

# An Introduction to the Hanford Site Radioactive Solid Waste Burial Grounds (200-SW-2 Operable Unit)



## Introduction

This fact sheet provides an overview of the Hanford Site's radioactive solid waste burial grounds, also known as the 200-SW-2 Operable Unit (OU)<sup>1</sup>. The purpose of the fact sheet is to provide background information and set context for the burial grounds as they relate to the overall approach to cleanup of the Hanford Site. It discusses the types of landfills and waste structures found in the burial grounds, the methods used to manage and handle radioactive solid waste, burial ground safety, and next steps in deciding how to address cleanup of the 200-SW-2 OU.

The fact sheet is comprised of two sections:

- 1) An overview of Hanford cleanup goals
- 2) An introduction to the radioactive solid waste burial grounds (200-SW-2 OU)

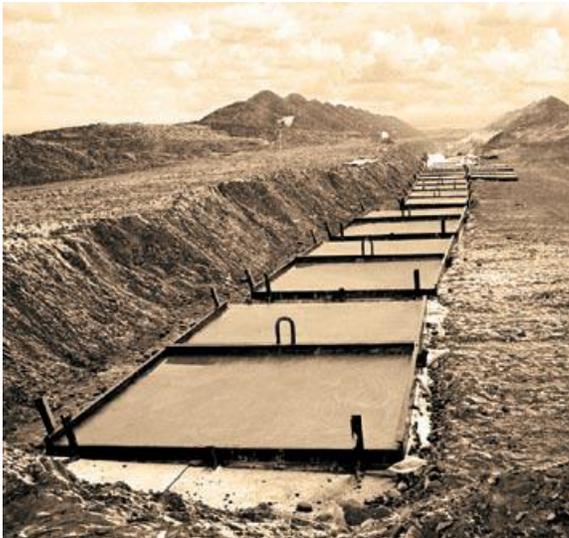
## Why are we focusing on 200-SW-2 Operable Unit?

The Tribal Nations, stakeholders and the public have expressed high interest in what is known about these burial grounds and how they will be cleaned up. This interest prompted the Tri-Party Agreement (TPA) agencies [(U.S. Department of Energy (DOE), Washington State Department of Ecology (Ecology) and U.S. Environmental Protection Agency (EPA)] to start early in the regulatory decision process to engage these groups. The 200-SW-2 OU is one of ten OU groups located in the Inner Area of the Central Plateau (see map). They will be cleaned up under the Resource Conservation and Recovery Act (RCRA) and Comprehensive

Environmental Response, Compensation, and Liability Act (CERCLA). Using the RCRA-CERCLA processes, the TPA agencies will determine:

- If there was a release or a threat of a release of hazardous substances that pose a risk to human health or the environment
- If the wastes disposed of in the burial grounds create an unacceptable risk to human health or the environment in their current condition
- What actions, need to be taken at the burial grounds to protect human health and the environment from exposure to hazardous and radioactive waste

Over the last several years, the TPA agencies have collected and reviewed information on the design, construction, operation, and closure of the various burial grounds. They have also conducted a variety of field investigations to add to the base of knowledge about the burial grounds and to assess if they have contributed to Hanford groundwater contamination.



*A standard burial box (right) is the type of box used for many years at Hanford before modern standards for containers were implemented. This photo was taken in 1973.*

OU is defined in the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) as: a group of land disposal sites placed together for the purposes of doing a Remedial Investigation/Feasibility Study and subsequent cleanup actions. The primary criteria for placement of a site into an OU include geographic proximity, similarity of waste characteristics and site type, and the possibility for economies of scale.

The solid waste burial ground evaluation process is at an early stage. Between now and the end of 2011, the TPA agencies plan to revise the current work plan to address how RCRA-CERCLA cleanup requirements will be integrated and met. The agencies will determine if additional data is needed to support the RCRA-CERCLA RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) & Remedial Investigation and Feasibility Study (RI/FS) processes, define how the RFI/CMS & RI/FS evaluations will be done, and develop a proposed corrective action decision and proposed plan to remediate the 200-SW-2 OU. The proposed corrective action decision and proposed plan is scheduled to be submitted to Ecology in 2016, and a public comment period will be held in 2017, prior to a final decision being made. Over the next few years, the TPA agencies plan to hold public meetings to exchange information, discuss issues, and provide updates on findings from the investigation work before releasing the proposed plan for public comment. Your input is important to the process.

## Overview of Hanford Cleanup Goals

DOE's *Hanford Site Cleanup Completion Framework* (DOE/RL-2009-10, Rev. 0) provides a comprehensive overview of Hanford cleanup. DOE wrote it in 2009 and revised in 2010 after undergoing public comment. This document lays out the approach DOE is using to complete cleanup of the Hanford Site. This document also identifies overarching cleanup goals. These goals are based on more than 20 years of dialogue between the TPA agencies, Tribal Nations, State of Oregon, stakeholders and the public. These goals help set priorities to identify what cleanup work should be funded and in what order cleanup work should be done for the greatest benefit. The goals for cleanup are:

**Goal 1:** Protect the Columbia River.

**Goal 2:** Restore groundwater to its beneficial use to protect human health, the environment, and the Columbia River.

**Goal 3:** Clean up River Corridor waste sites and facilities to:

- Protect groundwater and the Columbia River
- Shrink the active cleanup footprint to the Central Plateau
- Protect human health & the environment and comply with applicable requirements

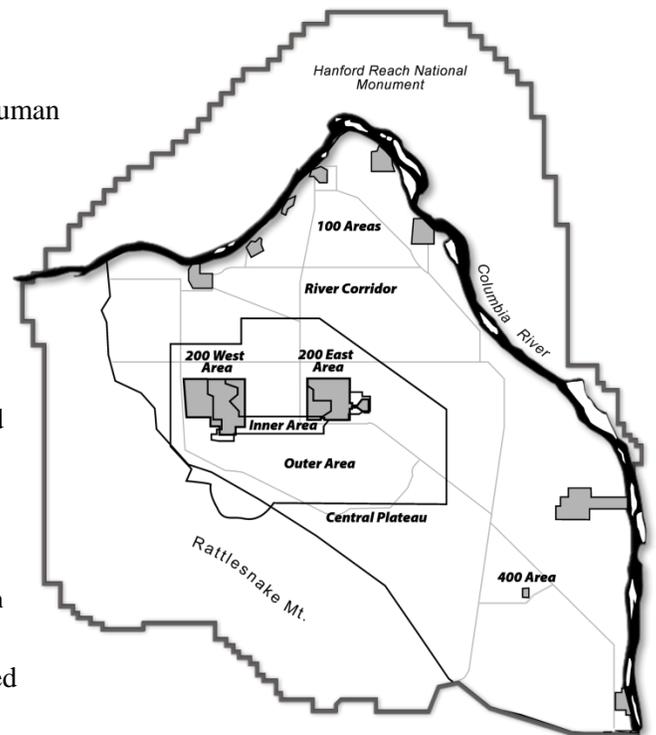
**Goal 4:** Clean up Central Plateau waste sites, tank farms, and facilities to:

- Protect groundwater
- Minimize the footprint of areas requiring long-term waste management activities
- Protect human health & the environment and comply with applicable requirements

**Goal 5:** Safely manage and transfer legacy materials scheduled for off-site disposition including special nuclear material (including plutonium), spent nuclear fuel, transuranic waste, and immobilized high-level waste.

**Goal 6:** Consolidate waste treatment, storage, and disposal operations on the Central Plateau.

**Goal 7:** Develop and implement institutional controls and long-term stewardship activities that protect human health, the environment, and Hanford's unique cultural, historical and ecological resources after cleanup activities are completed.



**Figure 1.** Principal components of Hanford's Cleanup Completion Framework: Central Plateau, River Corridor, Hanford Reach National Monument and Inner Area.

Components of the Hanford Site cleanup include the River Corridor, the Central Plateau and Tank Waste. The Central Plateau is further divided into the Inner and Outer Areas. The solid waste burial grounds are located in the Inner Area of the Central Plateau. DOE anticipates the Inner Area to be the final footprint of Hanford and will be dedicated to long-term waste management and containment of residual contamination. (The *Framework* discusses how DOE is working to ultimately reduce the active cleanup footprint to the Inner Area.) The radioactive burial grounds are identified in the *Framework* as one of the Central Plateau's cleanup key challenges.

### ***Burial grounds: A Central Plateau Cleanup key challenge***

There are more than 800 waste sites on the Central Plateau and the cleanup of the plateau will likely involve a mix of cleanup approaches such as removal, treatment (as necessary) and disposal (e.g., to Environmental Restoration Disposal Facility [ERDF]), containment, and in-place remediation (e.g., for deeper soils and groundwater). The number and variety of waste sites, surplus facilities (900+), active and inactive burial grounds, and active and inactive processing facilities means that many cleanup decisions and actions must be coordinated to use cleanup resource efficiently.

About seventy percent of Hanford's solid waste volume was disposed after 1970, mostly on the Central Plateau in large landfills<sup>2</sup> using common waste management practices of the day. A key challenge for remediating these landfills is to obtain a common understanding of the potential risk the waste poses to the environment and how to best minimize that risk.



Aerial view of the Environmental Restoration Disposal Facility

### ***Overview of solid waste disposal at the Hanford Site***

Since 1943, when the U.S. Army Corps of Engineers established the Hanford Site, a variety of facilities have been constructed, including reactors and chemical reprocessing facilities used to produce plutonium, and

---

<sup>2</sup> The term burial grounds and landfills have been used synonymously with one another in the 200-SW-1 Nonradioactive Landfills Group and 200-SW-2 Radioactive Landfills Group OU RI/FS Study Work Plan. Appendix A to the TPA Action Plan defines Burial Ground as: a land area specifically designated to receive contaminated waste packages and equipment, usually in trenches covered with overburden. The Resource Conservation and Recovery Act of 1976 (RCRA) defines a variety of land disposal units including landfills. Landfills are excavated or engineered sites where non-liquid hazardous waste is deposited for final disposal and covered. New landfills are selected and designed to minimize the chance of release of hazardous waste into the environment. Design standards for hazardous waste landfills require a double liner; double leachate collection and removal systems; leak detection system; run on, runoff, and wind dispersal controls; construction quality assurance program. Liquid wastes may not be placed in a hazardous waste landfill. (See 40 CFR Parts 264/265, Subpart N).

Current disposal is controlled through DOE Order 435.1 and the Disposal Authorization for the Hanford Site Low-Level Waste Disposal Facilities. Revision 2 dated November 1, 2001.

research and development facilities that focused on peacetime uses of the atom. Waste management and disposal was an integral component of all Hanford operations. Large underground radioactive waste tanks (single-shell and double-shell tanks) were constructed to receive high activity liquid waste streams; cribs, ponds and ditches were constructed to receive large volumes of low activity liquid waste; and burial grounds were constructed to dispose of radioactive contaminated solid waste and used equipment. Figure 3 illustrates the various disposal pathways that were used at the Hanford Site.

**Brief History of Radioactive Solid Waste Disposal at the Hanford Site**

Since the start of operations, radioactive solid wastes have been disposed or stored in the various burial ground facilities located throughout the Hanford Site. Burial and storage operations have been planned activities, with an emphasis on the confinement of contamination during the transport from the waste generator and during the

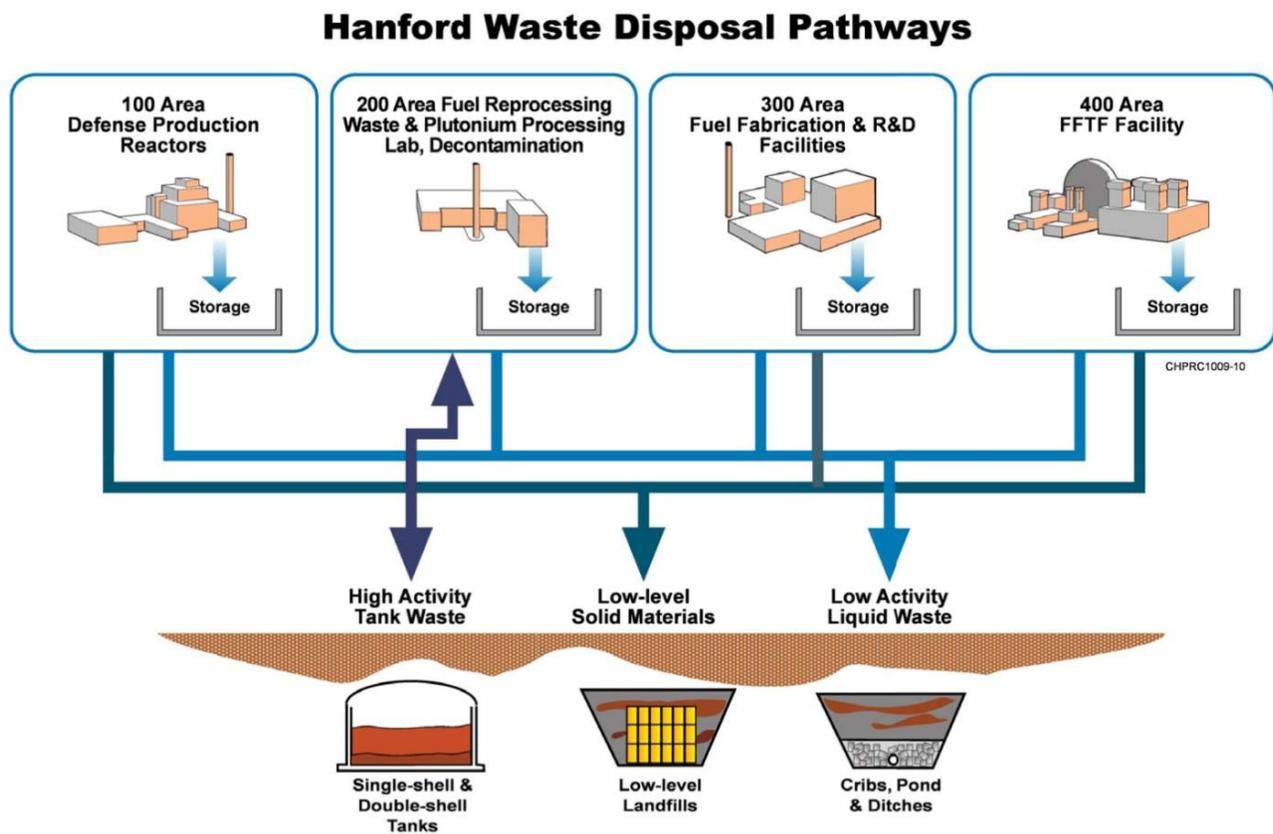


Figure 3. Overview of Waste Disposal Pathways at Hanford

disposal operations. The disposal practices used in all of the burial grounds were based on the principles of "as low as reasonably achievable" (ALARA). The waste was packaged so that the burial ground personnel handling it received minimal exposure.

During the first several decades of Hanford operations, each of the major operational areas – the 100 Areas (reactor operations), 200 East/200 West Areas (fuel reprocessing operations), and 300 Areas (fuel fabrication and research and development) – had their own solid waste disposal facilities. Most were located within or near the Area perimeter fences, although some were located farther away.

Over the years, various steps were taken to reduce the volume of radioactive materials disposed of in the burial grounds, to improve overall safety, to reduce the environmental impact of solid waste disposal activities, and to comply with changing requirements and regulations. For example:

- Starting in the 1950s, the economic recovery value of plutonium changed waste management practices for combustible materials and failed equipment. Waste boxes that contained more than 2 grams of plutonium were recycled using an incinerator and other reclamation processes to recover plutonium. This practice significantly reduced the amount of plutonium and plutonium-contaminated materials disposed in the burial grounds. The recovered plutonium was removed from the Hanford Site for storage elsewhere in the DOE complex.
- Large pieces of failed equipment that contained highly radioactive materials, previously disposed in the burial grounds, were diverted for storage in the underground tunnels at the PUREX canyon building. Disposition of this equipment will be addressed with the disposition of the PUREX canyon.
- Because of concern over potential health impacts of materials like plutonium, the Atomic Energy Commission (AEC) ordered that wastes containing concentrations of long-lived transuranic isotopes over a defined level, be placed in underground retrievable storage.

Starting in 1970, transuranic, or TRU, wastes were segregated from other solid wastes that came to be known as low-level wastes. In the late 1980s, the first of the storage buildings in the Central Waste Complex were constructed in the 200 West Area. At that time, burial of retrievably-stored TRU wastes was stopped in favor of above ground storage at the Central Waste Complex. For a few years,



Workers prepare to repackage a box of suspect transuranic waste from 200 West trench

containers of TRU wastes with radiation dose readings greater than 200 mrem/hour were buried in high integrity containers in underground retrievable storage for safety purposes. TRU wastes are currently being retrieved and processed in accordance with the schedule established in the M-091 milestone series of the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) for shipment to the Waste Isolation Pilot Plant near Carlsbad, New Mexico.

- By the early 1970s, increased attention was given to reducing the amount of radionuclides disposed in the environment. Most of the improvements were directed to improving the storage practices in the tank farms and in liquid wastes discharged to cribs and ponds. However, at this time it was decided that disposal of low-level solid wastes would be limited to the 200 Area burial grounds. The 200 Areas, located on the Central Plateau, are approximately 10 miles from the Columbia River and 200 to 300 feet above the groundwater. This provided more protection to the Columbia River and groundwater than the disposal facilities that were closer to the river and closer to the groundwater.
- In the late 1970s, radioactive waste disposal practices incorporated the concept of containment for waste handling and burial ground operations. The intent was to impose sufficient barriers between the waste, the workers handling the waste, and the environment to limit the potential internal exposure to the lowest practical level and minimize environmental exposure.

- While large bulk volumes of liquids were not disposed in the burial grounds, over the years small quantities of liquids were disposed in burial boxes and other containers. In the early 1980s, low-level liquid organic waste was banned from land disposal at the Hanford Site burial grounds and was segregated from other low-level wastes for storage on asphalt pads or in earthen trenches. This practice continued until below grade storage was terminated.
- In November of 1987, the chemical components of mixed waste became subject to RCRA regulations and the Washington State Dangerous Waste Regulations (Washington Administrative Code [WAC] 173-303). Since then mixed wastes are disposed in the RCRA/Dangerous Waste – permitted mixed waste trenches. At the same time, hazardous wastes banned from land disposal by RCRA were segregated.
- In 1989, certain RCRA, dangerous and mixed wastes and units became subject to the compliance schedules and plans of the TPA.
- In 2004, Hanford began disposing low-level waste in lined trenches.

**Where Are We Today?**

Operation of the Central Waste Complex and the RCRA-permitted low-level mixed waste trenches, as well as the retrieval and processing of retrievably stored TRU wastes are managed as part of DOE’s ongoing Waste Management program.

The legacy of the past practice low-level waste burial grounds are being addressed in accordance with the requirements of RCRA Corrective Action and CERCLA. For the Central Plateau, the 200-SW-2 (burial grounds) OU was formed to manage the cleanup of the past practice burial grounds in the Inner Area.

**Burial Grounds of the 200-SW-2 Operable Unit**

The scope of the 200-SW-2 OU includes 25 low-level waste landfills located in the Inner Area. There are 13 landfills in the 200 West Area and 12 landfills located in the 200 East Area (Figure 4).

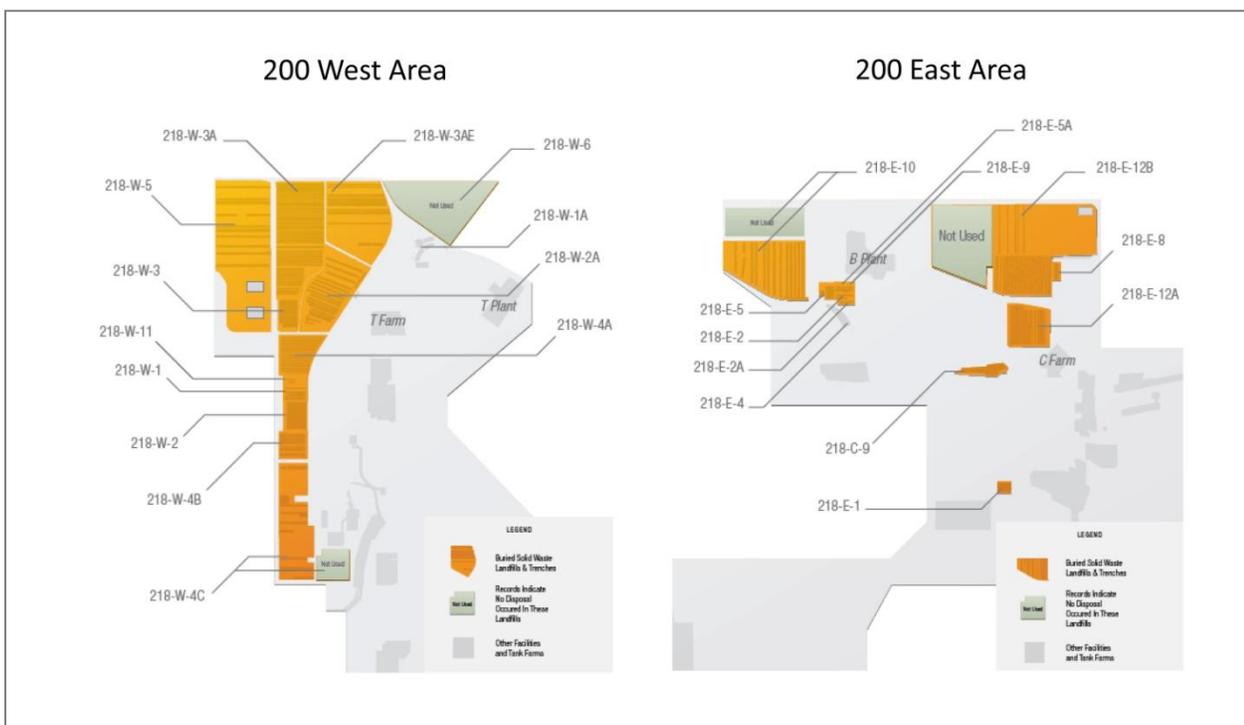


Figure 4. Radioactive Waste Landfills

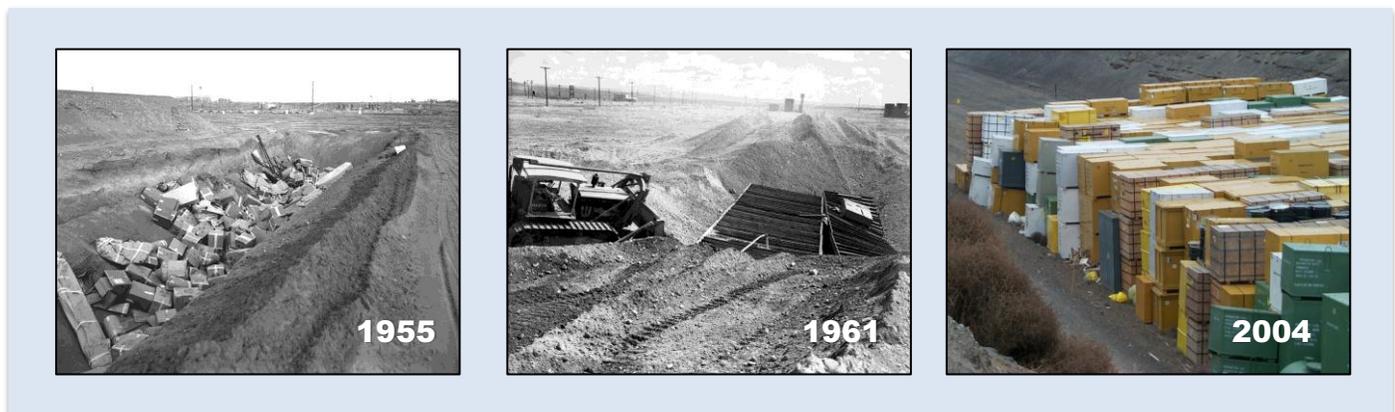
All burial grounds in the scope of the 200-SW-2 OU contain trenches that were engineered, designed and constructed to varying lengths, widths, and depths in accordance with the disposal requirements at the time. Disposal requirements evolved over the years as safety, engineering, and regulatory requirements changed. Certain landfills were dedicated to smaller waste items, while some landfills were dedicated to large/industrial equipment. Others received primarily construction- and/or demolition-related waste. Records indicate these landfills have collectively received approximately 450,000 m<sup>3</sup> (15.9 million ft<sup>3</sup>) of heterogeneous radioactive solid waste.



*All of the burial grounds are surrounded with markers to show their boundaries. These markers are made of concrete posts with a brass plate attached to the top. The brass plates are inscribed with the following message: "Buried Radioactivity-Do Not Excavate." A radiation symbol and the coordinates are also inscribed on the brass plate.*

None of the radioactive burial grounds associated with the 200-SW-2 OU are operating and the trenches have been backfilled and covered with soil. As noted previously, there were no known discharges of bulk liquids to the radioactive solid waste burial grounds. On-going groundwater monitoring around the burial grounds shows that the groundwater contamination in the region originates from the cribs, ponds, and ditches used for process wastes and liquid effluents. There is no indication that the burial grounds are contributing to the groundwater contamination.

Figure 5 shows pictures of burial trenches in the 200-SW-2 OU as disposal practices evolved through the years of operation and as they appeared in more recent years; all photos show the waste configuration prior to backfilling the trenches with soil.



**Figure 5.** Disposal Practices over the Years

For purposes of evaluating the burial grounds/landfills in the RCRA-CERCLA processes the burial grounds and landfills have been sorted into six main categories based on similar characteristics. Because of the number and size of the trenches within the landfills, each landfill may have areas that fit in more than one category. The six categories are:

- **Treatment Storage and Disposal (TSD) Unit Landfills** – The TSD Unit landfills contain 17 areas with mixed low-level waste that were disposed after the effective date of RCRA in 1987 but were not identified as mixed wastes until after disposal occurred. Eight of the new landfills are considered TSD Units and are included in the Low-Level Burial Grounds RCRA Permit Part A (DOE/RL-88-20). Of the

147,000 records pertaining to burial ground operations located to date, approximately 110,000 are related to these areas.

- **Industrial Landfills** – These landfills includes past-practice landfills that received radioactive waste that was usually packaged in large wooden or concrete boxes, containing large quantities of fission products. For the most part, these landfills were restricted to burial of large pieces of failed or obsolete equipment from the chemical processing facilities, although some items came from the 100 Areas. Many of these landfills contain burials made over 50 years ago. Historical burial documentation is good for the 218-W-2A and 218-E-5A Burial Grounds; however, historical burial documentation for the remaining sites (218-E-2, 218-E-5, 218-E-9, 218-W-1A, and 218-W-11 Burial Grounds) is limited.
- **Dry Waste Alpha Landfills** – These include past-practice landfills that received radioactive waste packaged primarily in fiberboard or small wooden boxes, wrapped in heavy brown paper or burlap, or placed in the trench without packaging. A small proportion of the waste is packaged in metal drums. All types of miscellaneous wastes, including contaminated soils and potentially contaminated rags, paper, wood, and small pieces of equipment such as tools, have been placed in these sites. Some larger equipment (e.g., motor vehicles, large canyon-processing equipment) is known to have been disposed to these sites. Historical documentation indicates that these four landfills contain at least 90 percent of the 200 Area pre-1970 alpha [radioactive materials that emit alpha radiation] landfill inventory. Historical documentation for the older landfills (the 218-W-1 and 218-W-2 Landfills) generally is poor, because these landfills received waste in the 1940s and 1950s. Historical documents for the two newer landfills in this grouping (the 218-W-3 and 218-W-4A burial grounds) are more numerous, because these landfills received waste in the mid-1950s to 1960s.
- **Dry Waste Landfills** – These landfills includes past-practice landfills that received radioactive waste packaged primarily in fiberboard or small wooden boxes, wrapped in heavy brown paper or burlap, or placed in the trench without packaging. A small proportion of the waste is packaged in metal drums. All types of miscellaneous wastes, including contaminated soils and potentially contaminated rags, paper, and wood have been placed in these sites. These also contain a few pieces of large equipment such as tank farm pumps. Historical documentation for these sites generally is poor.
- **Construction Landfills** – This includes past-practice landfills that mainly were limited to burial of wastes resulting from construction work on existing facilities or demolition of surplus facilities. Wastes are believed to contain very little radioactive contamination. Documentation for the 218-C-9 burial ground is believed to be nearly complete; however, historical documents for the 218-E-8 and 218-E-4 burial grounds are limited.
- **Caissons** – Caisson are special metal or concrete disposal structures that were installed in 218-W-4A and 218-W-4B burial grounds to receive waste and serve as an additional disposal container for wastes that required additional protection or shielding because of the radioactive material content. The term caisson also applies to metal or concrete structures called “vertical pipe units” used for disposal of hot-cell waste or high plutonium concentration waste. Documentation for the caissons in the 218-W-4A burial ground generally is limited, while the documentation for the caissons in the 218-W-4B burial ground generally is better.

As part of the RCRA-CERCLA RFI/CMS & RI/FS processes, historic records and documents have been assembled and reviewed on these landfills. The quantity and quality of burial records and/or relevant historical information varies greatly. Information generally is sparse for the earlier years and more substantive for waste buried after the late 1960s. About 60 percent of the waste buried in these landfills was from the Hanford Site 200 Areas processing facilities; some waste came from the 100 and 300 Areas, and a smaller fraction came from other Hanford Site areas and from various offsite generators. The waste form, waste packaging, and in-trench waste emplacement varied over time. Waste forms typically consisted of paper, plastic, rubber, wood,

glass, dirt, metal, and other types of approved waste. The typical containers used for disposal of low-level waste were metal drums and boxes made of wood, concrete, metal, and fiber-reinforced plastic. Drums and boxes in various sizes held the waste items, with some waste wrapped in plastic. Large-package low-level waste shipments were received periodically at the low-level burial grounds. These packages included items such as intact rail cars, tanker trucks, cover blocks, cranes, and failed equipment.



*In 1964, this load of solid waste (above) was emptied from a burial box to a trench in the 200 West Area.*



*Burial of solid waste in central Hanford as photographed in 1973.*

Summary information on the 200-SW-2 landfills is presented below in Table 1.

**Table X. Summary Information for the 200-SW-2 Operable Unit Landfills.**

Landfill	Number of Trenches	Average Length of Trenches		Volume <sup>a</sup> of Buried Waste		Area <sup>a</sup>		Landfill Categories
		m	ft	m <sup>3</sup>	ft <sup>3</sup>	m <sup>2</sup>	ac	
<b>200 East Landfills</b>								
218-C-9	1	0	0	7,573	267,421	18,100	5	Construction
218-E-1	15	107	350	3,030	106,999	9,600	2	Dry Waste
218-E-2	8	200	660	9,033	318,996	20,500	5	Industrial
218-E-2A	1	160	530	--	--	4,440	1	Industrial
218-E-4	0	--	--	1,586	55,999	13,810	3	Construction
218-E-5	2	80	260	3,172	112,018	10,900	3	Industrial
218-E-5A	1	0	0	6,173	218,000	4,440	1	Industrial
218-E-8	1	160	530	2,265	79,999	4,440	1	Construction
218-E-9	0	--	--	--	--	--	--	Industrial
218-E-10 <sup>b</sup>	14	345	1,100	26,900	646,964	226,600	56	TSD Unit
218-E-12A	28	290	940	15,400	543,845	121,300	30	Dry Waste
218-E-12B <sup>b</sup>	39	290	940	65,086	2,298,453	303,500	75	TSD Unit
<b>Total 200 E</b>	<b>110</b>			<b>140,218</b>	<b>4,648,694</b>	<b>737,800</b>	<b>182</b>	
<b>200 West Landfills</b>								
218-W-1	15	107	350	7,164	252,997	33,100	8	Dry Waste Alpha
218-W-11	2	80	260	1,160	40,949	14,200	4	Industrial
218-W-1A	12	40	130	13,700	483,810	48,600	12	Industrial
218-W-2	20	160	530	8,240	290,996	34,400	9	Dry Waste Alpha
218-W-2A	27	180	590	26,000	918,181	164,700	41	Industrial
218-W-3	20	160	530	12,400	437,901	39,500	10	Dry Waste Alpha
218-W-3A <sup>b</sup>	61	240	780	97,528	3,444,086	219,200	54	TSD Unit
218-W-3AE <sup>b</sup>	8	400	1,300	34,240	1,209,150	229,100	57	TSD Unit
218-W-4A	30	160	530	16,886	596,323	72,800	18	TSD Unit, Dry Waste Alpha w/ Caissons
218-W-4B <sup>b</sup>	27	120	390	7,213	254,724	40,700	10	TSD Unit, w/Caissons
218-W-4C <sup>b</sup>	16	200	660	15,211	537,174	184,900	46	TSD Unit
218-W-5	13	250	810	70,961	2,505,908	385,600	94	TSD Unit
218-W-6 <sup>b</sup>	--	--	--	d	d			d
<b>Total 200 W</b>	<b>251</b>			<b>310,703</b>	<b>10,972,199</b>	<b>1,466,200</b>	<b>363</b>	
<b>Total E &amp; W</b>	<b>361</b>			<b>450,921</b>	<b>15,620,893</b>	<b>2,204,000</b>	<b>545</b>	

<sup>a</sup> All numbers are estimates based on historical information and include only the used portions of the landfills.

<sup>b</sup> Landfill contains a small area that is a permitted treatment, storage, and/or disposal unit landfill under the *Resource Conservation and Recovery Act of 1976*.

<sup>c</sup> Recent geophysical investigations suggest that there is only one trench.

<sup>d</sup> The 218-W-6 Burial Ground has not received waste. Pending Tri-Party Agreement change package C-09-07 transfers the 218-W-6 Burial Ground to the 200-OA-1 (Outer Area) Operable Unit.

## What's Next?

Over the past several years a large body of historic process information has been collected on the design, construction and operation of the burial grounds to support the on-going work associated with the RFI/CMS & RI/FS processes for 200-SW-2. In addition, field investigations and on-going groundwater monitoring provides new information.

The next step in the cleanup process is to review this compilation of information and revise the existing RI/FS work plan to identify if there are additional data needed to complete the remedial alternative evaluations. Because landfills are considered disposal sites, they are assessed to determine if there has been or is potential for a release that will pose an unacceptable risk to human health and the environment. It is recognized by their very nature that these landfills contain radioactively contaminated materials. A secondary interest is whether these radioactively and chemical contaminants pose a risk that is significant to consider whether they should be exhumed and relocated to another landfill.

Preparation of the revised work plan and the evaluation documents will be a collaborative effort between DOE and the lead regulatory agency, Ecology. The revised work plan will be submitted to Ecology for review in 2011 (proposed TPA milestone M-015-93A). The RFI/CMS & RI/FS report and proposed corrective action decision and proposed plan will be submitted to Ecology in 2016 to meet the proposed TPA milestone M-015-93B.



Workers prepare to disassemble boxes from Hanford trenches at a simulation test site. This allows workers to test tools and become familiar with the overall processes before performing the actual work.

We are early in the cleanup process for the 200-SW-2 Operable Unit. There will be several opportunities for public input and information exchange through public meetings and workshops. Ultimately, the proposed plan will be provided for public review before the Tri-Party agencies select final remedies for the burial grounds.

# Frequently Asked Questions about Hanford's Radioactive Solid Waste Burial Grounds



## Introduction

Many people want to know more about Hanford's radioactive solid waste burial grounds. Here are some answers to questions about the burial grounds in the 200-SW-2 Operable Unit.

### **Q: Where on the Hanford Site are the solid waste landfills?**

A: The burial grounds are in 200 East and 200 West Areas, near the center of the Hanford Site.

### **Q: Burial Grounds or Landfills – Which are they?**

A: The terms are interchangeable in the documents that address them—the 200-SW-1 Nonradioactive Landfills Group and 200-SW-2 Radioactive Landfills Group Operable Units Remedial Investigation/Feasibility Study Work Plans.

Appendix A to the Tri-Party Action Plan defines Burial Ground as: a land area specifically designated to receive contaminated waste packages and equipment, usually in trenches covered with overburden.

The Resource Conservation and Recovery Act of 1976 (RCRA) defines a variety of land disposal units including landfills. Landfills are excavated or engineered sites where non-liquid hazardous waste is deposited for final disposal and covered. New landfills are selected and designed to minimize the chance of release of hazardous waste into the environment. Today's design standards for hazardous waste landfills require a double liner; double leachate collection and removal systems; leak detection system; run on, runoff, and wind dispersal controls; construction quality assurance program. RCRA does not allow disposal of liquid wastes in a hazardous waste landfill. The mixed low-level waste is treated to meet RCRA requirements prior to disposal. RCRA does not regulate radioactive solid waste.

### **Q: Are any of the 200-SW-2 radioactive landfills (burial grounds) still in operation?**

A: No, none of the landfills included in 200-SW-2 are operating. The last disposal in a landfill occurred in 2004. All trenches have been backfilled and the waste covered. These facilities continue to be monitored.

### **Q: How many trenches are there in the radioactive landfills? How large are the trenches?**

A: There are about 360 trenches. The depth of the trenches varies, generally ranging from 15 to 25 feet. Trench lengths also vary. Table 1 shows the number of trenches in each landfill. It also shows the total linear length of the trenches, and the area of each landfill.

Summary information on the 200-SW-2 landfills is presented in table below.

**Q: Were any of the radioactive landfills lined?**

**A: No.** Lining of landfills was only required for new hazardous waste landfills since the passage of the RCRA.

**Table X. Summary Information for the 200-SW-2 Operable Unit Landfills.**

Landfill	Number of Trenches	Average Length of Trenches		Volume <sup>a</sup> of Buried Waste		Area <sup>a</sup>		Landfill Categories
		m	ft	m <sup>3</sup>	ft <sup>3</sup>	m <sup>2</sup>	ac	
<i>200 East Landfills</i>								
218-C-9	1	0	0	7,573	267,421	18,100	5	Construction
218-E-1	15	107	350	3,030	106,999	9,600	2	Dry Waste
218-E-2	8	200	660	9,033	318,996	20,500	5	Industrial
218-E-2A	1	160	530	--	--	4,440	1	Industrial
218-E-4	0	--	--	1,586	55,999	13,810	3	Construction
218-E-5	2	80	260	3,172	112,018	10,900	3	Industrial
218-E-5A	1	0	0	6,173	218,000	4,440	1	Industrial
218-E-8	1	160	530	2,265	79,999	4,440	1	Construction
218-E-9	0	--	--	--	--	--	--	Industrial
218-E-10 <sup>b</sup>	14	345	1,100	26,900	646,964	226,600	56	TSD Unit
218-E-12A	28	290	940	15,400	543,845	121,300	30	Dry Waste
218-E-12B <sup>b</sup>	39	290	940	65,086	2,298,453	303,500	75	TSD Unit
<b>Total 200 E</b>	<b>110</b>			<b>140,218</b>	<b>4,648,694</b>	<b>737,800</b>	<b>182</b>	
<i>200 West Landfills</i>								
218-W-1	15	107	350	7,164	252,997	33,100	8	Dry Waste Alpha
218-W-11	2	80	260	1,160	40,949	14,200	4	Industrial
218-W-1A	12	40	130	13,700	483,810	48,600	12	Industrial
218-W-2	20	160	530	8,240	290,996	34,400	9	Dry Waste Alpha
218-W-2A	27	180	590	26,000	918,181	164,700	41	Industrial
218-W-3	20	160	530	12,400	437,901	39,500	10	Dry Waste Alpha
218-W-3A <sup>b</sup>	61	240	780	97,528	3,444,086	219,200	54	TSD Unit
218-W-3AE <sup>b</sup>	8	400	1,300	34,240	1,209,150	229,100	57	TSD Unit
218-W-4A	30	160	530	16,886	596,323	72,800	18	TSD Unit, Dry Waste Alpha w/ Caissons
218-W-4B <sup>b</sup>	27	120	390	7,213	254,724	40,700	10	TSD Unit, w/Caissons
218-W-4C <sup>b</sup>	16	200	660	15,211	537,174	184,900	46	TSD Unit
218-W-5	13	250	810	70,961	2,505,908	385,600	94	TSD Unit
218-W-6 <sup>b</sup>	--	--	--	d	d			d
<b>Total 200 W</b>	<b>251</b>			<b>310,703</b>	<b>10,972,199</b>	<b>1,466,200</b>	<b>363</b>	
<b>Total E &amp; W</b>	<b>361</b>			<b>450,921</b>	<b>15,620,893</b>	<b>2,204,000</b>	<b>545</b>	

<sup>a</sup> All numbers are estimates based on historical information and include only the used portions of the landfills.

<sup>b</sup> Landfill contains a small area that is a permitted treatment, storage, and/or disposal unit landfill under the *Resource Conservation and Recovery Act of 1976*.

<sup>c</sup> Recent geophysical investigations suggest that there is only one trench.

<sup>d</sup> The 218-W-6 Burial Ground has not received waste. Pending Tri-Party Agreement change package C-09-07 transfers the 218-W-6 Burial Ground to the 200-OA-1 (Outer Area) Operable Unit.

These requirements do not apply to radioactive solid waste. However, some of the solid waste was placed in enclosed containment structures. Some of these containment structures were constructed of steel, concrete, and wood. Some trenches had asphalt pads and others utilized concrete boxes that were placed in the trenches and then sealed when full and then covered with soil. Structures served to protect workers during shipment and placement of the radioactive solid waste prior to being buried.

**Q: What kinds of waste are in the radioactive landfills?**

**A:** Most waste came from operations in 200 East and 200 West Area. Some came from Hanford’s 100 and 300 Areas and from offsite sources before 2006. (Since 2006, a moratorium has prevented most offsite waste from coming to Hanford for disposal).

We have sorted the burial grounds or landfills<sup>1</sup> into six main categories based on similar characteristics. Each landfill may have areas that fit in more than one category. The six categories are:

**Treatment Storage and Disposal (TSD) Unit Landfills** – The TSD Unit radioactive landfills contain 17 areas with mixed low-level waste that were disposed after the effective date of RCRA in 1987 but were not identified as mixed wastes until after disposal occurred. Eight of the newer landfills are considered TSD Units and are included in the Low-Level Burial Grounds Part A Permit (DOE/RL-88-20). Of the 147,000 records pertaining to burial ground operations located to date, approximately 110,000 are related to these areas.

**Industrial Landfills** – These landfills includes past-practice (use ended in 1987) landfills that received radioactive waste that was usually packaged in large wooden or concrete boxes, containing large quantities of fission products. These landfills were mostly restricted to burial of large pieces of failed or obsolete equipment from the chemical processing facilities. Some items came from the 100 Areas.

Much of the waste in these landfills was buried more than 50 years ago. Historical burial records are good for the 218-W-2A and 218-E-5A Landfills; however, historical landfill records for the other sites (218-E-2, 218-E-5, 218-E-9, 218-W-1A, and 218-W-11 Landfills) are limited.

**Dry Waste Alpha Landfills** – These landfills received radioactive waste packaged mostly in cardboard or small wooden boxes, wrapped in heavy brown paper or burlap, or placed in the trench without packaging. Some of the waste is packaged in metal drums.

The waste in these landfills were of various sorts, including contaminated soils and contaminated rags, paper, wood, and small pieces of equipment such as tools. We know that some larger equipment (e.g., motor vehicles, large canyon-processing equipment) are also in these

landfills. Records show these sites have at least 90 percent of the 200 Areas landfill pre-1970 alpha [radioactive materials that emit alpha radiation] inventory. Records for the older landfills (the 218-W-1 and 218-W-2 Landfills) generally are poor, because these landfills received waste in the 1940s and 1950s. Records for the newer landfills (the 218-W-3 and 218-W-4A Landfills) are more numerous, because these landfills received waste in the mid-1950s to 1960s.

**Dry Waste Landfills** – These landfills received radioactive waste packaged primarily in cardboard or small wooden boxes, wrapped in heavy brown paper or burlap, or placed in the trench without packaging. A small proportion of the waste is in metal drums. All types of miscellaneous wastes, including contaminated soils and contaminated rags, paper, and wood have been buried here. These also contain a few pieces of large equipment such as tank farm pumps. Records for these sites generally are poor.

**Construction Landfills** – These landfills hold construction waste, which probably does not have much contamination. Construction waste is 2% of the solid waste volume in this operable unit. We believe records for the 218-C-9 Landfill are nearly complete; but records for the 218-E-8 and 218-E-4 Landfills are limited.

**Caissons** – A few landfills have caissons, which are vertical pipes made of metal or concrete for disposal and shielding for wastes with high concentrations of radioactivity. Caissons are in 218-W-4A and 281-W-4B Landfills. Records for the caissons in the 218-W-4A Landfill are limited, while records for the caissons in the 218-W-4B Landfill are better.

The waste form, waste packaging, and in-trench waste emplacement varied over time. Waste forms typically consisted of paper, plastic, rubber, wood, glass, dirt, metal, and other types of waste. The typical containers used for disposal of low-level waste were metal drums and boxes made of wood, concrete, metal, and fiber-reinforced plastic. Drums and boxes in various sizes held the waste items, with some waste wrapped in plastic.

Some of the waste items were very large. These packages included items such as intact rail cars, tanker trucks, cover blocks, cranes, and failed equipment. Certain landfills were dedicated to smaller waste items, while some landfills were dedicated to large/industrial equipment. Others received primarily construction or demolition-related waste. Records indicate these landfills have collectively received approximately 450,000 m<sup>3</sup> (15.6 million ft<sup>3</sup>) of heterogeneous radioactive solid waste.

**Q: What do we know about the depth of soil over the landfills?**

**A:** Initially there was a requirement to place a minimum of two feet of soil cover. For certain waste types, the requirements called for up to 8 feet of soil cover. The trenches ranged in depth from 15 to 25 feet below the ground surface. In addition to the top cover, a significant volume of backfill material was placed around the sides of the disposed of solid waste and associated containers to fill the trench to grade.

**Q: What burial information was kept on the landfills? What level of confidence do you have about the completeness of this information?**

**A:** So far, more than 100,000 separate burial actions have been documented with information on the waste generator, container type, volume, landfill, trench number and trench location. The quantity and quality of burial information from the earlier years of operations were low-to absent, but improved with time. Some landfills have a large amount of burial information while others have very little information. Engineering drawings exist for all landfills. These drawings identify locations of trenches and cross-sections of the individual trenches. Additional discussion and details on specific burial information is provided in the DOE/RL-2004-60, Rev 0.

**Q: During what years were they used?**

**A:** Not all of the landfills operated at the same time. Waste went to the landfills starting in 1944, during the Manhattan Project. The last disposal in a landfill was in 2004. The operating periods of individual landfills varied. Workers designed and built new landfills as needed

**Q: What other past practices went on where these landfills are currently located?**

**A:** Portions of two landfills (218-C-9, and 218-W-3AE) were previously used as cooling water ponds. The dried pond at 218-C-9 was covered with a layer of washed gravel, and material from the deactivation and demolition material of the Hot Semiworks Plant was disposed. The 218-C-9 site has been categorized as a construction landfill and was used for disposal of demolition debris. Portions of the land in the 218-W-3AE landfill were previously used as the 216-T-4 seep pond that was used for T Plant condensate effluent.

**Q: How are the landfills labeled?**



*All of the burial grounds are surrounded with markers to show their boundaries. These markers are made of concrete posts with a brass plate attached to the top. The brass plates are inscribed with the following message: "Buried Radioactivity-Do Not Excavate." A radiation symbol and the coordinates are also inscribed on the brass plate.*

**A:** All of the landfills are surrounded with markers to show their boundaries. These markers are made of concrete posts with a brass plate attached to the top. The brass plates are inscribed with the following message: "Buried Radioactivity-Do Not Excavate." A radiation symbol and the coordinates are also inscribed on the brass plate.

**Q: Has there been any confirmation of the contents and locations of the landfills?**

A. Yes. Old records give some indication of the contents buried in the landfills. As part of the development of the revised work plan, we will use historical records as well as more recent field investigations and groundwater monitoring to determine if there have been any releases from any of the landfills. Part of this evaluation will also assess if we need more field investigations. Workers have done surface geophysical investigations (e.g., ground-penetrating radar) on all of the pre-1970 landfills to determine the trench locations, depths to top of waste, and to find metallic or magnetic signatures of the waste materials. This information also serves as an aid to verify locations of specific burials.

**Q: What is meant by "pre-70" waste? Why is waste stored after 1970 handled differently?**

**A:** In 1970, the Atomic Energy Commission issued a directive that transuranic isotopes would be segregated by type and labeled, and placed in retrievable storage. Before May 1970, the isotopes were disposed along with other low-level radioactive solid waste. This gave rise to the terms "pre-1970" and "non-segregated waste."

**Q: Were different parts of the landfills used for different waste streams? Are there different types of waste in different parts of the landfills, or is the waste pretty well mixed throughout?**

**A:** Various landfills were used for different types of waste. The composition of the waste in the landfills is related to the processes in place during the operational period of the landfill. Consequently, a mixture of wastes was placed within them. Construction landfills were typically used for building construction and demolition debris. Industrial landfills were typically used for the disposal of larger, contaminated waste processing equipment. Certain landfills received the majority of the plutonium contaminated waste. Other landfills receive a variety of low-level and non-segregated radioactive waste. Caissons also were used in several trenches for disposal of hot cell and alpha-contaminated waste which will be retrieved as part of TPA milestone M-091. Further information on the landfill types and usage can be found in the RI/FS Work Plan (DOE/RL-2004-60, Rev 0).

**Q: Are there old documents that show "unusual events" that can be correlated to material placement in specific areas of the landfills?**

**A:** Yes. We have documents that report a number of unusual events in the landfills. These documents often provide unique information about the waste characteristics and the location of waste. The history of the 200 Area Burial Ground Facilities (WHC-EP-0912) discusses 54 unusual events between 1949 and 1994. The events were associated with preparing material for disposal, transporting the waste and disposing of the waste.

**Q: Was there any waste stream disposed of in the radioactive landfills that regulatory requirements will mandate retrieval of that waste?**

**A:** The 200-SW-2 OU landfills contain radioactive solid waste that does not require retrieval as mandated by Atomic Energy Commission (AEC) directives. However, there have been limited disposals of radioactive and

chemical mixed waste in portions of the radioactive landfills. Both the RCRA permitting process and the RFI/CMS & RI/FS evaluations of these landfills will consider whether or not this radioactive mixed waste should be retrieved.

**Q: How is groundwater (and/or the deep vadose zone) being monitored under the landfills?**

**A:** Groundwater monitoring is being conducted for the entire Hanford Site. Results are reported on an annual basis and can be found at the following locations: [www.hanford.gov/rl/uploadfiles/GWRep09/start.htm](http://www.hanford.gov/rl/uploadfiles/GWRep09/start.htm)

**Q: Have there been any large releases of chemicals or radioactive materials that were detected through groundwater monitoring?**

**A:** No, groundwater monitoring to date has not indicated that the landfills are contributing to groundwater contamination. The large planned and unplanned liquid discharges to cribs, ponds, and ditches and unplanned releases from pipelines and tanks caused the extensive groundwater contamination on the Central Plateau.

**Q: What is the deep vadose zone and how far down is it under the landfills?**

**A:** The vadose zone is the area between the ground surface and the water table. The deep vadose zone is the part that is below the depth that soil can be practicably and economically dug up (45-60 feet below ground surface is rule of thumb for maximum depth of practical excavation).

**Q: Is contamination reaching the deep vadose zone now and could any contamination reach it?**

**A:** No data show that the deep vadose zone has received any releases from the landfills. Limited field investigation at the 218-W-4C showed carbon tetrachloride soil vapors down to depths of 30 feet; however, the actual source (e.g., landfills or neighboring liquid disposal sites) of carbon tetrachloride has yet to be determined. One of the objectives of the revised work plan is to collect more information to confirm or refute our understanding of the depth of contamination.

**Q: How far down is the groundwater under the landfills?**

**A:** Groundwater is approximately 250 feet below the ground surface of the burial grounds.

**Q: What is the current extent of contaminant migration out of these trenches/landfills and what are the contaminants of concern?**

**A:** No contamination has been confirmed other than carbon tetrachloride to a depth of 30 feet at the 218-W-4C landfill. Contaminants of concern will be defined as part of the RCRA-CERCLA process.

**Q: How are the radioactive solid waste landfills regulated?**

**A:** Several regulations apply. The radioactive landfills have been designated as the 200-SW-2 OU. They are part of the OUs to be remediated under the TPA, and regulated under Washington's Hazardous Waste Management Act (a federally-authorized program with regulations equivalent to RCRA) and CERCLA. Some

of the radioactive landfills contain inadvertently disposed of RCRA and dangerous wastes. DOE Order 435.1, Radioactive Waste Management requires a “disposal authorization statement” to authorize or continue operation of low-level waste disposal facilities. This authorization was granted October 25, 1999.

**Q: What are some options being considered for remediation?**

**A:** The RCRA-CERCLA RFI/CMS & RI/FS process requires that the Feasibility Study develop a range of remediation alternatives that provides the decision-makers sufficient information to compare alternatives against one another and select a remedy for the site. The 200-SW-2 OU Feasibility Study will evaluate a range of alternatives and include:

- No Action
- Alternatives that would reduce the need for long-term management. Generally, alternatives that address long-term management include:
  - Total excavation, treatment (as necessary) and disposal of waste either on or offsite. Typically referred to as RTD (Remove, Treat, and Dispose), or
  - Limited excavation, treatment (as necessary) and disposal of discrete areas
- Alternatives that use treatment as a primary component to reduce toxicity, mobility or volume of the waste
  - In-situ or ex-situ treatment of the waste (e.g., in-situ vitrification or grouting, solidification, stabilization, thermal, or fixation)
- Alternatives that would involve in-place containment of waste with little or no treatment but protect human health and the environment by preventing potential exposure and/or reducing the mobility of contaminants and minimizing infiltration of water
  - Capping – clay, synthetic membranes, multi-layers, etc.
  - Vertical or horizontal barriers
  - Other surface controls
- Alternatives that consist of some combination of the above

**Q: What is the plan from this point forward?**

**A:** Between now and the end of 2011, we will develop a revised work plan for the 200-SW-2 Operable Unit. This revision is described in proposed TPA milestone M-015-93A. The plan will address how we will integrate RCRA and CERCLA requirements. We will also see if we need more data to support to support a final decision.

Because landfills are considered a disposal site, the aim of the assessment is to determine if there has been or there could be a release from them that will pose an unacceptable risk to human health and the environment. By their very nature, these landfills contain radioactive contaminated material. A secondary interest is whether these radioactively contaminated materials pose a significant risk, and whether they should be exhumed and relocated to another landfill.

A revised work plan is due in 2011, and the RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) & Remedial Investigation and Feasibility Study (RI/FS), with the proposed corrective action decision and proposed plan for cleanup, is due in 2016. The RFI/CMS & RI/FS will have public comment before it is final.

**Q: How can we get more information?**

**A:** The documents mentioned in this FAQ are available to you. You can hyperlink to them if you are reading this online. ([www.hanford.gov](http://www.hanford.gov), or [www.ecy.wa.gov/programs/nwp](http://www.ecy.wa.gov/programs/nwp)) We will be scheduling future public meetings. If there are specific topics about the landfills that you would like to be addressed, please call the Hanford Cleanup Line at 800-321-2008.

The TPA agencies have scheduled regional public meetings to provide a forum to provide information on the 200-SW-2 OU and gain insight on stakeholder interests through informal feedback and discussions. The TPA agencies will consider input received as they revise the 200-SW-2 RI/FS Work Plan in 2011. The proposed TPA milestone for this area requires the DOE to submit a proposed cleanup plan in 2016, and the TPA agencies will seek public comment on the proposed plan prior to making final remedy decisions.

**REGIONAL PUBLIC MEETINGS**

<p>October 18, 2010                  Best Western Hotel                  1108 E. Marina Way                  Hood River, Oregon</p> <p>6:00 – 7:00 p.m. – Poster Session                  7:00 – 9:00 p.m. – Meeting</p>	<p>October 20, 2010                  Red Lion Hotel Portland –                  Convention Center                  1021 NE Grand Avenue                  Portland, Oregon</p> <p>6:00 – 7:00 p.m. – Poster Session                  7:00 – 9:00 p.m. – Meeting</p>	<p>October 26, 2010                  University Heights Center                  5031 University Way Northeast                  Seattle, Washington</p> <p>6:00 – 7:00 p.m. – Poster Session                  7:00 – 9:00 p.m. – Meeting</p>
--	--	---

The DOE/RL-2004-60, Rev. 0 200-SW-1 Nonradioactive Landfills Group and 200-SW-2 Radioactive Landfills Group Operable Units Remedial Investigation/Feasibility Study Work Plan is available in the Administrative Record for 200-SW-2.

**Administrative Record and Public Information Repository**  
**Address:** 2440 Stevens Center Place, Room 1101, Richland, WA 99352  
**Phone:** 509-376-2530  
**Website Address:** <http://www2.hanford.gov/arpir/>