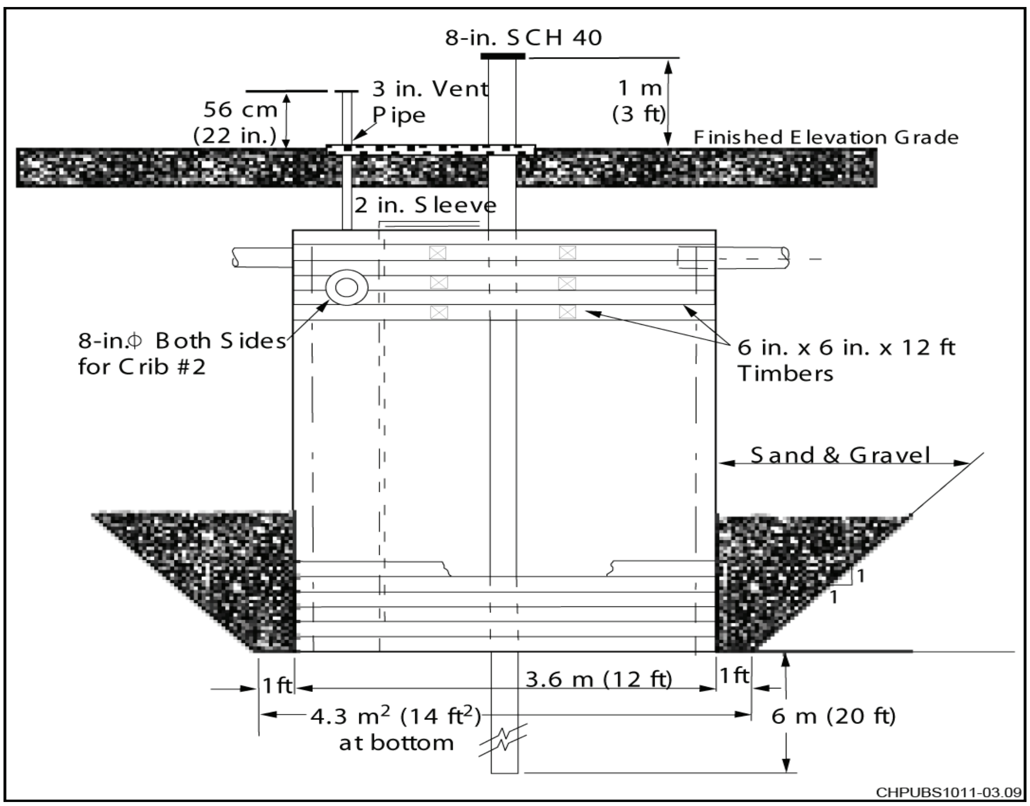


Figure 10. 216-Z-1&2 Crib (Primary COCs are Pu and Am-241)

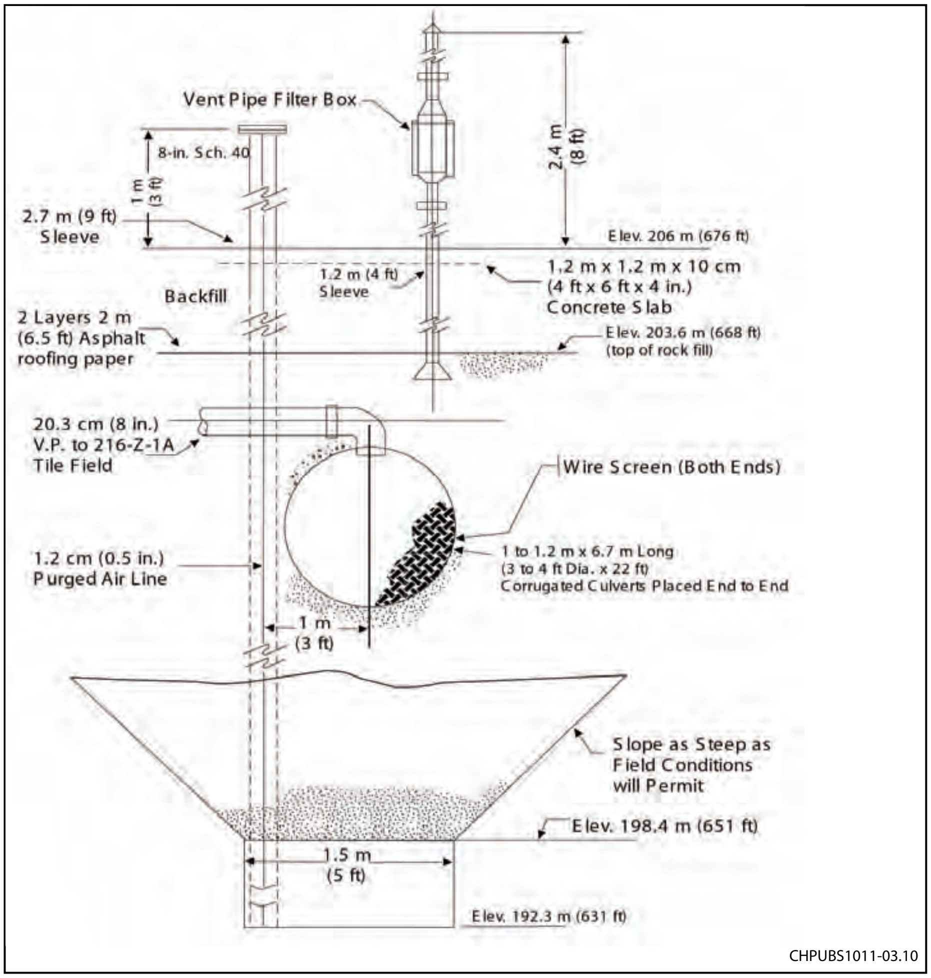


Figure 11. 216-Z-3 Crib (Primary COCs are Pu and Am-241)

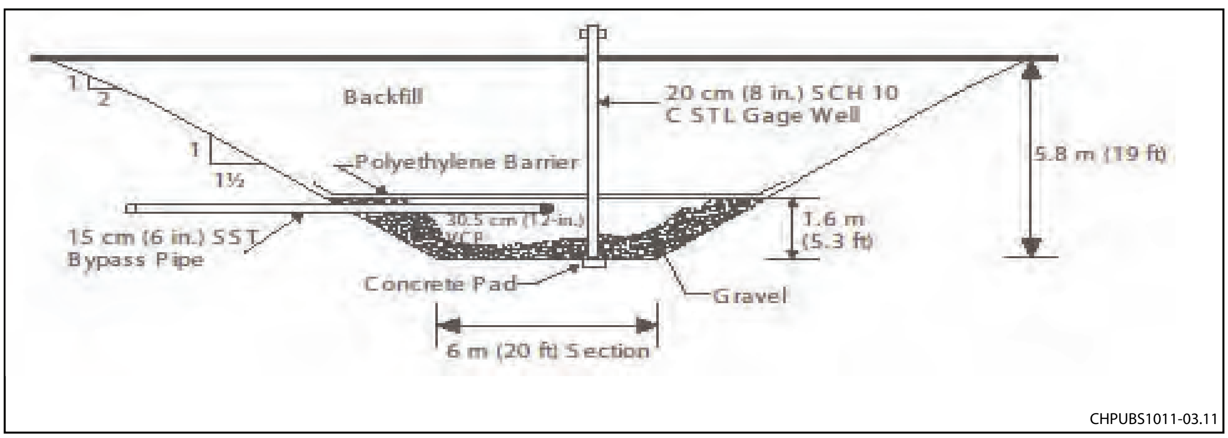


Figure 12. 216-Z-12 Crib (Primary COCs are Pu and Am-241)

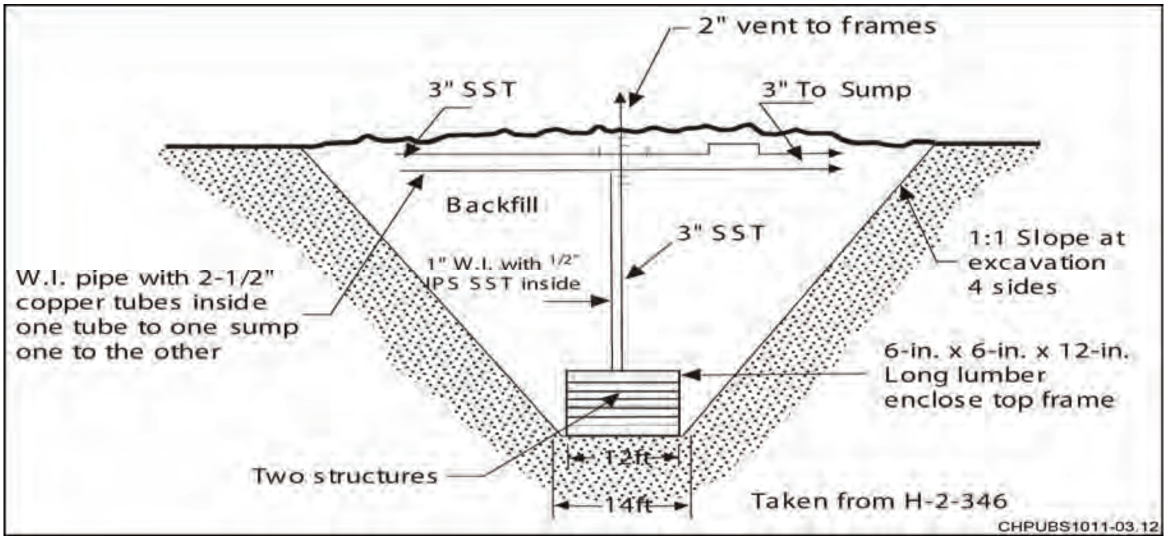


Figure 13. 216-Z-5 Crib (Primary COCs are Pu and Am-241)

Settling Tanks Waste Group (200-PW-1 and 200-PW-6)

There are two waste sites in the Settling Tanks Waste Group (241-Z-361 Settling Tank and 241-Z-8 Settling Tank) where waste particles (sludge) accumulated before the liquid waste drained to other disposal sites.

The 241-Z-361 Settling Tank was constructed with concrete and lined with steel (Figure 14). The 241-Z-8 Settling Tank was constructed of steel or wrought iron plate (Figure 15).

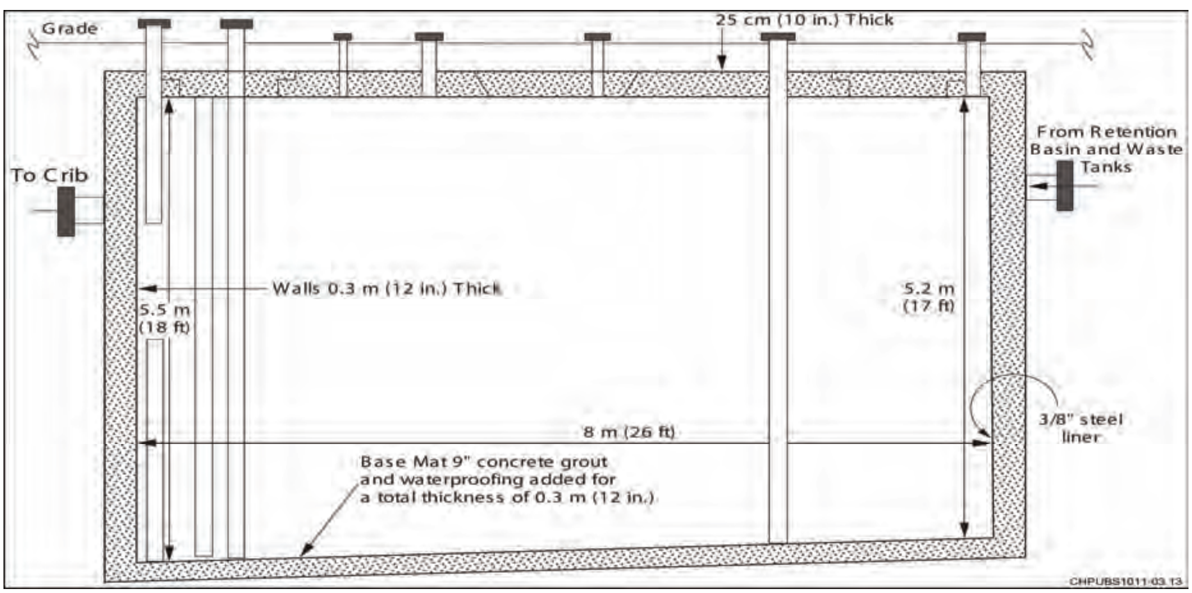


Figure 14. 241-Z-361 Settling Tank (Primary COCs are Pu and Am-241)

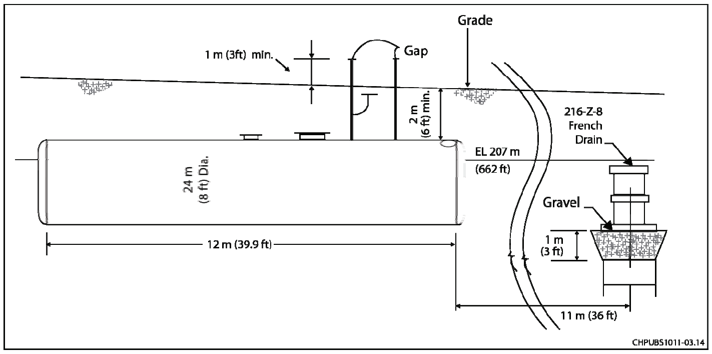


Figure 15. 241-Z-8 Settling Tank (Primary COCs are Pu and Am-241)

The 241-Z-361 Settling Tank fed the four cribs in the Low-Salt Waste Group. The tank currently contains a mixture of sludge (75 m^3 [82 yd^3]) and liquid (800 L [210 gal]) waste. The 241-Z-8 Settling Tank received aqueous silica gel waste from back flushes of the feed filters at the RECUPLEX. The tanks contain waste sludge contaminated with plutonium and americium.

Cesium-137 Waste Group (200-PW-3)

There are five waste sites in the Cesium-137 Waste Group (216-A-7 Crib, 216-A-8 Crib, 216-A-24 Crib, and 216-A-31 Crib; and the UPR-200-E-56 Unplanned Release). These waste sites are located in the 200 East Area.

The four cribs received process water directly or indirectly derived from **Plutonium and Uranium Extraction (PUREX)** Plant operations. The 216-A-8 and the 216-A-24 Cribs received condensate from waste storage tanks in tank farms associated with PUREX. The 216-A-7 Crib received sump waste from operations associated with PUREX and a one-time discharge of organic liquid waste from a PUREX chemical storage area. The 216-A-31 Crib received waste from PUREX. Waste streams discharged to these cribs contained fission products (primarily cesium-137), and both aqueous and non-aqueous phase organics. These contaminants are located in the sediment near the bottom of the waste sites. Confirmation samples collected from below the sediment are clean (i.e., not contaminated).

The UPR-200-E-56 Unplanned Release is an area where liquid waste that was discharged to the adjacent 216-A-24 Crib migrated laterally to the north on a caliche layer (i.e., a calcium-carbonate encrusted subsoil layer occurring in arid and semi-arid regions) located about 4.6 m (15 ft) bgs. Schematics of the 216-A-7 and 216-A-8 Cribs are shown in Figures 16 and 17, respectively.

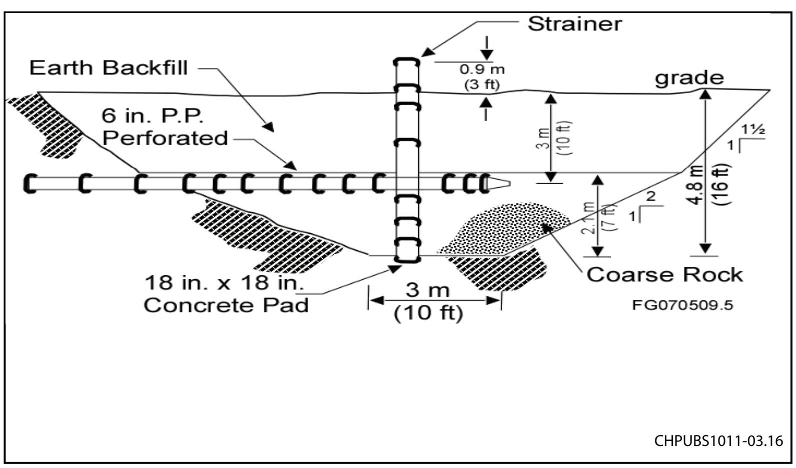


Figure 16. 216-A-7 Crib (Primary COC is Cs-137)

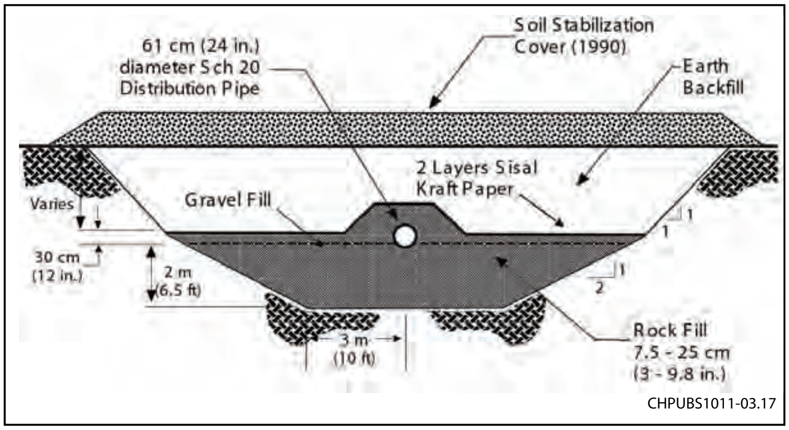


Figure 17. 216-A-8 Crib (Primary COC is Cs-137)

The 216-A-24 (Figure 18) and 216-A-31 Cribs (Figure 19) were constructed with a perforated steel pipes placed horizontally below grade and backfilled.

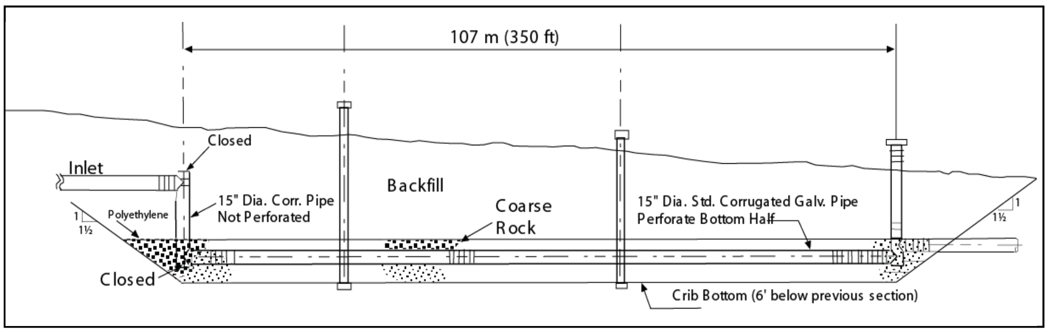


Figure 18. 216-A-24 Crib (Primary COC is Cesium-137)

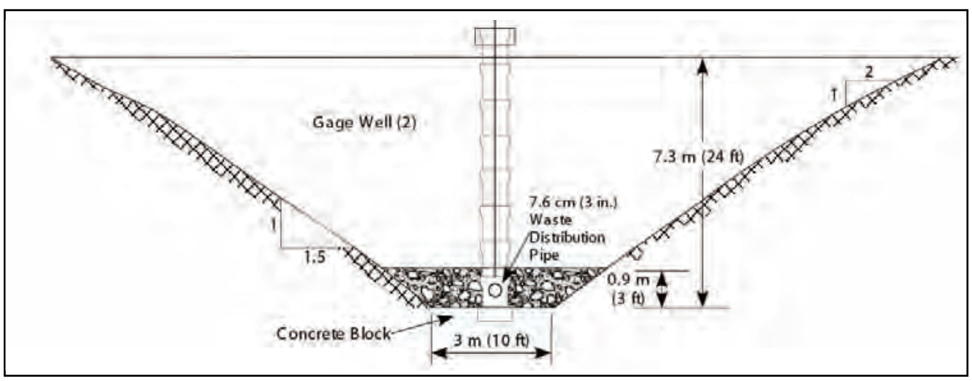


Figure 19. 216-A-31 Crib (Primary COC is Cesium-137)

Other Sites Waste Group (200-PW-6)

There are two waste sites in the Other Sites Waste Group (216-Z-10 **Injection/Reverse Well** and 216-Z-8 French Drain). These are waste sites that have limited contamination and do not pose a risk to human health and the environment.

Pipelines

Pipelines conveyed liquid waste from nuclear processing facilities to the disposal structures associated with the 200-CW-5, 200-PW-1, and 200-PW-6 OUs. There is one pipeline for the Z-Ditches Waste Group (200-W-207-PL), two for the High-Salt Waste Group (200-W-174-PL and 200-W-206-PL), two for the Low-Salt Waste Group (200-W-208-PL and 200-W-210-PL), and two for the Settling Tanks Waste Group (200-W-205-PL and 200-W-220-PL). The pipelines associated with 200-PW-3 are part of another operable unit.

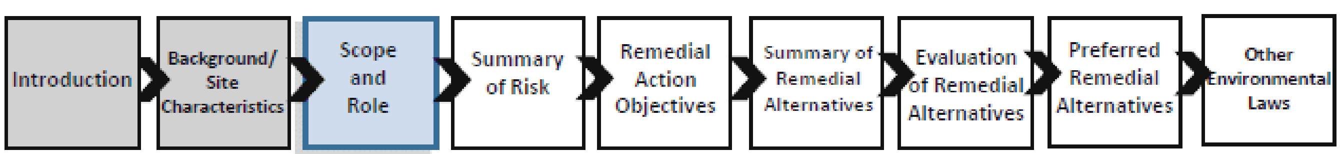
The pipelines are constructed of various materials, primarily stainless steel or vitrified clay pipe. Of the pipelines included in this decision, most (967 m [3,174 ft] out of a total length of 980 m [3,214 ft] of pipeline trenches) are buried at or less than 3 m (10 ft) bgs. The remaining deeper portions of the pipelines are anticipated to be within the footprint of the proposed remedy for the associated waste sites.

Principal Threat Wastes

Principal threat waste is defined as source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. They include soils containing significant concentrations of highly toxic materials and surface or subsurface soils containing high concentrations of contaminants that are, or potentially are mobile due to wind entrainment, volatilization, surface runoff, or subsurface transport.

EPA guidance states that wastes that constitute principal threat waste should be treated to address associated threats wherever practicable. At these waste sites, the soils contaminated with radionuclides of plutonium or cesium are considered principal threat wastes since they contain significant concentrations of these highly toxic contaminants. EPA has a preference to treat principal threat waste, wherever practicable. However, there is no feasible technology to practicably treat radionuclides.

In addition, any measures to stabilize radionuclide contaminated waste significantly increases the volume of the waste material to be disposed. This is a limiting factor since plutonium waste generated at 200-PW-1 and 200-PW-6 waste sites will include **transuranic waste**, which by law must be disposed at the Waste Isolation Pilot Plant (WIPP), a half-mile deep repository in southern New Mexico that has limited capacity. The law that created WIPP also exempts it from the usual requirement that chemically hazardous waste be treated to reduce its hazard before disposal. While radiological constituents from the Hanford waste stream that are disposed at WIPP will not be treated, the deep geologic disposal in a dry, 220 million-year-old salt bed has many of the same benefits as treatment with respect to permanence and control of migration.



SCOPE AND ROLE

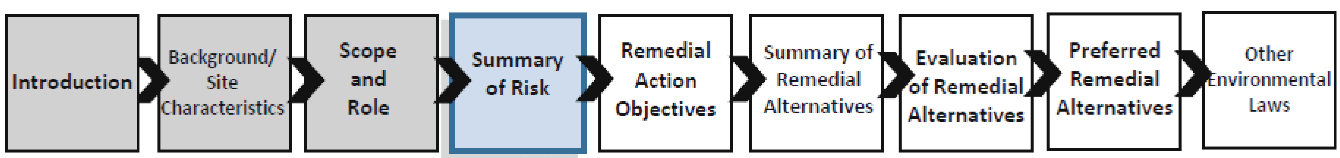
The 200-CW-5 and 200-PW-1,3,6 OUs are part of the soil remediation effort in the Hanford Site's Central Plateau. The 200-CW-5, 200-PW-1, and 200-PW-6 OUs are located in the 200 West Area and the 200-PW-3 OU is located in the 200 East Area. From the 1940s through the 1980s, liquid wastes from materials used and produced at the Hanford Site were disposed near the ground surface at these sites and has contaminated the shallow soils. These waste sites constitute the majority of liquid disposal from the plutonium processing facilities. However, some of the mobile contaminants have reached the groundwater. These are being addressed through separate CERCLA processes for the 200-ZP-1 and 200-UP-1 groundwater OUs. The remaining Inner Area waste sites and groundwater OUs will be addressed under the CERCLA RI/FS process.

DOE's overall strategy for cleaning up the Central Plateau is identified in the *Central Plateau Cleanup Completion Strategy* (DOE/RL-2009-81) (Completion Strategy). The document provides a context for DOE's cleanup proposals for structures, soil, debris, and groundwater from a plateau-wide perspective. The Completion Strategy organizes the Central Plateau cleanup into the following three major components:

- ***The Inner Area*** is approximately 26 km^2 (10 mi^2) in the middle of the Central Plateau encompassing the region where chemical processing and waste management activities occurred.
- ***The Outer Area*** is greater than 168 km^2 (65 mi^2) and includes much of the open area on the Central Plateau where limited processing activity occurred. Cleanup levels in the outer area are expected to be comparable to those being used for waste sites along the Columbia River (River Corridor).
- ***Groundwater Remediation*** is necessary for approximately 207 km^2 (80 mi^2) of groundwater beneath the Hanford Site contaminated above drinking water standards because of past processing activities that occurred on the Central Plateau. Cleanup that started in 1995 is being expanded to contain contaminant plumes in the Central Plateau, remove contaminants, and restore groundwater to beneficial use.

Figure 20 shows the location of the Inner and Outer Area with the four OUs addressed in this Proposed Plan shown in red.

DOE's overall strategy for cleaning up the Hanford Site is described in the *Hanford Site Cleanup Completion Framework* (DOE/RL-2009-10). This document outlines DOE's proposals to (1) contain and remediate contaminated groundwater, (2) implement a geographic cleanup approach that guides remedy selection from a plateau-wide perspective, (3) evaluate and deploy viable treatment methods for **deep vadose zone** contamination, and (4) conduct essential waste management operations in coordination with cleanup actions. One aspect of the Cleanup Completion Framework is to put in place a process to identify the "final footprint" for long-term waste management and containment of residual contamination. The overall cleanup objective is to make the final footprint of the Inner Area as small as practical.



SUMMARY OF RISK

This section describes the risks to human health and the environment that may be posed by the contaminants associated with the waste groups covered in this Proposed Plan. As part of the RI/FSs for the 200-CW-5 OU and the 200-PW-1,3,6 OUs, two separate **baseline risk assessments** were conducted to characterize the current and potential threats to human health and the environment that may be posed by contaminants associated with these OUs. The baseline risk assessment assists in identifying where there is a need for remedial actions, establishing site-specific cleanup goals, and in developing remedial alternatives.

The results of the two baseline risk assessments are combined in this Proposed Plan to provide a single, integrated assessment of human health and ecological risks posed by the contaminants associated with the Z-Ditches (200-CW-5), High-Salt (200-PW-1), Low-Salt (200-PW-1 and 200-PW-6), Settling Tanks (200-PW-1 and 200-PW-6), Cesium-137 (200-PW-3), and Other Sites Waste Groups. These waste sites are located in the Inner Area of the Central Plateau where the reasonably anticipated future land use is industrial and surface water would only be potentially impacted through a groundwater connection.

Finally, an evaluation of the potential migration of contaminants located in the soil to the groundwater was done in two steps: (1) screening values were assessed and any exceedances were identified, and (2) fate and transport modeling was performed using site-specific information.

Figure 20. Inner and Outer Area on Central Plateau (Note: The four OUs addressed in this Proposed Plan are shown in red.)

Summary of Human Health Risks

The human health risk assessments for these waste sites were developed to quantitatively evaluate both the cancer risks and noncancer health hazards from exposure to radionuclides and nonradioactive contaminants. The human health risk assessments considered exposures to these contaminants assuming no remediation and no IC to limit reasonably anticipated future land uses that could occur at the waste sites. A range of human exposure scenarios, including industrial worker scenarios, was considered to help evaluate the need for a cleanup action, and to develop **Preliminary Remediation Goals (PRGs)**. The PRGs described below are based on an industrial site cleanup and supported the development and evaluation of remedial alternatives for these waste sites. Information on the human exposure scenarios considered are described in the respective FS for these OUs.

A range of human exposure scenarios, including industrial worker scenarios, was considered to help evaluate the need for a cleanup action, and to develop PRGs. The PRGs, which are described below, supported the development and evaluation of remedial alternatives for these waste sites. Information on the human exposure scenarios considered are described in the respective FS for these OUs.

Exposure Assessment

Cancer risks and noncancer health hazards were evaluated for a hypothetical subsistence farmer and an industrial worker. Consistent with EPA policy and guidance, cancer risks and noncancer health hazards were evaluated for the reasonably maximally exposed (RME) individual. The goal of using an RME individual to evaluate cancer risks and noncancer health hazards is to provide an exposure scenario that is both protective and reasonable, but not the worst possible case (OSWER Directive 9285.6-03, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance "Standard Default Exposure Factors"*).

The subsistence farmer exposure scenario assumes that exposure to soil occurs when a resident establishes a residence on the waste site and receives an exposure by direct contact with the soil and through the food chain. The direct contact pathway includes potential exposure through external radiation, incidental soil ingestion, dermal contact with soil, and inhalation of ambient vapors and dust particulates. The food chain pathway includes exposure from ingestion of fruits and vegetables grown in a "backyard" garden and consumption of meat (beef and poultry) and milk from livestock raised in a contaminated area. Uptake of contamination into crops and livestock is assumed to occur from contamination present in soil and from groundwater contaminated by migration of contaminants in the soil. The subsistence farmer exposure scenario was used to estimate risks assuming no action was taken to mitigate or control exposures. Risks estimated with the assumption of no action are called baseline risks. Baseline risks were estimated to determine if remedial action was warranted at these waste sites.

The unrestricted land use soil cleanup standards defined in WAC 173-340-740(3)(b), "Model Toxics Control Act—Cleanup," "Unrestricted Land Use Soil Cleanup Standards," were used for nonradiological contaminants to represent unrestricted land use conditions in the Central Plateau. The unrestricted land use soil cleanup standards represent an acceptable target risk level of 1×10^{-6} for a resident who is exposed to nonradiological contaminants through incidental soil ingestion. Concentrations of nonradioactive contaminants in soil (metals and PCBs) from the Z-Ditches (200-CW-5) exceed unrestricted land use soil cleanup standards defined in WAC 173-340-740(3)(b).

The industrial worker exposure scenario assumes that the workplace is the key source of contaminant exposure and that the receptor could potentially be exposed to the contaminants in the shallow zone soil (i.e., less than 4.6 m [15 ft] bgs). Potential routes of exposure to soil include direct external exposure, incidental soil ingestion, dermal contact with soil, and inhalation of ambient vapors or dust generated from wind or maintenance activities. The industrial worker exposure scenario reflects the reasonably anticipated future land use at these sites. It was used to develop PRGs for waste sites where cleanup was determined to be needed.

Two exposure scenarios provided by Tribal Nations (Yakama Nation and the Confederated Tribes of the Umatilla Indian Reservation) were also evaluated and presented in the risk assessments to assist risk managers, the Tri-Party Agreement decision makers, and others interested in evaluating the alternatives presented in this Proposed Plan. The risk results for these exposure scenarios are similar to those presented for the subsistence farmer exposure. The details of these Tribal Nations risk evaluations are presented in Appendix F of the 200-CW-5 FS (DOE/RL-2004-24) and Appendix G of the 200-PW-1,3,6 FS (DOE/RL-2007-27).

Toxicity Assessment

A toxicity assessment determines the types of adverse health effects associated with contaminant exposures and the relationship between the magnitude of exposure (dose) and severity of adverse effects (response). Toxicity values published by EPA were combined with the results from the exposure assessment to assess cancer and noncancer health effects. The resulting risk estimates are discussed in the Human Health Risk Characterization section.

Human Health Risk Characterization

The calculated cancer risk estimates the probability that additional cases of cancer may develop within a population if the people are exposed to the contaminated soil over the course of a lifetime. This risk estimate is referred to as the **excess lifetime cancer risk (ELCR)**. To evaluate health risks, EPA has developed the following acceptable exposure values under CERCLA. For contaminants that are known or suspected to cause cancer, acceptable exposure levels are generally concentration levels that represent an ELCR range to an individual of one in 1,000,000 (referred to as 10^{-6}) to one in 10,000 (referred to as 10^{-4}). The results of this baseline risk assessment indicate that concentrations of radiological contaminants in soil from Z-Ditches (200-CW-5), High-Salt (200-PW-1), Low-Salt (200-PW-1 and 200-PW-6), and Cesium-137 (200-PW-3) Waste Groups pose an unacceptable cancer risk (greater than 10^{-4}) under a subsistence farmer exposure scenario. These estimated baseline human health risks are presented in Table 2.

Table 2. Summary of Baseline Human Health Risks Developed with the Subsistence Farmer Scenario

Contaminant	ELCR	% Contribution
216-Z-1A Tile Field (High-Salt)		
Americium-241	1.8 in 1,000	~15%
Plutonium-239	8 in 1,000	~67%
Plutonium-240	2.2 in 1,000	~19%
Total ELCR	1.2 in 100	
216-Z-8 French Drain (Other)		
Americium-241	4.0 in 10,000,000	2.8%
Plutonium-238	1.9 in 10,000,000	1.3%
Plutonium-239	1.1 in 100,000	79%
Plutonium-240	2.3 in 1,000,000	17%
Total ELCR	1.4 in 100,000	
216-Z-9 Trench (High-Salt)		
Americium-241	6.5 in 1,000	4.6%
Carbon Tetrachloride	4.8 in 100,000	<1%
Europium-152	2.2 in 10,000	<1%
Neptunium-237	1.6 in 10,000	<1%
Nickel-63	5.9 in 1,000,000	<1%
Plutonium-238	3.9 in 100,000	<1%
Plutonium-239	1.1 in 10	78%
Plutonium-240	2.4 in 100	17%
Protactinium-231	3.1 in 1,000,000	<1%
Radium-226	2.2 in 10,000	<1%
Radium-228	3.2 in 100,000	<1%
Strontium-90	1.1 in 10,000	<1%
Thorium-228	5.8 in 100,000	<1%
Total ELCR	1.4 in 10	

Table 2. Summary of Baseline Human Health Risks Developed with the Subsistence Farmer Scenario

Contaminant	ELCR	% Contribution
216-A-8 Crib (Cesium-137 Sites)		
Cesium-137	6.5 in 10	~99%
Neptunium-237	3.3 in 1,000,000	<1%
Radium-228	6.6 in 10,000	<1%
Thorium-228	2.8 in 10,000	<1%
Total ELCR	6.5 in 10	
Z-Ditches		
Americium-241	1.2 in 10	14%
Cesium-137	5.0 in 100	5.6%
Plutonium-238	5.2 in 10,000	<1%
Plutonium-239	1.3 in 100	1.5%
Radium-226	7.1 in 10	79%
Radium-228	4.7 in 100,000	<1%
Strontium-90	3.3 in 1,000	<1%
Thorium-228	4.6 in 1,000,000	<1%
Thorium-230	9.8 in 1,000,000	<1%
Thorium-232	1.1 in 10,000	<1%
Uranium-238	1.2 in 1,000,000	<1%
Total ELCR	0.9 in 10	

Concentrations of nonradiological contaminants in soil (metals and PCBs) from the Z-Ditches (200-CW-5) exceed unrestricted land use soil cleanup standards defined in WAC 173-340-740(3)(b). The results from this comparison are presented in Table 3.

Table 3. Summary of Baseline Human Health Risks: Comparison to WAC 173-340-740(3)(b) Unrestricted Land Use Soil Cleanup Standards

Contaminant	Concentration in Soil (mg/kg)*	WAC 173-340-740 Carcinogen Cleanup Level (mg/kg)
Z-Ditches		
PCBs (Aroclor 1254)	52	0.5
PCBs (Aroclor 1260)	78	0.5

* The concentration in soil used in this assessment is the maximum concentration detected.

Risks from PCBs were estimated by comparing the concentration in waste site soil with the cleanup standard defined for the unrestricted land use soil cleanup standards defined in WAC 173-340-740(3)(b). If the concentration in soil exceeds the soil cleanup standards, then remedial action at these waste sites might be needed to reduce risks from PCBs in soil.

The ELCR results for the two Tribal exposure scenarios are similar to the risks presented in Table 2 for the subsistence farmer exposure scenario.

Summary of Ecological Risks

A screening-level ecological risk assessment was conducted for the High-Salt (200-PW-1), Low-Salt (200-PW-1 and 200-PW-6), Settling Tanks (200-PW-1 and 200-PW-6), Cesium-137 (200-PW-3), and Z-Ditches (200-CW-5) Waste Groups to identify contaminants, receptors, and exposure pathways that should be considered in the development of remedial alternatives. The FS determined that are no risks to endangered species. The process for estimating site-related ecological risks includes the following:

- ***Problem Formulation—***a qualitative evaluation of contaminant release, migration, and fate; identification of contaminants of potential ecological concern; identification of receptor organisms, exposure pathways, and ecological effects of the contaminants; and selection of endpoints for further study, if warranted.
- ***Screening-Level Exposure and Effects Assessment—***a quantitative evaluation of ecological risks involving comparison of exposure point concentrations in soil with ecological benchmark concentrations.
- ***Risk Characterization—***estimation of potential adverse ecological effects.

Problem Formulation

Vegetation in the 200 Area is characterized by native shrub steppe, interspersed with large areas of disturbed ground dominated by annual grasses and forbs. The undisturbed portions of the 200 Area are characterized by sagebrush/cheatgrass or sagebrush/Sandberg's bluegrass communities. The dominant plants on the Central Plateau 200 Area are big sagebrush, rabbit brush, cheat grass, and Sandberg's bluegrass. The shrub and grassland habitat of the Hanford Site supports many groups of terrestrial wildlife. Mammals common to the 200 Area, including badgers, Great Basin pocket mice, and deer mice, are known to burrow in soil and can excavate significant amounts of soil as they construct their burrows. Burrowing by these mammals can potentially unearth buried contaminants. Soil macro-invertebrates at the Hanford Site, including darkling beetles and harvester ants, also burrow, and can excavate potentially contaminated soils. In addition, soil macro-invertebrates may be consumed by birds and mammals, which would then potentially receive an exposure.

Many of the waste sites in the 200 Area have been backfilled with clean soil and planted with crested or Siberian wheatgrass to stabilize surface soil, control soil moisture, or displace more invasive deep-rooted species like Russian thistle. In addition, contaminated portions of the 200 Area are actively managed by monitoring, removing deeply rooted vegetation, and controlling burrowing mammals and insects. However, determining if cleanup is needed to protect ecological receptors involved assessing potential ecological risks under baseline conditions. In this case, baseline conditions included the assumptions that the soil covers would no longer be maintained and that other active management methods would no longer be performed.

Initially, the screening-level assessment of ecological risks involved developing the conceptual model of ecological exposure pathways, and comparing that model to site conditions. This comparison was performed to determine if there could potentially be complete exposure pathways from site contaminants to ecological receptors. Any waste sites where contaminants might be present in shallow soil (less than 4.6 m [15 ft]) that is potentially accessible to ecological receptors, have a potential complete ecological exposure pathway. The depth of 4.6 m (15 ft) reflects the standard point of compliance for ecological protection as described in the state of Washington's regulations for cleanup for protection of ecological receptors (WAC 173-340-7490[4][b], "Terrestrial Ecological Evaluation Procedures"). This depth is based on unrestricted use where human activities could bring contamination to the biologically active zone. The physical dimensions of the waste sites and the distribution of soil contaminants detected in them were considered with respect to the biologically active zone. The results from this comparison indicated that potentially complete ecological exposure pathways could be present at several of the waste sites in the High-Salt (200-PW-1), Low-Salt (200-PW-1 and 200-PW-6), Settling Tanks (200-PW-1 and 200-PW-6), Cesium-137 (200-PW-3), and Ditches (200-CW-5) Waste Groups.

Screening-Level Ecological Exposure and Effects Assessment

The next step in the screening-level ecological risk assessment is an evaluation of the potential ecological exposures and effects. The potential ecological exposure pathways that could exist at these waste sites included the potential for the following:

- Accumulation of radionuclides and inorganics by burrowing of invertebrates and animals into contaminated soils.
- Exposures to insect-eating birds and mammals from ingestion of burrowing invertebrates and animals that have accumulated radionuclides and inorganic contaminants.
- Accumulation by deep-rooted plants of contaminants in soils that are subsequently incorporated into surface soil through wind action and rainfall.
- Exposures of wildlife from ingestion of radionuclides and nonradioactive contaminants in contaminated soil that has been exhumed and brought to the surface by burrowing invertebrates and animals.

Ecological risks potentially associated with these exposure pathways were assessed by comparing contaminant concentrations in soil with ecological screening levels. The ecological screening levels for radionuclides were Biota Concentration Guides (BCGs), developed by DOE using international consensus standards for protection of plants and wildlife from exposure to radiation. The ecological screening levels for nonradionuclides were Ecological Indicator Soil Concentrations developed by the state of Washington. Contaminant concentrations within the top 4.6 m (15 ft) of soil at the Z-Ditches were compared with ecological screening levels. Under the current conditions, contaminants were not sampled within the biologically active zone at the High-Salt, Low-Salt, Settling Tanks, and Cesium-137 waste sites, so no comparison with ecological screening levels was performed; however, an evaluation of site information indicates that contaminants could be present within the biologically active zone at these sites. Therefore, for purposes of determining if cleanup action is needed, a more conservative approach was taken by assuming that complete ecological exposure pathways and ecological risks could be present at these waste sites. The comparison of contaminant concentrations in soil at the Z-Ditches with ecological screening levels is presented in Table 4.

Ecological Risk Characterization

The results of the comparison of concentrations in soil to the ecological screening levels indicate the potential for unacceptable ecological exposures at Z-Ditches. A comparable approach for conservatively addressing the risks at the remaining sites was determined to be appropriate. This analysis provides the basis for action to address ecological risk.

Table 4. Comparison of Contaminant Concentrations in Soil to Ecological Screening Levels (Z-Ditches)

Contaminant	Units	Contaminant Concentration in Soil[a]	Ecological Screening Level[b]
Z-Ditches			
PCBs (Aroclor 1254)	mg/kg	52	0.65
PCBs (Aroclor 1260)	mg/kg	78	0.65
Boron	mg/kg	24	0.5
Mercury	mg/kg	0.66	0.1
Americium-241	pCi/g	202,640	4,000
Cesium-137	pCi/g	2,570	20
Plutonium-239/240	pCi/g	28,291	6,000
Radium-226	pCi/g	5,200	50
Strontium-90	pCi/g	95	20

a. The concentration in soil used in this assessment is the 95% upper confidence limit on the average concentration in waste site soil, which represents an RME or the maximum concentration detected.

b. The ecological screening levels for nonradioactive contaminants are "Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals," defined in WAC Table 749-3 (WAC 173-340-7493, "Site-Specific Terrestrial Ecological Evaluation Procedures"). The ecological screening levels for radionuclides are BCGs listed in DOE-STD-1153-2202, *A Graded Approach for Evaluation Radiation Doses to Aquatic and Terrestrial Biota*.

Summary of Groundwater Protection Evaluation

The potential migration of contaminants to groundwater was evaluated for the waste groups. For the Z-Ditches, the evaluation indicated that there were no contaminants that would migrate through the soil from the Z-Ditches that could affect groundwater above the federal maximum contaminant levels (MCLs) within 1,000 years (fate and transport models were run for 1,000 years). For the remaining waste groups (High-Salt, Low-Salt, Settling Tanks, and Cesium-137), groundwater protection screening values were exceeded for numerous volatile contaminants. A fate and transport evaluation of volatile and nonvolatile soil contaminants identified that carbon tetrachloride and methylene chloride are the only volatile contaminants that could potentially migrate through the soil and only from the High-Salt waste sites (216-Z-1A Tile Field, 216-Z-9 Trench, and 216-Z-18 Crib) and impact groundwater above the federal MCLs within 1,000 years. In addition, technetium-99 was the only radionuclide and nitrate was the only nonradioactive contaminant that were retained as potential groundwater contaminants.

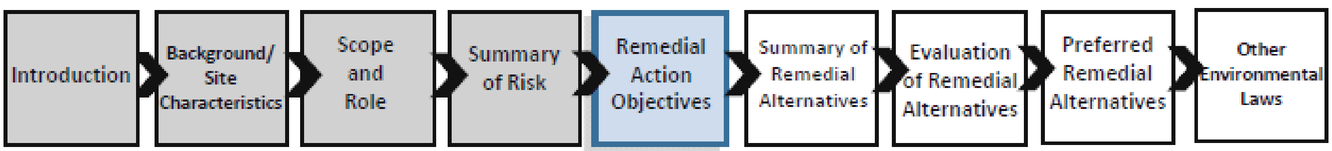
Identification of Contaminants of Concern

Based on the results of this evaluation, the list of COCs for soils for the Z-Ditches (200-CW-5), High-Salt (200-PW-1), Low-Salt (200-PW-1 and 200-PW-6), Settling Tanks (200-PW-1 and 200-PW-6), Cesium-137 (200-PW-3), and Other Sites Waste Groups are: americium-241, cesium-137, plutonium-239/240, radium-226, strontium-90, PCBs, boron, and mercury. Two additional contaminants were identified for 200-PW-1 and 200-PW-6 for protection of groundwater: carbon tetrachloride and methylene chloride.

Two other contaminants at the 200-PW-1 and 200-PW-6 waste sites, technetium-99 and nitrate, had a high level of uncertainty as potential threats to groundwater. These contaminants are not expected to pose an unacceptable risk based on fate and transport modeling results and process knowledge of the type of liquid waste discharged at these waste sites. Additional sampling will be conducted to confirm contaminant levels as part of the remedial design.

Radiological COCs for protection of human health were identified by the comparison of Exposure Point Concentrations (EPCs) to PRGs developed for the industrial worker exposure scenario that correspond to an ELCR of 10^{-4}. The industrial worker receptor is exposed to radiological contaminants through external gamma radiation, incidental soil ingestion, and inhalation of dust. Nonradiological COCs for protection of human health were identified by the comparison of EPCs to PRGs based on the WAC 173-340-745(5)(b), "Standard Method C industrial soil cleanup levels" that will achieve an ELCR of 10^{-5} or a noncancer **hazard quotient** of 1. The industrial worker exposure scenario represents reasonably anticipated future land use in the Central Plateau.

It is DOE's and EPA's judgment that the preferred alternatives identified in this Proposed Plan, or one/some of the other active measures considered in the Proposed Plan, are necessary to protect public health or welfare or the environment from actual or threatened releases, from these waste sites, of hazardous substances or pollutants or contaminants which may present an imminent and substantial endangerment to public health or welfare.



REMEDIAL ACTION OBJECTIVES

This section presents the **remedial action objectives (RAOs)** for the 200-CW-5, 200-PW-1,3,6 OUs. The industrial worker scenario was considered in developing the RAOs and PRGs. The RAOs, which are listed below, are descriptions of what the remedial action is expected to accomplish and are used to evaluate the various remedial alternatives and long-term protectiveness.

- ***RAO 1***—Prevent or mitigate unacceptable risk to human health and ecological receptors associated with radiological exposure to waste, soil, or debris contaminated above risk-based criteria, by removing the source or eliminating the pathway.
- ***RAO 2***—Prevent or mitigate unacceptable risk to human and ecological receptors associated with nonradiological exposure to waste, soil, or debris contaminated above risk-based criteria by removing the source or eliminating the pathway.
- ***RAO 3***—Control the sources of potential groundwater contamination to support the Central Plateau groundwater goal of restoring and protecting the beneficial uses of groundwater, including protecting the Columbia River from adverse impacts.

Preliminary Remediation Goals

The PRGs establish acceptable exposure levels, for specific contaminants and exposure pathways that are protective of human health, the environment, and groundwater (Table 5).

The human health PRGs for radiological COCs are based on the industrial worker exposure scenario (i.e., RME) that will achieve an ELCR of 10^{-4}.

The human health PRGs for nonradiological COCs are WAC 173-340-745(5)(b), "Standard Method C Industrial Soil Cleanup Levels," that will achieve an ELCR of 10^{-5} or a noncancer hazard quotient of 1.

Table 5. COCs and Preliminary Remediation Goals for Soil Based on a Risk of 10^{-4} to 10^{-6}

COCs	Human Health (Industrial Exposure Scenario)	Protection of Groundwater	Ecological
Plutonium-239-240	2,900 pCi/g	Not calculated[a]	6,000 pCi/g
Americium-241	940 pCi/g	Not calculated[a]	4,000 pCi/g
Cesium-137	18 pCi/g	Not calculated[a]	20 pCi/g
Radium-226	4 pCi/g	Not calculated[a]	50 pCi/g
Strontium-90	1,970 pCi/g	Not calculated[a]	20 pCi/g
PCBs	66 mg/kg	Not calculated[a]	0.65 mg/kg
Boron	700,000 mg/kg	Not calculated[a]	0.5 mg/kg
Mercury	560 mg/kg	Not calculated[a]	0.1 mg/kg
Carbon Tetrachloride	Not presented[b]	0.0315[c] mg/kg	Not presented[d]
Methylene Chloride	Not presented[b]	0.0218 mg/kg	Not presented[d]

a. PRG not calculated because this contaminant was not identified as a threat to groundwater based on screening values and fate and transport modeling.

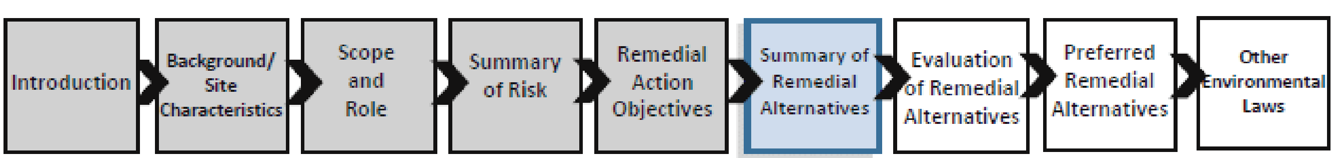
b. PRG not presented because these contaminants were not identified as a COPC for protection of human health. These contaminants were either not detected in the top 4.6 m (15 ft) of soil or did not exceed EPA's upper target risk threshold of 10^{-4} for the subsistence farmer scenario.

c. Carbon tetrachloride screening value calculated from the EPA Soil-Water partition equation with a groundwater protection level of 3.4 µg/L.

d. PRG not presented because this contaminant was not identified as COPC for the ecological risk assessment, as it was not detected in the top 4.6 m (15 ft) or the concentrations were below screening levels.

The PRGs for protection of ecological receptors from exposure to radiological COCs are based on a dose rate of 0.1 rad/day for terrestrial organisms and 1 rad/day for terrestrial plants. Nonradiological COCs are from WAC 173-340-7490, Table 749-3, "Terrestrial Ecological Evaluation Procedures," which are based on an individual ecological hazard quotient of 1.

The PRGs will be used to assess the effectiveness of the identified remedial alternatives in meeting the RAOs. To support the RAO for protection of groundwater, soil cleanup goals for soils exposed during the RTD remedies at the High-Salt and Low-Salt sites are provided in Table 5. These interim PRGs are set using the screening levels for groundwater protection or background concentrations. These values are preliminary and alternative values may be developed as further data is collected. The PRGs for protection of groundwater do not apply to RTD of the Z-Ditches Waste Group, as no contaminants were identified as COCs for groundwater protection for these waste sites.



SUMMARY OF REMEDIAL ALTERNATIVES

This section describes the remedial alternatives for attaining the identified RAOs described in the previous section. The feasibility studies (DOE/RL-2004-24 and DOE/RL-2007-27) for the Z-Ditches, High-Salt, Low-Salt, Settling Tanks, Cesium-137, and Other Sites Waste Groups and associated pipelines considered a broad range of remedial alternatives developed from candidate remedial technologies and process options based on their effectiveness, implementability, and relative cost for attaining the RAOs at each of the waste groups. The preferred alternatives address contaminated soil through a combination of RTD, soil cover, and SVE. The following alternatives were evaluated in the FS:

- ***No Action***: This alternative would leave a waste site "as is" (i.e., in its current state). No active remedial action would be taken to address potential threats to human health and the environment; therefore, there are no distinguishing protectiveness or implementation features associated with this alternative. The NCP requires consideration of a No Action alternative to provide a baseline to compare against other alternatives (40 CFR 300.430(e)(6)), "National Oil and Hazardous Substances Pollution Contingency Plan," "Remedial Investigation/Feasibility Study and Selection of Remedy").

- ***Maintain and Enhance Existing Soil Cover***: This alternative would include the maintenance of, or enhancing, the existing soil covers and any additional clean fill (as appropriate) to isolate the waste from direct contact exposure. IC (e.g., land use restrictions) would be required to limit access or intrusion by humans. This alternative would leave all contamination in place along with long-term monitoring to assure that contamination is contained.

- ***Engineered Surface Barrier (Barrier Alternative)*****:** This alternative would leave all contamination in place at the waste site; an engineered surface barrier would be constructed over the waste site to create a minimum of 4.6 m (15 ft) of separation between the contaminated soil and the ground surface. The conventional engineered surface barrier would be modified to include an **evapotranspiration** barrier layer to limit the natural infiltration of precipitation and to provide an added level of protection to human health and the environment. For waste sites containing long-lived plutonium contamination, a physical barrier component would be added into the design to reduce inadvertent access to the contamination. This component would include a 1.3 m (4 ft) thick layer of course, fractured basalt rock. Waste sites constructed with voids would have the voids filled with material that would prevent collapse of the structure. The Barrier alternative provides no treatment for radionuclides, but prevents access to contamination through engineering controls. Institutional controls would be required to maintain protectiveness of the barriers and restrict access.

- ***In Situ Vitrification***: This alternative would reduce the availability and mobility of radionuclides and hazardous substances by applying an electric current sufficient to melt the soil and turn it into a chemically stable, leach-resistant glass block. A vacuum hood is placed over the treated area during melting to collect off-gasses, which are treated before release. Melting and then solidifying the contaminated soil reduces the volume by about 30 percent because it eliminates the pore space of the soil and gravel. The subsidence area would be backfilled with clean soil fill to match the surrounding grade and then replanted with native vegetation. In areas where the glass block would be within 4.6 m (15 ft) of the ground surface, a barrier would be placed over the site to break the direct exposure pathway to the block. This alternative would require IC for maintaining barrier performance, waste isolation, and intrusion prevention. At waste sites that contain plutonium and americium, the vitrified glass block would mitigate the direct contact pathway (inhalation, ingestion, and external radiation) and would melt the top 6 m (20 ft) of soil.

- ***Removal, Treatment, and Disposal***: This alternative would remove a portion of the contaminated soil, sludge, and/or debris; treat the waste to meet disposal criteria (if necessary); and then dispose of the waste. Waste sites remediated under RTD would be sampled to verify that cleanup goals had been achieved.

For the Z-Ditches Waste Group, the RTD alternative is intended to reduce risk to human health and the environment by removing contamination that exceeds RAOs. For cost-estimating purposes, it is assumed that the soil excavated from these sites can be removed and packaged to meet the waste acceptance criteria for disposal in the **Environmental Restoration Disposal Facility (ERDF)**.

Initially, five RTD options were developed to accommodate a range of removal objectives for plutonium-contaminated soils from the High-Salt and Low-Salt Waste Groups. Each of these options for removal of contaminated soils includes complete removal of the subsurface waste disposal structures. Only four of the RTD options were retained in this Proposed Plan.

- Option A—Remove to 0.6 m (2 ft) below the bottom of a waste site that contains the highest concentration of contaminants. See Table 6 for proposed excavation depths for each waste group.
- Option B—Remove contaminated soils that could result in a direct contact risk to industrial workers and that are less than 4.6 m (15 ft) below the current ground surface. This option only applies to one High-Salt waste site (216-Z-1A Tile Field) and three cesium-137 waste sites (216-A-7 Crib, 216-A-8 Crib, and UPR-200-E-56 Unplanned Release). See Table 6 for proposed excavation depths for each waste group.
- Option C—Remove a significant portion of plutonium contamination based on an evaluation of soil contaminant concentration with depth. See Table 6 for proposed excavation depths for each waste group.
- Option E—Remove contaminated soils with concentrations resulting in a direct contact risk greater than a 10^{-4} risk level (in the subsistence farmer risk scenario) so that long-term IC at a waste site are not necessary. See Table 6 for proposed excavation depths for each waste group.

Table 6. Summary of Removal Depths Below Ground Surface for the Four RTD Options for 200-PW-1,3,6 OUs

Waste Site	Removal Depth for RTD Options (m [ft] bgs)			
	A	B	C	E
High-Salt Waste Group (200-PW-1 OU)				
216-Z-1A Tile Field	6.1 (20)	7 (23)	11 (36)	27.4 (90)
216-Z-9 Trench	7 (23)	NA[1]	11 (36)	27.4 (90)
216-Z-18 Crib	6.1 (20)	NA[1]	11 (36)	27.4 (90)
Low-Salt Waste Group (200-PW-1 and 200-PW-6 OUs)				
216-Z-1&2 Crib	7 (23)	NA[1]	7.6 (25)	7.6 (25)
216-Z-3 Crib	9.5 (31)	NA[1]	10.1 (33)	10.1 (33)
216-Z-5 Crib	6.1 (20)	NA[1]	6.7 (22)	6.7 (22)
216-Z-12 Crib	6.7 (22)	NA[1]	7.3 (24)	7.3 (24)
Settling Tanks Waste Group (200-PW-1 and 200-PW-6 OUs)				
241-Z-361 Settling Tank	Remove sludge from settling tank and backfill empty tank.			
241-Z-8 Settling Tank	Remove sludge from settling tank and backfill empty tank.			
Cesium-137 Waste Group (200-PW-3 OU)				
216-A-7 Crib	NA[2]	4.6 (15)	6.1 (20)	NA[2]
216-A-8 Crib	NA[2]	4.6 (15)	7 (23)	NA[2]
216-A-24 Crib	NA[2]	NA[2]	6.1 (20)	NA[2]
UPR-200-E-56 Unplanned Release	NA[2]	4.6 (15)	6.1 (20)	NA[2]

Table 6. Summary of Removal Depths Below Ground Surface for the Four RTD Options for 200-PW-1,3,6 OUs

Waste Site	Removal Depth for RTD Options (m [ft] bgs)			
	A	B	C	E
216-A-31 Crib	NA[2]	NA[2]	8.5 (28)	NA[2]
Other Sites Waste Group (200-PW-6 OU)				
216-Z-8 French Drain	NA[3]	NA[3]	NA[3]	NA[3]
216-Z-10 Reverse Well	NA[3]	NA[3]	NA[3]	NA[3]

Notes:

Option A—Remove 0.6 m (2 ft) below the base of a waste site, which contains the highest concentration of contaminants.

Option B—Remove contaminated soils that could be a direct contact risk to industrial workers and that are less than 4.6 m (15 ft) below the current ground surface. Option B only applies to the High-Salt Waste Group and 216-A-7 Crib, 216-A-8 Crib, and UPR-200-E-56 Unplanned Release in the Cesium-137 Waste Group. The other sites would not be excavated under this option because all of the contamination is located deeper than 4.6 m (15 ft).

Option C—Remove a significant portion of plutonium contamination (or cesium-137 contamination) using an evaluation of soil contaminant concentration with depth.

Option E—Remove contaminated soils with greater than a 10^{-4} risk level so that long-term IC at a waste site are not necessary.

1. Not applicable to particular waste site. Five RTD options were developed for the plutonium waste sites. For those plutonium waste sites, RTD Option B was not evaluated where the contamination is deeper than 4.5 m (15 ft) bgs.

2. Not applicable to particular waste site. RTD Options 3B and 3C were evaluated for the cesium-137 waste sites, to address cases where contamination is located shallower than 4.5 m (15 ft) bgs and to evaluate removal of the mass of the cesium contamination. Options 3A and 3D were not evaluated because they are only applicable to sites with plutonium waste. Option 3E was not evaluated because minimizing the risk associated with cesium-137 was captured in either Option 3B or 3C.

3. Not applicable for particular waste site. For the 216-Z-8 and 216-Z-10 sites, baseline risks are below the CERCLA risk range; therefore, the RTD options were not evaluated (i.e., NA) at these sites.

Option D was evaluated and is discussed in the FS but is not retained in this Proposed Plan because this option and Option E are similar in the depth of excavation that would be required for remediation for the High-Salt and Low-Salt waste sites. In addition, Option E is the bounding alternative for the 10^{-4} risk level for unrestricted land use.

These RTD options for the High-Salt and Low-Salt wastes sites will generate TRU waste. The definition and disposal requirements of TRU are set by federal regulation (40 CFR 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes"). Transuranic waste is waste that has been contaminated with alpha-emitting TRU radionuclides possessing half-lives greater than 20 years and in concentrations greater than 100 nCi/g. Because TRU wastes have longer half-lives, it is disposed of more cautiously than other radioactive wastes. TRU generated by this action would be disposed at WIPP, which meets those disposal requirements. Table 6 summarizes the removal depths per waste site for the removal options outlined in this Proposed Plan.

To evaluate the total project costs for comparison of RTD alternatives that generate TRU waste, an estimate of the WIPP disposal cost is made and included in the cost information for the High-Salt, Low-Salt, and Settling Tanks Waste Groups. The average disposal cost is $44,000 per cubic meter versus about $100 per cubic meter for disposal in ERDF. The disposal cost for contaminated soils at WIPP is considerably higher than for ERDF because of the increased costs associated with transportation, placement, and monitoring of waste.

- ***Soil Vapor Extraction***: This remedial alternative applies a vacuum to wells to access the subsurface, draw contaminated soil vapor into the well, and then up to the surface. The VOCs from the soil vapor are absorbed onto granular activated carbon, followed by the offsite thermal treatment of the granular activated carbon.

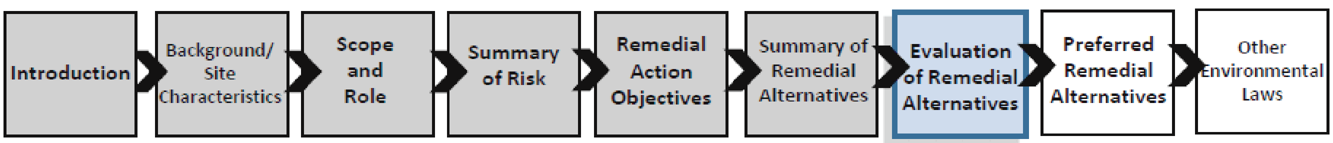
Carbon tetrachloride and other VOCs are currently being removed from the soil at the high-salt waste sites using SVE.

Common Elements

Elements common to all of the above alternatives include the following:

- Institutional controls, long-term monitoring, and maintenance will be required under all alternatives because they do not meet standards that would allow unrestricted use and unlimited exposure.
- SVE will be required to address contamination from carbon tetrachloride and other VOCs at three of the high-salt sites. Operation of the SVE system was selected in earlier CERCLA cleanup decisions. Continued operation of this system is necessary for protection of groundwater resulting from VOCs at the high-salt waste sites.

  Environmental surveillance and groundwater monitoring will be conducted to evaluate the effectiveness of the remedy selected. The sludge and liquid contents of the settling tanks at the 200-PW-1 and 200-PW-6 OUs will be removed, stabilized, and disposed of at an approved disposal facility.



EVALUATION OF REMEDIAL ALTERNATIVES

As part of the FS process, the remedial alternatives were subjected to a detailed comparative evaluation to identify the advantages and disadvantages of each alternative relative to one another. The detailed evaluation was conducted using the nine criteria defined in the NCP (Figure 21). The nine criteria are categorized into three groups: threshold criteria, balancing criteria, and modifying criteria. A remedial alternative must meet the first two “threshold criteria” overall protection and compliance with ARARs, to be eligible as a preferred alternative.

The ARAR identification process is based on CERCLA, the NCP, and guidance. The lead and nonlead agencies are to identify requirements applicable or relevant and appropriate to the release or remedial action at a CERCLA site (40 CFR 300.400(g)). The guidance states, in part, that any ARAR standard, requirement, criterion, or limitation promulgated under any federal environmental law, or any more stringent state requirement promulgated pursuant to a state environmental statute, be met (or a waiver justified) for any hazardous substance, pollutant, or contaminant that will remain at the site after remedial action is completed. The waste sites in the 200-CW-5 and 200-PW-1,3,6 OUs will be remediated under a CERCLA decision. The Tri-Party Agreement states that the technical requirements for both the RCRA corrective action program and the CERCLA remedial actions process will be satisfied by a single action. The proposed remedial actions presented herein will satisfy both CERCLA and RCRA corrective actions. The FS reports identified and evaluated potential ARARs for these waste sites. All preferred alternatives presented in this Proposed Plan would be protective of human health and the environment and meet statutory requirements for remedy selection and compliance with ARARs. Final ARARs for remediation will be established in the ROD.

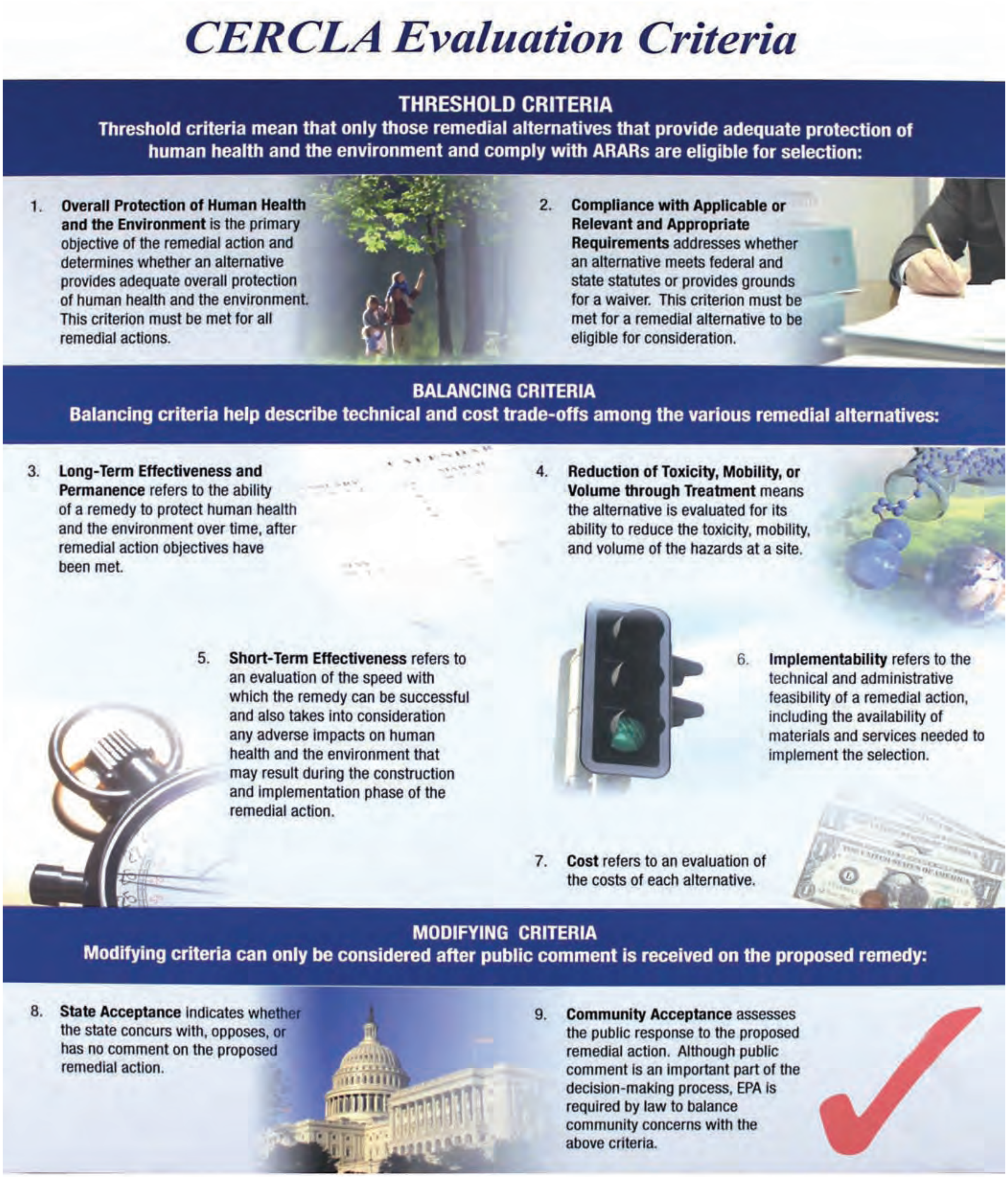


Figure 21. CERCLA Evaluation Criteria

The five “balancing criteria” allow for a comparison of major trade-offs among the alternatives. The two “modifying criteria”, state and community acceptance, are not fully considered until public comments are received on this Proposed Plan. The modifying criteria are of equal importance to the balancing criteria in the final evaluation of remedial alternatives.

A summary of the comparative evaluation based on the threshold and balancing criteria for each waste group is presented in Figure 21. As part of the evaluation, several key factors influenced consideration of the remedial alternatives including the following:

- The location of the waste sites within the Central Plateau where they are adjacent to other long-term waste disposal facilities.
- The depth between contaminated soil and groundwater at the waste sites (68 to 97 m [223 to 318 ft]).
- The semiarid climate of the area that has an average annual precipitation of 17 cm (6.8 in.).

Each of the alternatives that were subject to the detailed comparative evaluation met the threshold criteria and would achieve RAOs. Those alternatives that did not meet threshold criteria were not retained.

Z-Ditches Waste Group (200-CW-5)

The Z-Ditches Waste Group is associated with waste sites that managed cooling water and steam condensate from the PFP. A more detailed evaluation of the alternatives for the Z-Ditches is presented in Chapter 7 of the 200-CW-5 OU FS (DOE/RL-2004-24). Table 7 presents the results of this evaluation. Because of the proximity of the Z-Ditches to each other, they were evaluated as one combined unit. Based on differences in contaminant concentration and distribution, the unit was divided into three work areas (Figure 22).

Overall Protection of Human Health and the Environment: Four of the five alternatives (RTD, Barrier, a combination of ISV with RTD and a barrier, and a combination alternative of ISV with a barrier) meet the threshold criteria for protection of human health and the environment. The No Action and MESC/ICs alternatives are not protective of human health and the environment and were not retained.

Compliance with ARARs: The same four alternatives comply with ARARs.

Long-Term Effectiveness: The RTD alternative provides the greatest long-term effectiveness because contaminants are removed from the ground, treated if necessary, and disposed of in an approved facility. Based on an evaluation of the existing concentration and inventory data and anticipated excavation quantity and method, the waste generated would meet ERDF waste acceptance criteria. The barrier requires long-term maintenance to remain effective.

Reduction of Toxicity, Mobility, or Volume through Treatment: The ISV/RTD/Barrier and ISV/Barrier alternatives rank moderately well for reduction in toxicity, mobility, and volume through treatment because they both treat contaminated material (i.e., PCBs) using vitrification to reduce mobility. ISV does not reduce the mobility of plutonium or americium, as they are not mobile under existing or anticipated conditions. The barrier decreases the amount of water that infiltrates into the contaminated soil, which potentially reduces the mobility of contaminants. For the ISV/Barrier alternative, the barrier provides additional protection of human health and the environment.

Table 7. Comparative Analysis Summary for the Z-Ditches Waste Group

Alternatives	Threshold Criteria		Balancing Criteria				Costs ($ millions)[a]		
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume through Treatment	Short-Term Effectiveness	Implementability	Capital	Total O&M[b]	Present Worth
216-Z-1D Ditch, 216-Z-11 Ditch, 216-Z-19 Ditch, 216-Z-20 Tile Field, and UPR-200-W-110 Unplanned Release									
No Action	No	No	Not Ranked[c]				--	--	--
MESC/ICs	No	No	Not Ranked[c]				--	--	--
RTD	Yes	Yes	○	●	◐	◐	$60.4	$0	$58.1
Barrier	Yes	Yes	◐	●	○	○	$9.4	$285.1	$19.6
ISV/RTD/Barrier	Yes	Yes	○	◐[d]	◐	●	$338.9	$283.4	$318
ISV/Barrier	Yes	Yes	◐	◐[d]	◐	●	$296.9	$284	$287

a. These cost estimates are based on the best available information for the site-specific anticipated remedial actions. The actual costs are expected to range from -30 to +50 percent of these estimated values. Major changes to assumed remedial action scope can result in remedial action costs outside of this range. Present Worth calculations are based on 1,000 years.

b. Total O&M costs presented as total Nondiscounted Annual and Periodic Costs and include 1,000 year IC/O&M, where applicable.

c. No Action and MESC/ICs alternatives are not ranked because they do not meet the threshold criteria.

d. Rated "performs moderately well" for this criterion overall. ISV applies only to Work Area 2. No treatment of contaminants in Work Areas 1 or 3.

Evaluation Metric

● = Performs less well against the criterion relative to the other alternatives with significant disadvantages or uncertainty

◐ = Performs moderately well against the criterion relative to the other alternatives with some disadvantages or uncertainty

○ = Performs very well against the criterion relative to the other alternatives with minor disadvantages or uncertainty

Short-Term Effectiveness: The Barrier alternative ranks highest for short-term effectiveness because it provides lower potential for worker and environmental exposure to contaminants than the RTD alternatives that include excavation of contaminated material, which could potentially result in an exposure. In addition, a Barrier can be constructed in a relatively short period compared to ISV or RTD.

Implementability: The Barrier alternative ranks high for implementability because it is a proven technology and relatively easy to construct with readily available construction methods and materials. The RTD alternative ranks moderately well because contaminated soils that are excavated must be packaged to meet disposal requirements and will require disposal at ERDF. The implementability of ISV is ranked low because of the challenges of applying the technology over a relatively large area.

Cost: The Barrier alternative is the lowest cost alternative, RTD is the next lowest cost alternative, followed by the combination alternatives, ISV/Barrier and ISV/RTD/Barrier.

High-Salt Waste Group (200-PW-1)

The High-Salt Waste Group received liquid waste containing plutonium as well as carbon tetrachloride and other liquid VOCs. Table 8 presents the results of the detailed evaluation of alternatives for the three waste sites in the High-Salt Waste Group. A more detailed evaluation of the alternatives for the High-Salt Waste Group is presented in Chapter 7 of the 200-PW-1,3,6 OUs FS (DOE/RL-2007-27). Table 6 summarizes the removal depths for the four RTD Options (A, B, C, and E) considered for the High-Salt Waste Group.

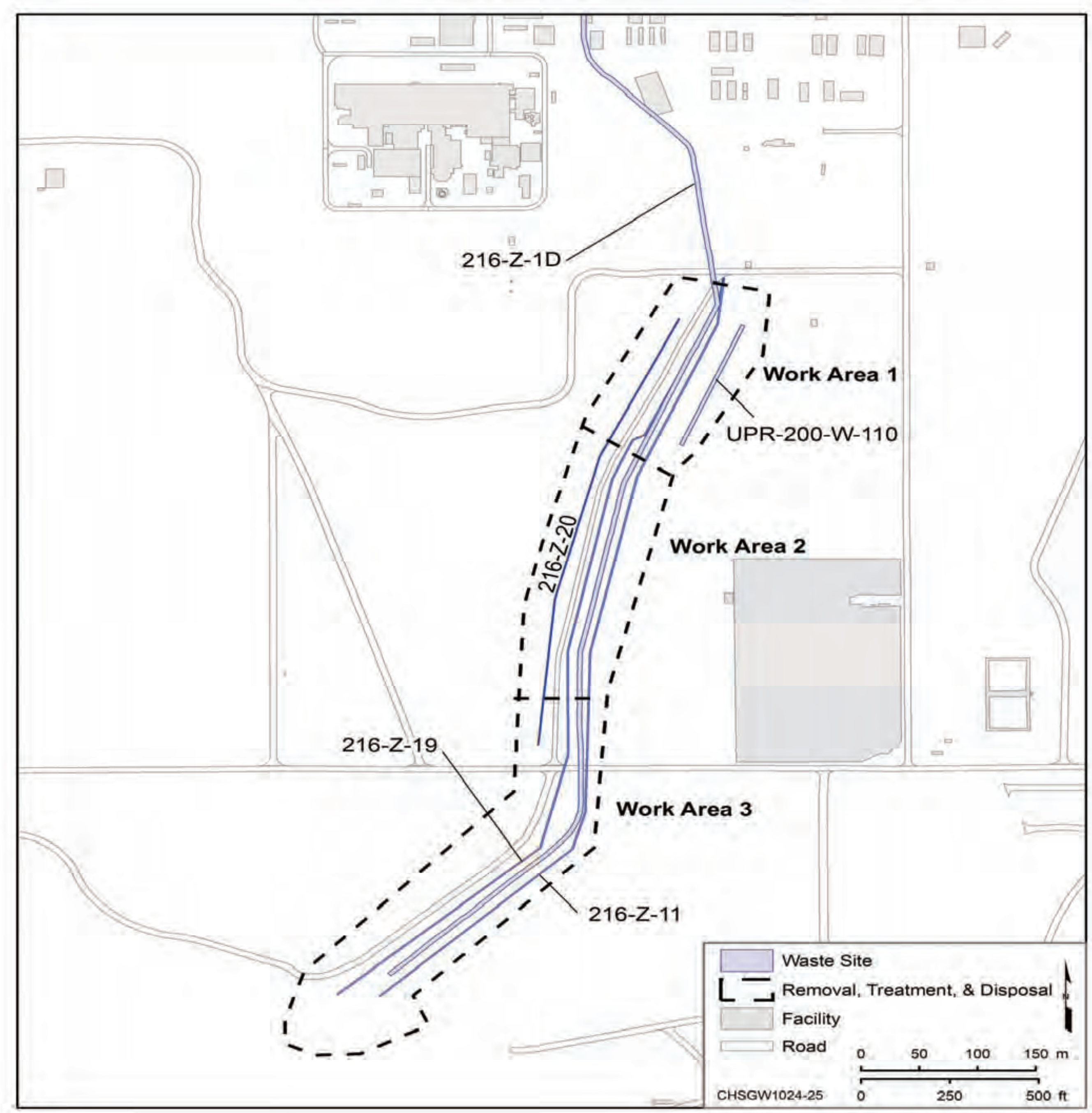


Figure 22. Generalized Waste Site Work Areas for the Z-Ditches

Overall Protection of Human Health and the Environment: The Barrier is protective of human health and the environment using evapotranspiration and physical barriers to minimize the potential for exposure to human or environmental receptors. ISV is protective of human health and the environment because it would break the exposure pathway by solidifying the contaminants in a glass block. The RTD alternatives remove contamination to varying depths to minimize the potential for an exposure at the waste sites. The excavated material, after treatment, would have to meet the waste acceptance criteria at WIPP. Each of these alternatives, except RTD (Option E), which removes contamination to the groundwater, will require long-term IC to maintain protectiveness. The No Action and Barrier alternatives do not meet the threshold criteria, as they are not protective of human health and the environment and were not retained.

Compliance with ARARs: The Barrier, ISV, and RTD alternatives comply with ARARs.

Long-Term Effectiveness: The RTD alternatives (Options A, B, and C) ranked moderately well because they remove varying amounts of contaminants from the soil; however, IC would still be required since waste will be left in place. RTD Option E ranks higher because all contaminated soil would be removed. Because RTD Option A and Option C propose excavation to depths greater than 4.6 m (15 ft) bgs, they would remove any contamination that poses a threat to human health or ecological receptors. By removing these soils, the exposure pathway is interrupted for the industrial worker scenario and ecological receptors. Excavating to greater depths would further reduce the mass of plutonium in the ground, but it provides little additional beneficial protection to groundwater, human health, or ecological receptors (under the reasonably anticipated future land use).

Reduction of Toxicity, Mobility, or Volume through Treatment: The Barrier alternative helps reduce mobility by limiting the amount of water that infiltrates into the subsurface, but it does not reduce contaminant toxicity or volume. ISV captures contaminants in a glass block, reducing volume of the contaminated media and potentially reducing their mobility, but it does not reduce toxicity. The RTD alternatives reduce the amount of contaminated soil in the environment. However, the RTD alternative does not reduce toxicity or volume. Therefore, each alternative ranks as performing moderately well for this criterion.

Short-Term Effectiveness: The Barrier alternative ranks highest for short-term effectiveness because it provides lower potential for worker and environmental exposure to contaminants than the RTD alternatives that include excavation of contaminated material, which could potentially result in an exposure. In addition, a Barrier can be constructed in a relatively short period compared to ISV and RTD.

Implementability: The Barrier alternative ranks high for implementability because it is a proven technology and relatively easy to construct with readily available construction methods and materials. The implementability of ISV is ranked low because of the challenges of applying the technology below a depth of 7.6 m (25 ft) and over a relatively large area. The RTD alternatives rank moderately well because contaminated soils that are excavated must be packaged to meet transportation and WIPP disposal requirements. The RTD Option E is ranked lower for implementability because of the challenges of excavating to 27 m (90 ft).

Cost: The Barrier alternative has the lowest cost followed by RTD Option B, ISV, and RTD Options A, C, and E. The costs associated with final disposal include estimated costs for disposal at the WIPP for any TRU waste that is generated.

Table 8. Comparative Analysis Summary for the High-Salt Waste Group

Alternatives	Threshold Criteria		Balancing Criteria				Cost ($ millions)[a]		
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume through Treatment	Short-Term Effectiveness	Implementability	Capital[b]	Total O&M[c]	Present Worth[b]
216-Z-1A Tile Field, 216-Z-9 Trench, and 216-Z-18 Crib									
No Action	No	No	Not Ranked[d]				--	--	--
Barrier	Yes	Yes	◐	◐[e]	○	○	$12.3	$107.5	$19.1
ISV[f]	Yes	Yes	◐	◐[e]	◐	●	$115.1	$107.4	$94.0
RTD (Option A)	Yes	Yes	◐	◐[e]	◐	◐	$112.2	$107.5	$107.2
RTD (Option B)[g]	Yes	Yes	◐	◐[e]	◐	◐	$78.1	$107.5	$77.5
RTD (Option C)	Yes	Yes	◐	◐[e]	◐	◐	$642.5	$107.4	$577.0
RTD (Option E)	Yes	Yes	○	◐[e]	◐	●	$895.5	$6.6	$786.3

a. These cost estimates are based on the best available information for the site-specific anticipated remedial actions. The costs are expected to range from -30 percent to +50 percent of these estimated values. Major changes to remedial action scope can result in remedial action costs outside of this range. Present Worth calculations are based on 1,000 years.

b. Capital and Present Worth costs include WIPP disposal costs.

c. Total O&M costs presented as total Nondiscounted Annual and Periodic Costs and include 1,000 year IC/O&M, where applicable.

d. The No Action alternative is not ranked because it does not meet the threshold criteria.

e. Carbon tetrachloride and other VOCs removed by SVE are subject to treatment.

f. Uncontaminated soil located above the contaminated material would be excavated prior to application of ISV and backfilled after completion.

g. Excavation to 4.6 m (15 ft) bgs applies to 216-Z-1A Tile Field ONLY because the waste is shallower than 4.6 m (15 ft). The costs presented for Option B include the placement of a barrier over the 216-Z-9 Trench and the 216-Z-18 Crib. Additional investigation may indicate waste at these sites is shallower than 4.6 m (15 ft).Therefore, if a need is identified to excavate these additional sites, the costs for remediation may be similar to the remedial costs associated with Option A.

Evaluation Metric

● = Performs less well against the criterion relative to the other alternatives with significant disadvantages or uncertainty

◐ = Performs moderately well against the criterion relative to the other alternatives with some disadvantages or uncertainty

○ = Performs very well against the criterion relative to the other alternatives with minor disadvantages or uncertainty

Low-Salt Waste Group (200-PW-1 and 200-PW-6)

The five waste sites in the Low-Salt Waste Group primarily received neutral to basic aqueous waste streams from the Plutonium Isolation Facility or the PFP Complex. Table 9 presents the results of an evaluation of remedial alternatives for the five waste sites in the Low-Salt Waste Group. A more detailed evaluation of the alternatives for the Low-Salt Waste Group is presented in Chapter 7 of the 200-PW-1,3,6 OUs FS (DOE/RL-2007-27).

Table 6 summarizes the removal depths for three of the five RTD alternatives considered for each waste site within the Low-Salt group. The RTD Option B alternative does not apply to any of the Low-Salt waste sites; therefore, it has not been included in the summary in Table 9.

Table 9. Comparative Analysis Ranking Summary for the Low-Salt Waste Group

Alternatives	Threshold Criteria		Balance Criteria				Cost ($ millions)[a]		
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume through Treatment	Short-Term Effectiveness	Implementability	Capital[b]	Total O&M[c]	Present Worth [b]
216-Z-1&2 Crib, 216-Z-3 Crib, 216-Z-12 Crib and 216-Z-5 Crib									
No Action	No	No	Not Ranked[d]				--	--	--
Barrier	Yes	Yes	◐	●	○	○	$4.2	$171.0	$10.1
ISV	Yes	Yes	◐	●	◐	●	$17.8	$171.0	$23.7
RTD (Option A)	Yes	Yes	◐	●	◐	◐	$61.8	$171.0	$67.7
RTD (Option C)	Yes	Yes	○	●	◐	◐	$81.4	$0	$81.4
RTD (Option E)	Yes	Yes	○	●	◐	◐	$81.4	$0	$81.4

a. These cost estimates are based on the best available information for the site-specific anticipated remedial actions. The costs are expected to range from -30 percent to +50 percent of these estimated values. Major changes to remedial action scope can result in remedial action costs outside of this range. Present Worth calculations are based on 1,000 years.

b. Capital and Present Worth Costs include WIPP disposal costs.

c. Total O&M costs presented as total Nondiscounted Annual and Periodic Costs and include 1,000 year IC/O&M, where applicable.

d. The No Action alternative is not ranked because it does not meet the threshold criteria.

Evaluation Metric

● = Performs less well against the criterion relative to the other alternatives with significant disadvantages or uncertainty

◐ = Performs moderately well against the criterion relative to the other alternatives with some disadvantages or uncertainty

○ = Performs very well against the criterion relative to the other alternatives with minor disadvantages or uncertainty

Overall Protectiveness of Human Health and the Environment: The Barrier, ISV, and RTD alternatives meet the threshold criteria for protection of human health and the environment. The No Action alternative does not meet the threshold criteria because it is not protective and was not retained.

Compliance with ARARs: The Barrier, ISV, and RTD alternatives meet the threshold criterion for compliance with ARARs.

Long-Term Effectiveness: RTD Option C and Option E rank high for long-term effectiveness because these options would remove any contamination that poses a threat to human health or ecological receptors. The Barrier, ISV, and RTD Option A alternatives leave contamination in place meaning ICs restricting land-use would still be required; therefore, they only rank as performing moderately well.

Reduction of Toxicity, Mobility, or Volume through Treatment: None of the alternatives is effective in reducing the mobility of plutonium or americium, the primary contaminants, as they are not mobile under existing or anticipated conditions. Therefore, all alternatives are ranked as performing less well for this criterion.

Short-Term Effectiveness: The Barrier alternative ranks highest for short-term effectiveness because it provides lower potential for worker and environmental exposure to contaminants than the RTD alternatives that include excavation of contaminated material, which could potentially result in an exposure. In addition, a Barrier can be constructed in a relatively short period compared to ISV and RTD.

Implementability: The Barrier alternative ranks high for implementability because it is a proven technology and relatively easy to construct with readily available construction methods and materials. The implementability of ISV is ranked low because of the challenges of applying the technology over a relatively large area. The RTD alternatives (Options A, C, and E) all rank moderately well because contaminated soils that are excavated must be packaged to meet transportation and WIPP disposal requirements.

Cost: The Barrier alternative has the lowest cost, followed by the ISV, and then the RTD alternatives. The RTD Option A alternative would cost less than Options C and E because less soil would be excavated.

Cesium-137 Waste Group (200-PW-3)

The four cribs and the UPR site comprising the Cesium-137 Waste Group received waste effluent derived directly or indirectly from PUREX operations. Table 10 presents the results of an evaluation of remedial alternatives for the five waste sites in the Cesium-137 Waste Group. Chapter 7 of the 200-PW-1,3,6 OUs FS (DOE/RL-2007-27) provides a more detailed remedial alternative evaluation for the Cesium-137 Waste Group.

Table 6 summarizes the removal depths for the two RTD options considered for each waste site within the Cesium-137 Waste Group. Three of the five waste sites (216-A-7 Crib, 216-A-8 Crib, and UPR-200-E-56 Unplanned Release) have soil contamination within 4.6 m (15 ft) of the current ground surface; the other sites (216-A-24 Crib and 216-A-31 Crib) do not have soil contamination within 4.6 m (15 ft) of the current ground surface. Therefore, these waste sites would include maintenance of the existing soil cover under the RTD (Option B) alternative.

Overall Protection of Human Health and the Environment: The Maintain/Enhance Existing Soil Cover (MEESC) and RTD alternatives (Options B and C) meet the threshold criteria for protection of human health and the environment The No Action alternative does not meet the threshold criteria because it is not protective and was not retained.

Compliance with ARARs: The MEESC and RTD alternatives (Options B and C) comply with ARARs.

Long-Term Effectiveness: The MEESC and RTD alternatives (Options B and C) leave some contamination in place, meaning IC restricting land-use would still be required; therefore, these options only rank as performing moderately well.

Reduction of Toxicity, Mobility, or Volume through Treatment: None of the alternatives are effective in reducing the mobility of cesium, the primary contaminant, as it is not mobile under existing or anticipated conditions. Therefore, all alternatives are ranked as performing less well for this criterion.

Short-Term Effectiveness: The MEESC alternative ranks highest for short-term effectiveness because it provides lower potential for worker and environmental exposure to contaminants than the RTD alternatives that include excavation of contaminated material, which could potentially result in an exposure.

Table 10. Comparative Analysis Summary for the Cesium-137 Waste Group

Alternatives	Threshold Criteria		Balancing Criteria				Cost ($ millions)[a]		
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume through Treatment	Short-Term Effectiveness	Implementability	Capital	Total O&M[b]	Present Worth
216-A-7 Crib, 216-A-8 Crib, 216-A-24 Crib, 216-A-31 Crib and UPR-200-E-56 Unplanned Release									
No Action	No	No	Not Ranked[c]				--	--	--
Maintain/Enhance Existing Soil Cover	Yes	Yes	◐	●	○	○	$4.4	$68.0	$11.1
RTD (Option B)[d]	Yes	Yes	◐	●	◐	◐	$13.2	$63.9	$19.6
RTD (Option C)	Yes	Yes	◐	●	◐	◐	$22.7	$63.9	$29.1

a. These cost estimates are based on the best available information for the site-specific anticipated remedial actions. The costs are expected to range from -30 percent to +50 percent of these estimated values. Major changes to remedial action scope can result in remedial action costs outside of this range. Present Worth calculations are based on 350 years.

b. Total O&M costs presented as total Nondiscounted Annual and Periodic Costs and include 1,000 year IC/O&M, where applicable.

c. The No Action alternative is not ranked because it does not meet the threshold criteria.

d. Excavation to 4.6 m (15 ft) bgs applies to 216-A-7 Crib, 216-A-8 Crib, and UPR-200-E-56 Unplanned Release ONLY because the wastes at these sites are shallower than 4.6 m (15 ft). The costs presented for Option B include maintenance of existing soil cover for 216-A-24 Crib and 216-A-31 Crib. Additional investigation may indicate waste at these sites is shallower than 4.6 m (15 ft). Therefore, if a need is identified to excavate these additional sites, the costs for remediation may be similar to the remedial costs associated with Option C.

Evaluation Metric

● = performs less well against the criterion relative to the other alternatives with significant disadvantages or uncertainty

◐ = performs moderately well against the criterion relative to the other alternatives with some disadvantages or uncertainty

○ = performs very well against the criterion relative to the other alternatives with minor disadvantages or uncertainty

Implementability: The MEESC alternative ranks high for implementability because it is relatively easy to construct with readily available construction methods and materials. The RTD alternatives rank moderately well because contaminated soils that are excavated must be packaged to meet ERDF disposal requirements

Cost: The MEESC alternative has the lowest cost, followed by the RTD alternatives. RTD Option B has lower costs because less contaminated soil would be excavated than for RTD Option C.

Settling Tanks Waste Group (200-PW-1 and 200-PW-6)

The 241-Z-361 Settling Tank contains 800 L (210 gal) of liquid and 75 m^3 (82 yd^3) of sludge. Table 11 presents the results of an evaluation of the remedial alternatives for the Settling Tanks Waste Group. Chapter 7 of the 200-PW-1,3,6 OUs FS (DOE/RL-2007-27) provides a more detailed remedial alternative evaluation for the two settling tanks sites.

Table 11. Comparative Analysis Ranking Summary for the Settling Tanks Waste Group

Alternatives	Threshold Criteria		Balancing Criteria				Cost ($ millions)[a]		
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume through Treatment	Short-Term Effectiveness	Implementability	Capital[b]	Total O&M[c]	Present Worth[b]
241-Z-361 Settling Tank and 241-Z-8 Settling Tank									
No Action	No	No	Not Ranked[d]				--	--	--
Sludge Removal and Tank Stabilization	Yes	Yes	○	●	◐	◐	$33.4	$0	$39.6

a. These cost estimates are based on the best available information for the site-specific anticipated remedial actions. The costs are expected to range from -30 percent to +50 percent of these estimated values. Major changes to remedial action scope can result in remedial action costs outside of this range. Present Worth calculations are based on 1,000 years.

b. Capital and Present Worth Costs include WIPP disposal costs.

c. Total O&M costs presented as total Nondiscounted Annual and Periodic Costs.

d. The No Action alternative is not ranked because it does not meet the threshold criteria.

Evaluation Metric

● = performs less well against the criterion relative to the other alternatives with significant disadvantages or uncertainty.

◐ = performs moderately well against the criterion relative to the other alternatives with some disadvantages or uncertainty.

○ = performs very well against the criterion relative to the other alternatives with minor disadvantages or uncertainty.

The Sludge Removal and Tank Stabilization option meets the threshold criteria for overall protection of human health and the environment and compliance with ARARs. It ranks high for long-term effectiveness since the contaminated sludge will be removed and the tanks will be grouted for stabilization. Treatment is not a component of this alternative; therefore, it is ranked as performing less well. For short-term effectiveness, it ranks moderately well since the removal of the sludge from the Settling Tanks will require significant contaminated material handling requirements for worker safety and environmental protection. For implementability, it ranks moderately well since the sludge must be packaged to meet transportation and WIPP disposal requirements.

Pipelines

In situ stabilization of the pipelines, where grout is pumped into the pipelines, was considered as a possible alternative. However, it did not meet the threshold criteria and was not retained. Table 12 presents the results of an evaluation of the remedial alternatives for the Pipelines. The RTD alternative was evaluated to take advantage of the observational approach. Under this alternative, pipelines outside the footprint of the associated waste site would be excavated and disposed of at an approved facility. Under this alternative, any significant releases from the pipelines would be investigated for possible future remedial action. The remaining lengths of pipeline will be removed as part of the implementation of the preferred alternative (i.e., RTD). The cost for RTD of the pipelines to be addressed as part of this decision is $4.9 million.

Table 12. Comparative Analysis Ranking Summary for the Pipelines

Alternatives	Threshold Criteria		Balancing Criteria				Cost ($ millions)[a]		
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume through Treatment	Short-Term Effectiveness	Implementability	Capital	Total O&M[b]	Present Worth
Pipelines									
No Action	No	No	Not Ranked[c]				--	--	--
In Situ Stabilization	No	No	Not Ranked[d]				--	--	--
RTD	Yes	Yes	○	●	◐	◐	$4.9	$0	$4.9

a. These cost estimates are based on the best available information for the site-specific anticipated remedial actions. The costs are expected to range from -30 percent to +50 percent of these estimated values. Major changes to remedial action scope can result in remedial action costs outside of this range. Present Worth calculations are based on 1,000 years and include estimated WIPP disposal costs.

b. Total O&M costs presented as total Nondiscounted Annual and Periodic Costs.

c. The No Action alternative is not ranked because it does not meet the threshold criteria.

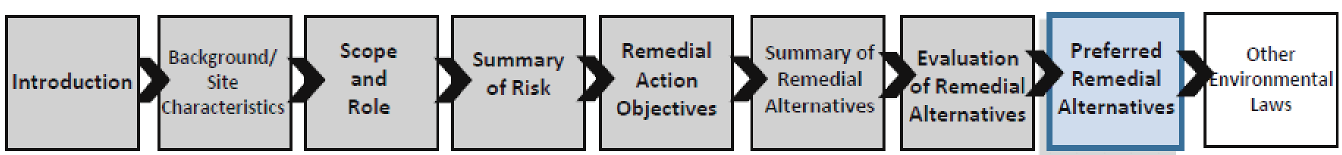
d. In Situ Stabilization is not ranked because it does not meet threshold criteria.

Evaluation Metric

● = Performs less well against the criterion relative to the other alternatives with significant disadvantages or uncertainty.

◐ = Performs moderately well against the criterion relative to the other alternatives with some disadvantages or uncertainty.

○ = Performs very well against the criterion relative to the other alternatives with minor disadvantages or uncertainty.



PREFERRED REMEDIAL ALTERNATIVES

Table 13 is a summary of the preferred alternatives for these waste sites. Public comment and any new information will be considered before identifying the final alternatives for implementation.

Z-Ditches Waste Group

The preferred alternative for the Z-Ditches Waste Group is the RTD alternative. However, for the north portion of 216-Z-1D, it is anticipated that no RTD will be required. The north portion is believed to currently meet PRGs for industrial use, ecological receptors, and protection of groundwater based on existing sampling data and process knowledge. Therefore, the north portion will contribute zero area and zero volume requiring active remediation.

The RTD alternative provides for RTD of contaminated media. The waste generated by implementing the alternative is expected to be low-level, which can be disposed of in ERDF.

Table 13. Summary of Preferred Alternatives

Waste Group	Preferred Alternative
Z-Ditches	RTD with disposal at ERDF.
High-Salt	RTD—Option A: Remove to 0.6 m (2 ft) below the bottom of a waste site, which contains the highest concentration of contaminants. Plutonium waste will be disposed of at WIPP.
Low-Salt	RTD—Option C: Removal of a significant portion of plutonium contamination. Plutonium waste will be disposed of at WIPP.
Cesium-137	Maintain/ Enhance Soil Cover. Reduce infiltration of precipitation by supporting natural vegetation.
Settling Tanks	Sludge Removal and Tank Stabilization.

The basis for selecting this alternative is that it reduces site risk through removal of contamination from the waste sites. This alternative would meet RAO-1 and -2 by removing contamination and placing the contaminated soil in ERDF, which will eventually isolate it from the environment through an engineered barrier. This alternative meets RAO-3 by removing contamination above the PRGs that could potentially affect groundwater. This alternative will provide a cost-effective balance between long-term protection and permanence and short-term risk. Excavation of shallow contamination with onsite disposal is readily implementable. This alternative is cost-effective relative to other alternatives, taking into account the reduction of overall site risk achieved and reduction of the cost of long-term IC and maintenance.

The preferred alternative would include sampling during design to determine the extent of excavation that would be required. After remediation is complete, sampling would be conducted to verify the remediation meets cleanup standards.

High-Salt Waste Group

The preferred alternative for the High-Salt Waste Group is RTD (Option A) consisting of excavation of the highest concentrations of contaminated soils to 0.6 m (2 ft) below the base of the waste site (6 to 7 m [20 to 23 ft] total depth bgs), removal of the structures associated with these waste sites, backfill of the excavation with clean fill, construction of a physical evapotranspiration barrier over the sites, and IC. In addition, as part of the preferred alternative, the SVE system would continue to be operated for treatment of the carbon tetrachloride soil contamination at the High-Salt Waste Group.

RTD Option A was identified at the preferred alternative over RTD Option C because the incremental cost of retrieving and disposing of the additional quantity of contaminated soils under Option C are disproportionate to the human health and environmental risks posed. The potential risk reduction benefits of additional retrieval are only realized under certain aspects of an unrestricted use scenario. Such a land use is inconsistent with the reasonably anticipated future land use.

Because residual contamination would be left in place after the RTD remedial action was completed, an evapotranspiration barrier would be constructed over the waste sites to control the amount of precipitation that infiltrates into the contaminated media, thereby reducing the potential migration of contaminants to groundwater. This combination of alternatives also includes addressing the associated pipelines, IC, and site monitoring. Also included in the preferred alternative is the removal and disposal of the above-grade structures at the 216-Z-9 Trench.

Low-Salt Waste Group

The preferred alternative for the Low-Salt Waste Group is the RTD Option C alternative, which includes removal of a significant portion of plutonium contamination, physical barriers, and IC. The RTD Option C alternative was selected over the RTD Option A alternative because excavating to 10.1 m (33 ft) under RTD Option C would remove an estimated 90 percent of the plutonium beneath these waste sites. Because some contamination would be left in place after RTD remedial action was complete, an evapotranspiration barrier would be constructed over the waste sites. This combination of alternatives also includes addressing associated pipelines, IC, and site monitoring.

Cesium-137 Waste Group

The preferred alternative for the Cesium-137 Waste Group is maintenance and/or enhancement of the existing soil cover to ensure that the potential exposure pathways are broken, that the waste sites will support native vegetation, and reduce the infiltration of water to the subsurface. In general, the depth to waste of concern is currently between 3.6 and 4.6 m (12 and 15 ft). After actions to enhance existing cover, all sites will provide a minimum of 4.6 m (15 ft) of cover over the waste preventing human health or environmental risk exceeding risk-based levels.

Settling Tanks Waste Group

The preferred alternative for the Settling Tanks Waste Group is the removal of plutonium and americium contaminated sludge followed by tank stabilization. The empty tanks would be backfilled with a suitable fill material that reduces the potential for collapse. This alternative is recommended because it will achieve substantial risk reduction by removing the source materials and providing safe management of remaining materials.

Pipelines

The preferred alternative for the Pipelines is RTD with the implementation of the preferred alternative for the associated waste site (i.e., RTD). Pipelines outside the footprint of the selected remedy for the associated waste sites would be excavated and disposed of at an approved facility.

Summary

Based on information available at this time, the DOE and the EPA have concluded that the preferred alternative and proposed actions would be protective of human health and the environment, comply with ARARs, be cost-effective, and use long-term solutions and alternative treatment technologies to the maximum extent practicable. The preferred alternative and proposed actions may be modified or changed by the Tri-Parties in response to public comment or new information that becomes available after this Proposed Plan is released.

NATIONAL ENVIRONMENTAL POLICY ACT VALUES

Under DOE's CERCLA and *National Environmental Policy Act of 1969* (NEPA) Policy, established in 1994, DOE relies on the CERCLA process for review of actions to be taken under CERCLA (i.e., no separate NEPA document or NEPA process is ordinarily required [Cook, 2002]). NEPA values are incorporated into DOE's CERCLA documentation (DOE O 451.1B Chg 1, *National Environmental Policy Act Compliance Program*); NEPA values include (but are not limited to) consideration of the cumulative, ecological, cultural, historical, and socioeconomic impacts of the proposed remedial action. NEPA values were thoroughly evaluated in the CW-5 and PW-1,3,6 Feasibility Studies. Based on the evaluations, DOE expects minimal or no impacts.

COMMUNITY PARTICIPATION

Public input is a key element in the DOE's decision-making process. Tribal Nations and the public are encouraged to read and provide comments on any of the alternatives presented in this Proposed Plan, including the preferred alternatives. The public comment period for this Proposed Plan extends from July 5, 2011, through August 5, 2011. Comments on the preferred alternatives, other alternatives, or any element of this Proposed Plan will be accepted through August 5, 2011. Comments may be sent to:

Paula Call, Department of Energy, Richland Operations Office
Mail: P.O. Box 550, A7-75
Richland, WA 99352
Phone: (509) 376-8230
Fax: (509) 372-3548
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Mail: Hanford Project Office
309 Bradley Blvd. Suite 115
Richland, WA 99352
Phone: (509) 376-4919
Fax: (509) 376-2396
E-mail: laija.emerald@epa.gov

To request a meeting in your area, please contact Emerald Laija.

Location of Public Information Repositories

Hanford Public Information Repository Locations

Administrative Record and Public Information Repository:
2440 Stevens Center Place,
Room 1101, Richland, WA
Phone: (509) 376-2530
Web site address:
http://www2.hanford.gov/arpir/

Portland
Portland State University
Bradford Price and Millar Library
1975 SW Park Avenue
Portland, OR
Attn: Claudia Weston (503) 725-4542
Map: http://www.pdx.edu/map.html

Seattle
University of Washington
Suzallo Library
Government Publications Division
Seattle, WA
Attn: David Maack (206) 543-4664
Map: http://tinyurl.com/m8ebj

Richland
U.S. Department of Energy Public Reading Room
Washington State University, Tri-Cities
Consolidated Information Center,
Room 101-L
2770 University Drive, Richland, WA
Attn: Janice Parthree (509) 372-7443
Map: http://tinyurl.com/2axam2

Spokane
Gonzaga University Foley Center
East 502 Boone, Spokane, WA
Attn: Linda Pierce (509) 323-3834
Map: http://tinyurl.com/2c6bpm

After the public comment period, DOE and EPA will consider the comments regarding the Proposed Plan and information gathered during the comment period and then make a decision. The preferred alternatives could be modified or another alternative selected. The DOE and EPA will then prepare a CERCLA ROD. This ROD will identify the chosen alternative (i.e., remedy). A responsiveness summary containing agency responses to the comments received during the public comment period will be made available with the ROD.

July 5, 2011 – August 5, 2011						
SUN	MON	TUE	WED	THU	FRI	SAT
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

Read the Hanford Site Cleanup Completion Framework to understand how this Proposed Plan fits within the overall cleanup of the Hanford Site at http://www.hanford.gov\important documents.

GLOSSARY

Administrative Record: The lead agency is required to establish an administrative record that contains the documents (e.g., reports, public comments, and correspondence) that form the basis for the selection of a response action under CERCLA (CERCLA Chapter 113(k); 40 CFR 300.800, "National Oil and Hazardous Substances Pollution Contingency Plan," "Establishment of an Administrative Record"). A list of locations where the Administrative Records for the Hanford Site are available appears in the Community Participation section of this Proposed Plan.

Applicable or Relevant and Appropriate Requirements (ARARs): ARARs represent the body of federal and state laws, regulations, and standards governing environmental protection and facility siting that are either applicable or relevant and appropriate for the situation. The selected remedy must comply with ARARs except those that are waived.

Baseline Risk Assessment: A study that identifies and evaluates the contaminants present at a site and assesses the current and potential threats to human health and the environment if no remedial action is taken at the site; it is also used to determine the need, or basis, for action.

Community Relations Plan: The Community Relations Plan outlines the public participation processes implemented by the Tri-Parties under the Tri-Party Agreement, and identifies several ways the public can participate in the Hanford Site cleanup decision-making process.

***Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA):** Also known as the Superfund Act, CERCLA is the federal law that establishes a program to identify, evaluate, and remediate sites where hazardous substances, pollutants, or contaminants may have been released (e.g., leaked, spilled, or dumped) to the environment or where there is a substantial threat of such a release.

Contaminant of Concern (COC): Radionuclides and chemicals that exceed risk threshold values in the Baseline Risk Assessment, Applicable or Relevant and Appropriate Requirements (ARARs), and/or contaminant-specific cleanup levels

Cribs, Tile Field, and French Drain: A near-surface underground structure designed to receive liquid waste that can percolate directly into the soil.

Debris: Building or construction material that has been demolished.

Environmental Restoration Disposal Facility (ERDF): The ERDF is the Hanford Site's CERCLA approved disposal facility for most hazardous (radioactive and nonradioactive) substances and contaminated environmental media, generated under a CERCLA response action, that meet the waste disposal acceptance criteria.

Evapotranspiration: The portion of precipitation returned to the air through direct evaporation and by transpiration of vegetation.

Excess Lifetime Cancer Risk (ELCR): A numerical estimate of the incremental probability of an individual developing cancer over a lifetime as a result of a reasonable maximum site related exposure to a potential carcinogen.

Hazard Quotient (HQ): A hazard quotient is a numerical expression that indicates whether the concentration of a chemical is likely to result in specific adverse health effects.

In Situ Vitrification (ISV): ISV is a process that converts contaminated soil into glass using high temperatures, producing an unleachable medium that prevents release of contaminants to the environment.

Injection/Reverse Well: A well designed to receive liquid waste that will percolate into the vadose zone.

Institutional Controls (IC): Non-engineered instruments such as administrative or legal measures to protect human health and the environment from exposure to contamination. Institutional controls are maintained until requirements are met for safe, unrestricted land use.

Model Toxics Control Act: The Model Toxics Control Act (RCW 70.105D, "Hazardous Waste Cleanup – Model Toxics Control Act") provides state standards that set cleanup regulations for protection of human health and the environment. The standards and requirements established to implement the Act are published in WAC 173-340, "Model Toxics Control Act—Cleanup."

***National Environmental Policy Act of 1969* (NEPA):** NEPA is a federal environmental law that requires federal agencies to integrate environmental values into their decision-making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. Federal agencies conducting CERCLA actions may rely on the CERCLA process for environmental reviews that are functionally equivalent and are not required to engage in a separate NEPA analysis such as preparation of Environmental Assessments [EAs] and Environmental Impact Statements [EISs]) (40 CFR 1500, "Purpose, Policy, and Mandate"; O'Leary, 1994).

"National Oil and Hazardous Substances Pollution Contingency Plan" (NCP): The first National Contingency Plan (NCP) was developed and published in 1968 to address potential spills in U.S. waters. Following the passage of Superfund legislation in 1980, the NCP was revised and it now addresses releases of hazardous substances or pollutants or contaminants into the environment (40 CFR 300).

National Priorities List (NPL): The list, compiled by EPA pursuant to CERCLA section 105, of uncontrolled hazardous substances releases in the United States that are priorities for long-term remedial evaluation and response.

No Action: No remedial action would be conducted at a site and it would remain in its current condition.

Operable Unit (OU): A group of land disposal sites placed together for performing a remedial investigation and feasibility study and subsequent cleanup actions. The primary criteria for placing a site into an operable unit include geographic proximity, similarity of waste characteristics and site type, and the possibility for economies of scale.

Plutonium: Plutonium is a toxic, heavy, radioactive metallic element; atomic number 94. There are 15 isotopes of plutonium; plutonium-239 is the most important isotope as it is fissile and is used in nuclear weapons and some reactors. Plutonium production at the Hanford Site formally ended in 1990. Plutonium has an extremely long half-life (approximately 24,100 years) and is not mobile under current site conditions.

Plutonium and Uranium Extraction (PUREX) Plant: Also known as “A” Plant, PUREX was the facility that recovered plutonium and uranium. PUREX began operation in late 1955 and ran continuously until 1972. The plant was restarted in 1983 and ran intermittently until 1988.

Plutonium Finishing Plant (PFP): Also known as Z Plant, the PFP began operations in late 1949 to process plutonium nitrate solutions into plutonium oxide, plutonium nitrate, and plutonium metal. The PFP was also used to fabricate plutonium and for reprocessing scrap plutonium.

Plutonium Reclamation Facility (PRF): A facility for plutonium scrap recovery and solvent extraction purification processes.

Preferred Alternative: The remedial action proposed after an evaluation of a range of viable alternatives. The preferred alternative must be protective of human health and the environment.

Preliminary Remediation Goal (PRG): Preliminary remediation goals establish acceptable exposure levels that are protective of human health and the environment. Initially, PRGs are developed based on readily available information, such as chemical specific ARARs. PRGs are modified as more information becomes available during the RI/FS. Alternatives are developed and evaluated based on how well they meet the goals. Final remediation goals are determined when the remedy is selected in the ROD.

Principal Threat Waste: Principal Threat Wastes are those source materials that generally cannot be reliably contained or would present a significant risk to human health or environment should exposure occur. They include liquids and other highly mobile materials (e.g., solvents) or materials having high concentrations of toxic compounds ((OSWER Publication 9380.3-06FS)

Proposed Plan: Proposed plans are prepared by the lead and support agencies to identify and present to the public, the alternative that best meets the requirements of CERCLA and the NCP (40 CFR 300.430(f)(1)). Proposed plans identify and present not only the preferred alternative, but also other alternatives analyzed for remedial actions at the subject waste sites. Proposed plans are based on and summarize the remedial investigation/ feasibility studies for the subject waste sites. The Proposed Plan also provides the community with a reasonable opportunity to comment on the proposed remedial action as well as the other alternatives that were considered.

Radionuclide: An unstable atom that emits excess energy (decays) in the form of radioactivity (rays or particles). Depending on the type and amount of decay, prolonged exposure may be harmful.

Record of Decision (ROD): A ROD is a legally binding public document that identifies the remedy that will be used and the rationale behind its selection. The Responsiveness Summary is made available with the ROD and contains the public comments received on the proposed plan and the Tri-Party agencies’ responses.

Recovery of Uranium and Plutonium by Extraction (RECUPLEX): The RECUPLEX was an early facility that purified plutonium in batches. It was replaced in 1964 by the Plutonium Reclamation Facility.

Remedial Action Objective (RAO): A RAO is a medium-specific (e.g. soil) or OU-specific goal for protecting human health and the environment. RAOs specify contaminant(s) and media of concern, potential exposure pathways, and remediation goals.

Remedial Alternatives: Differing remedial actions, each of which could be taken at a site in the event of a release or threatened release of a hazardous substance into the environment, to prevent or minimize the release of hazardous substances for the protection of human health and the environment. Remedial actions identified for a given site that are protective of human health and the environment by recycling waste or by eliminating, reducing, and/or controlling risks posed through each pathway by a site. Remedial alternatives are evaluated using the selection criteria set forth in the NCP (40 CFR 300.430; 40 CFR 300.5, "Definitions;" and 40 CFR 300.6, "Use of Number and Gender").

Remedial Investigation/Feasibility Study (RI/FS): The RI/FS process as outlined in this Proposed Plan represents the methodology that the Superfund program has established for characterizing the nature and extent of releases or threats of release of hazardous substances, assessing risks posed thereby, and evaluating potential remedial action alternatives for the site.

Remediation/Remedial Action: Actions consistent with permanent remedy taken instead of, or in addition to, removal action in the event of a release or threatened release of a hazardous substance into the environment, so that they do not migrate to cause substantial danger to public health or welfare or the environment

Removal, Treatment, and Disposal (RTD): A cleanup-method where soil and debris are excavated in such a way that no contaminants above the approved remedial action goals or concentration for direct exposure and groundwater protection remains at the Site. Excavated material is treated (as necessary) and sent to an appropriate onsite or offsite engineered facility for disposal.

Soil Vapor Extraction (SVE): SVE is a process that removes volatile organic contaminants in the form of vapors from the soils above the water table. The vapors are removed by applying a vacuum, treated through a granulated activated carbon system, and then disposed of accordingly.

Transuranic (TRU) Waste: Transuranic waste (TRU) is waste which has been contaminated with alpha emitting transuranic radionuclides possessing half-lives greater than twenty years and in concentrations greater than 100 nCi/g. Elements having atomic numbers greater than that of uranium are called transuranic (after uranium).

Tri-Party Agreement: The U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and Washington State Department of Ecology (Ecology) signed the *Hanford Federal Facility Agreement and Consent Order*, or Tri-Party Agreement, on May 15, 1989 (EPA et al., 1989). The Tri-Party Agreement, as updated and modified through formal change control, is a comprehensive cleanup and compliance agreement for achieving compliance with the Comprehensive Environment Response Compensation and Liability Act (CERCLA) remedial action provisions and with the Resource Conservation and Recovery Act (RCRA) treatment, storage, and disposal unit regulations and corrective action provisions.

Unplanned Release (UPR): An unplanned release is an unintentional release, such as an accidental spill of hazardous substances into the environment.

Vadose Zone and Deep Vadose Zone: The vadose zone is the unsaturated soil column between the land surface and the groundwater. The deep vadose zone is the region below the practical depth of surface remedy influence. The practical depth of the surface remedy influence varies based on site-specific conditions.

Waste Isolation Pilot Plant (WIPP): The WIPP is DOE's deep geologic repository at which defense-related transuranic waste, which includes radioactive waste that contains high levels of elements such as plutonium and americium, is permanently disposed. WIPP is located in the desert outside of Carlsbad, New Mexico, and began disposal operations in 1999.

Waste Sites: Waste sites are contaminated or potentially contaminated sites. Contamination may be contained in environmental media (e.g., soil, groundwater) or in manmade structures or solid waste (e.g., debris).

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