Environmental restoration and waste management activities continued on the Hanford Site during 2014. The following sections describe ongoing Hanford Site River Corridor closure, cleanup, remediation, facility decommissioning, waste management operations, underground waste storage tank status, construction of the WTP and its associated facilities, and research activities related to waste cleanup.

### 5.1 Cleanup and Remediation Activities

The following sections describe ongoing cleanup and remediation activities at the Hanford Site.

#### 5.1.1 River Corridor Closure

*JA Lerch*

The 220-square-mile River Corridor includes the Hanford Site 100 Area and 300 Area, which border the Columbia River. The River Corridor includes nine deactivated plutonium-production reactors, numerous support facilities, and liquid- and solid-waste disposal sites. DOE’s focus is to complete source cleanup actions in the 100 and 300 Areas with the following principal goals:

- Deactivate, decontaminate, decommission, and demolish excess facilities
- Place former production reactors in an interim safe and stable condition
- Remediate liquid- and solid-waste disposal sites
- Meet all regulatory requirements
- Determine the adequacy of the current cleanup criteria in protecting human health and the environment
- Prepare the River Corridor for transition to the DOE-RL long-term stewardship program (surveillance and maintenance).

The Tri-Party Agencies agreed in 1991 to a strategy to apply available funding to actual cleanup rather than spending available resources on extensive characterization and risk assessment activities. Waste site cleanup under interim action RODs were initiated in the 100 and 300 Areas during the mid-1990s and continue today within the River Corridor. As the interim actions are completed, associated geographical areas are transitioned into the RL long-term stewardship program. Through 2014, transitions have been completed for 153 of the 220 square miles of the River Corridor.

In parallel with continued cleanup activities, the remedial investigation/feasibility study (RI/FS) process is being implemented for six decision areas of the River Corridor (100-B/C, 100-K, 100-N, 100-D/H, 100-F/IU-2/IU-6, and 300 Area) to integrate the interim actions and establish final cleanup decisions for source and groundwater operable units. Final action RODs were issued in November 2013 ([DOE/EPA/Ecology 2013](DOE/EPA/Ecology 2013)) for the 300 decision area and in September 2014 ([DOE/EPA 2014](DOE/EPA 2014)) for the 100-F/IU-2/IU-6 decision area. Completion of RI/FS reports, public review of proposed actions, and development of RODs for the remaining four decision areas are anticipated to be complete between 2015 and 2017.

#### 5.1.2 100 Area

This section describes ongoing cleanup and remediation activities in the 100 Area.
5.1.2.1 100-B/C, 100-D, 100-F, 100-K, 100-H, and 100-N Areas Waste Sites

DG Saueressig

The 100 Area waste sites vary in complexity and waste type. Typical waste sites include waste burial grounds, liquid effluent waste sites, burn pits, retired septic systems, piping systems, and miscellaneous waste sites. Full-scale remediation of waste sites in the 100 Areas began in 1996 with the primary focus on waste sites receiving liquid waste because those sites generally contained significant quantities of contaminants and served as potential sources for groundwater contamination. In 2014 the 100 Area remediation activities were completed for 100-B/C, 100-D, 100-H, 100-N, and IU-2/6 Areas. Remediation activities focused on hexavalent chromium release sites, pipeline sites and miscellaneous waste sites. Due to the high mobility associated with past hexavalent chromium releases, excavation to groundwater is often necessary to ensure complete remediation of these sites.

Miscellaneous waste sites vary in the nature and extent of contamination and are generally smaller-size areas when compared to hexavalent chromium release sites. Sampling requirements for determining if a miscellaneous waste site requires cleanup or complies with post-cleanup goals can vary significantly from one waste site to another. The interim action RODs for 100 Area waste sites and the Action Memorandum for General Hanford Site Decommissioning Activities (DOE/RL-2010-22) authorize remediation activities. Waste generated from the cleanup of waste sites is disposed at ERDF in the 200 Area. This centralized disposal facility is the primary disposal pathway, but other disposal options are available if the material does not meet the waste acceptance criteria for the facility.

A total of 884,500 tons (802,400 metric tons) of contaminated soil and debris from 100 Area remediation activities were disposed at ERDF in 2014. Quantities and respective locations are as follows:

- 117,500 tons (106,600 metric tons) from the 100-B/C Area
- 478,300 tons (433,900 metric tons) from the 100-D Area
- 206,500 tons (187,300 metric tons) from 100-H Area
- 53,200 tons (48,300 metric tons) from the 100-N Area
- 24,500 tons (22,200 metric tons) from the IU-2/6 Area
- 4,500 tons (4,100 metric tons) for miscellaneous restoration activities in the 100 Areas.

5.1.2.2 100-K Basins

BM Barnes and JW McKibben

The 100-K Area remediation activities included facility demolition, waste site remediation, cleanout of the 100-K West Basin, and groundwater pump-and-treat operations. The K West Basin is the only remaining operating nuclear facility. The K West Basin is undergoing cleanout that involves removing radioactive contaminated sludge and debris as a precursor to facility deactivation and demolition. For nearly 30 years, the basins stored 2,300 tons (2,100 metric tons) of N Reactor spent fuel and a small quantity of slightly irradiated single-pass reactor fuel from other Hanford Site reactors. In October 2004, the major cleanup effort to remove the fuel from the K East and K West Basins was completed.

This fuel corroded during storage and the fuel washing and packaging process left behind approximately 989 cubic feet (28 cubic meters) of sludge. The sludge is currently stored in underwater containers in the K West Basin for subsequent removal and disposition. The project’s CERCLA remedial design documentation will describe the means of sludge treatment and location of the national repository for sludge disposal. The sludge for subsequent removal and disposition includes the K West Basin knock-out-
pot sludge, K West Basin settler tube sludge, and K East Basin floor and pit sludge. The K West Basin fuel cleaning system transferred sludge generated from the cleaning of fuel to either knock-out-pots or settler tanks. Knock-out-pots collect particles greater than 0.02 inch (500 microns) in size by using either a downstream strainer or an internal screen. Settler tanks, a series of horizontal tubes downstream of the knock-out-pots, allow particles less than 0.02 inch (500 microns) to settle and not be recirculated. The basin floor and pit sludge is a non-homogenous mixture of debris that includes windblown sand and environmental particulates; concrete fragments from the basin walls; corrosion products from fuel canisters and fuel racks; fuel cladding pieces; tiny pieces of corroded uranium (uranium oxides, hydrates, and hydrides); ion-exchange resin beads; PCBs; and fission products. Sludge has been defined as any material that is less than or equal to 0.25 inch (0.64 centimeter) in size.

5.1.2.2.1 100-K Area Remediation Progress and Accomplishments (2014)

○ Continued 105-KE Reactor Building interim safe storage activities, engineering for reactor penetration sealing and the safe storage enclosure
○ Continued construction activities on the 100-K Annex in support of sludge removal operations.
○ Continued groundwater pump-and-treat operations
○ Continued testing systems and components to be used to remove K Basins sludge at the Maintenance and Storage Facility located in the 400 Area prior to deployment to the K West Basin and its radiological environment.

5.1.2.2 K Basins Progress on Defense Nuclear Facilities Safety Board Recommendations

RA Quintero

In a letter dated April 23, 2014 (DNFSB 2014a), to the DOE-RL manager, Board Closes the Remaining Issue Concerning the Preliminary Design and Safety Basis for Phase I of the Sludge Treatment Project (STP) Richland Operations Office (RL), the Defense Nuclear Facilities Safety Board (DNFSB) closed the Hanford Site, K-Basin Closure Sludge Treatment Project, a previously identified issue concerning safety instrumented systems.

In a letter dated May 2, 2014 (DNFSB 2014b), to the DOE-RL manager, Board Summary of Sludge Treatment Project Final Design and Safety Basis, the DNFSB reiterated its closure of the aforementioned issue for the Hanford Site, K-Basin Closure Sludge Treatment Project, as well as a previously identified issue concerning Non-Bounding Spray Leak Consequence Analysis as reported in their Report to Congress on the Status of Significant Unresolved Technical Differences between the Board and the Department of Energy on Issues Concerning the Design and Construction of DOE’s Defense Nuclear Facilities, dated December 26, 2013 (DNFSB 2013).

Section 5: Environmental Restoration & Waste Management

5.1.3 200 Area – Central Plateau

PA Burke

The Central Plateau is a 75-square-mile (194-square-kilometer) region near the center of the Hanford Site, which includes the area designated in DOE/EIS-0222-F and ROD (64 FR 61615) as the Industrial-Exclusive Area, a rectangular area of about 20 square miles (52 square kilometers) in the center of the Central Plateau. The Industrial-Exclusive Area contains the 200-East and 200-West Areas, used primarily for Hanford Site nuclear fuel processing and waste management and disposal activities. The Central Plateau also encompasses the CERCLA 200 Area NPL site. The Central Plateau has a large physical inventory of chemical processing and support facilities, tank systems, liquid- and solid-waste disposal and storage facilities, utility systems, administrative facilities, and groundwater monitoring wells.

The *Hanford Site Cleanup Completion Framework* (DOE/RL-2009-10) defines the path forward for cleanup at the Hanford Site. The framework document defines the main components of cleanup in two main geographic areas—the River Corridor and Central Plateau. As a result of the goals established in DOE/RL-2009-10, the Tri-Party Agencies developed changes to the TPA that reflect the path forward for Central Plateau cleanup.

The Central Plateau includes two principal cleanup areas: the Inner and Outer Areas (Figure 5.1):

**Inner Area.** This area contains major nuclear fuel processing, waste management, and disposal facilities, and is defined as the final footprint area of the Hanford Site that will be dedicated to permanent waste management and containment of residual contamination. The Inner Area is anticipated to be approximately 10 square miles (26 square kilometers) and will remain under federal ownership and control for as long as potential hazards exist.

**Outer Area.** This area is defined as areas of the Central Plateau beyond the boundary of the Inner Area. Completing cleanup for the approximately 65-square-mile (168-square-kilometer) Outer Area will reduce the active footprint of cleanup for the Central Plateau to the Inner Area.

5.1.3.1 Inner Area

The Inner Area (anticipated to encompass approximately 10 square miles (26 square kilometers) is the projected final footprint region of the Hanford Site. Dedicated to waste management and residual contamination containment, it will remain under federal ownership and control as long as potential hazards exist. Operable units within the Inner Area include those described in the following subsections.

5.1.3.1.1 200-PW-1, 200-PW-3, 200-PW-6, and 200-CW-5 Operable Units

This operable unit group includes 22 waste sites located in the 200 East and 200 West Areas that are contaminated with plutonium or cesium from processing activities at PFP and the Plutonium Uranium Extraction (PUREX) Plant. Specific sites are listed in the *Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology/EPA/DOE 1989b), Appendix C. At EPA’s request, the Tri-Party Agencies agreed to retain the 200-PW-1, 200-PW-3, 200-PW-6 Operable Unit group and the 200-CW-5 Operable Unit and consolidate them into a single decision (Table 5.1).
Table 5.1. Central Plateau Operable Unit Structure

<table>
<thead>
<tr>
<th>New Operable Unit Group</th>
<th>Description</th>
<th>Predecessor Operable Units</th>
<th>Lead Regulatory Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner Area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200-PW-1/3/6, 200-CW-5</td>
<td>Plutonium-contaminated soil sites located near the PFP and cesium-contaminated sites near the Plutonium Uranium Extraction Plant (PUREX)</td>
<td>No change</td>
<td>EPA</td>
</tr>
<tr>
<td>200-WA-1 and 200-BC-1</td>
<td>Soil waste sites located in the 200 West Inner Area that are not included in the 200-SW-2, 200-CR-1, 200-PW-1, 200-PW-6, 200-CW-5, and 200-IS-1 Operable Units; Soil waste sites in the BC Cribs and Trenches</td>
<td>200-BC-1, 200-LW-1/2, 200-MG-1/2, 200-MW-1, 200-PW-2/4</td>
<td>EPA</td>
</tr>
<tr>
<td>200-EA-1</td>
<td>200-East Inner Area that are not included in the 200-SW-2, 200-CB-1, 200-CP-1, and 200-PW-3 Operable Units</td>
<td>200-CS-1, 200-IS-1, 200-LW-1/2, 200-MG-1/2</td>
<td>Ecology</td>
</tr>
<tr>
<td>200-IS-1</td>
<td>Selected pipelines, diversion boxes, etc., in the Inner Area</td>
<td></td>
<td>Ecology</td>
</tr>
<tr>
<td>200-SW-2</td>
<td>Solid waste burial grounds and waste sites in the footprint of the burial grounds</td>
<td>200-CW-1, 200-MG-1/2</td>
<td>Ecology</td>
</tr>
<tr>
<td>200-DV-1</td>
<td>Selected soil waste sites in the Inner Area with deep vadose zone contamination</td>
<td>200-TW-1/2</td>
<td>Ecology</td>
</tr>
<tr>
<td>200-CB-1</td>
<td>B Plant Canyon; associated waste sites</td>
<td>200-IS-1, 200-MG-1/2, 200-MW-1</td>
<td>Ecology</td>
</tr>
<tr>
<td>200-CP-1</td>
<td>PUREX Canyon; Associated waste sites</td>
<td>200-IS-1, 200-MG-1/2</td>
<td>Ecology</td>
</tr>
<tr>
<td>200-CR-1</td>
<td>REDOX Canyon; associated waste sites</td>
<td>200-IS-1, 200-MG-1/2</td>
<td>EPA</td>
</tr>
<tr>
<td>Outer Area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200-OA-1 200-CW-1 200-CW-3</td>
<td>Sites located in the Outer Area</td>
<td>200-CS-1, 200-CW-1, 200-CW-3, 200-IS-1, 200-MG-1/2</td>
<td>EPA</td>
</tr>
</tbody>
</table>

The Record of Decision Hanford 200 Area Superfund Site 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units (DOE/EPA/Ecology 2011) was issued in December 2011. The selected remedy in the ROD addresses soils and subsurface disposal structures contaminated primarily with plutonium and cesium, two settling tanks, and associated pipelines. The remove, treat, and dispose approach for contaminated soil and debris will be used to address plutonium contaminated soils and subsurface structures, and consists of: 1) removing a portion of contaminated soil, structures, settling tanks, and
associated debris; 2) treating these removed wastes as required to meet disposal requirements at ERDF (see Section 5.4.3.7) or waste acceptance criteria for offsite disposal at the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico; and 3) disposing at ERDF or WIPP. The 200-CW-5 Operable Unit, also known as the Z-Ditches, will use the remove, treat, and dispose approach to excavate contaminated soils and dispose at ERDF or the WIPP, as appropriate.

Three of the six 200-PW-1 waste sites, also known as the High-Salt Waste Group, will use the remove, treat, and dispose approach to excavate the highest concentrations of contaminated soils, located up to 2 feet (0.6 meters) below the bottom of the disposal structure, and dispose at ERDF or the WIPP, as appropriate. An evapotranspiration barrier will be constructed over the remaining waste in these waste sites. 200-PW-3 Operable Unit. This operable unit, also known as the Cesium-137 Waste Group, will require additional backfill for three of the five waste sites to achieve coverage of at least 15.0 foot (4.57 meter) depth. Contamination at the other two waste sites is deeper than 15.0 feet (4.57 meters) from the ground surface and will not require additional backfill.

200-PW-6 Operable Unit. This operable unit and three of the six 200-PW-1 waste sites, also known as the Low-Salt Waste Group, will use the remove, treat, and dispose approach to excavate a significant portion, approximately 90 percent, of the contaminated soils to a depth of 33 feet (10 meters) below ground surface, and dispose at ERDF or WIPP, as appropriate. An evapotranspiration barrier will be constructed over the remaining waste in these waste sites. A soil vapor extraction system is being used to remove and treat carbon tetrachloride contamination at waste sites in the High-Salt Waste Group and will continue to be used until vadose zone cleanup levels are met. Soil covers will be used to provide coverage to a depth of at least 15.0 feet (4.57 meters) over cesium-contaminated soils. This consists of maintaining or enhancing the existing soil cover with additional backfill.

Institutional controls and long-term monitoring will be required for waste sites in the 200-CW-5, 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units where waste is left in place and unrestricted land use is precluded.

5.1.3.1.2 200-WA-1/200-BC-1 Operable Unit (200-West Inner Area)

This operable unit group includes soil waste sites located in the BC Crib and Trenches and soil waste sites in the Inner Area portion of the 200-West Area not included in the 200-CR-1, 200-CW-5, 200-IS-1, 200-PW-1, 200-PW-6, and 200-SW-2 Operable Units. Specific sites are listed in the TPA Action Plan (Ecology/EPA/DOE 1989b), Appendix C. Additional sites may be added to the 200-WA-1/200-BC-1 Operable Unit as new waste sites in the geographic area are discovered or created (e.g., soil that is determined to require additional evaluation or remediation following demolition of a structure). The Remedial Investigation/Feasibility Study Work Plan 200-WA-1 and 200-BC-1 Operable Units (DOE/RL-2010-49) was issued in December 2011. In addition, DOE obtained approval of the 216-U-8 Crib and 216-U-12 Vadose Zone Characterization Sampling and Analysis Plan (DOE/RL-2009-94), which supports the 200-WA-1 Operable Unit remedial investigation.

5.1.3.1.3 200-EA-1 Operable Unit (200-East Inner Area)

This operable unit consolidates the remaining Inner Area sites in the 200-East Area except for the environmental media underlying tank farm waste management areas (WMA), landfills in the 200-SW-2 Operable Unit, PUREX, B Plant Canyon, and several waste sites with deep vadose zone contamination that are adjacent to WMA environmental media sites. Specific sites are listed in the TPA
Action Plan (Ecology/EPA/DOE 1989b), Appendix C. Additional sites may be added to the 200-EA-1 Operable Unit as new waste sites in the geographic area are discovered or created (e.g., soil that is determined to require additional evaluation or remediation following demolition of a structure). The 200-EA-1 Operable Unit will make use of a comprehensive application of the technical cleanup principles for the Inner Area developed for the 200-WA-1 Operable Unit.

Analysis for the 200-EA-1 Operable Unit will follow the same pattern as the 200-WA-1 Operable Unit and will utilize the same technical basis documents and comprehensive alternatives evaluation to clearly demonstrate how selected remedies for each fit within the framework of impacts from the entire Inner Area. The 200-EA-1 work plan has not been initiated.

5.1.3.1.4 200-IS-1 Operable Unit
This operable unit includes select inactive waste transfer pipelines and pipeline components in the 200-IS-1 Operable Unit and soil waste sites in the Inner Area portion of the 200-East Area that are not included in the canyon area operable units or in the tank farm WMAs. Specific sites are listed in the TPA Action Plan (Ecology/EPA/DOE 1989b), Appendix C.

The Tri-Party Agencies agreed to use a coordinated CERCLA remedial action and RCRA corrective action process for cleanup decisions in the pipelines operable unit group. The 200-IS-1 Operable Unit Pipeline System Waste Sites RFI/CMS/RI/FS Work Plan (DOE/RL-2010-114) was issued in September 2011.

5.1.3.1.5 200-SW-2 Operable Unit (Burial Grounds)
This operable unit includes 24 landfills located in the 200-East and 200-West Areas. Three soil waste sites located within the boundary of one of the burial grounds were added to the 200-SW-2 Operable Unit during restructuring. Specific sites are listed in the TPA Action Plan (Ecology/EPA/DOE 1989b), Appendix C. Portions of the burial grounds listed in the RCRA Permit (WA7890008967) include TSD facilities. DOE is working with Ecology to remove unused areas from the permit scope.

The Tri-Party Agencies agreed to use a coordinated CERCLA remedial action and RCRA corrective action process for cleanup decisions in the 200-SW-2 Operable Unit. The 200-SW-2 Radioactive Landfills Group Operable Unit RCRA RFI/CMS/RI/FS Work Plan (DOE/RL-2004-60) was issued in March 2015.

5.1.3.1.6 200-DV-1 Operable Unit (Deep Vadose Zone)
This operable unit includes 43 soil waste sites located in the Inner Area. The sites in this operable unit were previously located in the 200-TW-1/2 and 200-PW-5 Operable Units. Specific sites are listed in the TPA Action Plan (Ecology/EPA/DOE. 1989b), Appendix C. The Remedial Investigation/Feasibility Study and RCRA Facility Investigation/Corrective Measures Study Work Plan for the 200-DV-1 Operable Unit, DOE/RI-2011-102, Draft A, was submitted to the Washington State Department of Ecology for review on March 18, 2015. The Characterization Sampling and Analysis Plan for the 200-DV-1 Operable Unit, DOE/RL-2011-104, was issued on January 17, 2012. The Long-Range Deep Vadose Zone Program Plan (DOE/RL-2010-89), issued in October 2010, summarizes the state of knowledge about contaminant cleanup challenges faced by the deep vadose zone beneath the Central Plateau and the approach to solving those challenges.
5.1.3.1.7  **200-CB-1 Operable Unit (B Plant Canyon)**

This operable unit includes the B Plant Canyon Building (221-B) and the Waste Encapsulation Storage Facility (WESF), along with exterior ventilation system components for each structure (e.g., HEPA filters and sand filter) and 17 soil waste sites within the vicinity. Specific sites are listed in the TPA Action Plan (Ecology/EPA/DOE, 1989b, Appendix C). Additional sites may be added to the 200-CB-1 Operable Unit as new waste sites in the geographic area are discovered or created (e.g., soil that is determined to require additional evaluation or remediation following demolition of a structure). Sites near the B Plant Canyon currently assigned to the 200-IS-1 Operable Unit may be reassigned to the 200-CB-1 Operable Unit, pending the outcome of discussions among the Tri-Party Agencies. Cesium and strontium capsules located in the WESF are not included in the scope of the 200-CB-1 Operable Unit.

5.1.3.1.8  **200-CU-1 Operable Unit (U Plant Canyon)**

This operable unit includes the U Plant Canyon Building (221-U) and other structures included in the ROD for the U Plant Canyon (DOE/EPA/Ecology, Record of Decision 221-U Facility [Canyon Disposition Initiative] Hanford Site Washington). The U Plant Canyon Disposition Initiative is a pilot project for disposition of the five canyon buildings in the 200-East and 200-West Areas. Implementation of the selected remedial action (close in place – partially demolished structure) began in 2009.

5.1.3.1.9  **200-CP-1 Operable Unit (PUREX Canyon)**

This operable unit includes the PUREX Canyon Building (202-A), PUREX Storage Tunnels (218-E-15 and 218-E-16), exterior components of the ventilation system for each structure (e.g., deep bed filters), and 20 soil waste sites in the vicinity. Specific sites are listed in the TPA Action Plan (Ecology/EPA/DOE, 1989b, Appendix C). Additional sites may be added to the 200-CP-1 Operable Unit as new waste sites in the geographic area are discovered or created (e.g., soil that is determined to require additional evaluation or remediation following demolition of a structure). Sites near the PUREX Canyon currently assigned to the 200-IS-1 Operable Unit may be reassigned to the 200-CP-1 Operable Unit, pending the outcome of discussions among the Tri-Party Agencies. The 200-CP-1 work plan has not been initiated.

5.1.3.1.10  **200-CR-1 Operable Unit (REDOX Canyon)**

This operable unit includes the REDOX Canyon Building (202-S), exterior components of the ventilation system (e.g., filters), and 12 soil waste sites located in the vicinity. Specific sites are listed in the TPA Action Plan (Ecology/EPA/DOE 1989b, Appendix C). Additional sites may be added to the 200-CR-1 Operable Unit as new waste sites in the geographic area are discovered or created (e.g., soil that is determined to require additional evaluation or remediation following demolition of a structure). Sites near the REDOX Canyon Building currently assigned to the 200-IS-1 Operable Unit may be reassigned to the 200-CR-1 Operable Unit, pending the outcome of discussions among the Tri-Party Agencies. The 200-CR-1 work plan has not been initiated.

5.1.3.2  **Outer Area**

The Outer Area is defined as all areas of the Central Plateau beyond the boundary of the Inner Area. The Outer Area covers approximately 65 square miles (168 square kilometers) and contains more than 90 waste sites and structures scattered throughout the largely undisturbed sagebrush-steppe habitat. Most of the waste sites in the Outer Area are small near-surface sites that will be removed for treatment as needed for onsite disposal or sampled to confirm that no additional action is required, apart from implementing appropriate institutional controls. The largest components of Outer Area remediation are
ponds where cooling water and chemical sewer effluents were discharged and the BC Control Area where surface contamination was spread through animal intrusion.

### 5.1.3.2.1 200-OA-1, 200-CW-1, and 200-CW-3 Operable Units (Outer Area)

Soil waste sites in the Outer Area requiring cleanup are assigned to one of the following three operable units:

**200-CW-1 Operable Unit.** Contains ponds that were used for discharging large volumes of cooling water and other effluents with low levels of contamination or that were only potentially contaminated. There are 14 sites in the 200-CW-1 Operable Unit, including eight ponds and associated sewer lines, control structures, and unplanned releases.

**200-CW-3 Operable Unit.** Contains 16 sites that were associated with operating the 200 North Area, a small complex initially used for temporary storage of spent nuclear fuel and later for storing miscellaneous materials and rail cars. The soil waste sites (trenches, small ponds, septic tanks, and sewer lines) were cleaned up as part of interim actions conducted from 2005 through 2010.

**200-OA-1 Operable Unit.** Contains the remaining soil waste sites in the Outer Area that require cleanup under CERCLA, currently totaling 63 sites (debris and solid waste dumping areas, small liquid discharge sites, septic and sewer system components, and unplanned releases). Additional sites could be added as cleanup progresses and sites are discovered, or as existing non-CERCLA sites are reclassified.

The 200-OA-1, 200-CW-1, and 200-CW-3 Operable Unit group incorporates soil waste sites from several previous operable units. The [200-CW-3 Operable Unit Interim Remedial Action Report (DOE/RL-2011-58)](https://example.com) was issued in September 2011. The summary of waste site remediation activities, cleanup verification processes, and cost information will support developing a final remedial action for the Outer Area of the Hanford 200 Area NPL site.

#### 5.1.3.2.2 Nonradioactive Dangerous Waste Landfill and Solid Waste Landfill (NRDWL)

The NRDWL and SWL are located in the Outer Area and are not included in the operable units described above. The NRDWL is a RCRA-permitted disposal facility for dangerous waste generated at the Hanford Site that was not contaminated with radioactive materials. The NRDWL received dangerous waste from 1975 through 1985, as well as asbestos waste through 1988, and sanitary solid waste during 1976. The SWL is a non-RCRA solid waste landfill south of the NRDWL. The SWL received non-dangerous and nonradioactive solid waste, including paper, construction debris, asbestos, and lunchroom waste from 1973 through March 1996. The SWL also received up to 1.3 million gallons (5 million liters) of sewage and 100,000 gallons (380,000 liters) of garage wash water.

Because the NRDWL is a RCRA-permitted TSD site, closure is being managed in accordance with [WAC 173-303](https://example.com). The Solid Waste Landfill is regulated under [WAC 173-350](https://example.com).

#### 5.1.4 300 Area

*D G Saueressig and CP Strand*

Beginning in 2002, the 300-FF-2 Operable Unit interim ROD ([EPA/ROD/R10-01-119](https://example.com)) authorized remediation activities for the 300-FF-2 Operable Unit. Today, remediation activities continue under the 300-FF-2 final ROD ([DOE/EPA/Ecology 2013](https://example.com)) issued in November 2013, which authorizes remediation activities and the alternative remediation method of enhanced attenuation of uranium using sequestration in the vadose zone, periodically rewetted zone, and the top of the aquifer. In 2014, remediation focused
on the 300-FF-2 Operable Unit waste sites, where sampling was performed to determine whether suspect 
waste sites exceeded cleanup objectives; confirm that cleanup objectives were met; and conduct physical 
excavation operations; sort and segregate waste; sample, treat, and dispose of waste; and backfill and 
revegetate the affected sites.

Waste generated from the cleanup of waste sites in the 300-F-2 Operable Unit was disposed at the ERDF, 
located on the Central Plateau, and other EPA-approved disposal facilities. In 2014, approximately 
489,000 tons (436,600 metric tons) of contaminated soil from the 300-FF-2 Operable Unit were disposed at 
the ERDF. In addition, the 340 Building remediation and 340 Vault removal were completed, and final 
below-grade demolition of the 309 Plutonium Recycle Test Reactor continued. Remedial actions have 
been initiated on all remaining waste sites south of Apple Street in the 300 Area.

The 618-10 Burial Ground (Figure 5.1), located just west of Route 4 South, was operated from 1954 to 
1963. It is approximately 5.2 acres (2.1 hectares) in size. The 618-11 Burial Ground, located close to the 
Energy Northwest Columbia Generating Station, operated from 1962 through 1967 and is approximately 
8.6 acres (3.5 hectares) in size. Both 
burial grounds received waste, 
including transuranic material, 
from the 300 Area laboratory 
facilities. The burial grounds 
consist of multiple trenches, 
vertical pipe units, and caissons. 
The 618-11 Burial Ground contains 
trenches, vertical pipe units and 
four caissons. Remediation of the 
618-11 Burial Ground will 
commence after the 618-10 Burial 
Ground remediation is completed.

Waste burial grounds require 
cleanup, but also present a 
significant health and safety risk to 
workers because of incomplete waste disposal records and the potential for discovering unknown material 
from past disposal practices. This unknown material may require further characterization. 
Characterization is critical to ensure worker safety and proper management of waste for potential 
treatment and disposal. When characterizing material to verify that limits and controls identified in 
approved work authorization documents are adequate for the work scope, additional time and planning is 
required to ensure proper protective gear is used in the field when unknown material is discovered. If 
work authorization documents do not adequately cover the material discovered, work is stopped until the 
documents can be revised and work can be safely restarted. Based on the characterization results, 
additional waste treatment may be required before disposal.
Remediation of the 618-10 Burial Ground trenches began in April 2011 and continued through 2014. The 2014 activities focused on burial ground trenches (Figure 5.2). Future activities will include remediation of vertical pipe units that consist of the following three configurations:

- Carbon steel pipes up to 15-feet (4.6-meters) long and 10 to 24 inches (25 to 61-centimeters) in diameter.
- Corrugated steel pipes up to 15-feet (4.6-meters) long and 14 inches (36 centimeters) in diameter.
- Drums 14.4-feet (4.4-meters) long, 22-inches (56-centimeters) in diameter, and vertical pipe units constructed from 55-gallon (209-liter) drums.
- These drum style vertical pipe units (VPU) were constructed by welding five 55-gallon (209-liter) bottomless drums together end-to-end and burying them vertically. The VPUs are generally open to the soil at the bottom and closed at the top with a concrete cover. The current remediation planned for the corrugated style and drum style VPUs will involve installation of a 48-inch (122-centimeter) steel over-casing around each vertical pipe unit. Each VPU will be augured to size-reduce it, its contents, and the soil within the over-casing. The material will be mixed with water, amended water, or flowable grout prior to retrieval from the over-casing. The material will then be removed, stabilized as necessary, and packaged for either storage or disposal depending on the radiological content of the material. The current remediation plan for the carbon steel VPUs involves exposing small sections of the VPU, covering it in a flowable grout, and processing it with a shear. The material will then be removed and packaged either for storage or disposal depending on the radiological content of the material.

5.2 Facility Decommissioning Activities

This section provides information regarding the transition of Hanford Site facilities from stabilization to surveillance and maintenance and eventual decommissioning. Decommissioning activities include the interim safe storage of plutonium production reactors and deactivation and decommissioning of facilities in the 100, 200, 300, and 400 Areas, and ancillary reactor facilities.
5.2.1 100 Area

DG Souressig and CP Strand

Deactivation, decontamination, decommissioning, and demolition activities in the 100 Area during 2014 included demolition actions at the 100-B, 100-D, and 100-N Areas. The activities were conducted as non-time-critical removal actions under CERCLA. Listed below are the 100 Area facilities demolished in 2014.

- 183-D Water Treatment Plant (Figure 5.3)
- 151-B Primary Electrical Substation
- 181-N Cable Float Barriers
- M0-474 (mobile office).

5.2.2 200 Area – Central Plateau

Central Plateau facilities include buildings and waste sites in the 200 East, 200 West, and 200 North Areas, as well as those on the adjoining Rattlesnake Unit (Fitzner/Eberhardt Arid Lands Ecology Reserve). The transition toward decommissioning encompasses surveillance, maintenance, and deactivation activities.

5.2.2.1 Plutonium Finishing Plant Decommissioning Progress

WG Cox

The PFP began processing plutonium nitrate solutions into metallic plutonium during 1949 for shipment to nuclear weapons-production facilities. Operation of this plant continued into the late 1980s. DOE issued a shutdown order for PFP in 1990 and, in 1996, authorized the deactivation and transition of plutonium-processing portions of the facility in preparation for decommissioning.

All special nuclear materials and stored fuel elements have been removed from the plant, and security was downgraded by the end of 2009. The removal and disposal of process equipment, chemicals, glove boxes, and hoods from the buildings began in 2009 and continued through 2014. The following sections describe the significant accomplishments at PFP during 2014 (Figure 5.4).

5.2.2.1.1 Plutonium Finishing Plant Complex

During 2014, the 270-Z and 2704-Z buildings were demolished, and six mobile offices were removed from the complex.
5.2.2.1.2 234-5Z, Plutonium Finishing Plant

Removal of plutonium-contaminated process equipment continued, with a particular focus on removing gloveboxes, associated piping, and ductwork. The total gloveboxes removed to date is now 94 percent complete. The following removals were completed in 2014:

- Removed 21 gloveboxes – 94 percent of all PFP glove boxes and hoods
- Removed 580 linear feet of asbestos for a total of 18,071 feet (75 percent complete)
- Removed 667 linear feet of E4 ducting in 234-5Z duct level for a total of 1,479 feet (18 percent complete).

5.2.2.1.3 236-Z, Plutonium Reclamation Facility (PRF)

- Removed, size reduced, and dispositioned 53 pencil tank units (88 percent complete).

5.2.2.2 Canyon Disposition Initiative

BJ Dixon

The Canyon Disposition Initiative was created to investigate the potential for using the five former chemical separations facilities (B Plant, T Plant, U Plant, PUREX Plant, and REDOX Plant) in the 200 Areas as disposal facilities for Hanford Site remediation waste rather than demolishing these canyon buildings. The U Plant was selected as the pilot project for the Canyon Disposition Initiative. The remaining canyon buildings are to be addressed on a case-by-case basis, building on previous canyon disposition work.

Planning and sampling activities to support preparation of a CERCLA feasibility study for implementing the Canyon Disposition Initiative at U Plant began in the mid-1990s. In fall 2005, EPA issued a ROD (DOE/EPA/Ecology 2005), with a remedy that calls for the process equipment already in U Plant to be consolidated into the belowground plant process cells, and for the cells, two lower galleries, and other void spaces to be filled with grout. The exterior walls and roof would then be collapsed in place, and the site would be covered with an engineered barrier.

Implementation of the selected alternative began in 2009 for the 221-U Facility. By October 2011, the equipment consolidation phase had been completed, and facility voids below the canyon deck level (process cells, hot pipe trench, piping and electrical galleries, drain header, process sewer, and ventilation tunnel and ducts) were filled with grout in accordance with the Remedial Design/Remedial Action Work Plan for the 221-U Facility (DOE/RL-2006-21). The 221-U Plant facility actions were limited to surveillance and maintenance during 2014.
5.2.3 300 Area

CP Strand

Deactivation, decontamination, decommissioning, and demolition activities in the 300 Area (Figure 5.5) continued to focus on removing physical barriers to perform remedial actions in the 300-FF-2 Operable Unit. These activities were conducted as non-time-critical removal actions under CERCLA in accordance with Action Memorandum #1 for the 300 Area Facilities (DOE/EPA 2005), Action Memorandum #2 for the 300 Area Facilities (DOE/EPA 2006a), and Action Memorandum #3 for the 300 Area Facilities (DOE/EPA 2006b). Additionally, DOE/RL-2010-22 authorized deactivation, decontamination, decommissioning, and demolition activities for several other 300 Area facilities.

During decommissioning and decontamination activities at the 324 Building in late 2009, a breach in the Radiochemical Engineering B-Cell floor liner was noted in the bottom of a sump. Radiological dose measurements of approximately 14,000 rad/hour were observed at the failure location, indicating a possible release occurred during past operations from the 324 Building. Casings containing closed-end push probes were installed in November 2010 under B-Cell at the northern corner of the 324 Building. Dose measurements taken from these probes showed peak radiation readings of 8,900 rad/hour, confirming a significant source term from within B-Cell had been released to the soil column beneath the 324 Building. Additional probes to greater depths, and reviews of down-gradient monitoring wells, confirmed that contamination had not come into contact with the groundwater. Characterization sampling of the contaminated soils has been performed, and ongoing engineering evaluations are being used to develop a retrieval methodology that is protective of both workers and the environment.

In November 2014, six additional push probes were installed under B-Cell along the west footing. Higher peak radiation readings of 12,700 rad/hour were observed. This new information is being considered as the 324 Building remedial design advances.

Decommissioning efforts in 2014 included significant progress on continuing to remove the below-grade portions of the 309 Plutonium Recycle Test Reactor (Figure 5.6). The 340 Waste Neutralization Facility vault was successfully lifted and transported to ERDF for disposal. With the exception of the ongoing work at the 309 below-grade structure, all remaining surplus 300 Area facilities were demolished in 2014.
The 300 Area buildings and structures demolished in 2014 are as follows:

- 309 Plutonium Recycle Test Reactor Core
- 310 Retention Transfer System
- 320 Boiler Annex (slab)
- 340 Vault
- 342 Lift Station Complex
- 351 Electrical Substation (B3S4)
- 352-F Switch Station (C3S4)
- 3730 Gamma Irradiation Facility (below-grade)
- 3790 Central Badging
- MO-745 (mobile office)
- MO-767 (mobile office)
- MO-827 (mobile office)

### 5.2.4 400 Area

*DR Turlington*

This section provides information on the Fast Flux Test Facility.

#### 5.2.4.1 Fast Flux Test Facility

FFTF is a formerly operating 400-megawatt (thermal) liquid-metal cooled (sodium) research and test reactor located in the 400 Area (Figure 5.7). Built in the late 1970s, the original mission of the facility was to develop and test advanced fuels and materials, and to serve as a prototype facility for future Liquid Metal Fast Breeder Reactor Programs. Other missions were also pursued. FFTF operated from April 1982 to April 1992 and provided the nuclear industry with significant advances in fuel performance, medical isotope production, material performance, and passive and active safety systems testing. The reactor was placed in a standby mode in December 1993. After multiple studies, a decision was made to complete facility deactivation, including removing all nuclear fuel, draining the sodium systems, and deactivating systems and equipment to place the facility in a low-cost, long-term surveillance and maintenance condition, the facility deactivation was completed in June 2009. FFTF remains in a long-term surveillance and maintenance condition, and routine surveillances are performed on an annual basis.

The FFTF decommissioning was included in [DOE/EIS-0391](#), issued on November 12, 2012; and the supplement analysis ([DOE/EIS-0391D-SA-01](#)) issued in February 2012, which concluded there were no substantial changes. The preferred action for the FFTF is entombment, which would remove all above-
grade structures, including the reactor building. The below-grade structures, the reactor vessel, piping, and other components would remain in place and be filled with grout to immobilize the remaining radioactive and hazardous constituents. Waste generated from these activities would be disposed at IDF, with an engineered modified RCRA Subtitle C barrier constructed over the filled area. Remote-handled special components would be processed at Idaho National Laboratory and returned to Hanford. Bulk sodium inventories would be processed at Hanford for use in the WTP. DOE issued the final record of decision on FFTF decommissioning on December 13, 2013 (78 FR 75913).

5.3 Waste Management Activities
This section provides information regarding Hanford Site liquid and solid waste management.

5.3.1 Waste Classifications

WE Toebe
Hanford Site cleanup operations result in the generation of solid wastes that must be evaluated for proper management. Solid wastes are reviewed against procedures in WAC 173-303-070(3), “Designation of Dangerous Waste,” and are classified as dangerous when the criteria for this classification are met. The radionuclides in solid waste are exempt from evaluation under WAC 173-303-070(3), but are subject to evaluation and categorization as transuranic, HLW, or LLW under the AEA. Wastes that contain constituents regulated under both WAC 173-303 and the AEA are classified as mixed wastes.

Radioactive and/or mixed wastes are managed in several ways. HLW is stored in large underground single-shell and double-shell tanks. LLW typically is stored in tanks or containers. The method used to store LLW depends on the source, composition, and waste concentration. Transuranic waste is stored in vaults, in storage buildings, on aboveground storage pads, and underground pending future retrieval. The DOE Hanford Site Annual Dangerous Waste Report lists the dangerous and mixed wastes that are generated, treated, and disposed on site or shipped off site. Dangerous and mixed wastes are treated, stored, and prepared for disposal at several Hanford Site facilities. Dangerous waste generated at the site is shipped off site for treatment and/or disposal. Some types of dangerous waste, such as used lead–acid batteries and aerosol products (e.g., spray paint), are shipped off site for recycling.

Waste that does not contain hazardous or radioactive substances is non-regulated waste. Historically, non-regulated waste generated at the Hanford Site was disposed onsite. Beginning in 1999, non-regulated waste (e.g., refuse and drummed nonhazardous waste) has been disposed at municipal or commercial solid waste disposal facilities. Since 1996, medical waste has been shipped to a commercial medical waste treatment and disposal facility. Non-regulated waste originates at several areas across the Hanford Site. Examples include construction debris, office trash, cafeteria waste, and packaging materials. Other materials and items classified as non-dangerous waste include solidified filter backwash and sludge from the treatment of Columbia River water, failed and broken equipment and tools, air filters, uncontaminated used gloves and other clothing, and certain chemical precipitates (i.e., oxalates). Non-regulated demolition waste from 100 Area decommissioning projects was buried in situ (in place) or in designated disposal locations on the Hanford Site.
5.3.2 Solid Waste Inventories

**JF Berger and DE Nester**

The Solid Waste Information and Tracking System is a computer database used to track a portion of mixed and radioactive waste at the Hanford Site, primarily non-CERCLA containerized waste managed by CHPRC, MSA, and WRPS. The database does not include all waste from WCH, ERDF, or any PNNL wastes. The database also does not include high-level radioactive waste volumes managed at Hanford Site tank farms.

Quantities for both mixed and radioactive wastes generated onsite or received from offsite sources and disposed at the Hanford Site, as tracked by the Solid Waste Information and Tracking System database, are shown in Tables 5.2 and 5.3. Quantities of dangerous waste shipped offsite, as tracked by the database, are shown in Table 5.4. Hanford Site solid waste management is discussed in Section 5.3.3.

**Table 5.2. Solid Waste$^a$ Quantities Generated on the Hanford Site**

<table>
<thead>
<tr>
<th>Waste Category</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tons</td>
<td>281</td>
<td>286</td>
<td>522</td>
<td>305</td>
<td>206</td>
<td>140</td>
</tr>
<tr>
<td>Metric tons</td>
<td>255</td>
<td>260</td>
<td>474</td>
<td>277</td>
<td>187</td>
<td>127</td>
</tr>
<tr>
<td>Radioactive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tons</td>
<td>696</td>
<td>725</td>
<td>4,022</td>
<td>343</td>
<td>513</td>
<td>572</td>
</tr>
<tr>
<td>Metric tons</td>
<td>631</td>
<td>658</td>
<td>3,649</td>
<td>311</td>
<td>465</td>
<td>519</td>
</tr>
</tbody>
</table>

$^a$ Solid waste includes containerized liquid waste.

**Table 5.3. Solid Waste$^a$ Quantities Received on the Hanford Site from Offsite Sources**

<table>
<thead>
<tr>
<th>Waste Category</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed$^b$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tons</td>
<td>257</td>
<td>152</td>
<td>320</td>
<td>66</td>
<td>36.5</td>
<td>38.4</td>
</tr>
<tr>
<td>Metric tons</td>
<td>233</td>
<td>138</td>
<td>290</td>
<td>60</td>
<td>33</td>
<td>35</td>
</tr>
<tr>
<td>Radioactive$^b$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tons</td>
<td>196</td>
<td>388</td>
<td>257</td>
<td>82</td>
<td>62.8</td>
<td>57</td>
</tr>
<tr>
<td>Metric tons</td>
<td>178</td>
<td>352</td>
<td>233</td>
<td>74</td>
<td>60</td>
<td>52</td>
</tr>
</tbody>
</table>

$^a$ Solid waste includes containerized liquid waste. Solid waste quantities do not include U.S. Navy reactor compartments.

$^b$ Total includes Hanford Site-generated waste treated by an offsite contractor and returned as newly generated waste. Includes both low-level radioactive and transuranic waste.
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Table 5.4. Dangerous Waste\textsuperscript{a} Quantities Shipped Off the Hanford Site

<table>
<thead>
<tr>
<th>Waste Category</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containerized</td>
<td>Tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(DW Only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metric tons</td>
<td>47</td>
<td>55</td>
<td>53</td>
<td>18</td>
<td>65.4</td>
<td>103</td>
</tr>
<tr>
<td>Containerized</td>
<td>Tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(MW Only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metric tons</td>
<td>79</td>
<td>37</td>
<td>43</td>
<td>91</td>
<td>50.6</td>
<td>33.7</td>
</tr>
<tr>
<td>Bulk Solids</td>
<td>Tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(DW Only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metric tons</td>
<td>3.8</td>
<td>20</td>
<td>26</td>
<td>3</td>
<td>—</td>
<td>22.1</td>
</tr>
<tr>
<td>Bulk Solids</td>
<td>Tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Non-Rad/Non-DW)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metric tons</td>
<td>79</td>
<td>210</td>
<td>120</td>
<td>17</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Bulk Liquids</td>
<td>Tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(DW Only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metric tons</td>
<td>1.8</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>22</td>
</tr>
<tr>
<td>Bulk Liquids</td>
<td>Tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Non-Rad/Non-DW)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metric tons</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Totals</td>
<td>Tons</td>
<td>211</td>
<td>322</td>
<td>242</td>
<td>129</td>
<td>116</td>
</tr>
<tr>
<td>Metric tons</td>
<td>191</td>
<td>292</td>
<td>220</td>
<td>117</td>
<td>105</td>
<td>164</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Does not include Toxic Substances Control Act waste.
\textsuperscript{b} Dangerous waste (DW) only.
\textsuperscript{c} Mixed waste (radioactive and dangerous).

5.3.3 Solid Waste Management

LC Petersen

Solid waste management includes treatment, storage, and disposal of solid waste produced during Hanford Site operations or received from offsite sources authorized by DOE to ship waste to the site. These facilities are operated and maintained in accordance with state and federal regulations and facility permits. The following sections describe specific waste management locations at the Hanford Site.

5.3.3.1 Central Waste Complex

LC Petersen

The CWC, a solid waste storage facility located in the 200 West Area (Figure 5.8), operates under interim status standards specified in the RCRA Permit (WA7890008967), CWC Part A Form. CWC receives waste from the Hanford Site and offsite sources authorized by DOE to ship waste to the site for treatment, storage, and disposal; however, the majority of waste received at the CWC is generated from ongoing cleanup, research, and development activities at the Hanford Site. Waste types include low-level, mixed low-level, transuranic, and PCB radioactive. The CWC can store as much as 735,000 cubic feet (20,800 cubic meters) of waste, which is an adequate capacity to store the projected volumes of generated waste from the activities identified above, assuming on-schedule treatment and disposal of the stored waste. An outside storage area was constructed in 2007 to store large containers of suspect transuranic waste from waste retrieval operations. The volume of waste currently stored in the CWC Outside Storage Areas is 195,400
cubic feet (5,534 cubic meters), and the volume of waste stored at CWC at the end of 2014 totaled approximately 310,800 cubic feet (8,802 cubic meters).

5.3.3.2 Waste Receiving and Processing (WRAP) Facility

LC Petersen

The WRAP Facility (Figure 5.9) began operating in 1997 with the mission to analyze, characterize, and prepare drums and boxes of low-level, mixed, and transuranic wastes for disposal. The 52,000-square-foot (4,800-square-meter) facility, along with two 21,500-square-foot (2,000-square-meter) storage buildings, are located north of the CWC in the 200West Area. The WRAP Facility is operating under interim status standards specified in the RCRA Permit (WA7890008967), WRAP Facility Part A Form.

Waste destined for the WRAP Facility includes stored waste as well as newly generated waste from current Hanford Site cleanup activities. The waste consists primarily of contaminated cloth, paper, rubber, metal, and plastic (i.e., debris). Processed waste that qualifies as low-level radioactive waste and meets disposal requirements is buried at the Hanford Site. Low-level radioactive waste not meeting burial requirements is processed at the WRAP Facility for onsite burial or prepared for future treatment at other onsite or offsite TSD facilities. Waste determined to be transuranic is certified and packaged for shipment to the WIPP for disposal.

In response to budget constraints, actions were taken in late 2011 and 2012 to place the WRAP Facility into a layup status until future funding is available to restart the facility. The layup actions during the interim period maintain facility safety, environmental compliance, and operational viability to enhance the transition to operational status at the end of the layup period.

5.3.3.3 T Plant Complex

LC Petersen

The T Plant Complex (Figure 5.10) is located in the 200 West Area and provides solid waste treatment, storage, and decontamination services for the Hanford Site and offsite facilities. The T Plant Complex is operating under interim status standards specified in the RCRA Permit (WA7890008967), T Plant Complex Part A Form.
5.3.3.4 Canister Storage Building (CSB)

LC Petersen

The CSB (Figure 5.11) is a large, 42,000-square-foot (3,906-square-meter) facility located in the 200-East Area. The facility stores about 2,300 tons (2,086 metric tons) of spent nuclear fuel packaged in approximately 400 multi-canister overpacks from the 100-K Basins, 100-N Reactor, and T Plant. The multi-canister overpacks are stored in 220 carbon steel tubes in a below-grade concrete vault. The irradiated fuel was cleaned, packaged, dried, and relocated to the CSB beginning in 2004 to provide safe interim storage in a consolidated location, allowing for cleanup of older facilities, which reduces the cleanup footprint of the Hanford Site and risk. The CSB has a design life of 40 years, and will safely store the multi-canister overpacks until they are permanently placed in a National Repository.

Adjacent to the CSB is the Interim Storage Area, which also contains spent nuclear fuel packaged in various containers. This spent nuclear fuel will be subsequently repackaged and sent to a National Repository.

5.3.3.5 Low-Level Burial Grounds (LLBG)

LC Petersen and DE Nester

The low-level burial grounds consist of eight separate burial grounds. Two are located in the 200 East Area, and six are located in the 200 West Area. These burial grounds are regulated under the AEA. Two of the burial grounds are used for disposal of LLW and mixed waste (i.e., low-level radioactive waste with a dangerous waste component regulated by WAC 173-303). The 218-W-5 Burial Ground, located in the 200 West Area, contains Trenches 31 and 34. The 218-E-12B Burial Ground, located in the 200 East Area, contains Trench 94. Trench 94 is dedicated for disposal of defueled U.S. Navy reactor compartments. Trenches that contain mixed LLW are regulated under RCRA. Five burial grounds in the 200 West Area were used to dispose of LLW and/or retrievable storage of transuranic waste, as were portions of the 218-E-12B Burial Ground. The 218-W-6 Burial Ground has never received waste.

The LLBGs are operating under interim status standards specified in the RCRA Permit (WA7890008967), Low-Level Burial Grounds Part A Form. In addition, the LLBGs are included in DOE/RL-2004-60, 200-SW-1 Nonradioactive Landfills Group and 200-SW-2 Radioactive Landfills Group Operable Units Remedial Investigation/Feasibility Study Work Plan.
5.3.3.5.1 Low-Level Waste Burial Ground 218-W-5, Trenches 31 and 34

Trenches 31 and 34 (Figure 5.12) are rectangular landfills with approximate base dimensions of 250 by 100 feet (76 by 30 meters), with a variable depth of 30 to 40 feet (9 to 12 meters). These trenches comply with WAC 173-303 requirements for double liners and leachate removal/collection systems.

These lined disposal units were originally designated for mixed LLW. Disposal of LLW in the unlined trenches ceased June 23, 2004. Since that date, Trenches 31 and 34 have accepted LLW and mixed LLW for disposal. Disposal in Trench 31 began in May 2005, and disposal in Trench 34 began in September 1999. The first operational layer of waste packages have been covered with compacted gravel and soil, and the covering of the second waste layer has been initiated for Trenches 31 and 34.

Trench 31 is filled to approximately 50 percent of waste capacity, with approximately 193,675 cubic feet (5,674 cubic meters) of waste in 3,300 waste packages. In 2014, a total of 6,568 cubic feet (186 cubic meters) of waste was disposed of in Trench 31. Trench 34 is filled to approximately 82 percent of waste capacity, with approximately 200,349 cubic feet (5,171 cubic meters) of waste in 5,290 waste packages. In 2014, no waste was disposed of in Trench 34.
5.3.3.5.2 Low-Level Waste Burial Ground, Trench 94

The LLBG Trench 94 (Figure 5.13) received two defueled U.S. Navy reactor compartments in 2014. The total number of reactor compartments received into Trench 94 (218-E-12B Burial Ground) to date is 127. All U.S. Navy reactor compartments shipped to the Hanford Site for disposal originated from decommissioned defueled nuclear-powered submarines or cruisers. Decommissioned submarine reactor compartments are approximately 33 feet (10 meters) in diameter, 47 feet (14.3 meters) long, and weigh between 1,000 and 1,500 tons (900 and 1,400 metric tons). Decommissioned cruiser reactor compartments are approximately 33 feet (10 meters) in diameter, 42 feet (12.8 meters) high, and weigh approximately 1,500 tons (1,362 metric tons).

5.3.3.6 Waste Encapsulation and Storage Facility (WESF)

DJ Watson

The WESF (Figure 5.14), located in the 200 East Area, was constructed in 1970 and 1971 on the west end of B Plant and became operational in 1974. The WESF is operating under interim status standards specified in the RCRA Permit (WA7890008967), WESF Part A Form. The WESF is a storage-only unit for strontium and cesium encapsulated salts in double-containment stainless-steel capsules in underwater pool cells; and does not generate regulated waste. The water provides cooling and shielding for the capsules that are considered sealed sources.

The mission of the WESF was encapsulation and storage of cesium chloride and strontium fluoride salts that had been separated from the Hanford Site’s high-level radioactive tank waste. The facility is a two-story, 20,000-square-foot (1,860-square-meter) building, 157 feet (48 meters) long, and 40 feet (12 meters) high. The facility is constructed of steel-reinforced concrete and partitioned into seven hot cells, a hot cell service area, operating areas, building service areas, and a pool cell area. The hot cells are labeled A through G, and activities within the hot cells are performed remotely using manipulators. Waste and drum load-out can be performed in Hot Cell A. Hot Cells B through E are pending stabilization until final closure. Of these, only Hot Cells F and G remain active for supporting cesium and strontium capsule storage. The operating areas and other building service areas associated with the hot cells provide areas for instrumentation monitoring, utility support, or manipulator repair as required.
5.3.3.7 Integrated Disposal Facility (IDF)

LC Petersen

The IDF (Figure 5.15) is located in the south-central part of the 200 East Area, and is a new, unused landfill that is not actively operating. The landfill is an expandable RCRA hazardous waste-compliant unit (i.e., a double high-density polyethylene-lined trench with leachate collection and a leak detection system). The IDF operates in accordance with the RCRA Permit. The landfill is divided lengthwise (north to south) into two distinct cells: the east cell is for disposal of low-level radioactive waste (non-RCRA permitted), and the west cell is for disposal of low-level mixed waste (radioactive and RCRA-regulated hazardous waste). The IDF has a process design capacity of 2.89 million cubic feet (82,000 cubic meters). The IDF is referenced in DOE/EIS-0391 as a future disposal option for Hanford Site wastes.

5.3.3.8 Environmental Restoration Disposal Facility (ERDF)

MA Casbon

ERDF (Figure 5.16) is the largest disposal facility in the DOE cleanup complex. The massive landfill located near the 200-West Area is regulated by the EPA; and covers 107 acres at the base of the disposal trench – roughly the same area as 52 football fields – and currently has a capacity of 18 million tons (16.3 million metric tons). The facility began operations in July 1996 and serves as the central disposal site for contaminated waste removed during Hanford Site cleanup operations conducted under CERCLA regulations. The total available expansion area of the ERDF site was authorized in a 1995 ROD (EPA/ROD/R10-95/100, Record of Decision Hanford 200 Area) to cover as much as 1.6 square miles (4.1 square kilometers). To provide a barrier to prevent contaminant migration from the in ground facility, ERDF is constructed to RCRA Subtitle C minimum technology requirements, which includes a double liner and leachate collection system (40 CFR 264.301, Subpart N, “Landfills”). Remediation waste disposed in the facility includes soil, rubble, or other solid waste materials contaminated with hazardous, low-level radioactive, or mixed (combined hazardous and radioactive) LLW.

Designed to be expanded as needed, ERDF consists of disposal areas called cells. Each pair of cells is 70 feet (21 meters) deep, 500 feet (152 meters) wide and 1,000 (305 meters) feet long at the base. There are currently 10 cells at ERDF. Cells 1 through 8 can each hold 2.8 million tons (2.5 million metric tons) of material per pair of cells. Super Cells 9 and 10 can each hold 3.0 million tons (2.7 metric tons).
As each pair of cells reaches capacity, an interim cover is installed to prevent the infiltration of water. Cells 1 through 4 are full with an interim cover, Cells 5 and 6 are being filled and near operational capacity, Cells 7 and 8 are over half-full, and disposal in Super Cells 9 and 10 continues. A permanent cap will be placed over the facility when Hanford cleanup is completed.

The DOE and its contractors have disposed of 17 million tons (14.5 million metric tons) of contaminated material at the ERDF since the facility began operations in 1996. The disposal record is a measure of the tremendous amount of progress being made at the Hanford Site. The majority of cleanup waste at ERDF comes from the 220-square-mile River Corridor, located along the banks of the Columbia River. The low-level waste consists mainly of soil contaminated by the effluent of Hanford’s nine plutonium production reactors, which operated from 1943-1987, as well as contaminated rubble from building demolition. In addition, ERDF also receives cleanup waste from other Hanford contractors.

### 5.3.4 Liquid Waste Management

**DJ Watson**

Facilities are operated on the Hanford Site to store, treat, reduce, and dispose of various types of liquid effluent generated by site cleanup activities. These facilities are operated and maintained in accordance with state and federal regulations, and facility permits.

#### 5.3.4.1 200 Area Effluent Treatment Facility (ETF)

The 200 Area ETF (Figure 5.17, on the left) is located in the 200 East Area. The 200 Area ETF stores and treats liquid effluent to remove toxic metals, radionuclides, and ammonia, in addition to destroying organic compounds. The treatment process constitutes best available technology and includes pH adjustment; filtration; ultraviolet light and peroxide oxidation to destroy organic compounds; reverse osmosis to remove dissolved solids; and ion exchange to remove the last traces of contaminants. The facility began operating in December 1995 and has a maximum treatment capacity of 150 gallons (570 liters) per minute. The 200 Area ETF operates in accordance with the RCRA Permit.

The effluent discharges are managed in accordance with limitations set forth in the State Waste Discharge Permit [ST-4500](#) and the 200 Area ETF Delisting Petition approval conditions. The treated effluent is stored in tanks, sampled and analyzed, and discharged via a dedicated pipeline to the State-Approved Land Disposal Site (also known as the 616-A Crib). This disposal site is located just north of the 200 West Area and is an underground drain field. The percolation rates for the field have been established by site testing and evaluation of soil characteristics. Tritium in the liquid effluent from the ETF cannot be practically removed. The location of the disposal site maximizes the time for migration of tritium to the Columbia River to allow for radioactive decay (the half-life of tritium is 12.35 years).
The volume of wastewater treated and disposed in 2014 was approximately 1.19 million gallons (4.5 million liters). This wastewater was primarily process condensate from the 242-A Evaporator. The 200 Area ETF was not operating for most of the year due to a failed heat exchanger. A new replacement heat exchanger was procured and is pending receipt and installation.

5.3.4.2 Liquid Effluent Retention Facility (LERF)

The LERF (Figure 5.17, on the right) is located in the 200 East Area, and operates in accordance with the RCRA Permit. The LERF consists of three RCRA-compliant surface impoundments used to store process condensate from the 242-A Evaporator, groundwater from various operable unit pump-and-treat systems, leachate from ERDF and from LLBG Trenches 31 and 34, and other aqueous waste. The LERF provides a steady flow and consistent pH for the 200 Area ETF feed. Each basin has a maximum capacity of 7.8 million gallons (29.5 million liters) and is constructed of two flexible, high-density polyethylene membrane liners. A system is provided to detect, collect, and remove leachate from between the primary and secondary liners. Beneath the secondary liner is a soil and bentonite clay barrier, should both the primary and secondary liners fail. Each basin has a floating membrane cover constructed of very low-density polyethylene to keep out windblown soil and weeds and minimize evaporation of small amounts of organic compounds and tritium that may be present in the basin contents. The facility began operating in April 1994 and receives liquid waste resulting from cleanup activities regulated by both RCRA and CERCLA. Historically, RCRA and CERCLA wastewaters were segregated in the surface basins and processed with different disposal destinations; however, this became unnecessary after the ROD for ERDF was amended in 2007 to allow receipt of all RCRA and CERCLA waste (DOE 2007, Amended Record of Decision for the Environmental Restoration Disposal Facility). Segregation of RCRA and CERCLA wastewater is no longer required in the LERF basins.

The volume of wastewater received for the LERF basin storage in 2014 was approximately 3.57 million gallons (13.5 million liters). The majority of wastewater received at the LERF was pipeline-transported CERCLA-regulated leachate from ERDF, totaling approximately 1.8 million gallons (6.81 million liters). The other major contributor to wastewater received into LERF was approximately 1.37 million gallons (5.19 million liters) of process condensate from the 242-A Evaporator. Approximately 0.38 million gallons (1.44 million liters) of wastewater was received by tanker trucks from various other facilities. The volume of wastewater being stored in the LERF at the end of 2014 was approximately 13.4 million gallons (50.7 million liters).
5.3.4.3 200 Area Treated Effluent Disposal Facility (TEDF)

The 200 Area TEDF (Figure 5.18), located east of the 200 East Area, is a collection and disposal system for non-RCRA waste streams. The individual waste streams must be treated or otherwise comply with best available technology and all known available and reasonable treatment methods in accordance with “Submission of Plans and Reports for Construction of Wastewater Facilities” (WAC 173-240), which is the responsibility of the generating facilities. Effluent discharges comply with the limitations established in State Waste Discharge Permit ST-4502.

The 200 Area TEDF consists of approximately 11 miles (18 kilometers) of buried pipelines connecting three pumping stations, the 6653 Building (known as the disposal sample station) and two 5-acre (2-hectare) disposal ponds. The facility began operating in April 1995 and has a capacity of 3,400 gallons (12,900 liters) per minute. The volume of unregulated effluent disposed to this facility in 2014 was approximately 359 million gallons (1,360 million liters).

5.3.4.4 242-A Evaporator

The 242-A Evaporator (Figure 5.19), located in the 200-East Area, concentrates dilute liquid tank waste by evaporation in accordance with the RCRA Permit. The resultant water vapor is captured, condensed, filtered, sampled, sent to the nearby LERF for storage, and then further treated at ETF. This process reduces the volume of liquid waste sent to the double-shell tanks for storage and reduces the potential need for additional tanks.

In 2014, waste volume reduction operations resumed at the 242-A Evaporator after four years of facility upgrades to extend the 242-A Evaporator service life for certain systems through 2032. In 2014, the 242-A Evaporator completed processing 2.2 million gallons (8.3 million liters) of waste from the double-shell tank system, resulting in a 793,000-gallon (3,002,000-liter) reduction in tank waste volume.
5.4 Underground Waste Storage Tanks

AL Prignano

Hanford’s 56 million gallons of highly radioactive and chemical waste is stored in 177 underground tanks until it is prepared for disposal (Figure 5.20). The tank waste is material left over from years of World War II and post-war production of nuclear weapons. The waste is stored in 149 older SSTs and 28 safer DSTs that are grouped into 18 farms in the 200 East and 200 West Areas. This section provides information about the SSTs and DSTs and activities that occurred in 2014 related to their operation and closure.

In 2014, an independent assessment team looked into vapor exposure issues at the Hanford Tank Farms as part of the WRPS commitment to eliminate or reduce worker exposure to chemical vapors. WRPS is implementing the recommendations from that assessment.

*Figure 5.20. 200 Area Tank Farms Aerial Overview*
5.4.1 Single-Shell Tank (SST) System

The SST system includes 149 tanks that were constructed between 1943 and 1964 to store mixed waste generated on the Hanford Site; 67 of the tanks are assumed to have leaked over 1 million gallons. Pumpable liquids in the SSTs were transferred to the newer and safer DSTs several years ago under the Interim Stabilization Program to help prevent additional environmental releases. The SST system is undergoing closure and operates under interim status standards specified in the RCRA Permit, Single-Shell Tank System Part A Form.

In 2014 progress continued in retrieving waste from the C Farm tanks and transferring it to newer, safer DSTs to prepare to feed tank waste to the WTP. C Farm (Figures 5.21 and 5.22) is one of 18 tanks farms located on the Hanford Site. The figure shows the retrieval status for the 16 tanks as 13 complete and 3 in progress. More than 84 percent of waste has been retrieved from tank C-102, 89 percent from tank C-112, and 95 percent of the waste from tank C-107 using the Mobile Arm Retrieval System (MARS). MARS is a robotic arm mounted on a central mast that uses powerful jets to wash down the inside of the tank and drive the waste to a central pump.
5.4.2 Double-Shell Tank (DST) System

The DST system includes 28 DSTs (25 tanks in 200 East Area and 3 tanks in 200 West Area located in five tank farms (AN, AP, AW, AY, AZ, and SY) that were constructed between 1968 and 1986 to store mixed waste generated on the Hanford Site. The DST system is operating under interim status standards specified in the RCRA Permit (WA7890008967), Double-Shell Tank System Part A Form. One of the tanks (AY-102) is assumed to have leaked waste into the annulus. The tanks contain liquids and settled solids from past nuclear operations, including waste transfers from older SSTs. The DST system storage capacity is approximately 33 million gallons (126 million liters) of radioactive and chemical waste. Storage space within the DST system is being managed to store waste pending treatment by the WTP and includes emergency pumping space available at all times for 1 million gallons (3.8 million liters).

Sample ports continued to be installed in ventilation exhaust ducts to directly measure flow rates from the tank waste in the ventilation outlet to address flammable gas safety concerns, including installing sample ports in ventilation exhaust to directly measure gases from the tank waste in the tank ventilation outlet.

At the end of 2014, there were 26.6 million gallons (101 million liters) of waste in the DSTs. Quantities of liquid waste generated in 2014 and stored in underground storage tanks are provided in the Hanford Site Annual Dangerous Waste Report Calendar Year 2014 (DOE/RL-2015-13). Table 5.5 summarizes the liquid waste generated and stored from 2009 through 2014 in underground storage tanks.

Table 5.5. Tank Farm System Quantities of Liquid Wastea Generated and Storedb

<table>
<thead>
<tr>
<th>Type of Waste</th>
<th>Units</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSTs year-end volume</td>
<td>Gallons</td>
<td>25,971</td>
<td>25,835</td>
<td>25,948</td>
<td>26,580</td>
<td>26,733</td>
<td>26,575</td>
</tr>
<tr>
<td></td>
<td>Liters</td>
<td>98,311</td>
<td>97,796</td>
<td>98,224</td>
<td>98,000</td>
<td>101,195</td>
<td>100,597</td>
</tr>
<tr>
<td>242-A Evaporator</td>
<td>Gallons</td>
<td>960</td>
<td>548</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>793</td>
</tr>
<tr>
<td></td>
<td>Liters</td>
<td>3,634</td>
<td>2,074</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3,002</td>
</tr>
<tr>
<td>Single-Shell Tanks</td>
<td>Gallons</td>
<td>102</td>
<td>240</td>
<td>560</td>
<td>238</td>
<td>70</td>
<td>262</td>
</tr>
<tr>
<td>volume pumpedd</td>
<td>Liters</td>
<td>386</td>
<td>909</td>
<td>2,120</td>
<td>900</td>
<td>263</td>
<td>991</td>
</tr>
</tbody>
</table>

a Quantity of liquid waste is defined as liquid waste sent to double-shell underground storage tanks during these years, rounded to the nearest 1,000; and does not include containerized (e.g., barreled) waste included in the solid waste category.
b Multiply volumes shown by 1,000.
c Includes other miscellaneous additions or reductions, e.g., dilution and flush waters and corrosion controls, not represented elsewhere on this chart.
d Volume includes dilution or flush water.

5.4.3 Underground Waste Storage Tanks and Associated Facilities Progress on Defense Nuclear Facilities Safety Board (DNFSB)

JM Garcia

Throughout 2014, ORP and its contractors met with and provided information to the DNFSB and its technical staff to resolve concerns regarding Hanford Site underground storage tank farm projects. The following issues were addressed:

- Tank 241-AY-102 and DST tank integrity
- DST space management
- SST level changes
- 242-A Evaporator
- Tank Farms Ventilation Systems.
Defense Nuclear Facilities Safety Board Recommendation 2012-2

On September 28, 2012, the DNFSB issued Recommendation 2012-2, Hanford Tank Farms Flammable Gas Safety Strategy. The DNFSB’s recommendation documented their position that DOE needs to upgrade the DST ventilation systems and other instrumentation systems used for safety-related functions at the Hanford tank farms.

On June 6, 2013, DOE delivered the Implementation Plan for Recommendation 2012-2 (DOE 2013a) to the DNFSB. Implementation Plan actions completed and provided to the DNFSB included:

- Action 1-1 and 4-1, implementation of the DOE-approved Documented Safety Analysis and associated Technical Safety Requirements for DST primary tank ventilation systems, completed March 2013.
- Action 1-3, a feasibility study for inspecting the condition and integrity of DST primary ventilation ductwork between the tank and flow monitoring locations, completed August 2014.
- Action 2-1, installation and testing of flow meters in selected DST ventilation exhausts to evaluate instrument performance, completed January 2014.
- Action 4-2, demonstration of current capabilities to recover from a loss of ventilation, completed February 2014.

Work will continue in 2015 to evaluate potential means to reduce the inventory of retained flammable gases in DSTs in a controlled manner. Action 2-2, installation of safety significant instrumentation for real-time monitoring of the ventilation exhaust flow from each DST, is the current focal project of 2012-2. Once complete, the selected air flow meter will be installed and used to monitor DST ventilation exhaust flow in real time.

In addition, DOE is evaluating Action 1-2, development of a streamlined approach to implement the planned improvements for upgrading the DST primary tank ventilation systems to meet safety significant requirements. All related information for Recommendation 2012-2, is available on the DNFSB website at http://www.dnfsb.gov/board-activities/recommendations/hanford-tank-farms-flammable-gas-safety-strategy.

5.4.4 Vadose Zone Program

SJ Eberlein

The Vadose Zone Program is responsible for implementing the Tank Farm RCRA Corrective Action Program through field characterization, laboratory analyses, technical analyses, risk assessment for past tank leaks, and installation of interim measures that will reduce the threat from contaminants until permanent solutions can be found. Results of vadose zone investigations and interim measures conducted the first 10 years of the project, are documented in the RCRA Facility Investigation Report for Hanford Single-Shell Tank Waste Management Areas (DOE/ORP-2008-01). In 2014, Draft A of the Phase 2 RCRA Facility Investigation Report for Waste Management Area C (RPP-RPT-58339) was produced to provide additional results of investigations conducted in Waste Management Area C to support the determination of need for corrective measures.

Field characterization efforts in 2014 continued in the 200-West Area in support of the 200 West Area Tank Farms Interim Measures Investigation Work Plan (RPP-PLAN-53808). Additional efforts were initiated in the Waste Management Area A-AX to support the Field Sampling and Analysis Plan for Soil Samples at Waste Management Area A-AX (RPP-PLAN-57332). Monitoring was also conducted at the two interim surface barriers (one covers a portion of the 241-T Tank and one covers all the
241-TY Tank Farm). These two surface barriers cover areas where soil has been contaminated due to past leaks from tanks or tank associated equipment. They reduce water infiltration through the contaminated soil.

5.4.4.1 Direct-Push Boreholes and Sampling
Direct-push technology using a hydraulic hammer unit to evaluate subsurface contamination in the vadose zone continued to be used in TX Tank Farm during 2014, and was deployed in Waste Management Area A-AX. Four direct push boreholes were placed in TX Tank Farm, in addition to the eight direct-push boreholes placed in 2013. Each borehole was logged for moisture and gamma-emitting radionuclides, then a companion borehole was placed next to the first borehole, and soils samples were obtained at selected depths. During decommissioning of the logging boreholes, deep electrodes were placed to support future electrical resistivity work. In September 2014, the Vadose Zone Characterization Report for 241-TX Tank Farm (RPP-RPT-57964) documented the results of these field efforts. In Waste Management Area A-AX, eight direct-push boreholes were placed and logged for moisture and gamma-emitting radionuclides. During decommissioning of the logging boreholes, deep electrodes were placed to support future electrical resistivity work. Sampling in Waste Management Area A-AX will be initiated in 2015, and additional direct pushes are planned.

5.4.4.2 Surface Geophysical Exploration
Surface geophysical exploration is a combination of surface-deployed geophysical techniques, including pole-to-pole electrical resistivity, electro-magnetic induction, magnetic gradiometry, and ground-penetrating radar, to help define the presence and distribution of buried infrastructure so that those features can be considered during resistivity data analysis. The depth to which the resistivity measurements interrogate the subsurface is determined by the distance between electrode pairs (the farther apart, the deeper the interrogation). Resistivity is an indirect measure of several subsurface phenomena (e.g., moisture distribution, saline contaminants, and soil texture). The greater the depth of interrogation, the lower the resolution of the analysis. In 2014, ground-penetrating radar information was collected in Waste Management A-AX to support planned field activities. Electrical resistivity data were reported in 2014 in the Three-Dimensional Surface Geophysical Exploration of the U Tank Farm (RPP-RPT-56430) and the Three-Dimensional Surface Geophysical Exploration of the 200-Series Tanks at the 241-C Tank Farm (RPP-RPT-56760).

5.4.4.3 Interim Surface Barriers
The effectiveness of the T Tank Farm interim surface barrier at reducing infiltration is assessed through a barrier-monitoring program (PNNL-16538, T Tank Farm Interim Surface Barrier Demonstration – Vadose Zone Monitoring Plan). Pre-barrier data were collected and a monitoring report for FY 2007 was issued in January 2008 (PNNL-17306, T Tank Farm Interim Surface Barrier Demonstration – Vadose Zone Monitoring FY07 Report). Barrier monitoring continued during 2014, with information being reported annually. The barriers are resulting in slow drying of the vadose zone as water is diverted, which normally would recharge the surface. Two interim barriers were previously designed to be placed over most of the tanks in the SX Tank Farm. Modified asphalt was selected as the impermeable surface, and an evapotranspiration basin will be located south of the SX Tank Farm to redirect any runoff back to the atmosphere. The design and monitoring plan was approved by Ecology for future construction.
5.4.4.4 Interim Measures Pore Water Extraction Test

A proof of principle test for pore water extraction was initiated in 2013 and was completed in 2014 under the 200 West Area Tank Farms Interim Measures Investigation Work Plan (RPP-PLAN-53808). The test used the direct-push unit to place small diameter boreholes into the soil south of SX Tank Farm. A vacuum system was used to extract potentially contaminated pore water from the soil. Additional testing has been proposed, but a decision as to whether the testing will be conducted has not been reached at this time. Information on this test is presented in the Pore-Water Extraction Proof-of-Principle Field Test Report (RPP-RPT-56596).

5.5 Waste Treatment and Immobilization Plant (WTP)

BA Walker

The WTP (Figure 5.23, July 2014) is being built on 65 acres (26 hectares) in the 200 East Area to treat radioactive and hazardous waste stored in 177 underground tanks located on the Central Plateau. The WTP comprises four major facilities (Pretreatment Facility, High-Level Waste [HLW] Vitrification Facility, Low-Activity Waste [LAW] Vitrification Facility, and Analytical Laboratory) along with support buildings and associated infrastructure (Balance of Facilities). Construction of the WTP is managed in accordance with the RCRA Permit.

Two major achievements for 2014 included resuming production engineering at the HLW Vitrification Facility and completing conceptual design of the option to feed low-activity waste directly to the LAW Vitrification Facility. The latter achievement, referred to as Direct Feed LAW, supports the DOE Framework for cleanup of Hanford tank wastes as soon as practicable. A description of the WTP facilities and the progress at each facility in 2014 is provided below:
Pretreatment Facility: The Pretreatment (PT) Facility is where waste is received from the tank farms and separated into low-activity and high-level waste streams for transport to the LAW and HLW facilities for processing. In 2014, work continued to resolve the remaining technical issues that have impacted design and construction at the PT Facility since 2012. Significant progress on the technical issues was made in 2014 with the construction of the Full-Scale Vessel Testing platform. By the end of the 2014, testing at the new facility had begun on the mixing system for the pulse-jet mixers that will be used to ensure adequate mixing of waste within the waste process vessels at the PT Facility.

HLW Vitrification Facility: The HLW Vitrification Facility is where high-level waste from the PT Facility will be combined with glass-forming materials in high-temperature melters, poured into waste canisters, and allowed to cool to form a solid, immobilized glass form. The most significant accomplishment in 2014 was receiving DOE approval to resume full engineering and design of the HLW Vitrification Facility. Construction in 2014 included making 18 concrete placements, along with setting 179 tons (162 metric tons) of structural steel, and placing 1,040 feet (317 meters) of pipe and 1,696 feet (517 meters) of conduit.

LAW Vitrification Facility: The LAW Vitrification Facility is where low-activity waste from the PT Facility will be mixed with glass-forming materials in high-temperature melters, and poured into containers to form a solid, immobile glass form. Construction continued on interior equipment and commodities installation. Workers installed melter refractory for the two glass melters in the LAW Vitrification Facility.

Analytical Laboratory: Once operational, the Analytical Laboratory will process about 10,000 waste samples annually to support glass formulation and waste-form compliance. In 2014, workers completed sufficient construction and received or installed the necessary equipment to begin systemization. 'Ready for Systemization' represents a significant achievement in work progress at the Analytical Laboratory.

Emphasis in 2014 continued on facility completion efforts at the LAW Vitrification Facility and Analytical Laboratory and included placement of the standby diesel generator, which will provide emergency power to plant systems should primary power be lost.

5.5.1 Waste Treatment and Immobilization Plant Progress on Defense Nuclear Facilities Safety Board Recommendations

JM Garcia

Throughout 2014, ORP and its contractors met with and provided information to the DNFSB and its technical staff to resolve commitments and review the following WTP technical topics. The following are the two new safety issues identified in 2014:

- Volcanic Ashfall Hazard: In an October 23, 2014, letter to DOE, the DNFSB communicated a concern that the WTP design did not include an adequate control strategy to address the most recent volcanic ashfall hazard assessment at the Hanford Site.

- Unanalyzed Melter Accidents: In a December 5, 2014, letter to DOE, the DNFSB communicated a concern with the proposed nuclear safety control strategy for the HLW Vitrification Facility melter and associated support systems and their ability to adequately protect the public and facility workers.

Resolution of both these new issues is ongoing, with the latest status provided to Boards staff April 7 - 9, 2015. In addition, the following issues were closed in 2014:
LAW Vitrification Facility, Analytical Laboratory, and Balance of Facilities instrumentation and control system design. The DNFSB raised a number of issues regarding the design of the instrumentation and control systems at the WTP in their letter of May 5, 2011. In response, DOE directed the contractor to implement DOE-STD-1195-2011, Design of Safety Significant Safety Instrumented Systems Used at DOE Non-Reactor Nuclear Facilities. Revised hazard analysis and control selection process improvements were implemented. The DNFSB stated these actions adequately address the concern and the issue was closed, as noted in the DNFSB’s December 9, 2014, letter to DOE.

5.5.1.1 Defense Nuclear Facility Safety Board Recommendation 2010-2

On January 28, 2014, the DNFSB closed Recommendation 2010-2 citing DOE’s new technical approach to resolving safety-related pulsejet mixing issues. Since 2010, DOE has developed an entirely new approach, which was presented to the DNFSB in a briefing dated September 11, 2013. Based on this new approach the DNFSB concluded that the recommendations to Recommendation 2010-2 were no longer relevant.

5.5.1.2 Defense Nuclear Facilities Safety Board Recommendation 2011-1

The DNFSB issued Recommendation 2011-1, Safety Culture at the WTP on June 9, 2011. The DOE Office of Health, Safety and Security (HSS) conducted a follow-on assessment review in December 2013 through January 2014 on the WTP safety culture. The follow-on review was similar to the 2011 independent oversight review conducted of the safety culture for WTP, based on the January 30, 2012, letter to the DNFSB, in which the senior advisor to the DOE Office of Environmental Management (EM) committed to having HSS conduct a WTP safety culture progress assessment approximately 12 to 18 months from the issuance of the HSS WTP Safety Culture 2012 Report (DOE 2012). The final report was transmitted on June 17, 2014, by the DOE Office of Independent Enterprise Assessments (OEA), which replaced HSS in May 2014.


5.5.1.3 Pretreatment Facility – Hydrogen in Piping and Ancillary Vessels

During 2014, WTP executed new processes and procedures for conducting piping analyses in accordance with the qualitative and deterministic risk assessment processes. Hydrogen gas generated by the highly radioactive wastes to be processed in the WTP can be trapped and accumulate over time at high points within piping systems. For process piping that is less than or equal to four inches in diameter (≤ 4 inches outer diameter), the project has developed a ‘quantitative’ risk analysis (QRA) technique to model hydrogen explosions and help inform the design of WTP piping systems. The QRA is used to evaluate WTP piping to ensure it satisfies American Society of Mechanical Engineers (ASME) Code B31.3–1996, Process Piping, design requirements and will withstand the strains caused by hydrogen explosions without rupturing for the life of the plant. The QRA model, supported by years of full-scale representative testing, has been independently verified by a 12-person panel of industry experts, the Independent Review Team. QRA will be used for design purposes only, for piping ≤ 4 inch, to determine it will satisfy the design
requirements of ASME B31.3. Piping larger than 4 inches in diameter and ancillary vessels (such as pulse jet mixer bodies and breakpots) will also be evaluated to make sure they satisfy the ASME B31.3 requirements using engineering analysis other than QRA.

In September 2014, the project proposed using a deterministic method to perform the nuclear safety analysis of hydrogen events in WTP piping and ancillary vessels. The project plans to develop a conservative model to support deterministic conclusions on the adequacy of WTP design features and selected safety systems to accommodate hydrogen in piping and ancillary vessels events. The safety classification of controls will be determined from the results of the consequence analysis, consistent with accepted guidance in standard DOE-STD-3009-94. ORP acknowledged the pursuit of the proposed methodology but withheld endorsement of the deterministic approach until the safety analysis process could demonstrate a defensible basis for addressing hydrogen in piping and ancillary vessels. DNFSB staff have been briefed on the proposed process.

5.6 Long-Term Stewardship

*Raja Ranade*

The MSA Long-Term Stewardship (LTS) Program activities in 2014 focused on integrating the WCH draft transition and turnover packages and managing stewardship responsibilities for geographic areas previously transitioned to the MSA. Transition and turnover packages were completed in 2014 for the 105-C, 105-D, 105-DR, 105-H, and 105-N/109-N reactor buildings. The package describes activities that led to placing the reactors into interim safe storage configuration (ISS). The ISS is a process of demolishing all but the shield walls surrounding the reactor core, removing or stabilizing all loose contamination within the facility, and placing a new roof on the remaining structure. Access to the structure is provided for surveillance and maintenance work. Access doorways are welded shut, and all other openings in the shield walls are sealed to prevent intrusions and the release of radioactive materials.

Surveillance of these facilities is conducted every five years. MSA conducted a structural and radiologic assessment and inspection of temperature and flood level sensors located inside the 105-F Building in October 2014. The surveillance involved grinding off the door weld to enter the building. Radiological, biological, and physical safety conditions were evaluated before assessment teams entered the 105-F Building. The assessment teams found no change in conditions from the previous surveillance. MSA also conducted annual external surveillance of all LTS Program-managed ISS reactor buildings. Other stewardship activities included assessment of institutional controls at the LTS-managed waste sites and areas. Figure 5.24 shows a welder grinding the door weld off, and instrument technicians checking the temperature monitors inside 105-F.
5.7 Scientific and Technical Contributions to Hanford Site Cleanup

MD Freshley and RA Peterson

PNNL scientific and technical contributions to cleanup at the Hanford Site were focused on applied science, technology development and maturation, and basic science contributions. These contributions were funded through the DOE EM Office of Soil and Groundwater Remediation, RL, CH2M, DOE EM Office of Tank Waste Management, ORP, WRPS, and BNI. The contributions included performing scientific and technical evaluations and reviews and developing and advancing new technologies to address site cleanup challenges. The 2014 contributions to Hanford Site cleanup are provided below.

**Waste Processing.** Conducted fundamental engineering development to support resolution of the mixing issues associated with WTP, including working with BNI to identify necessary and sufficient testing to demonstrate single high solids vessel full-scale mixing. In addition, PNNL provided leadership in resolution of technical issues associated with criticality and flammable gas control within the WTP.

**Improve the Immobilization of Low-Activity Waste and High-Activity Waste.** In collaboration with WRPS and the Savannah River Site, cast stone was evaluated as technology to treat low-activity waste at the Hanford Site. In addition, researchers have teamed with Savannah River National Laboratory, Catholic University, and the Missouri University of Science and Technology to develop new glass formulations capable of significantly reducing the volume of both low-activity waste glass and high-activity waste glass.

**Speciation of Technetium in Tank Waste.** Researchers continued an effort to identify the speciation of technetium in tank wastes. Under normal processing conditions, technetium is usually present as the pertechnetate ion. However, a significant portion of the technetium in Hanford waste tanks is present as a complexed soluble species. Work identified several candidate complexes that may be present in tank wastes. These complexes will be further explored during 2015.

**Deep Vadose Zone Applied Field Research Initiative.** The Deep Vadose Zone Applied Field Research Initiative (AFRI) focused on improving best practices to enhance current baseline remediation technologies being deployed at the Hanford Site, conducting high-impact research to define alternatives to the current baseline, and develop next-generation solutions. The AFRI is 1) developing and implementing systems-based characterization and monitoring of contaminant sources and residual vadose zone contamination, 2) understanding the processes controlling the behavior, transport, and fate of contaminants in the environment to provide defensible decision support for risk-informed endpoints, and 3) developing transformational approaches to reduce contaminant mass flux to groundwater.

PNNL contributed to improving best practices by incremental technology maturation in the following areas:

- Applied understanding of microbial communities to optimize performance of the fluidized bed reactor for treating carbon tetrachloride and nitrate, resulting in uninterrupted operation of the system and more efficient contaminant removal.

- Tested performance of new sorbent materials for removal of iodine-129 for pump and treat systems (PNNL-23730; PNNL-23669). Tested sorbent materials using groundwater collected from a 200-West Area well. The results showed that several inorganic composites performed to specification. Further testing is needed for scale-up and to engineer appropriate forms of the composite materials for deployment in the pump-and-treat system.
Generated scale-up information for gas-phase treatment of uranium in the vadose zone using ammonia gas (PNNL-23699). Laboratory experiments were conducted to support calculations for field-scale treatment using ammonia gas, quantify field-scale advective and diffusive transport in unsaturated sediments, and evaluate pore-water chemistry changes with ammonia delivery. Gas-phase treatment of the vadose zone was shown to be amenable to monitoring using electrical geophysical methods.

Continued monitoring the soil desiccation treatability test in the Central Plateau, showing expected rewetting, and redistribution of moisture in the vadose zone (PNNL–23731).

Initiated summary of performance monitoring for the Prototype Hanford Barrier. Over two decades (from 1944 to 2013) of performance monitoring data have been collected, but not reviewed and summarized. Completed data processing and analysis as well as quality assurance documentation; the report will be issued in 2015.

Completed technical review of groundwater monitoring plans to identify opportunities to streamline operations and reduce overall cost. The panel assembled for the review decreased efforts by more than 50 percent by establishing monitoring requirements driven by technical objectives, knowledge of plume behavior, and integration with remedial actions.

PNNL continued investigating the 100-OL-1 Operable Unit to address residual contamination from farms and orchards that used lead and arsenic as pesticides. These farms and orchards existed on the Hanford Site before operations began. During FY 2014, a pilot study was conducted to evaluate field-portable x-ray fluorescence equipment, demonstrating that it operates within quality assurance criteria for analytical measurements used in remediation decisions (DOE/RL–2014–38, PNNL–23868). This result led to revision of the work plan for the Operable Unit.

PNNL reduced technical risks and uncertainty through high-impact technology development in the following areas:

- Developed guidance for transition, closure of pump-and-treat systems. It is often difficult to identify pathways to transition pump-and-treat systems to alternative remediation strategies. A structured approach was developed to assess pump-and-treat performance for optimization, transition, or closure. Guidance was provided on the steps for evaluating an endpoint for pump-and-treat operations for systems with diminishing returns.

- Conducted laboratory experiments to evaluate extension of gas-phase remediation to technetium-99 in the vadose zone (PNNL–23665). The laboratory experiments were used to examine changes in technetium-99 mobility in vadose zone sediments, suggesting that a combination of hydrogen sulfide and ammonia gas could provide a viable remedial approach.

- Released a computer code for inversion of very large data sets from subsurface electrical geophysics (PNNL–23783). The publically released code (E4D) is useful for inverting subsurface characterization of tank farms and includes capabilities for explicitly modeling and removing the effects of metallic infrastructure. The code meets NQA-1 quality assurance requirements for safety software.
PNNL undertook a number of applied science investigations, as described below:

- Developed a robust conceptual model for uranium in the Central Plateau vadose zone with varying waste chemistry. The conceptual model describes how uranium was distributed in the vadose zone during disposal, how it has continued to migrate, and how it is strongly influenced by geochemical reactions (PNNL-23666).
- Investigated the biogeochemistry of iodine in Hanford groundwater, including speciation analysis to define the composition and characterization to determine how microbial communities are impacted by iodine-129. These studies will provide a technical basis for in situ remediation or natural attenuation of iodine-129.
- The Deep Vadose Zone AFRI led a multi-national laboratory effort to identify research and development needed to successfully define and apply risk-informed remediation approaches for complex sites (DOE 2014a). Research topics were proposed in characterization and conceptual model development, predictions of site conditions, remediation approaches, monitoring, and remediation decision support.

**Advanced Simulation Capability for Environmental Management (ASCEM).** The project continued enhancing capabilities in the ASCEM toolset and initiated a supporting analysis of WMA C closure performance assessment. ASCEM is being developed as a workflow for understanding and predicting contaminant fate and transport in natural and engineered systems. The capability includes modular and open source toolsets that facilitate integrated approaches to modeling and site characterization and enable robust and standardized assessments of performance and risk for DOE EM cleanup and closure activities.