Draft for Public Review and Comment

HANFORD SITE
Cleanup Completion Framework

May 2012

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Date Published

Review Copy = May 2012

Prepared for the U.S. Department of Energy

Assistant Secretary for Environmental Management

P.O. Box 550
Richland, Washington 99352

Approved by

_________________________ __________

Matt McCormick Date
Manager
U.S. Department of Energy
Richland Operations Office

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APPROVED
By J. D. Aardal at 10:38 am, Jun 05, 2012

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Preface

Established in 1943, the Hanford Site's original mission was to produce plutonium for national defense. Operations to make the raw materials for nuclear weapons continued until the late 1980s. The waste remaining from those operations is a potential threat to human health and the environment including the Columbia River. In 1989, Hanford's mission shifted from production of weapons material to waste management and environmental cleanup. The progress to date has been supported by a dialogue among Hanford's regulators, Tribal representatives, diverse stakeholders, and public interest groups. Completing Hanford cleanup will require four to five more decades and the sustained investment of significant public resources. Those public resources must compete with many other national priorities. Completion of cleanup will require a sustained, open, and informed dialogue among Hanford's many interest groups. This document is intended to enhance that dialogue.

When faced with any single cleanup decision, Hanford's stakeholders have long desired a broader view of how that one decision fits with other Hanford cleanup decisions. It is in response to those desires that the U.S. Department of Energy (DOE) has prepared this document. In doing so, DOE hopes to make the long and complex task of cleaning up the Hanford Site more understandable to all interested parties. Through improved understanding, more effective involvement in cleanup decisions will result.

This document provides a comprehensive overview of Hanford cleanup and touches on what activities are possible for the site once cleanup is complete. Cleanup requires many dozens of individual decisions. This document shows how single decisions lead to completion of cleanup for the site as a whole, i.e., (1) it describes the challenges facing cleanup, (2) it describes the approaches for making decisions for the three major components of cleanup, and (3) it describes the actions needed to move from cleanup to post-cleanup activities.

This framework document defines the main components of cleanup. The River Corridor and Central Plateau represent the two main geographic areas of cleanup work. The River Corridor includes the former fuel fabrication area (300 Area), reactor operations areas (100 Areas) and considerable land area not directly affected by past production operations. This region is adjacent to the Columbia River and cleanup must deal with the threats to that valuable resource. The Central Plateau includes the former fuel processing facilities and numerous waste disposal facilities. Included within the Central Plateau is one of Hanford's most significant challenges – Tank Waste cleanup. Thus, this framework describes the three main components of cleanup – River Corridor, Central Plateau, and Tank Waste. Each of these components of cleanup is in itself a complex and challenging task requiring many years and billions of dollars to complete.

This document also guides the reader to other information that will aid in learning about Hanford cleanup. It does not make regulatory decisions nor does it provide budgetary information. Many separate, formal regulatory decisions must still be made.

In August 2009, DOE released a draft of this document for public review and comment. The comment period was 90 days in length. DOE received comments from a diverse set of organizations, Tribal Nations, and individuals. This feedback was used to improve and update this document. The comments received and DOE's responses to those comments can be found on the Hanford web site at http://www.hanford.gov/page.cfm/OfficialDocuments. DOE recognizes that this cleanup framework will evolve as cleanup progress occurs and as input from interested parties is received. DOE continues to seek your feedback on this *Completion Framework* and how it can better inform interested parties on matters related to Hanford cleanup.

Refer to information inside the back cover for details about other DOE information resources pertaining to Hanford Site cleanup. DOE informs the public on Hanford activities via its website (www.hanford.gov), tours, speakers bureau, public meetings, the news media, and social media channels (www.twitter.com\hanfordsite, www.facebook.com\hanfordsite, and www.youtube.com\hanfordsite).

The public is encouraged to participate in the Hanford Site decision-making process. In many cases, Hanford public involvement goes beyond what is required by law because DOE, the Environmental Protection Agency, (EPA) and the Washington State Department of Ecology (Ecology), also known as the Tri-Party Agencies, encourage and support public participation and believe it is essential to cleanup success. Public involvement activities are conducted both collaboratively and independently by the Tri-Party Agencies. The Hanford Public Involvement Plan (http://www.hanford.gov/?page=89) (also known as the Community Relations Plan) describes public participation processes at Hanford and identifies ways the public can participate in Hanford Site cleanup decisions.

What's New for 2012?

- The Central Plateau section (Chapter 4) incorporates the relevant portions of the *Central Plateau Cleanup Completion Strategy* (DOE 2009a), updates the strategy, and supersedes that document. Chapter 4 more fully describes the post-2015 work that remains after completion of the *2015 Vision* work scope.

- The Tank Waste section (Chapter 5) has been substantially updated to better align with the *River Protection Project System Plan*, Revision 6 (DOE 2011e).

- All sections have been updated with cleanup progress through fiscal year (FY) 2011 including discussions of results from the *American Recovery and Reinvestment Act* (ARRA) funding of nearly $2 billion over a three-year period.

- Footprint reduction maps and discussions have been updated with the current definition of Hanford land segments. Some land segments have been transitioned from cleanup to long-term stewardship.

- A new section (Chapter 7) has been added that discusses the post-cleanup future for the Hanford Site including potential reuse of portions of the site. Returning cleaned up Hanford land to beneficial uses is a key component of completing DOE's work at the Hanford Site.

Summary

Cleanup of the Hanford Site is a complex and challenging undertaking. This document provides a comprehensive overview for completing Hanford's cleanup including the transition to post-cleanup/future activities. This framework describes three major components of cleanup – River Corridor, Central Plateau, and Tank Waste. It provides the context for individual cleanup actions by describing the key challenges and approaches for the decisions needed to complete cleanup.

The U.S. Department of Energy (DOE), as regulated by the U.S. Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology), is implementing a strategy to achieve final cleanup decisions for the River Corridor portion of the Hanford Site. The DOE Richland Operations Office (RL) and DOE Office of River Protection (ORP) have prepared this document to describe that strategy and approach for making cleanup decisions for the remainder of the Hanford Site.

While it is important to understand what this overview document is, it is just as important to understand what it is not. This document does not make or replace any regulatory decision nor is it a *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) or *Resource Conservation and Recovery Act* (RCRA) document. This document does not substitute for, nor preempt, the regulatory decision processes as set forth in the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989), also known as the Tri-Party Agreement, and applicable laws, regulations, and other legal requirements. DOE's intent is that this document will facilitate dialogue among the Tri-Party Agencies and with Hanford's diverse interest groups, including Tribal Nations, State of Oregon, Hanford Advisory Board, Natural Resource Trustees, and the public. Future cleanup decisions will be enhanced by an improved understanding of the challenges facing cleanup and a common understanding of the goals and approaches for cleanup completion.

The overarching goals for cleanup are stated in Figure S-1. These goals embody more than 20 years of dialogue among the Tri-Party Agencies, Tribal Nations, State of Oregon, stakeholders, and the public. They carry forward key values captured in forums such as the Hanford Future Site Uses Working Group, Tank Waste Task Force, Hanford Summits, and Hanford Advisory Board Exposure Scenario Workshops, as well as more than 250 advice letters issued by the Hanford Advisory Board (http://www.hanford.gov/page.cfm/hab). These goals help guide all aspects of Hanford Site cleanup. Cleanup activities at various areas of the site support the achievement of one or more of these goals. These goals help set priorities to apply resources and sequence cleanup efforts for the greatest benefit.

These goals reflect DOE's recognition that the Columbia River is a critical resource for the people and ecology of the Pacific Northwest. The 50-mile stretch of the river known as the Hanford Reach is the last free flowing section of the river in the country. As one of the largest rivers in North America, its waters support a multitude of uses that are vital to the economic and environmental well-being of the region and it is particularly important in sustaining the culture of Native Americans. Cleanup actions must protect this river.

Goals for Cleanup

Goal 1: Protect the Columbia River.

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

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

- Protect groundwater and the Columbia River.
- Shrink the active cleanup footprint to the Central Plateau.
- Support anticipated future land uses.

Goal 4: Clean up Central Plateau waste sites and facilities to:

- Protect groundwater.
- Minimize the footprint of areas requiring long-term waste management activities.
- Support anticipated future land uses.

Goal 5: Safely mitigate and remove the threat of Hanford's tank waste.

- Safely store tank waste until it is retrieved for treatment
- Construct and operate the Waste Treatment and Immobilization Plant
- Close tank farms and mitigate the impacts from past releases of tanks waste to the ground.

Goal 6: Safely manage and transfer legacy materials scheduled for off-site disposition including special nuclear material (including plutonium), spent nuclear fuel, transuranic waste, and immobilized high-level waste.

Goal 7: Consolidate waste treatment, storage, and disposal operations on the Central Plateau.

Goal 8: Develop and implement institutional controls and long-term stewardship activities that protect human health, the environment, and Hanford's unique cultural, historical and ecological resources after cleanup activities are completed.

Figure S-1. Goals for Cleanup

The Hanford Site cleanup consists of three major components: (1) River Corridor, (2) Central Plateau, and (3) Tank Waste (note that the Tank Waste component is contained within the geographic boundaries of the Central Plateau). Each component of cleanup is in itself a complex and challenging undertaking involving multiple projects and contractors and requiring many years and billions of dollars to complete. These components are shown in Figure S-2.

Active Cleanup Footprint Reduction. Active cleanup footprint reduction refers to completion of primary cleanup activities needed to meet cleanup requirements and conditions consistent with anticipated future land use (see DOE 2010c). In some areas, groundwater remediation systems may continue to operate for longer periods to meet cleanup goals. Active cleanup footprint reduction does not mean that site boundaries have been physically reduced or that land has been declared excess. Figure S-3 illustrates the principal components of active cleanup footprint reduction. The Hanford Reach National Monument lands (~290 square miles) surround the Hanford Site. These lands are primarily managed to preserve natural and cultural resources. A portion of the monument along the south shore of the Columbia River is included in cleanup of the River Corridor. DOE completed cleanup of the other portions of the national monument in FY 2011. The following sections describe the components of active cleanup footprint reduction that will occur beyond the footprint reduction due to the national monument: the River Corridor, Central Plateau, and Tank Waste.

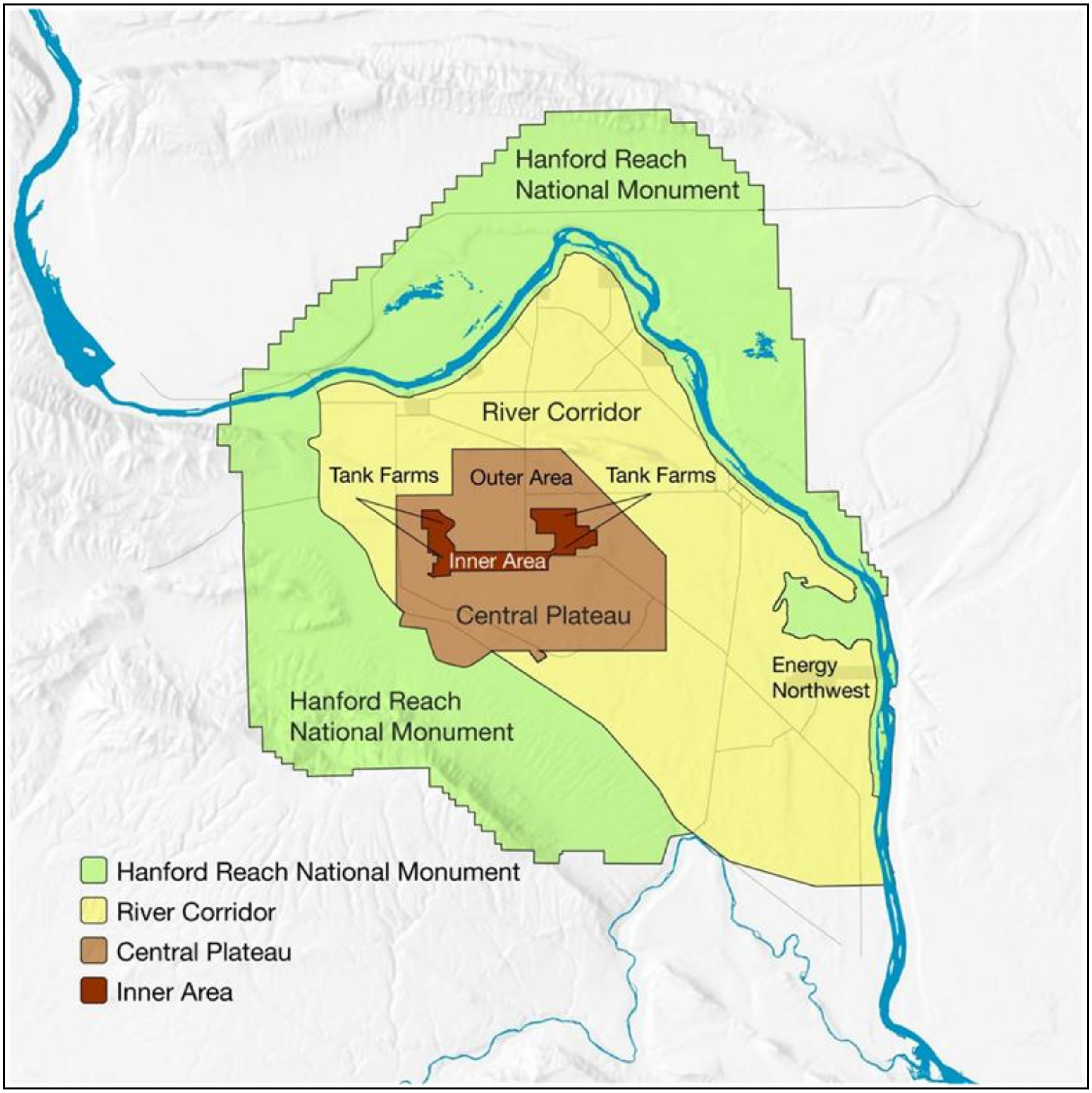

Figure S-2. Principal Components of Hanford's Cleanup Completion Framework: River Corridor, Central Plateau, and Tank Waste (Note: River Corridor Cleanup includes the south shore of the river that is part of the Hanford Reach National Monument.)

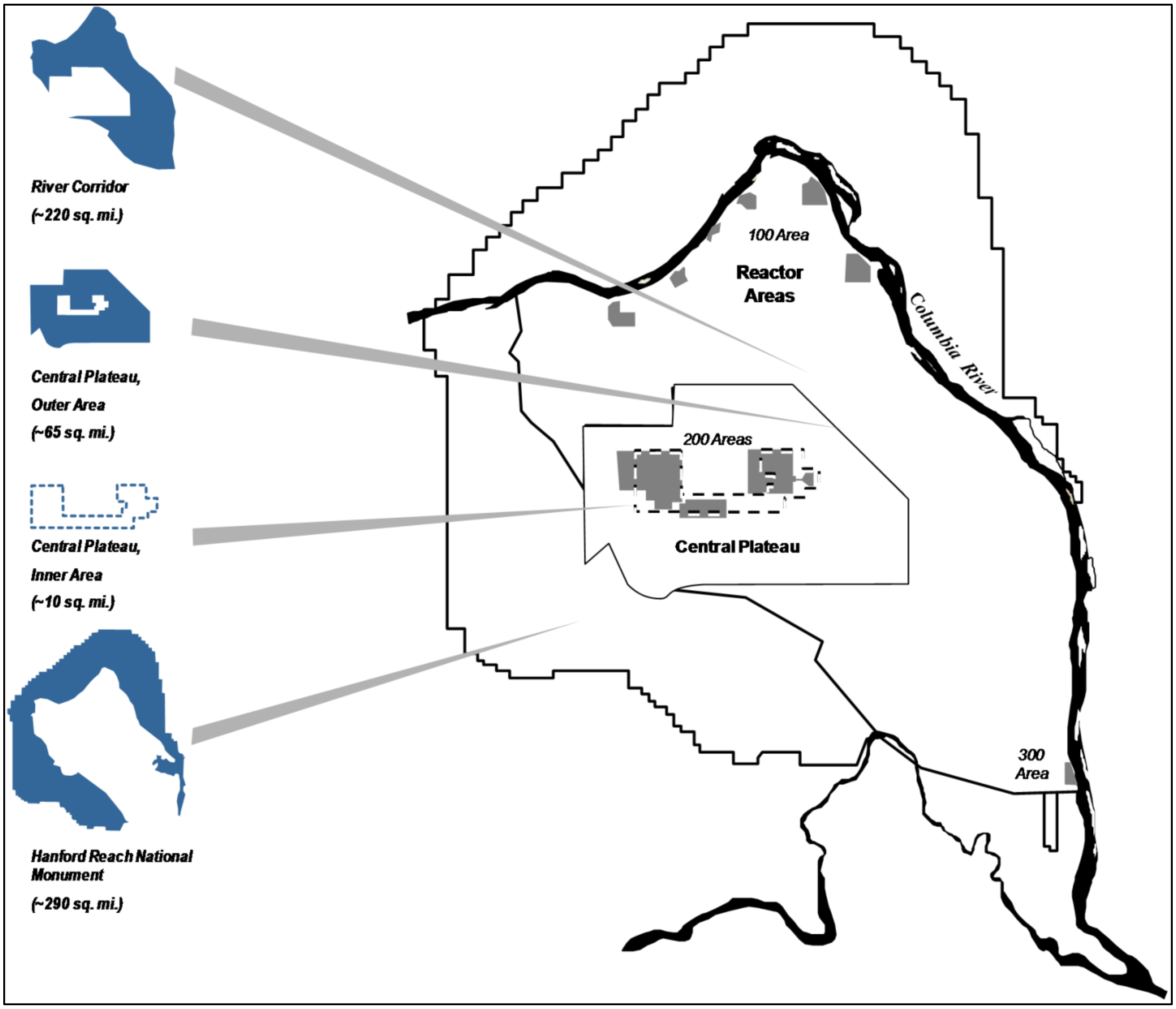

Figure S-3. Principal Components of Active Cleanup Footprint Reduction at Hanford
(from DOE 2010c)

River Corridor Cleanup. Cleanup of the River Corridor has been one of Hanford's top priorities since the early 1990s. This urgency is due to the proximity of hundreds of waste sites and contaminated facilities to the Columbia River. In addition, removal of the sludge from K West Basin, which is near the river, remains a high priority. (Refer to Chapter 3 for details about River Corridor cleanup.)

This component of cleanup includes approximately 220 square miles of the Hanford Site as shown in Figure S-3. The River Corridor portion of the Hanford Site includes the 100 and 300 Areas along the south shore of the Columbia River as well as considerable land area not directly affected by production operations (non-operational areas):

- The 100 Areas contains nine retired plutonium production reactors. These areas are also the location of numerous support facilities and solid and liquid waste disposal sites that have contaminated groundwater and soil.

- The 300 Area, located north of the city of Richland, contains fuel fabrication facilities, nuclear research and development facilities, and associated solid and liquid waste disposal sites that have contaminated groundwater and soil.
- Non-operational areas include substantial land area that was never used for locating production operations. The non-operational areas are adjacent to the 100 and 300 Areas and extend to the Central Plateau.

For purposes of this completion framework and to ensure that cleanup actions address all threats to human health and the environment, the River Corridor includes the adjacent areas that extend from the 100 Areas and 300 Area to the Central Plateau.

For sites in the River Corridor, remedial actions are expected to restore groundwater to drinking water standards and to ensure that the aquatic life in the Columbia River is protected by achieving ambient water quality standards in the river. In those instances where remedial action objectives are not achievable in a reasonable time frame, or are determined to be technically impracticable, programs will be implemented to contain contaminant plumes, prevent exposure to contaminated groundwater, and evaluate further risk reduction opportunities as new technologies become available. River Corridor cleanup work also relocates sources of contamination, which are close to the Columbia River, to the Central Plateau for final disposal. The intent is to shrink the footprint of active cleanup to within the 75-square-mile area of the Central Plateau by removing excess facilities and remediating waste sites. Cleanup actions will support anticipated future land uses consistent with the Hanford Reach National Monument, where applicable, and the *Hanford Comprehensive Land-Use Plan* (DOE 1999).

The River Corridor has been divided into six geographic decision areas to achieve source and groundwater remedy decisions. These decisions will provide comprehensive coverage for all areas within the River Corridor and will incorporate ongoing interim action cleanup activities. Cleanup levels will be achieved that support the anticipated land uses of conservation and preservation for most of this area and industrial use for the 300 Area. At the conclusion of cleanup actions, the federal government will retain ownership of most land in the River Corridor and will implement long-term stewardship activities to ensure protection of human health and the environment.

Central Plateau Cleanup. The Central Plateau component of cleanup includes approximately 75 square miles in the central portion of the Hanford Site as shown in Figure S-3. This component includes the Inner Area (~10 square miles) and the Outer Area (~65 square miles). The Inner Area contains the major nuclear fuel processing, waste management, and disposal facilities. The Inner Area will be dedicated to long-term waste management and containment of residual contamination. The Outer Area is that portion of the Central Plateau outside the boundary of the Inner Area. The Outer Area will be remediated to be protective of human health and the environment and the groundwater. Cleanup levels will support future reasonably anticipated land uses. Cleanup of the Outer Area is planned to be completed in the 2016 to 2020 time period as funding allows. Completing cleanup of the Outer Area will shrink the footprint of active cleanup by an additional 65 square miles leaving just the Inner Area remaining. (Refer to Chapter 4 for details about Central Plateau cleanup.)

Cleanup of the Central Plateau is a highly complex activity because of the large number of waste sites, surplus facilities, active treatment and disposal facilities, and areas of deep soil contamination. Past discharges of more than 450 billion gallons of liquid waste and cooling water to the soil have resulted in about 60 square miles of contaminated groundwater. Today, some plumes extend far beyond the plateau. Containing and remediating these plumes remains a high priority. For areas of groundwater contamination in the Central Plateau, the goal is to restore the aquifer to achieve drinking water standards. In those instances where remediation goals are not achievable in a reasonable time frame, programs will be implemented to contain the plumes, prevent exposure to contaminated groundwater, and evaluate further risk reduction opportunities as new technologies become available. Near-term actions will be taken to control plume migration until remediation goals are achieved.

At the completion of cleanup efforts, some residual hazardous and radioactive contamination will remain, both in surface disposal facilities and in subsurface media within portions of the Central Plateau. This portion of the Central Plateau is called the Inner Area. DOE's goal is to minimize the area used for long-term waste management activities that require institutional controls to ensure protection of human health and the environment.

The Central Plateau cleanup strategy includes the following elements:

- Implement groundwater treatment systems to contain contaminant plumes within the footprint of the Central Plateau, thereby protecting the Columbia River.
- Implement groundwater treatment alternatives, including active treatment, to restore the groundwater.
- Make and implement cleanup decisions in a geographic approach analogous to the geographic approach applied to the River Corridor.
- Develop and apply deep vadose zone treatment technologies to protect the groundwater.
- Make and implement cleanup decisions that are protective of human health and the environment and that support anticipated future land use.
- Remediate the outer portion of the Central Plateau to further reduce the active cleanup footprint of the Hanford Site.
- Remediate the inner portion of the plateau to make the area used for long-term waste management activities as small as practical.
- Regularly evaluate new and improved cleanup technologies to assess their potential to improve cleanup effectiveness and to allow for greater footprint reduction.

Tank Waste Cleanup. This component of cleanup lies within the Central Plateau Inner Area and is one of Hanford's most challenging legacies. The tank farms contain approximately 55 million gallons of radioactive waste stored in 177 underground tanks. Sixty-seven of these tanks have or are suspected to have leaked up to 1 million gallons of waste. In some areas, releases from some single-shell tank farms have reached groundwater. DOE expects these impacts to groundwater could increase in the future unless near-term actions are taken. Today, actions are being taken to slow the movement of those contaminants that were previously released. DOE is also containing and recovering those contaminants once they reach groundwater. A key step in reducing the risk that tank waste poses to human health and the environment is to retrieve as much waste from single-shell tanks as possible and put it into double-shell tanks. Then, the waste must be fed to the Waste Treatment Plant for processing and converted by a process called vitrification into solid glass waste forms.

The tasks of tank waste cleanup are to retrieve and treat Hanford's tank waste and close or remediate the tank farms within the Inner Area of the Central Plateau Area (see Figure S-2). Retrieval and treatment of tank waste will remain a difficult task facing completion of cleanup. These efforts will protect the groundwater on the Central Plateau, thereby protecting the Columbia River.

The tank waste cleanup strategy includes the following elements:

- Protecting human health and safety and the environment by safely storing tank waste until it is retrieved for treatment and by mitigating the impacts from past releases of tank waste to the ground.
- Constructing and operating the Waste Treatment and Immobilization Plant (WTP), which will vitrify both the high-level and the low-activity portions of the tank waste.
- Developing and potentially deploying additional treatment capability to safely treat the remainder of the low-activity waste that exceeds the capacity of the WTP currently under construction.
- Deploying interim storage capacity for the immobilized high-level waste pending determination of the final disposal pathway.
- Disposing of packaged immobilized low-activity waste onsite.
- Closing the single-shell and double-shell tank farms, ancillary facilities, and associated waste management and treatment facilities.
- Optimizing the overall mission by resolving technical and programmatic uncertainties; upgrading the tank farms to provide a steady, well-balanced feed to the WTP; and performing analyses to optimize treatment capacity and methods and the amount of immobilized high-level waste and immobilized low-activity waste.

Long-Term Stewardship. Following completion of Hanford Site cleanup actions, land areas will be placed into long-term stewardship. DOE has established the Hanford Long-Term Stewardship Program to ensure continued protectiveness of cleanup remedies, as defined by CERCLA and RCRA cleanup decision documents, and to ensure protection of natural resources, the environment, and human health. Long-term stewardship will include monitoring and maintenance activities to ensure continued protectiveness.

Post-Cleanup Future Activities. As cleanup of areas of the Hanford Site reach completion, e.g., the River Corridor and the buffer zone lands of the Hanford Reach National Monument, there is renewed interest in conversations regarding future uses for that land. Future activities will be bounded by the *Hanford Comprehensive Land-Use Plan* (DOE 1999), which defines land uses after cleanup is complete. Much of Hanford's 586 square miles is designated for conservation-preservation and is consistent with National Monument uses. However, more than 60 square miles close to the City of Richland is set aside for industrial uses. Returning cleaned up Hanford lands to beneficial uses – whether for area Tribal Nations to practice traditional cultural activities, for residents to enjoy areas along the river for the first time since the 1940s, for attracting businesses to the region, or to preserve open spaces in perpetuity – is a key objective of DOE's work at the Hanford Site.

Acronyms

AEA	*Atomic Energy Act*
ALE	Arid Lands Ecology (Reserve)
ARRA	*American Recovery and Reinvestment Act*
CCP	Hanford Reach National Monument Comprehensive Conservation Plan and Environmental Impact Statement
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOE-ORP	U.S. Department of Energy, Office of River Protection
Ecology	Washington State Department of Ecology
EIS	environmental impact statement
EPA	Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FFTF	Fast Flux Test Facility
FY	fiscal year
NEPA	*National Environmental Policy Act*
NPL	National Priorities List
NRDA	National Resource Damage Assessment
OSWER	(EPA) Office of Solid Waste and Emergency Response
PFP	Plutonium Finishing Plant
PUREX	Plutonium Uranium Extraction (Plant)
RCRA	*Resource Conservation and Recovery Act*
RCW	Revised Code of Washington
REDOX	Reduction-Oxidation (Plant)
TRIDEC	Tri-Cities Development Council
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
Tri-Party Agencies	U.S. Department of Energy, Environmental Protection Agency, Washington State Department of Ecology
USFWS	U.S. Fish and Wildlife Service
WAC	Washington Administrative Code
WTP	Waste Treatment and Immobilization Plant

Contents

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1.0 Introduction

Cleanup of the Hanford Site is a complex and challenging undertaking. This document provides a comprehensive overview of Hanford cleanup. Cleanup will require many individual decisions. This document shows how single decisions lead to completion of cleanup for the site as a whole, i.e., (1) it describes the technical challenges facing cleanup, (2) it describes the approaches for making decisions for three major components of cleanup, and (3) it describes the actions needed to move from cleanup to post-cleanup activities.

When faced with any single cleanup decision, Hanford's stakeholders have long desired a broader view of how that one decision fits with other Hanford cleanup decisions. It is in response to those desires that the two Hanford Site cleanup offices – DOE's Richland Operations Office (DOE-RL) and DOE's Office of River Protection (DOE-ORP) – have prepared this document. In doing so, DOE hopes to make the long and complex task of cleaning up the Hanford Site more understandable to all interested parties. Through improved understanding, more effective involvement in cleanup decisions will result.

1.1 Purpose of the Document

The purpose of this document[1] is to provide a comprehensive description for completing Hanford's cleanup mission including the transition to post-cleanup activities. This document does not make or replace any regulatory decisions. This framework defines the principal components of cleanup – River Corridor, Central Plateau, and Tank Waste – and provides the context for individual cleanup actions by providing the approaches and key guiding principles for those decisions needed to complete Hanford cleanup. This framework also defines the relationships among the principal Hanford cleanup components, i.e., River Corridor, Central Plateau, and Tank Waste.

DOE, as regulated by the U.S. Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology), is implementing a strategy to achieve cleanup decisions for the River Corridor portion of the Hanford Site (DOE 2009b). DOE-RL and DOE-ORP have prepared this document to describe the general approach to complete the remainder of the cleanup mission.

This document guides the reader to other information that will aid in learning about cleanup decisions. This document does not make regulatory decisions nor does it describe future budgets. However, it is DOE's intent that this document will facilitate continued constructive dialogue with the Tri-Party Agencies, Tribal Nations, State of Oregon, stakeholders and the public resulting in a common understanding of the goals and approaches for cleanup completion. DOE recognizes that this document does not substitute for, nor preempt, the regulatory decision processes as set forth in the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989), also known as the Tri-Party Agreement, and applicable laws, regulations, and other legal requirements.

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[1] This document replaces the *River Corridor Cleanup Strategy* (DOE 2002b) from September 2002. This document also updates and replaces the *Hanford Site End State Vision* (DOE 2005) and meets the requirements of DOE Policy 455.1. This document updates and replaces the *Central Plateau Cleanup Completion Strategy* (DOE 2009a).

1.2 Organization of the Document

The introduction defines the three principal components of Hanford's cleanup mission and articulates the over-arching goals that guide cleanup. Chapter 2 provides background regarding Hanford's cleanup mission, including the transition from a mission of plutonium production (1943 – 1989) to the mission of waste management and environmental cleanup (1989 to present). Chapter 2 also provides background information on land-use plans, the regulatory framework for making cleanup decisions, and the role of the Natural Resource Injury Assessment process. Chapters 3, 4, and 5 describe the strategies for completion of the River Corridor, Central Plateau, and the Tank Waste components, respectively. These sections also describe the primary areas of interaction and coordination between each component. Chapter 6 describes the final stages of completing cleanup including maintaining institutional controls and long-term stewardship of the site. Chapter 7 describes current thinking regarding returning portions of the site that have been cleaned up to beneficial uses. Appendix A describes Hanford's 2015 Vision and lists the key performance measures to be achieved.

1.3 Components of Hanford's Cleanup

This framework document defines the main components of cleanup. The River Corridor and Central Plateau represent the two main geographic areas of cleanup work. The River Corridor includes the former fuel fabrication and reactor operations areas. This region is adjacent to the Columbia River and cleanup must deal with the threats to that valuable resource. The Central Plateau includes the former fuel processing facilities and numerous waste disposal facilities. Included within the Central Plateau is one of Hanford's most significant challenges – Tank Waste cleanup. Thus, this framework describes the three main components of cleanup – River Corridor, Central Plateau, and Tank Waste. Each of these components of cleanup is in itself a complex and challenging task requiring many years and billions of dollars to complete. These components are shown in Figure 1-1.

The River Corridor component includes approximately 220 square miles of the Hanford Site as shown in Figure 1-1. The River Corridor portion of the Hanford Site includes the 100 and 300 Areas along the south shore of the Columbia River. The 100 Area contains nine retired plutonium production reactors, numerous support facilities, solid and liquid waste disposal sites, contaminated groundwater, and uncontaminated areas. The 300 Area, located north of the city of Richland, contains former fuel fabrication facilities, nuclear research and development facilities, associated solid and liquid waste disposal sites, and contaminated groundwater. The River Corridor encompasses the 100 Area and 300 Area National Priorities List sites. For purposes of this completion framework and to ensure that cleanup actions address all threats to human and environmental health, the River Corridor component includes the contiguous areas that extend from the 100 Areas and 300 Area to the Central Plateau boundaries.

The Central Plateau component[2] includes approximately 75 square miles in the central portion of the Hanford Site as shown in Figure 1-1. This region contains the 200 East and 200 West Areas that have

[2] The Central Plateau cleanup includes two distinct portions of the Central Plateau – Inner Area and Outer Area. The Outer Area is approximately 65 square miles and will be cleaned up to levels comparable to the River Corridor. The Inner Area is about 10 square miles and is the area dedicated to waste management and containment of residual contamination. Chapter 4 provides additional details regarding these two areas.

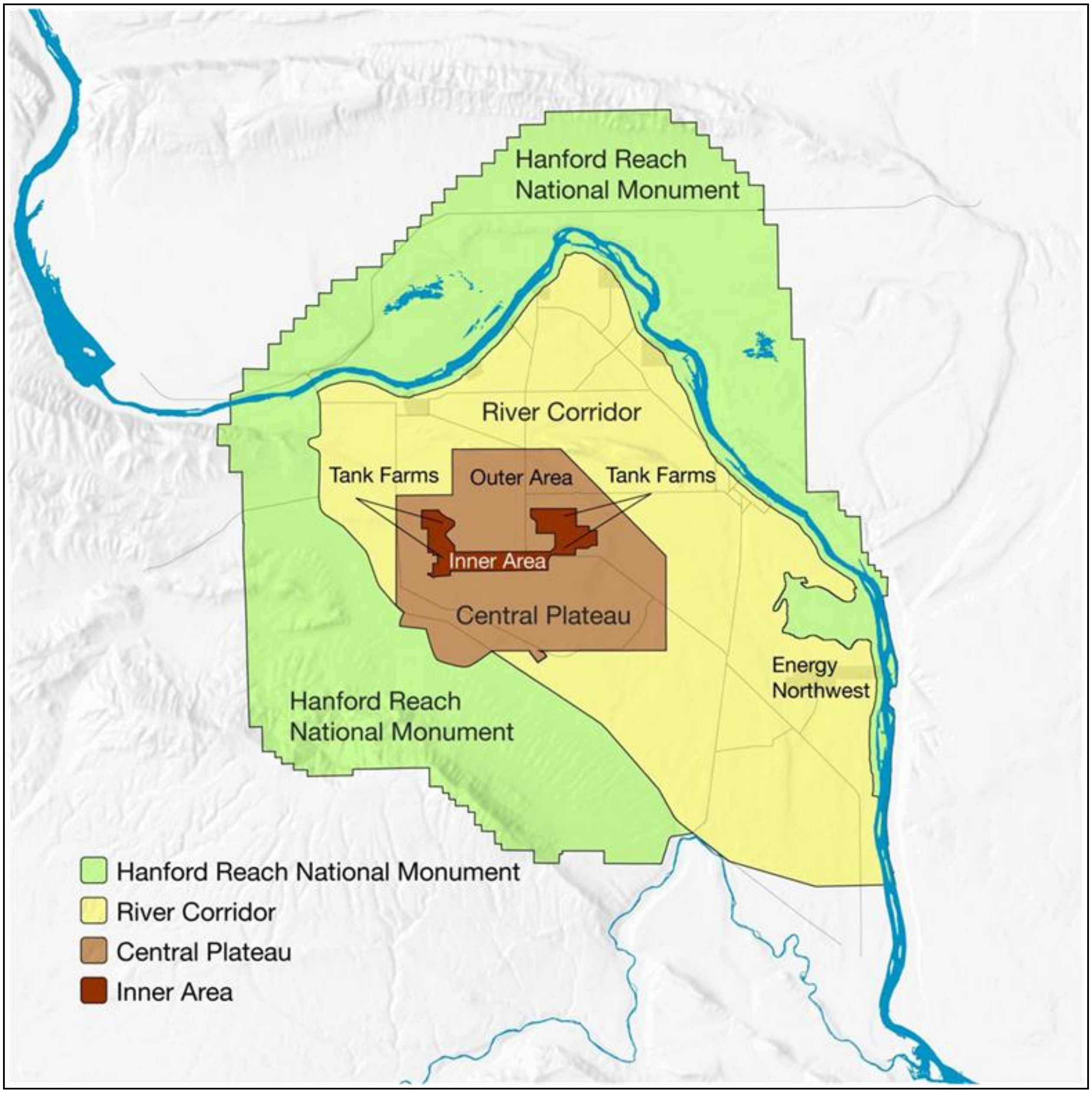

Figure 1-1. Principal Components of Hanford's Cleanup Completion Framework: River Corridor, Central Plateau, and Tank Waste

been used primarily for nuclear fuel processing, waste management and disposal activities. The Central Plateau encompasses the 200 Area National Priorities List (NPL) site. The Central Plateau has a large inventory of processing and support facilities, tank systems, liquid and solid waste disposal and storage facilities, utility systems, and contaminated groundwater.

Within the Central Plateau, the Tank Waste component (i.e., inside the Inner Area in Figure 1-1) includes retrieving and treating Hanford's tank waste and closing tank farms to protect the groundwater on the Central Plateau, thereby protecting the Columbia River. The tank farms include 177 underground storage tanks (149 single-shell tanks and 28 double-shell tanks) containing approximately 55 million gallons of chemically hazardous radioactive waste from past nuclear processing operations.

1.4 Goals for Cleanup

The overarching goals for cleanup are stated and discussed in the following paragraphs. These goals reflect more than 20 years of dialogue among the Tri-Party Agencies, Tribal Nations, State of Oregon, stakeholders, and the public. They carry forward key values captured in forums such as the Hanford Future Site Uses Working Group, Tank Waste Task Force, Hanford Summits, and Hanford Advisory Board Exposure Scenario Workshops, as well as more than 250 advice letters issued by the Hanford Advisory Board. These goals provide a set of principles that guide all aspects of Hanford Site cleanup. Cleanup activities at various areas of the site support the achievement of one or more of these goals. These goals help set priorities to apply resources and sequence cleanup efforts for the greatest benefit.

Goal 1: Protect the Columbia River.

The Columbia River is a critical resource to the people of the Pacific Northwest. As one of the largest rivers in North America, its waters support a multitude of uses that are vital to the economic and environmental well-being of the region. These uses include irrigating crops, generating hydroelectric power, providing outdoor recreation, serving as a transportation route, supplying drinking water, and providing habitat for native plants, fish, and wildlife. In addition, the Columbia River and its salmon are vital aspects of the Native American culture and, through established treaties, Tribal Nations retain the right to fish at usual and accustomed places along the Columbia River. Cleanup actions must protect this river.

EPA Policy for Groundwater Restoration

DOE's approach to groundwater cleanup is fully consistent with EPA policy:

> *EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the sites. When restoration of ground water to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated ground water, and evaluate further risk reduction.* [From 40 CFR 300.430(a)(1)(iii)(F), see also EPA OSWER Directive 9283.1-33, June 2009. EPA 2009].

The term "beneficial use" is established by federal policy. At Hanford, beneficial use will usually mean a level that supports use as a source of drinking water. But for some contaminants (e.g., hexavalent chromium), a more stringent cleanup level is set to ensure protection of aquatic life in the Columbia River.

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

For sites in the River Corridor, remedial actions are expected to restore groundwater to drinking water standards, and in those cases where groundwater discharges may impact surface water, ensure that the water quality criteria for aquatic life are achieved in areas where Hanford groundwater reaches the Columbia River.

For areas of groundwater contamination in the Central Plateau, the goal is to restore the aquifer to achieve drinking water standards. In those instances where remediation goals are not achievable in a reasonable time frame, programs will be implemented to contain contaminated groundwater, prevent exposure to contaminated groundwater, and evaluate further risk reduction opportunities as new technologies become available. Near-term actions will be taken when appropriate to control plume migration until remediation goals are achieved.

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

- Protect groundwater and the Columbia River.
- Shrink the active cleanup footprint to the Central Plateau.
- Support reasonably anticipated future land uses.

Cleanup of the River Corridor has been one of Hanford's top priorities since the early 1990s. This urgency is due to the proximity of hundreds of waste sites to the Columbia River. River Corridor cleanup work will remove potential sources of contamination that are close to the Columbia River to a disposal facility in the Central Plateau or to other disposal facilities as appropriate. To the extent practicable, cleanup actions will restore groundwater and protect the Columbia River. The intent is to shrink the footprint of active cleanup to within the Central Plateau by removing excess facilities and remediating waste sites within the River Corridor. Cleanup actions will support reasonably anticipated future land uses (see Chapter 2). The Hanford Reach National Monument (see Chapter 2) includes a ¼-mile-wide corridor on the south and west sides of the Columbia River that is included in cleanup of the River Corridor.

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

- Protect groundwater.
- Minimize the footprint of areas requiring long-term waste management activities.
- Support reasonably anticipated future land uses.

The Central Plateau has been used for waste management (treatment, storage, and disposal) operations since the beginning of Hanford's production mission. This makes the cleanup of the Central Plateau a highly complex activity because of the large number of waste sites, surplus facilities, active treatment and disposal facilities, and areas of deep soil contamination. Past discharges of more than 450 billion gallons of liquid waste and cooling water to the soil have resulted in about 60 square miles of contaminated groundwater. Today, some plumes extend far beyond the plateau. Containing and remediating these plumes remains a high priority and remediation of Central Plateau waste sites and facilities must be protective of groundwater. In addition, to enable cleanup of the River Corridor, waste and debris are relocated to the Central Plateau for final treatment, storage, or disposal. DOE's goal is to minimize the area requiring long-term waste management activities for protection of human health and the environment. For the foreseeable future, it is expected that a core portion of the plateau, called the Inner Area, will remain a waste management area and could support compatible federal government activities.

Goal 5: Safely mitigate and remove the threat of Hanford's tank waste.

- Safely store tank waste until it is retrieved for treatment
- Construct and operate the Waste Treatment and Immobilization Plant
- Close tank farms and mitigate the impacts from past releases of tanks waste to the ground.

Hanford has 149 single-shell tanks and 28 double-shell tanks containing approximately 55 million gallons of chemically hazardous radioactive waste from past nuclear processing operations. Sixty-seven of Hanford's tanks have, or are suspected to have, collectively leaked approximately 1 million gallons of waste into the ground. The cornerstone of tank waste cleanup is the construction and operation of the WTP. This facility will use a proven technology – called vitrification – to immobilize tank waste within an exceptionally sturdy form of glass to isolate it from the environment. Removing the threat of tank waste also requires safe storage of the waste until it is retrieved for treatment and mitigation of the impacts from past releases of tank waste to the ground.

Goal 6: Safely manage and transfer legacy materials scheduled for off-site disposition including special nuclear material (including plutonium), spent nuclear fuel, transuranic waste, and immobilized high-level waste.

Among the waste management operations underway within the Central Plateau is the management of spent nuclear fuel and high-level waste management. Some of these materials are yet to be generated, e.g., immobilized high-level waste from Hanford's tanks; therefore, safe management of these materials will be required for many decades.

Goal 7: Consolidate waste treatment, storage, and disposal operations on the Central Plateau.

To support cleanup of the entire Hanford Site, treatment, storage, and disposal facilities will continue to be used and in some cases expanded from current capabilities, e.g., disposal of immobilized low-activity waste from tank waste processing and systems for treatment of contaminated groundwater. It is DOE's intent to consolidate these services within the Inner Area of the Central Plateau. As a scoping document to the *Hanford Comprehensive Land-Use Plan* (DOE 1999), the *Hanford Future Site Uses Working Group* (Hanford Future Site Uses Working Group 1992) recommended:

> "***Use the Central Plateau Wisely for Waste Management.*** *Wastes would be moving in the Central Plateau from across the site. Waste storage, treatment and disposal activities in the Central Plateau should be concentrated within this area as well, whenever feasible, to minimize the amount of land devoted to, or contaminated by, waste management activities.*"

> **Goal 8:** Develop and implement institutional controls and long-term stewardship activities that protect human health, the environment, and Hanford's unique cultural, historical, and ecological resources after cleanup activities are completed.

Completion of cleanup will not result in the total elimination of all contamination from the site. Long-term controls will be necessary to ensure protection of human health and the environment. These controls need to be developed from a holistic, or site-wide, perspective. Ensuring the effectiveness of the long-term institutional controls is a major component of Hanford's Long-Term Stewardship Program.

1.5 Vision for Completion

Figure 1-2 illustrates the successive stages of Hanford Site cleanup. As cleanup progress is made, the portion of the site undergoing cleanup shrinks – the top series of maps. At the same time, corresponding portions of the site are made suitable for potential future uses – the bottom series of maps. The bottom series of maps shows the land-use designations established by the *Hanford Comprehensive Land-Use Plan* (DOE 1999) and record of decision (64 FR 61615). As of 2012, cleanup has been completed for most of the Hanford Reach land. In addition, cleanup of the initial land segments of the River Corridor and Outer Area of the Central Plateau has been completed. By the end of 2016, most of the River Corridor land segments will be complete. A portion of the 100 K Area will continue to require cleanup beyond 2016. DOE's goal is to complete cleanup of this small area no later than 2020. Surplus production reactors will remain in these segments and will be placed in an interim safe storage configuration (except for B Reactor). Also, groundwater treatment systems will continue to operate until cleanup goals are reached or further cleanup is judged to be impractical.

By 2020, the cleanup of the remainder of the Outer Area of the Central Plateau will be complete depending on the availability of funding. The Inner Area (~10 sq. miles) contains some of the most difficult cleanup challenges at Hanford including: deep vadose zone waste sites, tank farms, legacy burial grounds, and canyon facilities (see Chapters 4 and 5). In addition, waste management operations will be carried out within the Inner Area. These operations include the Waste Treatment Plant, solid and liquid waste management, and active disposal of on-site generated waste. These operations are expected to continue as long as active treatment operations are needed, e.g., to support the treatment of tank waste through 2050 or beyond.

This overall approach of shrinking the portion of the site dedicated to continued waste management is a core feature of Hanford's cleanup approach. The Inner Area of the Central Plateau receives the contaminated soil and debris removed from the River Corridor and from the Outer Area. i.e., it makes cleanup of the rest of the site possible.

1.6 Priorities for Completing Hanford Site Cleanup

While this Completion Framework is not a budget document, it is important for DOE to state its priorities for cleanup. These priorities help to guide budget requests and ensure that cleanup funds support DOE's vision for completing cleanup. Cleanup priorities help DOE schedule portions of work and allocate cleanup funds to achieve the most benefit. Not all work can be done at the same time. Initial cleanup efforts focused on immediate threats such as tanks with safety hazards and spent fuel stored in leaking storage basins near the Columbia River. One of Hanford's highest priorities is completing construction of the WTP. WTP will enable DOE to begin treatment of 55 million gallons of radioactive and chemically hazardous tank waste. DOE also places a high priority on activities that provide the greatest benefit to the environment and public health (e.g., cleanup of waste sites and groundwater close to the Columbia River) and activities that, once they are completed, will free funds for additional cleanup (e.g., removal of the Plutonium Finishing Plant Complex). Table 1-1 shows DOE's priorities for several time periods.

Hanford's 2015 Vision (see Appendix A) continues to drive Hanford's most immediate cleanup priorities. These priorities include:

- Complete most cleanup actions within the River Corridor to eliminate hazards near the Columbia River and to significantly reduce the active cleanup footprint.
- Install groundwater treatment systems in both the River Corridor and Central Plateau to put Hanford on a path to meet groundwater cleanup standards.
- Complete removal and remediation of the Plutonium Finishing Plant, Hanford's highest hazard nuclear facility, to reduce the safety hazard and eliminate the continuing cost of required safety systems.

Hanford Lifecycle Scope, Schedule and Cost Report

The Tri-Parties negotiated a milestone (M-036-01A) that calls for DOE to prepare an annual report "setting out the lifecycle scope, schedule and cost for completion of the Hanford Site cleanup mission. The report shall reflect all of those actions necessary for the DOE to fully meet all applicable environmental obligations…" The initial report was published in July 2011 (DOE 2011a) and the second report was published in January 2012 (DOE 2012a). The report encompasses the work scope of both DOE-RL and DOE-ORP including the Waste Treatment and Immobilization Plant. The report also includes post-closure activities (including monitoring) so as to provide a complete understanding of the resources necessary for completing the Hanford cleanup mission.

Also in the 2015 timeframe, DOE-ORP is focused on continuing construction of the WTP, completing retrieval of the remaining single shell tanks in the C Tank Farm, and building the waste feed delivery infrastructure that will be needed to support WTP operations. During the post-2015 time frame (2016 through 2020), DOE-RL will complete cleanup actions for the K Area, obtain final remedy decisions for the Central Plateau, and upgrade the infrastructure to support cleanup of the Central Plateau. During this timeframe, DOE-ORP will complete WTP construction and begin startup operations including use of new feed delivery systems. These priorities also reflect commitments within the Tri-Party Agreement.

In carrying out work, DOE maintains the utmost attention and priority on the safety of the public and workers. DOE and its contractors maintain Integrated Safety Management Systems (DOE Policy 450.4 and DOE Guide 450.4-1B) and associated policies and procedures to ensure that work is conducted in a manner that ensures protection of the public, workers, and the environment. In addition, DOE maintains a policy that allows workers to stop work that they deem to pose an "imminent danger" or "serious hazard." DOE is committed to a strong safety culture and a work-place environment that thrives on feedback and improvement.

The remainder of this document describes DOE's framework for reaching decisions for all areas of the Hanford Site to support completion of Hanford Site cleanup.

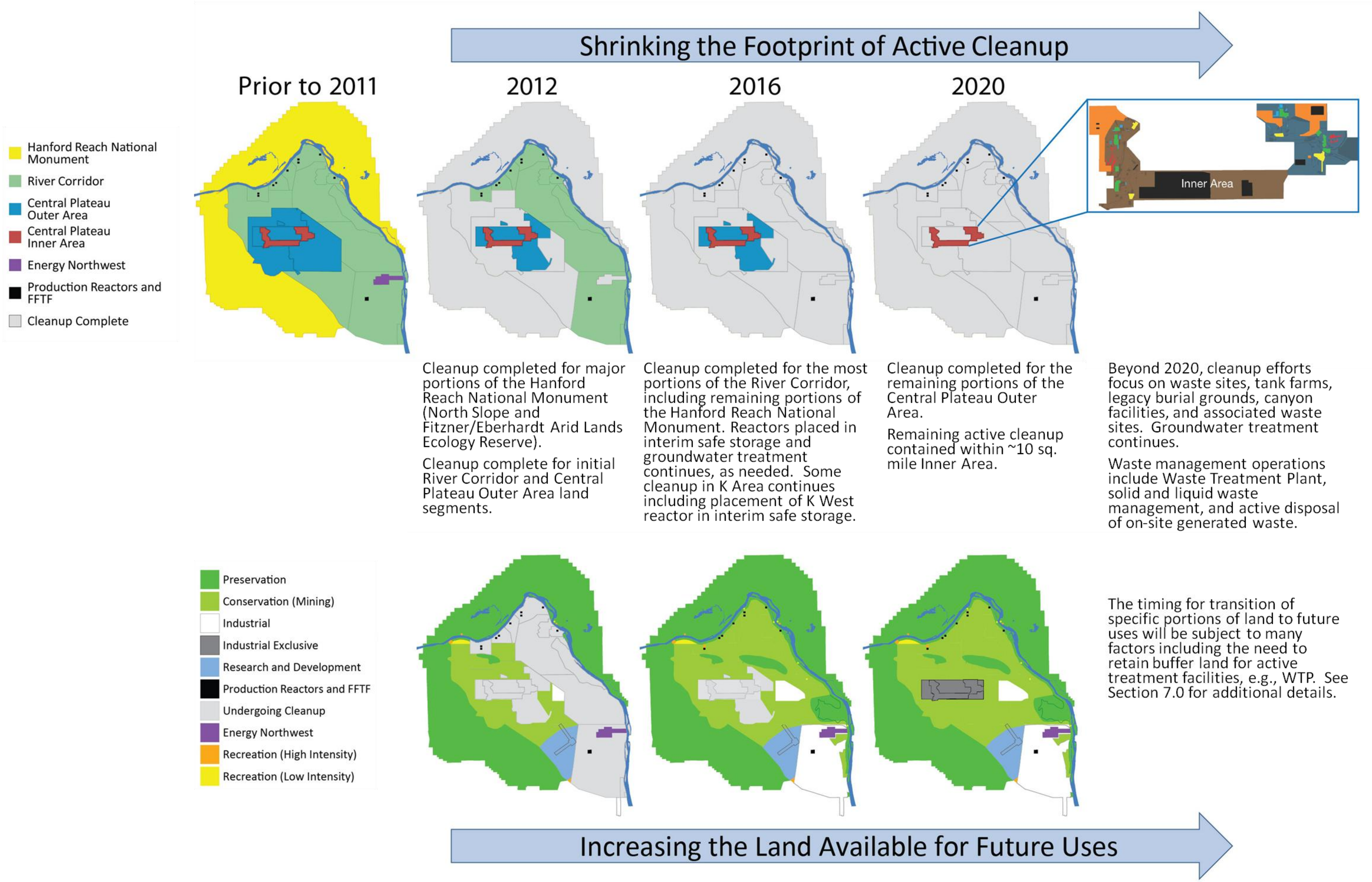

Figure 1-2. Successive Stages of Hanford Site Completion

Table 1-1. Time-Phased Cleanup Priorities for Hanford Site Cleanup Completion[3]

	Now - 2015	2016 - 2020	2021 - Completion
River Corridor	• Complete waste site remediation per interim records of decision for 100 Areas and 300 Area • Obtain final records of decision • Commence site remediation per records of decision • Complete surplus facility removal in 100 Areas and 300 Area • Complete installation of final groundwater remedies in all areas; stop chromium in excess of standards from entering the Columbia River, implement remedies for strontium-90 and 300 Area uranium • Complete transition of seven of nine surplus production reactors to interim safe storage configuration (not K West or B Reactor) • Remove sludge from K West Basin • Complete transition of Fast Flux Test Facility to surveillance and maintenance	• Transition areas for which cleanup has been completed to long-term stewardship • Complete interim safe storage for KW reactor • Continue surveillance and maintenance of Fast Flux Test Facility (FFTF) • Demolish K West Basin and complete K Area cleanup • Continue to operate groundwater remediation systems	• Complete final actions for surplus production reactors (e.g., remove or entomb) • Complete final action for Fast Flux Test Facility (e.g., remove or entomb) • Return to DOE-RL the four 300 Area facilities retained for near-term use by DOE Office of Science; remove facilities and remediate waste sites • Transition remaining areas to long-term stewardship
Central Plateau	• Complete removal of Plutonium Finishing Plant complex • Complete construction and begin operation of 200 West Area groundwater treatment system • Implement groundwater remedies for 200 West Area • Initiate cleanup of Outer Area • Continue retrieval, packaging and offsite shipment of retrievable-stored transuranic materials • Continue decision documentation supporting final decisions for the Inner Area, Outer Area, and any remaining groundwater operable units	• Obtain final decisions for Inner Area and Outer Area operable units • Complete remediation of Outer Area waste sites • Complete remediation of the U Plant Canyon • Complete remediation of the first Inner Area zone and start cleanup of additional Inner Area zones • Begin sludge treatment • Obtain final decision and implement final remedies for 200 East Area groundwater operable units • Continue to operate groundwater remediation systems • Initiate implementation of remedies for deep vadose zone contamination • Retrieve and ship transuranic waste to the Waste Isolation Pilot Plan • Construct and operate solid waste treatment capability for large box and remote-handled waste • Move cesium/strontium capsules to dry storage	• Complete cleanup of Inner Area geographic zones – waste site remediation, facility cleanup, and treatment, storage, and disposal facility closure • Provide waste disposal capability for WTP operations • Complete packaging and offsite shipment of transuranic materials • Complete canyon cleanup and implement remedy configuration • Complete active groundwater treatment operations • Complete transition to of Outer Area to long-term stewardship and Inner Area to long-term waste management • Continue safe storage of spent fuel and transport to a national repository or consolidation center.
Tank Waste	• Continue construction of Waste Treatment Plant (WTP) • Complete waste retrieval from C Farm tanks • Maintain and upgrade tank farm infrastructure • Develop waste feed delivery infrastructure • Mitigate impacts from past tank leaks	• Complete WTP construction • Start up and commission WTP • Close C Tank Farm; demonstrate closure methods and approaches for future single shell tank farms • Implement waste feed delivery systems and tank infrastructure to support WTP operation • Begin operation of the Integrated Disposal Facility and provide storage for immobilized high-level waste • Upgrade liquid effluent treatment capability to accommodate WTP operations	• Achieve initial plan operations for WTP (2022) • Continue tank waste retrieval – 9 tanks beyond C tank farm by 2022 and complete all SSTs by 2040 • Implement supplemental treatment capacity, as necessary • Close all single shell tanks (2043) • Complete treatment of tank waste (2047) • Close all double shell tanks (2052)

[3] Most of these activities support achievement of a Tri-Party Agreement milestone. More specific details of the scope, schedule and cost for all cleanup activities will be contained in the annual *Hanford Lifecycle Scope, Schedule and Cost Report* (DOE 2011a) required by a new Tri-Party Agreement milestone, M-036-01A.

2.0 Background for Cleanup Decision Making

2.1 Hanford's Past and Present Missions

Established in 1943, the Hanford Site's original mission was to produce plutonium for national defense. As a result, nine nuclear reactors were built along the banks of the Columbia River as the defense mission continued throughout the Cold War years. Uranium metal was received in the 300 Area and fabricated into fuel rods suitable for loading into nuclear reactors. The fuel rods were placed in the reactors in the 100 Areas and irradiated by nuclear fission reactions. Past waste disposal practices for the 100 Area reactors resulted in releases of radionuclides and other chemicals to soil and groundwater near the reactors. The primary source of these contaminants was cooling water that flowed through the reactor core, leaks in the reactor cooling water transfer systems, and intentional effluent disposal into cribs and trenches. In addition, solid waste containing radionuclides and chemicals was buried in unlined landfills to isolate the waste from ongoing operations.

The irradiated fuel rods were taken to the 200 Areas, where plutonium and uranium were separated from the residual activation and fission products using chemical separation processes. Chemical separations process facilities were located in both the 200 East and 200 West Areas. When the separation facilities were operating, large quantities of liquid waste (including cooling water) containing radionuclides and chemicals were discharged to the soil column and percolated into the vadose zone, i.e., the area between the surface of the land and the water table. Liquid waste was discharged to surface ponds and ditches or to underground cribs, reverse wells, and french drains. These infiltration facilities were generally located in the 200 Areas near the processing facilities.

This type of plutonium production ended at Hanford in 1988. However, more than 40 years of plutonium production created large amounts of radioactive and chemically hazardous waste. In 1989, with the cessation of plutonium production at Hanford, the site's mission shifted to waste management and environmental cleanup. The Tri-Party Agencies signed a cleanup agreement (Ecology et al. 1989) and the task of cleaning up the site began.

At the very beginning of cleanup efforts, the focus was to resolve immediate threats, e.g., tanks with immediate safety hazards, spent nuclear fuel stored in leaking basins near the Columbia River, and unstable plutonium. Cleanup has now reached the point where most immediate risks have been resolved and the task of mitigating the long-term risks is underway. Groundwater remains contaminated and contamination is present in the vadose zone representing a continuing threat to groundwater. Additionally, the majority of the waste in the single- and double-shell tanks remains to be retrieved, treated, and disposed.

2.2 Tri-Party Agreement and the Framework for Decision Making

DOE, EPA, and Ecology signed a cleanup and compliance agreement on May 15, 1989. The *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989), known as the Tri-Party Agreement, is a CERCLA federal facility agreement, a RCRA corrective action order, and a *Hazardous Waste Management Act* (RCW 70.105) consent order. It is a framework for implementing many of the environmental regulations that apply to Hanford. The agreement establishes the milestones for achieving compliance with CERCLA remedial action provisions and with RCRA treatment, storage, and disposal unit regulations and corrective action provisions. More specifically, the Tri-Party Agreement includes but is not limited to (1) cleanup commitments, (2) agency cleanup responsibilities, (3) enforceable milestones to achieve regulatory compliance and remediation, and (4) a basis for budgeting and requesting funds from Congress to support cleanup commitments. In addition to the Tri-Party Agreement, cleanup commitments are defined by a legally binding judicial Consent Decree (2010). The consent decree established new, enforceable commitments for cleaning up waste from Hanford's underground tanks.

2.2.1 Regulatory Processes

The primary regulatory processes that must be implemented and integrated to achieve cleanup decisions include the following:

- The CERCLA process guides cleanup decisions for most waste sites, canyon facilities, and structures that contain radioactive contamination or other hazardous substances. The Tri-Party Agreement also identifies a subset of waste sites as "RCRA past-practice"[4] sites. The Tri-Party Agreement establishes the expectation that either a RCRA corrective action[5] or a CERCLA cleanup will satisfy the requirements of both laws. In practice, this expectation becomes problematic because RCRA authority does not extend to radionuclides (e.g., see Section 2.2.2 regarding RCRA/CERCLA integration). Regardless of this issue with RCRA, Hanford cleanup of radionuclides in RCRA waste sites will be protective of human health and the environment and consistent with CERCLA cleanup practices and *Atomic Energy Act* (AEA) requirements. The *Hazardous Waste Management Act* incorporates the state's *Model Toxics Control Act* regulations (WAC 173-340) by reference for purposes of meeting RCRA and *Hazardous Waste Management Act* corrective action. Additionally, *Model Toxics Control Act* substantive standards may be applicable or relevant and appropriate requirements for CERCLA cleanup actions.
- The RCRA closure process usually guides decisions for active RCRA treatment, storage, and disposal facilities. EPA has authorized the RCRA program to the state of Washington in lieu of the federal program. Ecology implements the program via Washington's *Hazardous Waste Management Act* **(**RCW 70.105), Dangerous Waste Regulations, Chapter 173-303 of the *Washington Administrative Code* (WAC 173-303), and through facility specific permits. RCRA closure and post-closure requirements are contained in the Hanford Site RCRA Permit (Ecology 1994).
- *National Environmental Policy Act* (NEPA) requires DOE to evaluate the potential environmental impacts of major actions and their alternatives prior to making a decision and irrevocable commitments. This includes the selection of major cleanup and closure actions. The CERCLA process parallels the NEPA process and for CERCLA actions, DOE policy (DOE 2002a) calls for CERCLA documentation to incorporate NEPA values. When NEPA values are explicitly addressed in CERCLA remedial investigations/feasibility studies and records of decision, separate NEPA review of the action is not required. RCRA, however, does not provide the same NEPA functional equivalency as CERCLA; therefore, DOE must conduct a NEPA review for

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[4] The Tri-Party Agreement defines past-practice waste sites as sites where waste or substances have been disposed (either intentionally or unintentionally) and that are not subject to regulation as active treatment, storage, and disposal units.

[5] *Model Toxics Control Act* regulations (WAC 173-340) are applicable or relevant and appropriate requirements for CERCLA actions for purposes of meeting RCRA corrective action requirements.

RCRA-regulated actions. NEPA review and documentation is also required for decisions on demolishing surplus structures under the AEA that do not contain radioactive or hazardous contaminants and are not otherwise regulated under RCRA or CERCLA.

- DOE Order 435.1, *Radioactive Waste Management*, defines additional requirements and processes that are applicable to closure of tank farms and radioactive waste disposal facilities.

Figure 2-1 provides an overview of the sequence of steps for making cleanup decisions, implementing remedies, completing cleanup actions, and conducting post-completion or post-closure activities, i.e. long-term stewardship. Summary steps are shown for both CERCLA actions[6] and RCRA closure actions for treatment, storage and disposal facilities.

The NPL close-out procedures are described in *Close Out Procedures for National Priorities List Sites* (EPA 2000). The discrete stages of cleanup completion are:

- Construction Completion – Occurs when any necessary physical construction is complete, whether or not cleanup levels or other requirements have been achieved. Groundwater remediation may still be occurring at this stage.
- Remedial Action Completion – Occurs when remedial action objectives for an operable unit have been achieved and are documented in a remedial action report.
- Site Completion – Signifies that the response actions at the site were successful and no further action is required to protect human health and the environment; however, continuing CERCLA five-year review is still conducted.
- Partial Deletion – Applicable to large sites where portions of the site meet deletion criteria (e.g., portions of the 100 Area).
- Site Deletion – Applicable when all response actions have been implemented, it is determined that no further action is needed, and documentation is complete (e.g., the 1100 Area).

2.2.2 Integration of RCRA and CERCLA Processes

The clear intent of the Tri-Party Agreement and the site RCRA permit (Ecology 1994) is to minimize duplication and overlap of regulatory authorities while ensuring compliance with applicable requirements. As noted above, RCRA authority does not extend to the cleanup of radionuclides, while CERCLA and the AEA do. The Tri-Party Agreement states that the past-practice process selected for an operable unit shall be sufficiently comprehensive to satisfy the technical requirements of both authorities and their respective regulations.

[6] The Hanford Site also applies the RCRA corrective action process to the cleanup of some past-practice waste sites. These processes are very similar to the CERCLA process with the principal difference being the use of the RCRA Permit for specifying corrective action decisions. Section 5.4 of the Tri-Party Agreement (Ecology et al. 1989) Action Plan provides more detail on the corrective action process, which is not shown here in Figure 2-1.

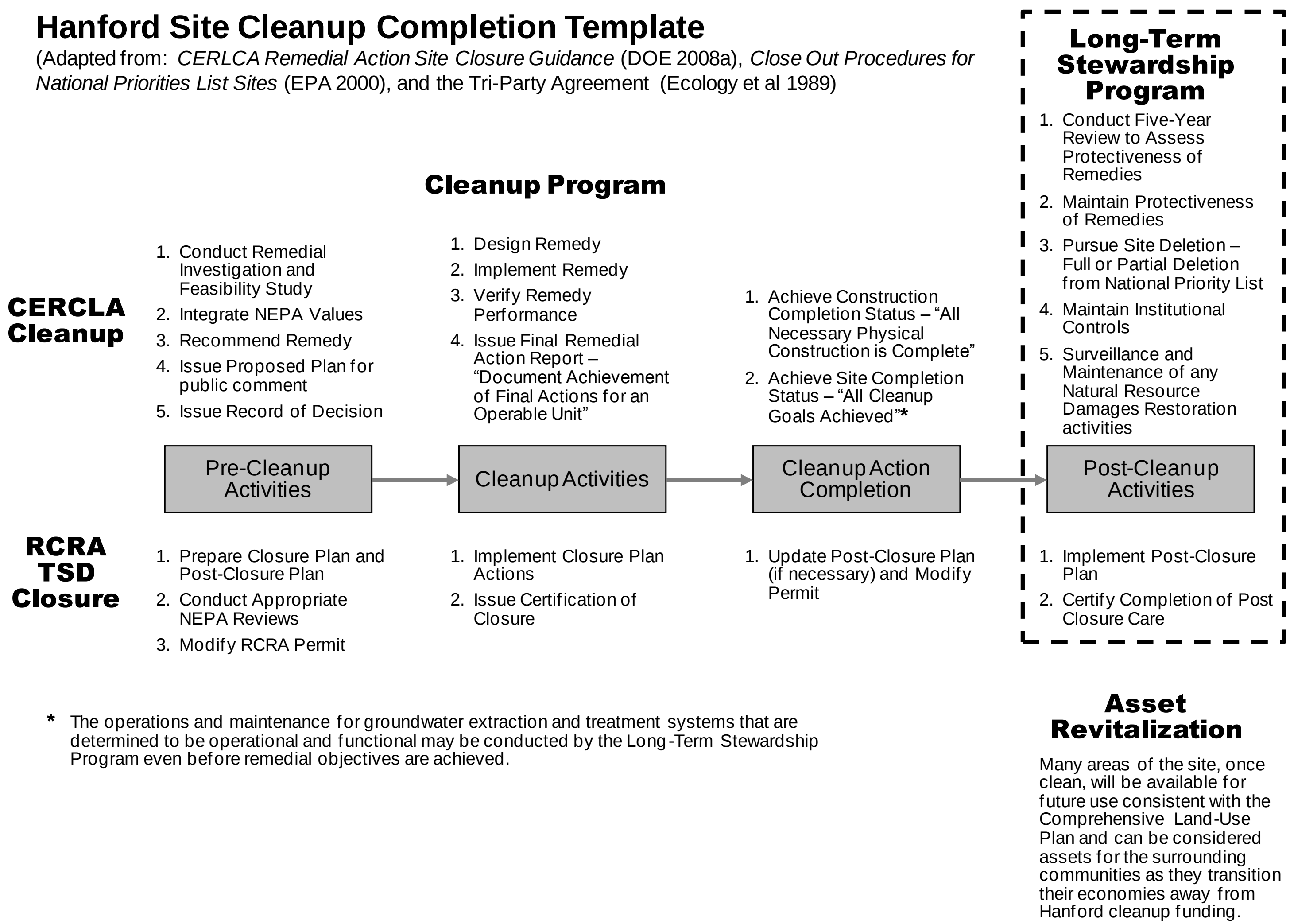

Figure 2-1. Overview of Sequence to Reach Cleanup Decisions, Implement Remedies, Complete Cleanup Actions, and Conduct Post-Completion or Post-Closure Activities

For groundwater contamination, whether currently regulated under RCRA or CERCLA, the Tri-Parties agree that the past-practice authority may provide the most efficient means of selecting remedies for groundwater plumes originating from both treatment, storage, and disposal units and past-practice units – provided remedial actions ensure compliance with applicable and relevant/appropriate requirements. Consequently, CERCLA decision processes may be used to reach decisions regarding groundwater operable unit remedies, and these decisions will also meet RCRA corrective action and other applicable requirements. Ecology, however, retains the right to enforce timely cleanup of groundwater contamination that is associated with treatment, storage, and disposal units as provided under its RCRA authority

Recent discussions among the Tri-Parties have identified an opportunity to conduct joint RCRA/CERCLA investigations and decisions for sites with both chemical and radiological contamination. It is DOE's intent to work with EPA and Ecology to integrate RCRA/CERCLA requirements for both River Corridor and Central Plateau remedy decisions. Integration of RCRA and CERCLA requirements is also needed for RCRA past-practice sites and tank farm corrective actions that include radionuclide releases from treatment, storage, and disposal units. An initial step in this effort was implemented with a Tri-Party Agreement change package approved in October 2010 (DOE 2010j, Change Package P-00-09-01).[7] This change established a process known as the Corrective Action Decision/Record of Decision that meets both CERCLA and RCRA corrective action requirements. This approach will ensure that there is CERCLA coverage for radionuclides while maintaining RCRA coverage for RCRA constituents in the contaminated media. In addition, documentation that supports these decisions will be prepared that incorporates both CERCLA and RCRA requirements with the intent of minimizing administrative workload and duplication of paperwork. This process is expected to include approval of the action in both a CERCLA record of decision and in the RCRA site permit where applicable.

2.3 Anticipated Land Use and Cleanup

Anticipated land use plays a key role in selecting cleanup remedies. This section provides an overview of the *Hanford Comprehensive Land-Use Plan* (DOE 1999) that established land-use designations for the Hanford Site. This section also summarizes the role of land use in remedy selection, and the role of land use in setting remedial action objectives and exposure scenarios for risk assessments to determine whether conditions are protective of people and the environment. Congress directed DOE to establish a land-use plan for the Hanford Site (*National Defense Authorization Act*, 42 USC. 7274k, redesignated 50 USC. 2582). As directed by Congress, DOE exercised its responsibility to determine reasonably anticipated

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[7] From Tri-Party Agreement Change Package P-00-09-01 (DOE 2010j). "The Tri-Parties have negotiated the coordination of RCRA corrective action and CERCLA decision processes (to produce a corrective action decision and record of decision, or corrective action decision and record of decision) for selected past-practice units in the 200 Areas. This change will align CERCLA and RCRA decision-making processes and procedures for past-practice units that, without the change, would have been addressed under corrective action authority under the Tri-Party Agreement Action Plan (with CERCLA authority reserved). Specifically, by adding a CERCLA decision-making process to selected past-practice units that previously would have been addressed under RCRA Corrective Action authority and by providing for Corrective Action Decisions to be prepared, issued and implemented under the authority of the Tri-Party Agreement, the coordinated RCRA and CERCLA processes will address all hazardous substances under the TPA using the authority of both jurisdictions."

land use as input to the CERCLA process. Similar land-use determinations have been applied at other superfund sites as well as at other DOE cleanup sites. Hanford's approach for designating reasonably foreseeable future land use is consistent with Congressional direction and EPA guidance.

2.3.1 Hanford's Comprehensive Land-Use Plan

As land manager, DOE is responsible for designating the reasonably foreseeable future land uses of Hanford. As the lead agency for CERCLA cleanup of the Hanford Site,[8] DOE is also responsible for identifying future land uses that will guide CERCLA risk assessments and cleanup decisions. DOE used the NEPA Environmental Impact Statement (EIS) process (*Hanford Site Comprehensive Land-Use Plan* [DOE 1999]) to examine land-use alternatives and conducted this process with nine cooperating agencies and consulting Tribal governments as a basis for determining future anticipated land uses.[9] This effort resulted in the *Hanford Comprehensive Land-Use Plan* (DOE 1999) that DOE adopted and implemented in the record of decision published on November 2, 1999 (64 FR 61615). The *Hanford Comprehensive Land-Use Plan* (DOE 1999) must be reviewed periodically to ensure that it remains current. The first review since adoption and implementation was documented in a supplement analysis that resulted in DOE issuing an amendment to the record of decision (73 FR 55824) on September 26, 2008. The *Hanford Comprehensive Land-Use Plan* (DOE 1999) is intended to provide "…a land-use plan for DOE's Hanford Site for at least the next 50-year planning period and lasting as long as DOE retains legal control of some portion of the real estate" (DOE 2008e).

The *Hanford Comprehensive Land-Use Plan* record of decision (64 FR 61615) designated future land uses for the Hanford Site. The 2008 amended record of decision (73 FR 55824) maintained those anticipated land uses, which are summarized below. Figure 2-2 shows the full set of nine land-use designations established by the plan.

The following selected land-use designations[10] are most relevant to this document:

- 100 Areas – Conservation-Mining.[11] An area reserved for protection of archeological, cultural, ecological and natural resources. Remediation activities in the 100 Areas (i.e., 100-B/C, 100-K, 100-N, 100-D, 100-H, and 100-F) are considered pre-existing land use in the preservation land-use designation.
- 300 Area – Industrial. An area suitable for industrial activities such as reactor operations and manufacturing.

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[8] Executive Order 12580, *Superfund Implementation*, (52 FR 2923) designated DOE as the "lead agency" for CERCLA cleanup at DOE sites.

[9] The cooperating entities were the U.S. Department of the Interior (Bureau of Land Management, Bureau of Reclamation, and the U.S. Fish and Wildlife Service); the City of Richland; Benton, Franklin, and Grant Counties; the Nez Perce Tribe; and the Confederated Tribes of the Umatilla Indian Reservation. Although not a cooperating agency, the Yakama Nation participated at points throughout the seven-year-long EIS process. The U.S. EPA also was extensively involved beginning with the Hanford Site Future Uses Working Group efforts in the early 1990s and continuing throughout the NEPA process.

[10] Refer to the *Hanford Site Comprehensive Land-Use Plan* (DOE 1999) and Supplement Analysis (DOE 2008e) for the land-use map, the full set of nine land-use designations that define the permissible uses for each area of the site, and the implementing procedures that govern the review and approval of future land uses.

[11] Limited mining may occur, such as quarrying for gravel, for governmental purposes only.

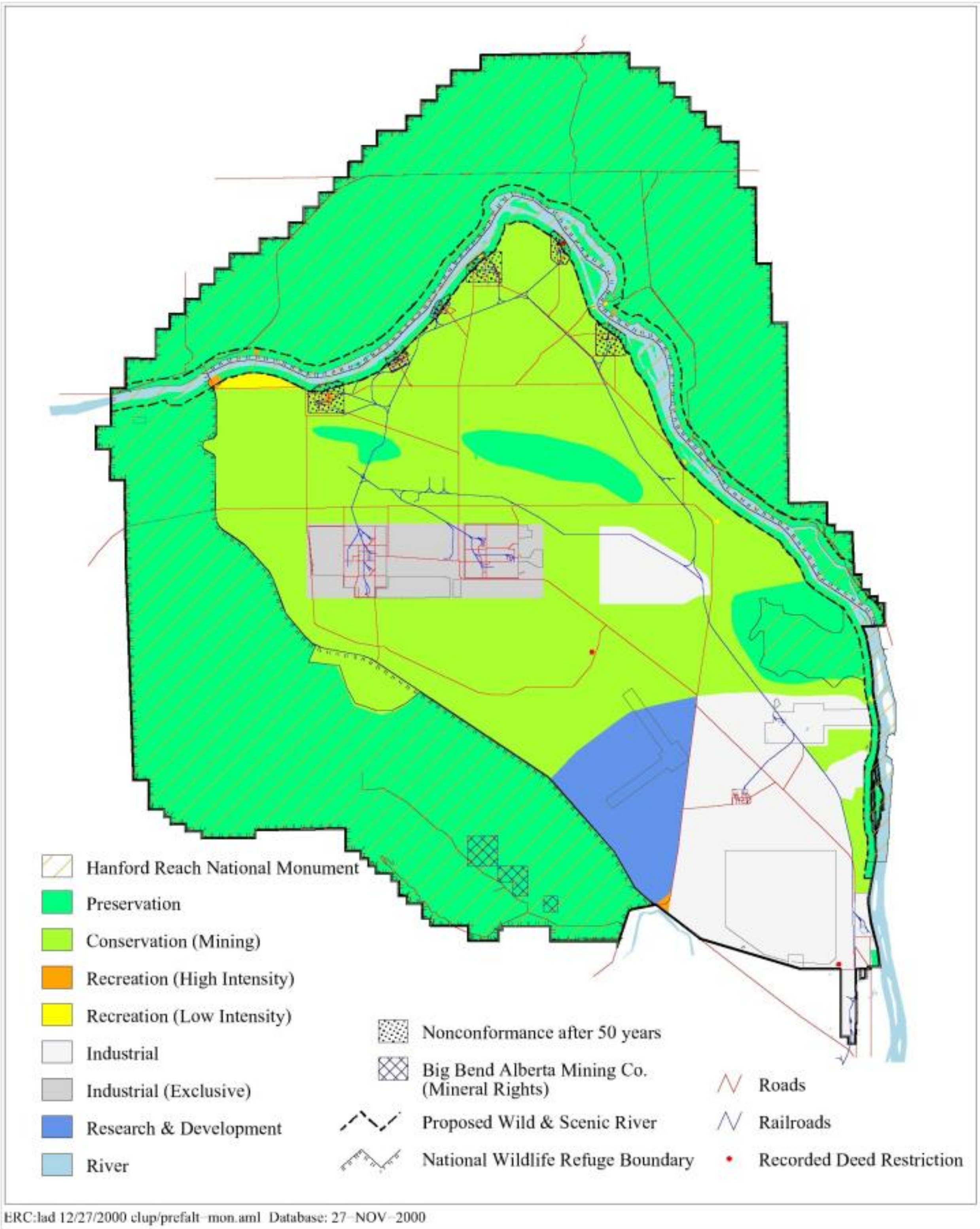

Figure 2-2. Final Designations from the Hanford Comprehensive Land-Use Plan

- Central Plateau (200 Areas) – Industrial Exclusive. An area suitable for treatment, storage, and disposal of hazardous and/or radioactive waste under federal control Wahluke Slope, Saddle Mountains, Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE Reserve), Gable Mountain, and Gable Butte – Preservation. An area managed for the preservation of archeological, cultural, ecological, and natural resources.
- Columbia River Corridor – High-Intensity Recreation, Low-Intensity Recreation, Conservation-Mining, and Preservation. High and low-intensity recreation allow for a range of visitor-serving activities and facilities.
- Research and Development – This area allows for the development and use of research and development facilities, such as the Laser Interferometer Gravitational Wave Observatory (LIGO), which could require substantial buffer zones for operation. In addition, research and development facilities not requiring large areas for operation could also be located within this area.

In June 2000, most of the lands that are designated as "preservation" were permanently withdrawn and protected by presidential proclamation (65 FR 37253, Proclamation 7319 of June 9, 2000) with the establishment of the Hanford Reach National Monument. The monument is superimposed over approximately 195,000 acres (304 square miles) of the 586-square-mile DOE Hanford Site.

> *The Hanford Reach National Monument is a unique and biologically diverse landscape, encompassing an array of scientific and historic objects. This magnificent area contains an irreplaceable natural and historic legacy, preserved by unusual circumstances. Maintained as a buffer area in a Federal reservation conducting nuclear weapons development and, more recently, environmental cleanup activities, with limits on development and human use for the past 50 years, the monument is now a haven for important and increasingly scarce objects of scientific and historic interest.* (65 FR 37253)

The majority of the monument is managed by the United States Fish and Wildlife Service (USFWS) through a Permit and Memorandum of Understanding granted by DOE (DOE 2001). The remaining monument lands that are managed by DOE are undergoing or supporting environmental cleanup (e.g., River Corridor Unit, McGee Ranch Unit). The Hanford Reach National Monument land continues to be under the custody and accountability of DOE for the federal government. Monument lands will remain under federal ownership and control for the foreseeable future.

2.3.2 Role of Land Use in CERCLA Remedy Selection

Land use is an important factor in selecting cleanup remedies under CERCLA. Figure 2-3 illustrates the primary relationships between current and future land use and the CERCLA remedy selection process. Remedial action objectives that are developed as part of the remedial investigation and feasibility study process are to reflect the reasonably anticipated future land use(s). These future land-use assumptions allow the baseline risk assessment and the feasibility study to focus on developing practical and cost-effective remedial alternatives. These alternatives should then support future site activities that are consistent with the reasonably anticipated future land use.

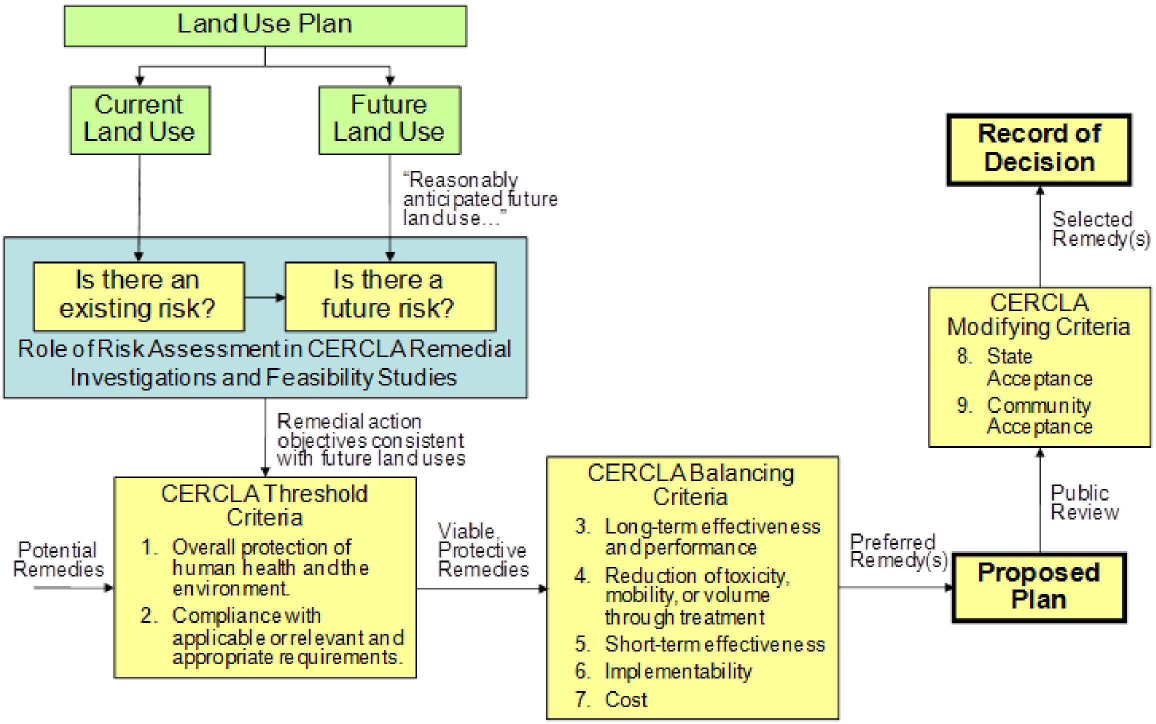

Figure 2-3. Land Use and CERCLA Remedy Selection (adapted from EPA 1995c)

The CERCLA remedy selection uses a multi-step process that applies ***nine criteria*** (shown in Figure 2-3) to support remedy selection in a record of decision. The first two criteria, the ***threshold criteria,*** are used to eliminate non-viable alternatives, i.e., those that cannot meet protection and regulatory requirements. Remedies are screened out at this stage if they are unable to satisfactorily protect human health and the environment, which in part depends on future uses of the land. The next five criteria, ***balancing criteria,*** are used to compare each viable alternative against other important considerations. Based on evaluation of these seven criteria, a proposed plan is developed that summarizes the preliminary conclusions as to why that option appears most favorable. The proposed plan is provided to the public and stakeholders for review and comment. The final step of the process considers comments on the proposed plan that are evaluated against the last two CERCLA criteria, ***modifying criteria***. This evaluation may result in modification to the remedy to improve its overall public acceptance. The final remedy is described in the record of decision.

Alternate land uses are examined in the CERCLA process to compare how long-term effectiveness of remedies might vary under different hypothetical scenarios as part of the balancing criteria evaluations. For example, a residential farmer or a residential Tribal member land-use scenario, which differ from the anticipated land uses, can be used to inform the decision maker about the potential impacts to specific populations from unexpected exposures. However, consistent with the EPA Guidance (EPA 1995c) concerning land use in the CERCLA remedy selection process, the remedial alternatives developed "…should lead to site activities which are consistent with the reasonable anticipated future land use." The following text box provides some key elements from the EPA directive (EPA 1995c).

Land Use in the CERCLA Remedy Selection Process

The EPA Office of Solid Waste and Emergency Response (OSWER) directive on the CERCLA remedy process (EPA 1995c) establishes EPA direction for consideration of future land use when selecting a CERCLA remedy. Remedial actions consistent with future land uses help to ensure that potential remedies are protective of human health and the environment in the future. The following key elements are some of the directives from that document:

- "Future land-use assumptions allow the baseline risk assessment and the feasibility study to be focused on developing practicable and cost effective remedial alternatives. These alternatives should lead to site activities which are consistent with the reasonable anticipated future land use."
- "Current land use is critical in determining whether there is a current risk associated with a Superfund site, and future land use is important in estimating potential future threats. The results of the risk assessment aid in determining the degree of remediation necessary to ensure long-term protection at NPL sites."
- "More than one future land-use assumption may be considered when decision makers wish to understand the implications of unexpected exposures."
- "In general, remedial action objectives should be developed in order to develop alternatives that would achieve cleanup levels associated with the reasonable anticipated future land use over as much of the site as possible."
- "A landfill site is an example where it is highly likely that the future land use will remain unchanged (i.e., long-term waste management area), given the National Contingency Plan's expectation that treatment of high volumes of waste generally will be impracticable and the fact that EPA's presumptive remedy for landfills is containment."
- "If any remedial alternative developed during the feasibility study will require a restricted land use in order to be protective, it is essential that the alternative include components that will ensure that it remains protective. In particular, institutional controls will generally have to be included in the alternative to prevent an unanticipated change in land use that could result in unacceptable exposures to residual contamination."

2.3.3 Land Use to Support the Cleanup Completion Framework

As noted in Section 2.3.2, future land uses influence the baseline risk assessment, the development of alternatives, and the cleanup remedy selection process.[12] The southeastern portion of the Hanford Site, close to Richland and the 300 Area, is designated as "industrial" or "research and development." These areas are viable for use by public and private entities for work that is consistent with the *Hanford Comprehensive Land-Use Plan* (DOE 1999).

Discussions are currently underway exploring the potential transfer of land to a DOE approved Community Reuse Organization (Tri-City Development Council) for economic development purpose to offset negative impacts on local communities as a result of declining work at the Hanford Site. The accelerated cleanup accomplished in the last two years from the ARRA work has created opportunities for potential reuse of these areas. DOE is also exploring the potential use of a portion of these areas for asset revitalization initiatives. Such initiatives would support the Nation's and DOE's goals of developing safe, secure, clean and sustainable energy sources for the future. The development and management of

[12] Further information on Hanford land-use designations and processes can be found in the *Hanford Comprehensive Land-Use Plan* (DOE 1999), the corresponding record of decision (64 FR 61615) of November 2, 1999, the recently released supplement analysis (DOE 2008e), and the amended record of decision (73 FR 55824) of September 26, 2008.

these areas, or other compatible uses, would be consistent with the *Hanford Comprehensive Land-Use Plan* (DOE 1999) and associated policies. See Chapter 7 for more details concerning potential land and asset reuse.

The federal government will retain ownership of the conservation and preservation areas of the Hanford Site for the foreseeable future. Access to these areas will be controlled, as necessary, to protect human health and safety as long as active waste management operations are being conducted and/or to meet the expectations of the applicable land-use designation.

The central portion of the Hanford Site includes an area designated as the Industrial-Exclusive Area. This is an area of 20 square miles that is designated for continued waste management operations and related activities. The *Hanford Comprehensive Land-Use Plan* (DOE 1999) provides further clarification of what the Industrial-Exclusive Area would be use for.

> "*DOE has defined two zones that are necessary to protect human health and safety – an inner exclusive-use zone and an emergency planning zone. The exclusive-use zone is reserved for DOE or other hazardous operations with severely restricted public access. This zone extends from the facility fence line to a distance at which threats to the public diminish and where public access can be routinely allowed. The exclusive-use zone is located within the emergency planning zone.*"

The final EIS record of decision (64 FR 61615), which established the Comprehensive Land-Use Plan, recognizes that as the cleanup mission progresses exclusive-use zones will shrink inward to the Central Plateau. This expectation is further reflected in the land-use policy (DOE 1999): "reduce exclusive use zone to maximize the amount of land available for alternate uses while still protecting the public from inherently hazardous operations." Emergency planning zones will be maintained to ensure public safety as long as waste management operations (e.g., Canister Storage Building and Waste Treatment Plant) are occurring on the Central Plateau.

DOE recognizes that long-term disposal, isolation, and protection of waste inventories in the future will be required. Within this area, DOE intends to shrink the region requiring long-term isolation and control to be much smaller than the current 20-square-mile area. Consistent with other DOE and non-DOE sites around the nation (e.g., Fernald, Rocky Flats, and Savannah River Site), Hanford's Industrial-Exclusive Area will be controlled for the foreseeable future.

2.3.4 Cleanup Objectives and Risk Assessment

Cleanup objectives must address the protection of human health, ecological receptors, and groundwater resources as well as meeting applicable or relevant and appropriate requirements. Different levels of cleanup may be required to achieve these cleanup objectives. From a CERCLA cleanup standpoint, anticipated future land use is particularly relevant in situations where near-surface contamination or consumption of groundwater is a primary exposure pathway. Where soil contamination is affecting groundwater, protection of the groundwater may drive more stringent soil cleanup levels than those required to be protective of human health based on the reasonably anticipated future land use. It is important to note that objectives for remediating groundwater and protecting it from future contamination, and protecting surface water, are consistent across all areas of the Hanford Site. Remedial action objectives for the protection of direct human exposure vary across the Hanford Site. These differences in remedial action objectives are due to differences in the designated future land uses that exist across the Hanford Site.

For the area of the Central Plateau outside of the Industrial-Exclusive Area, remedial action objectives will be evaluated using an exposure scenario that is consistent with the anticipated conservation land use, e.g., a National Monument worker, although a variety of exposure scenarios will be evaluated in the risk assessment process to support risk management decisions made in selecting cleanup actions.[13] For the area of the Central Plateau inside the Industrial-Exclusive Area, remedial action objectives will be evaluated using an exposure scenario that is consistent with the industrial-exclusive land use.[14]

EPA guidance (EPA 1995c) provides that risk assessments generally need to consider only the reasonably anticipated future land use; however, it may be valuable to evaluate risks associated with other land uses. DOE has developed realistic and defensible human health exposure scenarios for risk assessments required for site cleanup that reflect the reasonably anticipated land uses. It is DOE's intent to analyze, through a collaborative process, certain Tribal uses that DOE may consider in the future. DOE will also continue to calculate risks using human health exposure scenarios provided by the Tribal Nations to understand the implications of such unexpected exposures for consideration in cleanup decisions.

2.4 Natural Resource Damage Assessment

In enacting CERCLA, Congress intended to ensure the timely cleanup of contaminated sites and to place the cleanup costs on those responsible for the contamination. In addition to remediation of past releases, CERCLA also provides that injuries to natural resources and any service losses from baseline conditions resulting from certain past releases be identified in a process – known as Natural Resource Damage Assessment (NRDA). Federal, State, and Tribal Natural Resource Trustees are authorized to act on behalf of the public as trustees for site natural resources. This document focuses primarily on CERCLA's cleanup requirements; however, coordination with Natural Resource Trustees is an important element of selection and implementation of remedial actions.

The CERCLA-designated Natural Resource Trustees at Hanford include DOE, U.S. Department of Interior, U.S. Department of Commerce (through the National Oceanic and Atmospheric Administration); the states of Washington and Oregon; and the Yakama Nation, the Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe. The Trustees' role under CERCLA is to determine injuries to and loss of natural resources caused by releases of hazardous substances and to determine the extent of restoration appropriate. Recognizing the potential benefit of an approach to National Resource Damage Assessment that integrates Trustee viewpoints, the Trustees formed the Hanford Natural Resource Trustee Council in 1993.

The Trustees have established three broad goals for Hanford cleanup:

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[13] It is expected that this will achieve a level of cleanup for the outer areas of the Central Plateau that is consistent with cleanup levels established for the River Corridor.

[14] These uses could be for a long-term institutional control worker or a post-cleanup industrial worker supporting compatible federal activities. As described throughout this document, DOE is working with the regulatory agencies to define final-land-use-based exposure scenarios for the Central Plateau and to identify the designated areas where waste will permanently remain in place under institutional controls.

1. Achieve a cleanup of the site sufficient to avoid or minimize residual injury to natural resources and the services they provide to the public.

2. Have a cost-effective remediation of the site through coordination with NRDA restoration, such as post-cleanup revegetation and mitigation activities.

3. Post-cleanup land-use decisions that do not constrain or preclude effective NRDA restoration.

In April of 2007, DOE and the other federal trustees determined it was appropriate to begin planning Natural Resource Injury Assessment activities. The objective of this effort is to restore resources. An injury assessment plan may be used to identify natural resources that have been injured from releases of hazardous substances from the Hanford Site and that could benefit from early restoration. The plan will likely describe a holistic, site-wide approach for injury assessment and restoration. The effort will ultimately define those efforts desired for natural resource restoration of the Hanford Site.

3.0 River Corridor Cleanup Completion Strategy

> **Summary of Hanford Cleanup Progress**
> For a summary of cleanup progress at Hanford see:
>
> http://www.hanford.gov/news.cfm/DOE/Cleanup%20Progress%20at%20Hanford-04-2012.pdf

The River Corridor portion of the Hanford Site is approximately 220 square miles and includes the 100 and 300 Areas along the south shore of the Columbia River. This area contains nine retired plutonium production reactors, numerous support facilities, solid and liquid waste disposal sites, and contaminated groundwater. The 300 Area, located north of the city of Richland, contained fuel fabrication facilities, nuclear research and development facilities, and associated solid and liquid waste disposal sites. Both of these areas are on the NPL (or Superfund).

3.1 Current Status

Since 1995, DOE has implemented CERCLA records of decision for interim and final actions. These records of decision require removal of contaminated soil from waste sites and debris from demolished facilities in the 100 and 300 Areas (Figure 3-1) and disposal of the resulting waste in the Environment Restoration Disposal Facility (ERDF) located in the 200 Area (for example, see *Record of Decision for 100-BC-1, 100-DR-1 and 100-HR-1 Operable Units*, EPA [EPA 1995d]). The spent fuel in the K Basins has been removed and is in dry storage in the 200 Area. Reactors are being placed in interim safe storage to allow time for additional radioactive decay in the reactor core. Groundwater treatment systems have been operating and are being upgraded to prevent hexavalent chromium and strontium-90 in groundwater from entering the Columbia River at levels harmful to human health or the environment. As described in *Hanford's 2015 Vision* (see Appendix A), between 2010 and 2015 most areas of the River Corridor will be cleaned up consistent with records of decision for interim actions.

3.2 Key Challenges for River Corridor Cleanup

Cleanup of the River Corridor has been one of Hanford's top priorities since the early 1990s. This urgency is due to the proximity of hundreds of waste sites to the Columbia River. In addition, removal of the sludge from K West Basin, which is near the river, remains a high priority. Spent fuel stored in the 100-K Area has been safely removed and placed in dry storage on the Central Plateau. Highly radioactive materials have been removed from the 300 Area which is close to populated communities. Because groundwater contamination continues to threaten the Columbia River, DOE has set aggressive goals for cleaning groundwater to levels that protect the river by 2020.[15] Chromium treatment systems have been significantly expanded to accelerate progress toward protecting aquatic species in the Columbia River.

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[15] See Tri-Party Agreement target milestones M-016-110-T01 through M-016-110-T05 (and Table 3-2) for descriptions of the specific target goals and dates for cleanup of 100 Area and 300 Area groundwater contaminants.

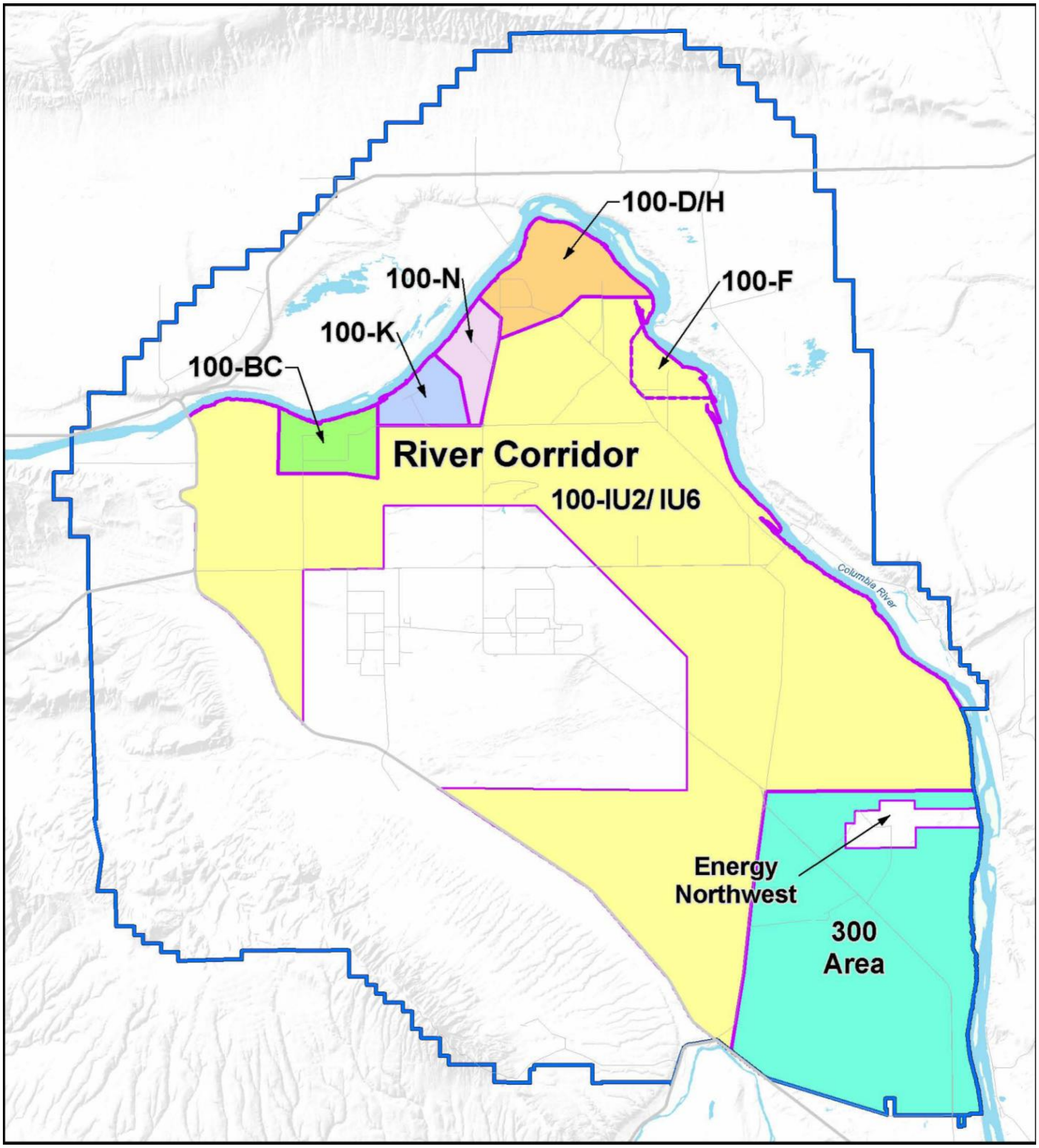

Figure 3-1. Geographic Decisions Areas within the River Corridor

To successfully complete cleanup of the River Corridor, DOE and its contractors face several important challenges:

1. **Remove, Treat and Dispose of K Basin Sludge**

- **What is the challenge?** Although the spent fuel has been removed from the K Basins, the sludge that remains is in engineered containers in the K West Basin (see Section 3.4.2). The sludge poses a significant challenge because it contains some of the highest concentrations of radioactive materials (after spent nuclear fuel and cesium and strontium capsules) on the Hanford Site. The composition of the sludge varies greatly and must be handled remotely because of its hazards to workers. Shielding and other radiological controls are required once the sludge is removed from the basin. Because of the sludge's unique composition, processing it for disposal will also be difficult.

- **Where are we today?** A total of 2,300 tons of spent fuel has been removed from the K East and K West Basins. The spent fuel was packaged and moved to dry, safe storage on the Central Plateau. Contaminated water has been removed from the K East Basin and the basin has been removed. The sludge from both basins has been placed in engineered containers that now reside in the K West Basin. Engineering and design efforts for sludge removal are underway. After completion of sludge removal, the K West Basin will be demolished and any contaminated soil underneath will be remediated. The remote-handled transuranic sludge will be stored on the Central Plateau pending treatment and subsequent shipment to the Waste Isolation Pilot Plant in New Mexico.

2. **Place Surplus Production Reactors into Interim Safe Storage Until Final Disposal**

- **What is the challenge?** Two surplus production reactors (K East and K West) remain to be placed into interim safe storage configuration. The B Reactor is being preserved as a National Historic Landmark (see Chapter 7 for more information on B Reactor status). The timing for final disposition of the reactors will be made by future decisions (see Section 3.4.1). Significant technical challenges remain to dismantle and move the radioactive graphite cores.

- **Where are we today**? Final reactor decommissioning actions could be established through either a NEPA record of decision and implemented through DOE's AEA authority, or through a CERCLA decision and action. Until reactor removal is complete, DOE will continue to conduct routine maintenance, surveillance, and radiological monitoring activities to ensure continued protection of human health and the environment during the interim storage period. Following reactor removal, any remaining waste sites will be remediated.

3. **Prevent Hexavalent Chromium from Impacting the Columbia River**

- **What is the challenge?** Hexavalent chromium is a significant groundwater contaminant in the 100-B/C, 100-D, 100-H, and 100-K Areas. Chromium is present in groundwater at more than 10 times drinking water standards. Hexavalent chromium poses a potential threat to the health of aquatic life along the shores of the river. Sodium dichromate was used as a water treatment chemical for cooling water used in Hanford's production reactors. Cooling water from the single-pass reactors was discharged to retention basins and eventually to the Columbia River. In addition to the cooling water discharges, much more concentrated sources of chromium have been found at locations where the chemical was brought to the Hanford Site, unloaded for use, accidently spilled on several occasions.

- **Where are we today?** Pump-and-treat systems have been installed and are being effective in removing chromium from groundwater at Hanford. These systems are being expanded to achieve remediation goals. Remediation goals have been established that are well below drinking water standards so that cleanup is also protective of aquatic species. Sources of chromium are being identified and remediated to prevent further contamination in the soil from reaching the groundwater. Sampling within the Columbia River itself has identified locations where chromium-contaminated groundwater is upwelling into the river.

4. Achieve Strontium-90 River Protection Goal

- **What is the challenge?** Strontium-90 is a significant groundwater contaminant in the 100-N Area. There is no ambient water quality standard for strontium-90, so the drinking water standard is the cleanup standard. Strontium-90 tends to bind tightly to soil and consequently is difficult to remove by standard pump-and-treat systems.

- **Where are we today?** In the mid-1990s, a CERCLA interim action led to operation of a pump-and-treat system to reduce the amount of strontium-90 entering the Columbia River. However, this effort was discontinued when it was determined that strontium -90 is not readily removed from groundwater. Treatment was only able to remove about one-tenth of the mass compared to natural radioactive decay over the same time period (DOE 2006). The pump-and-treat system is currently in cold-standby.

5. Remediate the 300 Area Uranium Plume

- **What is the challenge?** The uranium plume in the 300 Area has proven to be difficult to understand, predict, and remediate. An original remedy of monitored natural attenuation did not achieve cleanup levels within the predicted timeframe (EPA 1996 and DOE 2006).

- **Where are we today?** A remedial investigation/feasibility study supported by advanced science and technology investigations and applications is underway to tackle this complex uranium plume and other contaminants of concern. One of the new technologies is the application of polyphosphate injection aimed at sequestering uranium in the vadose zone. In addition, DOE's Office of Science has put in place an Integrated Field Research Challenge[16] test site in the 300 Area to enhance the understanding of the complex geochemistry and interactions with fluctuating Columbia River levels. This project is expected to improve the understanding of this plume and support development of effective remedies.

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[16] More information on this work is available at http://ifchanford.pnnl.gov/.

3.3 Strategy for River Corridor Cleanup

A key element of DOE's *2015 Vision* is to complete cleanup actions within the 220-square-mile River Corridor region of the Hanford Site. These actions, once completed, will reduce the active cleanup footprint to the 75-square-mile Central Plateau portion of the site. To achieve this vision, final remedy decisions must be obtained for all areas. These decisions will set cleanup levels for both soil and groundwater. In addition, waste sites need to be remediated and final groundwater remedies put in place. Facilities must be removed and reactors must be placed in an interim safe storage condition. At the end of 2015, some work will remain to be completed in the K Area. That work may include some soil cleanup, facility removal, fuel storage basin deactivation and removal, and placement of the KW Reactor into interim safe storage status. In addition, a few facilities in the 300 Area will continue to be used by the Pacific Northwest National Laboratory. Groundwater treatment systems will continue to operate until cleanup levels are reached.

River Corridor Remedial Investigation/Feasibility Study Work Plans

In January 2010, the DOE released the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE 2010d) and a series of addenda addressing specific segments of the River Corridor. See the following documents for the information being collected to support final River Corridor remediation decisions:

- **100-D and 100-H Areas** – *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 1: 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units* (DOE 2010e)
- **100-K Area** – *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 2: 100-KR-1, 100-KR-2, and 100-KR-4 Operable Units* (DOE 2010f)
- **100-B/C Area** – *Integrated 100 Area Remedial Investigation Study/Work Plan, Addendum 3: 100-BC-1, 100-BC-2, and 100-BC-5 Operable Units* (DOE 2010g)
- **100-F/IU-2/IU-6 Area** – *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 4: 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units•(*DOE 2010h)
- **100-N Area –** *Integrated 100 Area Remedial Investigation Study/Work Plan, Addendum 5: 100-NR-1 and 100-NR-2 Operable Units* (DOE 2010i)

DOE released the 300 Area work plan in April 2010 (*300 Area Decision Unit Remedial Investigation/ Feasibility Study Work Plan* (DOE 2010a).

3.3.1 Obtain Final Decisions

Final records of decision are required for the 100 and 300 Areas to ensure that remedial actions performed under interim action records of decision are protective of human health and the environment and to determine if additional actions are required. Six geographic decision areas (see Figure 3-1) have been defined for the River Corridor: 100 B/C Area, 100-K Area, 100-N Area, 100-D and H Areas, 100-F Area combined with 100-IU-2/6 Areas, and 300 Area (including nearby 600 Area waste sites). These decision areas contain liquid waste sites, solid waste burial grounds, surplus facilities and infrastructure, contaminated groundwater plumes, and surplus production reactors. These decision areas encompass the 100 and 300 Areas NPL sites.

To support decisions, DOE is undertaking remedial investigations in each of the six geographic decision areas. These six decision areas have been developed to ensure that final remedy decisions address the entirety of the 100 and 300 Areas. Together, surface remedies (i.e., for waste sites and facilities) and groundwater remedies must protect human health and the environment. Cleanup levels for final remedies will be protective of future uses consistent with the land use designations in the *Hanford Comprehensive*

Land-Use Plan (DOE 1999), i.e., conservation and preservation for most of the area and industrial use in the 300 Area. When interim records of decision for River Corridor 100 Area waste sites were selected in the mid-1990s, a conservative residential exposure scenario was used to determine protectiveness for those interim actions because DOE had not yet designated land uses. Cleanup goals established through interim records of decision will continue to be used to guide future remedial actions and will support reasonably foreseeable land uses in the River Corridor.

As shown in Figure 3-2, DOE will complete remedial investigations/feasibility studies for both source and groundwater operable units within each geographic decision area. The purpose of the remedial investigation is to characterize the nature and extent of Hanford contaminants and assess the risk from exposure to those contaminants within a decision area. In addition, DOE is assessing Hanford releases into the Columbia River to determine the extent of Hanford contamination in the river. The River.

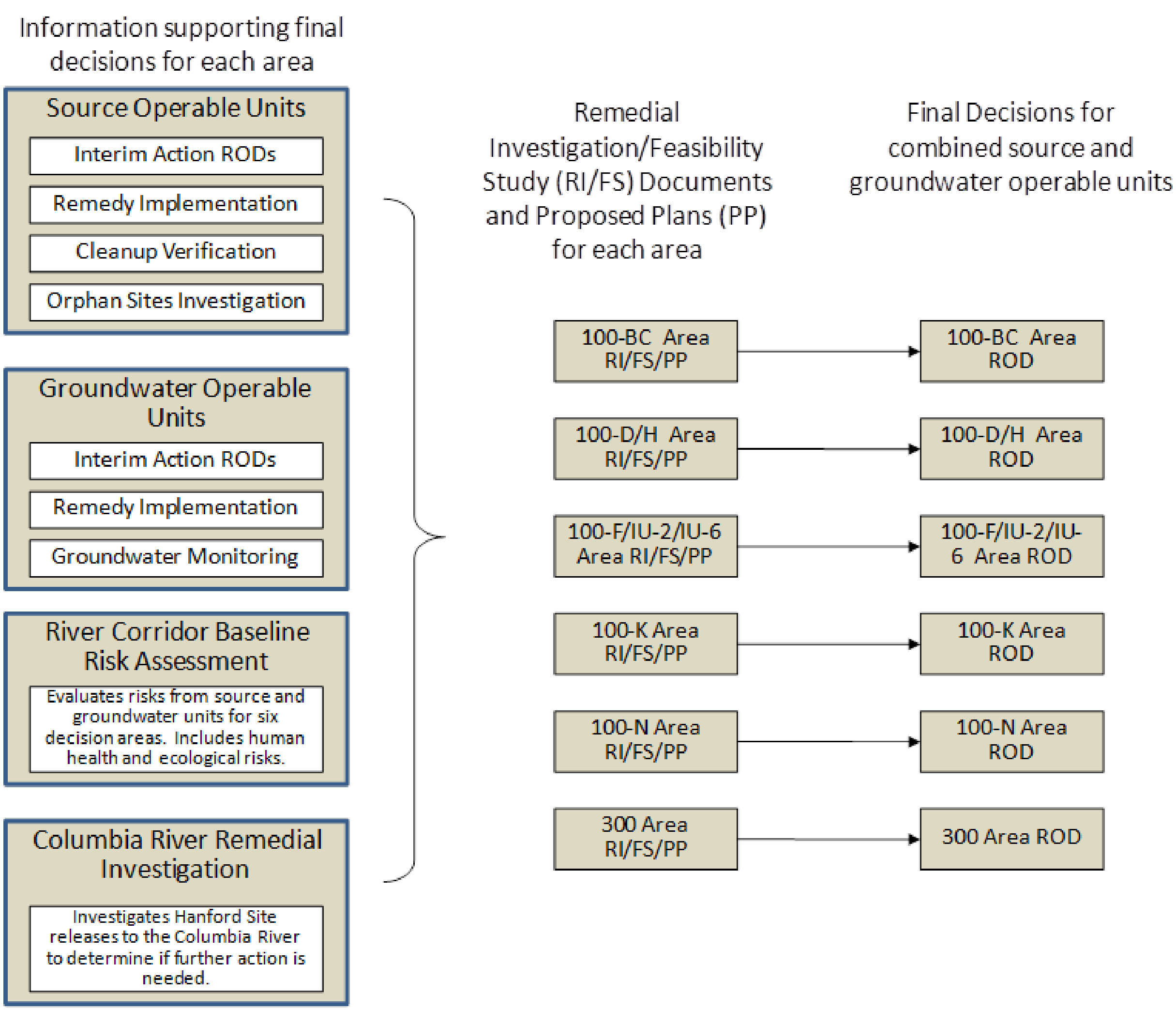

Figure 3-2. Strategy to Align River Corridor Geographic Decision Area Records of Decision

Corridor Baseline Risk Assessment, Columbia River remedial investigation (*Remedial Investigation of Hanford Site Releases to the Columbia River* [DOE 2008f]), waste site cleanup verification data, and field investigation data will provide characterization and baseline risk assessment information for contaminated areas within all six decision areas and the Columbia River. The feasibility studies will compare cleanup alternatives using the CERCLA criteria. A plan will be prepared for each of the six decision areas to propose final remedies for both source and groundwater operable units . The six records of decision will describe the remaining cleanup actions required for River Corridor cleanup completion. These six decisions (proposed plans and records of decision) are scheduled to be completed by 2014. Most cleanup actions are scheduled to be completed by 2015. However, some waste site cleanup associated with some major facilities will not be completed until after the facilities have been removed, e.g., waste sites associated with 100-K Area and K Basins

3.3.2 Surface Cleanup

Full-scale remediation of waste sites began in the 100 Areas in 1996. DOE has remediated hundreds of waste sites along the River Corridor. This work has involved demolishing structures, excavating contaminated soil, and disposing the contaminated material in the ERDF in the central portion of the Hanford Site. DOE has identified more than 1,000 waste sites in the River Corridor. Approximately two-thirds of these waste sites have been remediated through interim action to date. Removing the contaminated material eliminates sources of contamination that otherwise could directly contact humans or ecological species or be carried to groundwater by infiltrating precipitation. Remediation activities also include sampling to determine if suspected waste sites exceeded cleanup objectives; sampling to confirm that cleanup objectives had been met; physical excavation operations; waste sorting and segregation; waste treatment and waste disposal, backfill, and revegetation.

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. The primary focus early in the cleanup process was to address waste sites receiving liquid waste because those sites generally contained significant quantities of contaminants and served as potential sources for groundwater contamination.

3.3.3 Groundwater Cleanup

Groundwater cleanup in the 100 Areas has been underway since the mid-1995. Groundwater treatment actions are summarized in Table 3.1. Through 2011 groundwater treatment systems have been installed, improved and expanded. Table 3.1 also shows the mass of contaminants removed through 2011.

The Tri-Party Agreement now includes cleanup targets for all River Corridor areas. These are listed in Table 3-2.

Table 3-1. Groundwater Remediation Actions and Installed Treatment Capacity

River Corridor Area	Treatment Systems In Place	Installed Capacity
100-BC	No active treatment	
100-D and H	HR-3 pump-and-treat system (1997 to present) DR-5 pump-and-treat system (2004 to present) In situ redox manipulation barrier (1999 to present)	600 gpm 800 gpm
100-F	N active treatment	
100-K	KR-4 KW KX	1100 gpm (combined)
100-N	Apatite barrier (permeable reactive barrier) NR-2 pump-and-treat system (1995 to 2006)	
300	No active treatment	
gpm = gallons per minutes Installed capacity only applies to pump-and-treat systems, not barriers.		

Table 3-2. Target Dates for Cleanup of River Corridor Groundwater

Target Milestone	Description	Target Date
M-016-110-T01	DOE shall take actions necessary to contain or remediate hexavalent chromium groundwater plumes in each of the 100 Area NPL operable units such that ambient water quality standards for hexavalent chromium are achieved in the hyporheic zone and river water column.	12/31/2012
M-016-110-T02	DOE shall take actions necessary to remediate hexavalent chromium groundwater plumes such that hexavalent chromium will meet drinking water standards in each of the 100 Area NPL operable units.	12/31/2020
M-016-110-T03	DOE shall take actions necessary to contain the strontium-90 groundwater plume at the 100-NR-2 Operable Unit such that the default ambient water quality standard (8 pCi/L) for strontium-90 is achieved in the hyporheic zone and river water column.	12/31/2016
M-016-110-T04	DOE shall implement remedial actions selected in all 100 Area records of decision for groundwater operable units so that no contamination above drinking water standards or ambient water quality standards enters the Columbia River unless otherwise specified in a CERCLA decision.	12/31/2016
M-016-110-T05	DOE will have a remedy in place designed to meet Federal Drinking Water Standards for uranium throughout the groundwater plume in the 300-FF-5 Operable Unit unless otherwise specified in a CERCLA decision document.	12/31/2015
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act*. DOE = U.S. Department of Energy. NPL = National Priorities List.		

Three groundwater pump-and-treat systems for hexavalent chromium have been installed in the 100‑K Area and have undergone expansion in recent years to reach a total capacity of 1,100 gallons per minute. Remedial process optimization was started at the 100‑KR‑4 Groundwater Operable Unit in 2009. This process is intended to improve remediation of the hexavalent chromium plumes and other plumes that have been determined to impact groundwater and the Columbia River. The approach is to model groundwater flow and to determine where the hexavalent chromium plume will reach the Columbia River without any intervention; the current treatment system well configuration will then be revised to prevent plume intrusion into the river. Additional modeling will help to determine where longer term threats exist (e.g., areas away from the Columbia River) and more extensive system changes may be required.

A permeable reactive barrier was installed in 2006 to test its potential to reduce the migration of strontium-90 toward the Columbia River. Subsequently, there has been a steady decline in strontium-90 and gross beta measurements in the wells being sampled. Nearly all of the wells being monitored have shown ~90% decline in gross beta from measured pre-injection values. Because of the success of this test, the record of decision for this operable unit was amended to expand the barrier from its initial 300 foot length to 2,500 feet (EPA 2010).

The highest concentrations of hexavalent chromium in Hanford groundwater occur in the 100-D Area. DOE began to expand and optimize the 100-HR-3 treatment system in 2009. Active treatment capacity has been expanded to 1,400 gallons per minute for the combined 100-D and H Areas, including the area between D and H known as the "Horn." Remedial process optimization is being conducted to enhance remediation. As an outcome of the remedial process optimization, seventy new extraction and injection wells are being installed in this area as part of the expanded treatment system.

Also in D Area, an in situ redox manipulation barrier has been installed. This barrier reacts with hexavalent chromium turning it into less mobile and less toxic trivalent chromium. The barrier intersects a significant portion of the highest concentration portion of the chromium plume thus reducing migration of contamination toward the Columbia River.

3.3.4 Facility Cleanup and Removal

Within the six geographic decision areas described in Section 3.3.1, there are major facilities whose final disposition must be included in the completion of the River Corridor remediation. There are nine surplus plutonium productions reactors along the Columbia River in the 100 Areas. In the 100-K Area, the spent fuel has been removed from the storage basins. However, the K West Basin contains approximately 1,000 cubic feet of sludge in engineered containers that must be transported the Central Plateau for treatment and later shipment to the Waste Isolation Pilot Plant. The Fast Flux Test Facility (FFTF) is a research reactor formerly used to test advanced fuels and materials for possible use in breeder reactors. FFTF has been deactivated and currently is in long-term surveillance and maintenance. The final disposition of FFTF will be determined by the Tank Closure and Waste Management EIS record of decision. Finally, within the 300 Area, the DOE Office of Science will retain four facilities that will need to be removed on a schedule that is a decade or more after other work in the 300 Area is to be completed.

The 300 Area presents unique challenges to workers involved in decommissioning, deactivating, decontaminating, and demolishing the hundreds of facilities in the complex. Due to the many experiments that were conducted at the 300 Area, there are also many contaminated zones associated with it. Workers must take precautions to avoid coming in contact with chemical or radioactive wastes or products created by the experiments, and must also ensure that any waste they do encounter is not released into the air or the soil. Some of the waste was liquid, which has contaminated some of the groundwater beneath the 300 Area and migrated to the Columbia River, but workers today are actively removing and remediating that contamination.

3.3.4.1 Surplus Production Reactors

None of Hanford's nine reactors are in operation with the last reactor, the N Reactor, being shut down in 1988. In 1998, C Reactor was the first reactor in the DOE complex to be placed into interim safe storage using a process known as "cocooning."[17] Cocooning the reactor demonstrated new technologies to reduce worker exposure to radiation, lower maintenance costs, and accelerate site cleanup by transferring lessons learned about safe storage to other reactors. Ultimately, eight of the nine reactors at Hanford will be cocooned. C, D, DR, F, H and N Reactors are already cocooned, with K-East, and K-West Reactors next in line to be cocooned.

The NEPA *Record of Decision for the Decommissioning of Eight Surplus Production Reactors EIS* (58 FR 48509) documents DOE's decision of interim safe storage followed by one-piece removal to a Central Plateau disposal facility. N Reactor was not included in the EIS as it was not available for decommissioning at the time of the NEPA EIS and interim safe storage was approved through the CERCLA process. Final disposition of N Reactor will be determined by a subsequent NEPA or CERCLA decision process. B Reactor has been designated a National Historic Landmark by the U.S. Department of Interior and will be placed in a configuration consistent with controlled access by the general public for the foreseeable future. For all reactors except B Reactor, interim safe storage actions, selected through the CERCLA removal action process, are designed to prevent deterioration and release of contamination from the reactors for up to 75 years.

For each reactor, Table 3-3 summarizes its current status, identifies the geographic decision area within which it is contained, and indicates the basis for a final decision. As DOE completes remedial investigation/feasibility study reports for the six geographic areas, these reports will describe how and when final reactor decommissioning actions will be coordinated with cleanup actions. Until reactor removal is complete, DOE will continue to conduct routine maintenance, surveillance, and radiological monitoring activities to ensure continued protection of human health and the environment during the interim storage period. Following reactor removal, any remaining waste sites will be remediated.

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[17] Note: When a reactor is cocooned, about 80% of the buildings and auxiliary structures that were needed to support the reactor during its operating days are demolished and removed. The remaining 20% of the reactor complex, including the core of the reactor itself, is enclosed in a cement and steel, airtight and watertight structure called a cocoon. This cocoon prevents any radiation or contamination, left over from the nuclear operations, from escaping to the environment. These actions reduce a reactor's footprint and place it in a safe stable condition allowing for continued decay of short-lived radionuclides and preventing contamination from leaking out of the reactor. For example, in the late 1990s, KE and KW Reactors each contained about 25,000 curies of radioactivity though each reactor had been shut down since the early 1970s.

Table 3-3. Hanford Reactor Status and Final Disposition

Reactor	Current Status[a]	Decision Area	Final Disposition
B	National Historic Landmark 2008	100-B/C	ROD for Decommissioning of Eight Surplus Production Reactors EIS (58 FR 48509).
C	ISS since 1998		
D	ISS since 2004	100-D and H	
DR	ISS since 2002		
H	ISS since 2005		
F	ISS since 2003	100-F and IU-2/6	
KE	ISS to be completed	100-K	
KW	ISS to be completed		
N	ISS completed in 2012	100-N	ISS approved through EE/CA Action Memorandum. Final disposition will be addressed by NEPA or CERCLA decision.

[a]ISS decisions made through CERCLA removal action authority.
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act*
EE/CA = Engineering Evaluation/Cost Analysis
EIS = Environmental impact statement.
ISS = Interim safe storage.
NEPA = *National Environmental Policy Act.*
ROD = Record of decision.

3.3.4.2 K Basins

The 100-K Area includes the K East and K West spent fuel storage basins (K Basins). The spent fuel has been removed and is in dry storage in the 200 Area. Over the lifetime of these basins, debris, silt, sand, and material from operations resulted in the formation of sludge that accumulated in the bottom of these basins. There is a total of about 1,000 cubic feet of sludge contaminated with fission and activation products and uranium. The sludge from both basins has been placed in engineered containers that now reside in the K West Basin. The K East Basin has been demolished and removed and contaminated soil is almost entirely remediated. After completion of sludge removal, the K West Basin will be demolished and any contaminated soil will be remediated. The remote handled transuranic sludge will be stored on the Central Plateau pending treatment and eventual shipment to the Waste Isolation Pilot Plant in New Mexico. The 100-K Reactors will be placed in interim safe storage.

3.3.4.3 Fast Flux Test Facility

The FFTF lies within the 300 Area decision area. DOE is currently evaluating decommissioning and final disposition options for FFTF through the *Tank Closure and Waste Management EIS* (DOE 2009d). The EIS record of decision will identify the final disposition approach for FFTF. Pending implementation of a final decision, DOE has placed the facility in a minimum-safe surveillance and maintenance mode by deactivation of appropriate FFTF plant systems and components and removal of potential hazards.

3.3.4.4 Retained Facilities in the 300 Area

In 2007, DOE's Office of Science elected to retain four facility complexes in the 300 Area – Buildings 325, 331, 318, and 350 – for up to 20 years. These facilities will continue to support Office of Science missions implemented through the Pacific Northwest National Laboratory. When these facilities are determined to be excess to these missions, they will be returned to DOE-RL for demolition and remediation of any associated waste sites.

3.4 Interfaces with Central Plateau Cleanup

3.4.1 Impact of Central Plateau Groundwater Contamination on River Corridor Cleanup

There are historical groundwater contaminant plumes from the Central Plateau (200-BP-5 and 200-PO-1 Operable Units) that have reached the 100 and 300 Areas and the Columbia River. The principal contaminants are tritium, iodine-129, and nitrate that resulted from Hanford's last fuel processing operations at the Plutonium Uranium Extraction (PUREX) Plant in the 1980s. For legacy groundwater contamination plumes that have migrated off the Central Plateau, the higher concentration portion of the plumes has declined significantly in the past 10 years (DOE 2008c). It is anticipated that ongoing efforts to decrease groundwater recharge in the Central Plateau (e.g., cut-and-cap leaking water lines), coupled with natural processes occurring within the groundwater system itself, will result in these plumes meeting drinking water standards in a reasonable time frame.

The remedial investigation/feasibility study for the affected 100 Area decision area (100-IU-2/6 and 100-F) and the 300 Area decision area will evaluate current groundwater conditions to determine the overall protectiveness of the proposed source remedies. However, remedy decisions for the iodine, tritium, and nitrate plumes will be made through the record of decision for 200-PO-1 Operable Unit as part of the Central Plateau cleanup. Cleanup decisions and actions for the Central Plateau, including pump-and-treat systems and monitoring networks, are anticipated to prevent additional plumes from reaching the River Corridor area above drinking water standards; therefore, future plumes from the Central Plateau do not need to be considered in River Corridor decisions.

3.4.2 Environmental Restoration Disposal Facility

Remediation of River Corridor waste sites and contaminated facilities generate low-level, mixed low-level and other remediation waste requiring disposal. These types of waste will be transported to ERDF, an engineered disposal facility with its own CERCLA record of decision (EPA 1995a). ERDF is located on the Central Plateau between the 200 East and 200 West Areas, more than 7 miles from the Columbia River. ERDF is currently constructed to meet the disposal needs of Hanford cleanup efforts through 2020.

3.5 Close Out of the 100 Area and 300 Area National Priorities List Sites

Upon completion of cleanup as specified in the CERCLA records of decision, DOE will close the 100 Area and 300 Area NPL sites in accordance with CERCLA requirements (EPA 2000). NPL closeout procedures, such as site deletion, include a cumulative assessment of remedial actions taken to ensure they are protective of human health and the environment and that no future response action is likely.

Close out of these units will also include integration with the Hanford Long-Term Stewardship Program (http://www.hanford.gov/page.cfm/LongTermStewardship) to ensure institutional controls are implemented and maintained in accordance with records of decisions.

The first segment of land has been transitioned into the Long-Term Stewardship Program and the program has evolved from a conceptual process to an active program. The active cleanup of the 100-F/IU-2/IU-6, Segment 1 geographic area was completed and land management responsibilities transitioned to the Long-Term Stewardship Program in September 2011. The transition of Segment 1 into the Long-Term Stewardship Program is the first of several segments of the River Corridor to be completed and transitioned into the Long-Term Stewardship Program. Additional segments are scheduled to transition into the program as active cleanup of the River Corridor is completed over the next several years.

The CERCLA process requires DOE as lead agency for the Hanford Site, to conduct five-year reviews to be triggered by any remedial action that leaves hazardous substances onsite at levels that do not allow for unlimited use and unrestricted exposure (EPA 2001). See Section 6.4 for a description of the CERCLA five-year review process.

You may find more detailed information about River Corridor cleanup and remediation in the following resources:

- Records of decision and 5-year CERCLA reviews can be accessed at the EPA Region 10 site: http://yosemite.epa.gov/R10/CLEANUP.NSF/sites/Hanford
- *Hanford Site Active Cleanup Footprint Reduction*, DOE/RL-2010-18, US Department of Energy, Richland, Washington (DOE 2010x).
- *Hanford's 2015 Vision* (see Appendix A)
- DOE Hanford Site web site at http://www.hanford.gov
- *Hanford Story* video series: http://www.hanford.gov/page.cfm/HanfordStory.

4.0 Central Plateau Cleanup Completion Strategy

The Central Plateau is a 75-square-mile region near the center of the Hanford Site. It encompasses the 200 Area CERCLA NPL site and includes facilities used for Hanford's nuclear fuel processing and waste management and disposal activities. Its active treatment disposal facilities support cleanup of the River Corridor and other portions of the Hanford Site. Cleanup of the Central Plateau is a highly complex and challenging task because it contains a large inventory of chemical processing and support facilities, tank systems, liquid and solid waste disposal and storage facilities, utility systems, administrative facilities, and groundwater treatment systems. It has long been recognized that the Central Plateau, while requiring cleanup actions to protect human health and the environment, will also retain facilities that enable cleanup of the rest of the Hanford Site. For example, in the early 1990s the *Hanford Future Site Uses Working Group* (Hanford Future Site Uses Working Group 1992) recommended:

> "***Use the Central Plateau Wisely for Waste Management.*** *Wastes would be moving in the Central Plateau from across the site. Waste storage, treatment and disposal activities in the Central Plateau should be concentrated within this area as well, whenever feasible, to minimize the amount of land devoted to, or contaminated by, waste management activities.*"

In September 2009, DOE issued its draft *Central Plateau Cleanup Completion Strategy* (DOE 2009a) to provide an outline of its vision for completion of Central Plateau cleanup activities. As major elements of the Hanford cleanup along the Columbia River Corridor near completion, DOE believed it appropriate to articulate the agency vision for the remainder of the cleanup mission. The *Central Plateau Cleanup Completion Strategy* and the *Hanford Site Cleanup Completion Framework* were provided to the regulatory community, the Tribal Nations, political leaders, the public, and Hanford stakeholders to promote dialogue on Hanford's future. The Central Plateau strategy has evolved as the result of that dialogue and subsequent

Summary of Central Plateau Cleanup Progress (through FY 2011)

- More than 90 tons of carbon tetrachloride removed from soil and groundwater. Final record of decision obtained for cleanup of 5-square-mile carbon tetrachloride groundwater plume.
- Groundwater remediation actions in place for technetium-99 and uranium in the groundwater plumes in 200 West Area.
- Completed design and construction of 200 West Pump and Treat facility increasing Central Plateau treatment capacity by 100 Mgal/month.
- Plutonium Finishing Plant complex:
  - Packaged over 20 tons of plutonium-bearing materials in safe, stable forms and deactivated the vault complex.
  - Deactivated the Protected Area after shipping plutonium offsite and moving stored fuel to Hanford's Interim Storage Area.
  - Removed 166 contaminated glove boxes
  - Deactivated, decontaminated and demolished 51 structures.
  - Packaged and shipped more than 5,363 cubic yards of radioactive waste for treatment and disposal
  - Removed and disposed of more than 1,800 linear feet of highly contaminated process transfer line piping
  - Obtained final record of decision for plutonium and cesium waste sites
- Transuranic waste retrieval and shipment off site:
  - Retrieved approximately 60,000 drum-equivalents of suspect transuranic waste from trenches.
  - Made nearly 650 shipments (more than 21,000 drum equivalents) of transuranic waste to the Waste Isolation Pilot Plant in New Mexico.
- Demolished more than 50 Nuclear, Radiological and Industrial Facilities.
- Canyon facilities:
  - Readied U Canyon for demolition – removed 5 ancillary facilities, applied nearly 30,000 square feet of fixative and placed more than 25,000 cubic yards of grout.
  - Deactivated three of the remaining four canyon facilities and placed in surveillance and maintenance mode.

revisions to Tri-Party Agreement milestones to implement the strategy. This 2012 revision of the *Completion Framework* updates and replaces the original *Central Plateau Cleanup Completion Strategy* (DOE 2009a).

This dialogue led to negotiations among the Tri-Party Agencies that resulted in Tri-Party Agreement changes that were signed in October 2010 by the Parties. The Central Plateau strategy involves steps to: (1) contain and remediate contaminated groundwater, (2) implement a geographic cleanup approach that guides remedy selection from a plateau-wide perspective, (3) evaluate and deploy viable treatment methods for deep vadose contamination to provide long-term protection of the groundwater, and (4) operate waste management facilities and services to support Hanford Site cleanup work. The strategy also helps to keep Hanford ready to use funding as it is available as River Corridor and 2015 Vision cleanup projects are completed.

Implementing the Central Plateau strategy will lead to a Hanford Site footprint that is required for long-term waste management activities and containment of residual contamination and use that is consistent with the *Hanford Comprehensive Land-Use Plan* (DOE 1999). This footprint will be as small as practical and remain under federal ownership and control for as long as a potential hazard exists. Outside this footprint, the remainder of the Central Plateau will be available for other uses also consistent with the *Hanford Comprehensive Land-Use Plan* (DOE 1999).

4.1 Current Status

Liquid waste sites on the Central Plateau have discharged more than 450 billion gallons of liquid waste and cooling water to the ground. These past releases have created hundreds of contaminated soil sites and extensive plumes of groundwater contamination. Solid waste disposal sites, contaminated structures, pipelines, and unplanned releases also require cleanup on the Central Plateau. Cleanup has been initiated on many fronts at the Central Plateau to address the greatest risks and DOE, regulatory agency, and stakeholder priorities, including the following actions:

- Interim groundwater treatment has been ongoing in the 200 West Area since 1995. A record of decision for the large carbon tetrachloride plume (200-ZP-1 Operable Unit) was approved in 2008 (EPA 2008), and operation of the expanded groundwater treatment system (2,500 gallons per minute) began in FY 2012.
- A record of decision for remediation of the U Plant Canyon (EPA 2005) is being implemented with the canyon ready for demolition as of FY 2012.
- Removal of plutonium-bearing materials, contaminated gloveboxes, and contaminated structures at the Plutonium Finishing Plant is scheduled to be completed by FY 2015.
- Numerous interim actions have been completed to clean up waste sites and contaminated structures in the Outer Area.
- Removal of retrievably stored transuranic waste for packaging and disposal in the Waste Isolation Pilot Plant is over 80 percent complete.

- A record of decision for plutonium-contaminated soil sites (operable units 200-PW-1/3/6 and 200-CW-5) was signed in FY 2011 (EPA 2011).

A considerable amount of extremely challenging work remains. Table 4-1 identifies Central Plateau cleanup actions for which final decisions are still needed.

Table 4-1. Central Plateau Cleanup Actions Remaining

Central Plateau Area	Cleanup Actions Remaining
Inner Area Cleanup	• Remediate Below-Grade Portions of Plutonium Finishing Plant • Remediate Remaining 200-West Inner Area Contaminated Soil Sites • Remediate Remaining 200-East Inner Area Contaminated Soil Sites • Remediate B-Plant Canyon Building/Associated Waste Sites • Place Cesium/Strontium Capsules in dry storage pending final disposal • Remediate PUREX Canyon Building/Associated Waste Sites, including the storage tunnels • Remediate REDOX Canyon Building/Associated Waste Sites • Complete remediation of U Canyon and associated waste sites • Remediate T-Plant Canyon Building and associated waste sites • Remediate solid waste burial grounds • Remove Remaining Liquid Waste Disposal Facilities (SALDS, TEDF, LERF/ETF) • Remove Remaining Treatment, Storage and Disposal Facilities • Remediate pipelines and associated structures and releases • Remove Remaining Inner Area Buildings and Facilities
Outer Area Cleanup	• Remediate/Remove Remaining Outer Area Buildings and Facilities • Remediate Remaining Outer Area Contaminated Waste Sites • Complete NRDWL/SWL remedial actions
Groundwater and Deep Vadose Zone Cleanup	• Remediate Contaminated Deep Vadose Zone • Restore 200-West groundwater to Beneficial Use • Restore 200-East groundwater to Beneficial Use
ETF = Effluent Treatment Facility FFTF = Fast Flux Test Facility LERF = Liquid Effluent Retention Facility NRDWL = Nonradioactive Dangerous Waste Landfill	PUREX = Plutonium Uranium Extraction (Plant) REDOX = Reduction-Oxidation (S Plant) SALDS = State-Approved Land Disposal Site SWL = Solid Waste Disposal Facility TEDF = Treated Effluent Disposal Facility

4.2 Key Challenges for Central Plateau Cleanup

The challenges for cleanup of the Central Plateau differ from those in the River Corridor. Most cleanup efforts along the River Corridor have focused on removal of contaminants to the Central Plateau. A portion of the plateau, however, will retain significant inventories of contamination and long-term waste management activities will be required to ensure protection of human health and the environment. The Inner Area will continue to be used until completion of all cleanup activities including tank waste treatment and closure. Monitoring and maintenance of Central Plateau waste management facilities will extend long beyond the final cleanup action.

Cleanup of the Central Plateau is a highly complex activity because of the large number and diversity of waste sites, surplus facilities, active treatment and disposal facilities, and areas of deep soil contamination. The following paragraphs describe some of the significant challenges facing the cleanup of the Central Plateau:

1. Number, Variety, and Complexity of Cleanup Actions

- **What is the challenge?** There are more than 800 waste sites on the Central Plateau and the cleanup of the plateau will involve a mix of containment, removal and disposal (e.g., to ERDF), and in-place remediation (e.g., for groundwater). The number and variety of waste sites, surplus facilities (900+), active and inactive burial grounds, and active and inactive processing facilities means that many cleanup decisions must be coordinated. Also, the actions to implement cleanup decisions will need to be coordinated to make the efficient use of cleanup resources.
- **Where are we today?** The remedial investigation/feasibility study process is proceeding as established by the Tri-Party Agreement. Draft work plans were submitted to the regulators for the 200-IS-1, 200-SW-2, and 200-WA-1 operable units at the end of calendar year 2011. Remaining work plans and follow-on remedial investigation/feasibility study documents will be developed in accordance with Tri-Party Agreement milestones.

2. Need for Remediation of Deep Vadose Zone Contamination

- **What is the challenge?** A vast majority of Hanford's in-ground contaminants reside in the vadose zone of the 200 Area Central Plateau, where reprocessing operations occurred. The vadose zone at this location is comprised of about 250 feet of unsaturated soil above groundwater that eventually flows to the Columbia River. Contaminants in this zone originated from intentional liquid discharges to cribs, retention basins, and trenches and from unintended tank waste releases in the tank farms. The deep vadose zone is defined as the region below the practical depth of surface remedy influence (e.g., excavation or surface barrier). Traditional remedies will have limited effectiveness to solve these problems because of contaminant depth, contaminant sorption, and the presence of a complex geologic, geochemical and microbial environment.

> **Vadose Zone**
>
> The vadose zone is the area between the ground surface and the water table. Central Plateau waste sites have discharged more than 450 billion gallons of liquid waste and cooling water to the ground. Much of this contamination, however, remains above the water table and has the potential to contaminate groundwater in the future.
>
> **What is the Deep Vadose Zone?**
>
> The deep vadose zone is defined as the region below the practical depth of surface remedy influence (e.g., excavation or barrier). These deeper sections of the vadose zone pose unique problems for characterization and remediation of contaminants.

- **Where are we today?** DOE has initiated a series of treatability tests to identify and evaluate potential approaches to deep vadose zone contamination. These tests (DOE 2008b) focus on technologies for remediating deep technetium-99 and uranium. Field testing for desiccation[18] technology to reduce the mobility of technetium-99 in the vadose zone was conducted from

[18] Desiccation involves drying a targeted portion of the vadose zone by injecting dry air and extracting soil moisture. This method reduces the amount of pore fluid that could transport contaminants, impedes water movement, and augments the impact of surface water infiltration controls.

November 2010 through June 2011. Vadose zone monitoring is continuing at the test site. Based on the characterization results from the desiccation testing, DOE initiated a phased treatability test in August 2011 to remove technetium-99- and uranium-contaminated perched water and pore water from the deep vadose. Additional tests are planned to immobilize subsurface uranium through sequestration. In addition, DOE has established the Deep Vadose Zone Applied Field Research Initiative. This initiative provides additional resources for developing and testing remedies to deep vadose zone contamination. Refer to Section 4.6 for more details about deep vadose zone remediation.

3. Long-Term Effectiveness of Engineered Surface Barriers

- **What is the challenge?** Engineered surface barriers will be required for in-place waste disposal and for disposal sites on the Central Plateau including ERDF, the Integrated Disposal Facility, the mixed-waste disposal trenches, and canyon facilities such as U Plant. There is growing recognition that surface and subsurface engineered barriers are an integral part of waste site remediation that is needed to minimize further contamination spread, allow time for additional radionuclide decay, and lower worker and environmental risks. Nonetheless, DOE also recognizes concerns remain over the long-term effectiveness of barriers and their expected longevity. Long-term assurance of barrier performance will build upon near-term research, analysis, and field testing of each barrier component and the integrated barrier system to ensure that it will work as designed.

- **Where are we today?** The best example within the DOE complex of testing barrier performance is the 5-acre surface-engineered barrier built in 1994 atop a liquid waste site in the 200 East Area, called the Hanford Prototype Barrier. Barrier design was based on years of material and soil research that provided the foundation for barrier construction. Thus, the 1994 barrier was built from layers of natural sediments and human-made materials that control moisture and plant and animal entry while minimizing erosion. Barrier performance has now been monitored for 16 years—the longest period of any surface barrier in the DOE complex. Data confirm the barrier continues to achieve its performance goals. Results from such short-term (years to a few decades) research and tests are fed into models to continuously refine barrier performance predictions. In addition, post-remediation monitoring will be required to confirm and validate continued barrier performance. Performance monitoring and barrier maintenance will be carried out under the long-term site stewardship responsibilities (see Chapter 6.0).

4. Remediation of Legacy Solid Waste Burial Grounds

- **What is the challenge?** Sixty percent of Hanford's solid waste volume was disposed before 1970, mostly on the Central Plateau in large landfills using common waste management practices of the day. A key challenge for remediating these landfills is to obtain a common understanding of the potential risk the waste poses to the environment and how to best minimize that risk. Waste could be removed from burial grounds and disposed elsewhere on the Hanford Site under an engineered barrier, an engineered surface barrier could be installed directly over the burial grounds, or a combination of the two actions could be taken. If decisions are made to remove waste from some or all of the burial grounds, then complex technologies and containment structures might be required to ensure worker and environmental protection while characterization, removal, treatment, and/or repacking takes place.

- **Where are we today?** The draft work plan for the 200-SW-2 operable unit has been submitted to Ecology for review, outlining the plans for characterization and alternatives analysis for the burial grounds on the Central Plateau. Public workshops, sponsored by DOE, Ecology and EPA, will be held to engage the public in a dialogue about the path forward for these landfills.

4.3 Strategy for the Central Plateau Cleanup

DOE's 2015 Vision (Appendix A) seeks to protect the Columbia River, reduce the active footprint of Hanford cleanup to 75 square miles or less on the Central Plateau, and reduce lifecycle costs. Central Plateau activities that support the 2015 Vision include:

- Complete decontamination and decommissioning of the Plutonium Finishing Plant complex to slab-on-grade (reduce nuclear safety and life cycle costs).
- Put in place final groundwater remedies in 200 West Area (protect the Columbia River).
- Proceed with remedial investigations/feasibility studies for the remaining Central Plateau operable units (protect the Columbia River, reduce life cycle costs, reduce the active footprint).

Once the 2015 Vision is attained, Hanford's remediation activities will focus on the Central Plateau. Waste treatment, storage and disposal activities will continue to be needed to support the remediation of tank waste as well as the non-tank farm waste sites, pipelines, facilities, and canyons. Figure 4-1 shows the Inner and Outer Areas of the Central Plateau along with associated operable units.

The Central Plateau strategy is organized into the following three principal components:

- **Inner Area (Section 4.3.1)** – that footprint of the Hanford Site that will be dedicated to long-term waste management and containment of residual contamination and will remain under federal ownership and control for as long as a potential hazard exists. The Inner Area contains the majority of Hanford's active waste treatment, storage and disposal facilities. The Inner Area also includes hundreds of wastes, surplus facilities, many miles of buried pipelines, tank farms, and large canyon facilities. Cleanup of the Inner Area will make this footprint as small as practical.

- **Outer Area (Section 4.3.2)** – defined as all areas of the Central Plateau beyond the boundary of the Inner Area. It is DOE's intent to clean up the Outer Area to a level comparable to that achieved for the River Corridor. Contaminated soil and debris removed as part of Outer Area cleanup will be placed within the Inner Area for final disposal. Completion of cleanup for the approximately 65-square-mile Outer Area will shrink the active footprint of cleanup for the Central Plateau to the Inner Area.

- **Groundwater and Deep Vadose Zone Remediation (Section 4.3.3)** – DOE's goal is to restore Central Plateau groundwater to its beneficial uses, unless restoration is determined to be technically impracticable. An important element of groundwater protection and remediation is to develop and implement ways to protect groundwater from continuing influx of contaminants from the deep vadose zone.

Each of these elements is discussed in the following sections.

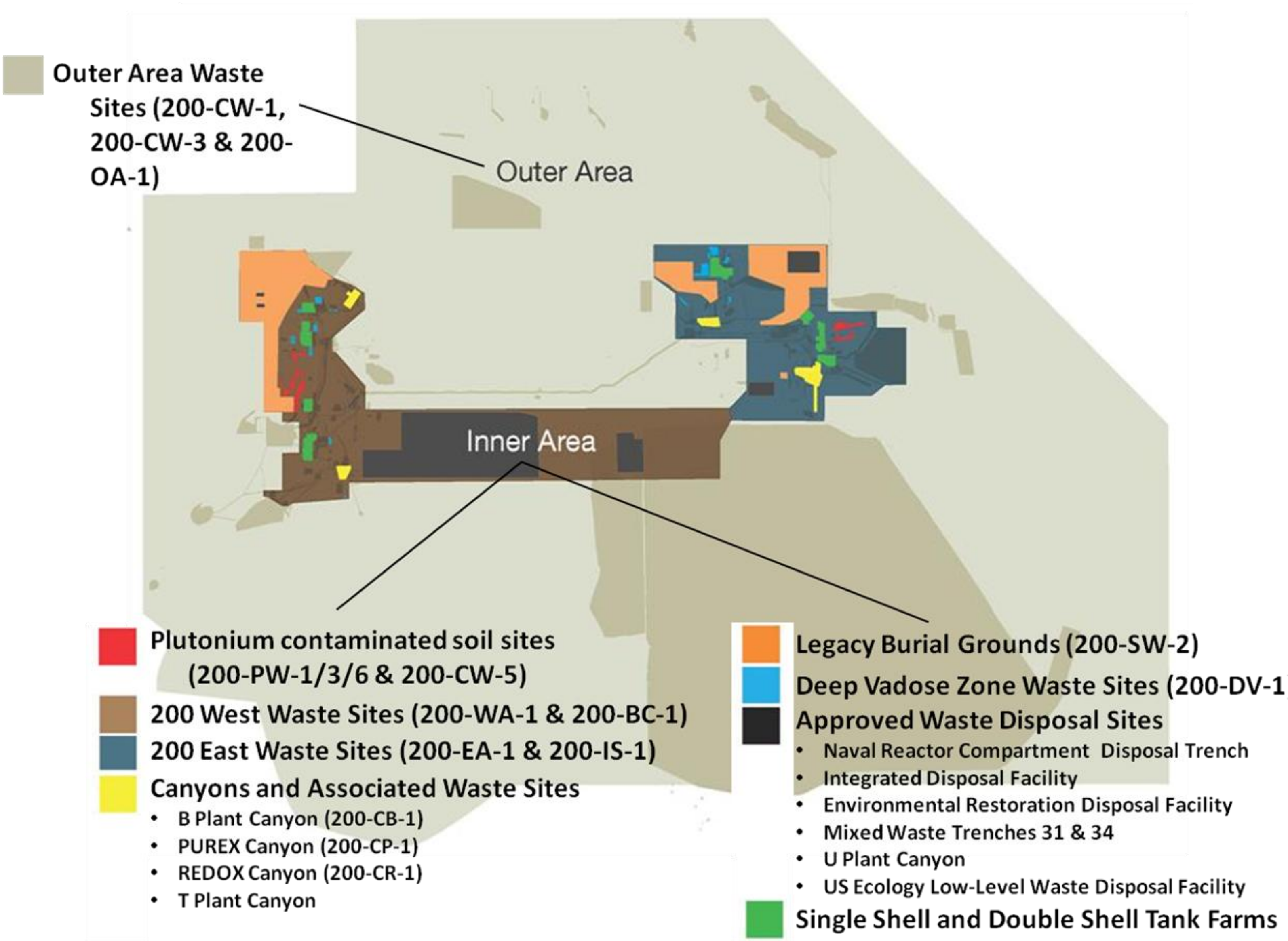

Figure 4-1. Central Plateau Inner and Outer Area Boundaries and Operable Units

4.3.1 Inner Area Cleanup

Recognizing that past decisions have already established long-term waste management areas within the Central Plateau Inner Area, the Tri-Parties have acknowledged that there will be a portion of the Central Plateau that will be dedicated to long-term waste management and containment of residual contamination. The Inner Area is anticipated to be approximately 10 square miles, or less, and will remain under federal ownership and control for as long as potential hazards exist. If future waste management facilities are required to support mission completion (e.g., tank waste treatment), it is DOE's intent to locate those facilities within the Inner Area whenever possible. Reducing the long-term waste management area to the smallest practical size is consistent with CERCLA and RCRA policy, DOE management goals, sound fiscal practices, and stakeholder input.

Figure 4-1 illustrates DOE's most current concept of the boundary for the Inner Area. In developing this boundary, DOE considered:

- Waste disposal decisions already in place, such as ERDF, the Integrated Disposal Facility, the Naval Reactor Compartment Disposal Trench, Trench 31 and 34 Mixed Waste Landfills, the U Plant canyon decision, and the US Ecology Washington Low-Level Radioactive Waste facility.
- Areas where post-closure and cleanup actions would likely result in engineered surface barriers even if some waste removal was performed, such as the remaining canyons, tank farms, portions of the WTP, and existing low-level waste burial grounds.
- Areas where deep vadose zone contamination exists below the effective range of surface remedies, which could require long-term institutional controls.

As cleanup decisions are made and implementation progresses, the boundary of the Inner Area will be refined as appropriate.

Inner Area remedy decisions must address:

- Contaminated waste sites and facilities.
- Deep vadose zone portions of waste sites (see Section 4.3.3).
- Solid waste burial grounds, pipelines, and associated subsurface structures.
- Canyon facilities – Plutonium Uranium Extraction (PUREX), Reduction-Oxidation (REDOX), T Plant, and B Plant.
- Closure of treatment, storage and disposal facilities.

To develop a holistic and efficient approach to Inner Area cleanup, DOE will focus on the following actions:

- **Characterization and investigation** – efficiently characterize Inner Area waste sites to support remedy evaluation and selection.

- **Decision making for remedy selection** – decisions across the entire Inner Area should be consistent with each other and with the use of the area for long-term waste management.

- **Geographic remedy implementation** – implement cleanup remedies using a geographic area approach that efficiently applies cleanup resources.

Each of these topics is discussed in the following sections.

4.3.1.1 Characterization and Investigation

Remedy evaluation and selection depends on waste site characterization data. A frequent cause of delays in making remedy decisions has been lack of adequate characterization data. However, Hanford cleanup experience demonstrates that additional characterization data is often developed after remedy selection and that new information can be used to modify the original decision. There are four principal opportunities within the CERCLA process to obtain characterization data:

- **Remedy Evaluation and Selection** – collection of characterization data during the remedial investigation phase to determine the need for action, support remedy selection activities, and perform the baseline risk assessments.
- **Remedial Design** – collection of additional field data as necessary to support remedial design determinations (e.g. detailed design of barriers or treatment systems to further delineate the extent of soil excavation).
- **Remedy Implementation** – additional remedy verification data is obtained during field execution as part of the overall approach to remedy performance. Real-time analysis, field screening, and other close-support laboratory techniques will be used to track the progress of the remedies and verify actual conditions encountered.
- **Remedy Completion** – remedy completion data is obtained during this stage to close out individual operable units and geographic areas, as individual site remedial actions are completed.

Plutonium Finishing Plant (PFP)

Completing PFP cleanup is an immediate priority for DOE because of the risk it poses and the cost required to maintain its safety. DOE plans to have work at the Plutonium Finishing Plant reduced to slab on grade by 2015.

PFP represented the end of the line (the final process step) associated with plutonium production at Hanford. The plant began operations in 1949. At this facility, the plutonium that had been extracted in a liquid form from the irradiated fuel rods at Hanford was processed into a solid form for use in the country’s weapons production facilities.

PFP is actually a complex consisting of more than sixty buildings. Ultimately, all of these structures are to be decontaminated and demolished as Hanford cleanup continues. The short-term goal for the entire complex is to bring it down to “slab on grade” which means that the buildings are all to be decontaminated and demolished, the debris removed, and all that will be left will be the concrete floors and some below grade structures and pipelines. Remediation of the remaining below grade structures and contamination will be addressed through the CERCLA process.

By December of 2009, DOE had successfully shipped all of the remaining plutonium material to an off-site location. The facility’s armed security presence was no longer needed. Even though stored plutonium has been removed from PFP, this facility is still the highest hazard nuclear facility at Hanford. This is because of kilogram quantities of plutonium that are held up in gloveboxes and other process equipment. This remaining inventory of plutonium requires tens of millions of dollars in maintenance and operating costs to ensure PFP safety systems (e.g., ventilation, fire protection) operate in a manner that protect human health and the environment.

Sufficient characterization information has been obtained over the past 20 years for remedies to be defined and evaluated for many of the Inner Area waste sites. But, to fill the gaps in that base of information, the Tri-Party Agencies will define any supplemental characterization needs in work plans for the various cleanup efforts.

4.3.1.2 Decision Making for Remedy Selection

DOE's strategy for making Inner Area remedy decisions recognizes that decisions across the entire Inner Area should be consistent with each other and with the use of the Inner Area for long-term waste management and containment of residual contamination.

In the past, key parameters that are considered in each of the remedial investigation/feasibility study documents, such as cleanup levels, points of calculation, and contaminants of potentials concern, have been developed independently for each operable unit. This has caused many of the same difficult issues to be revisited multiple times by multiple decision-makers. Frequently, progress on remedial investigation/feasibility study documents has stalled because no agreement could be reached or because the differences in parameters or technical approach between operable units resulted in significant inconsistencies in how cleanup levels were developed or remedies were evaluated.

DOE has identified a set of technical principles that require agreement among the Tri-Party Agencies to ensure Inner Area remedy decisions are completed in a timely and efficient manner. These principles are:

1. Use exposure scenarios to evaluate impacts to human receptors are consistent with anticipated future land use or as negotiated.
2. Develop and apply ecological protection parameters that are protective of soil biota, plants, and wildlife.
3. Establish soil cleanup levels protective of groundwater using a graded approach that considers the complexity of the specific site conditions when necessary.[19]
4. Identify contaminants of interest early in the remedial investigation/feasibility study process to support development of characterization data requirements.
5. Set dose and risk standards that are protective of human health.
6. Develop an Inner Area institutional control plan to provide the basis for documenting the controls already in place and to provide the foundation for estimating institutional control costs for proposed remedies.
7. Establish a set of applicable or relevant and appropriate requirements early in the remedial investigation/feasibility study process that can be evaluated for all operable units.

DOE will work with EPA and Ecology to reach agreement on these technical principles to enable the Tri-Parties to efficiently move forward with remedy evaluation and selection for Inner Area operable units. This agreement will be part of the CERCLA remedy selection process and will be subject to a public review and comment process.

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[19]A significant step in gaining Tri-Party consensus on this technical principle occurred with the publication of *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection* (DOE 2012b) in February 2012.

4.3.1.3 Geographic Implementation Strategy

Once cleanup decisions are in place, final remediation activities can begin. DOE is creating an optimized sequence for implementing remedy decisions for the Inner Area and remaining portions of the Outer Area. This sequence of activities aims to effectively and efficiently use cleanup resources. Among other factors, this sequence will be based on considerations of equipment procurement and staging, workforce mobilization/demobilization, workforce leveling, workforce skill-mix, and other project execution factors.

This remediation sequence is organized by "implementation areas" that are defined around important components, such as canyon buildings, landfills, and tank farms. These implementation areas have a defined inventory of facilities and waste sites and lie in relatively close physical proximity to each other.

Cleanup decisions will be made over a period of decades. Moreover, several portions of the Inner Area will be needed for waste treatment, storage and disposal activities that support the overall cleanup mission. These active areas will require access to site infrastructure and utilities and will not be ready for final remediation efforts until their active missions are complete. Consequently, the sequence of remediating implementation areas will be organized into near-, intermediate-, and long-term execution phases that recognize the ongoing use of portions of the Inner Area. The sequence and schedule of implementing remedies will be documented in regulator-approved work plans.

4.3.2 Outer Area Cleanup

The Outer Area (see Figure 4-1) covers approximately 65 square miles and contains more than 500 waste sites and structures scattered throughout largely undisturbed shrub steppe habitat. Key elements of DOE's strategy for cleanup of the Outer Area include:

- Remove, treat, and dispose using cleanup levels comparable to the River Corridor, with some exceptions.
- Accelerate cleanup by implementing interim actions.
- Consolidate final remedy decisions into a single Outer Area record of decision.
- Deactivate and demolish excess facilities using CERLCA or DOE authority.

Most of the waste sites in the Outer Area are near-surface sites that will be removed and treated as needed for onsite disposal. Sites will also be sampled to determine if additional action is required, other than implementation of appropriate institutional controls. The largest components of the Outer Area remediation are the ponds where cooling water and chemical sewer effluents were discharged and the BC Control Area where surface contamination was spread because of animal intrusion into a waste site.

The Outer Area of the Central Plateau will be remediated to be protective of human health and the environment and the groundwater. Cleanup levels will support the future reasonably anticipated land use of conservation/mining. Most of this area is reserved for the management and protection of archeological, cultural, ecological, and natural resources and related uses that require protection of human health and ecological receptors. Limited and managed mining (e.g., quarrying for sand, gravel, basalt, and topsoil for governmental purposes only) could also occur. Approximately 10 square miles of the Outer Area lies within the Industrial-Exclusive Area previously designated by the *Hanford*

Comprehensive Land-Use Plan record of decision (64 FR 61615), and, following cleanup, would be available for uses consistent with that designation.

Cleanup of the Outer Area primarily involves removal of contaminated soil and surplus facilities with disposal in ERDF or other approved disposal locations. Key elements of Outer Area cleanup include:

- Remediation of most waste sites consistent with a single future CERCLA record of decision for the associated operable units, 200-CW-1, 200-CW-3 and 200-OA-1 (see Figure 4-1).
- Closure of two inactive landfills (Nonradioactive Dangerous Waste Landfill and the Solid Waste Disposal Facility) in the southeastern portion of the portion of the Outer Area using Washington state landfill closure regulations and a NEPA record of decision[20].
- Previously cleanup activities completed using ARRA funding to "shrink the active cleanup footprint:"
    - Demolition and disposal of the 212-N, 212-P and 212-R facilities
    - Remediation of associated waste sites
    - Disposition of surplus rail cars to ERDF
    - Remediation of the large BC Control area (17 acres complete and more than 65,000 tons of soil disposed at ERDF) based on an aerial-based radiological survey
    - Cleanup actions on dozens of small miscellaneous waste sites in the former 200-MG-1 Operable Unit.

Monitoring and continued institutional control will likely be required at the large ponds in the Outer Area to allow radioactive contaminants to decay to levels suitable for unrestricted surface use, consistent with reasonably anticipated future land use of conservation/mining. These lands are expected to remain under continued federal ownership and control.

4.3.3 Central Plateau Groundwater and Deep Vadose Zone Cleanup

As discussed in Section 1.4, Goal 4, and as stated in the *Hanford Site Groundwater Strategy* (DOE 2004), DOE's goal is to remediate groundwater to achieve drinking water standards, unless determined to be technically impracticable. In those instances where remediation goals are not achievable in a reasonable timeframe, programs will be implemented to contain the plume, prevent exposure to contaminated groundwater, and evaluate further risk reduction opportunities as new technologies become available.

DOE has completed construction of a large groundwater treatment facility in the 200 West Area that is designed to meet cleanup goals for groundwater remediation in that portion of the Central Plateau. Remedies for 200 East Area groundwater plumes have not yet been evaluated, selected or implemented.

To protect groundwater, DOE must also consider the continuing threat to groundwater from multiple areas of deep vadose zone contamination that are present within the Inner Area of the Central Plateau.

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[20] See *Closure of Nonradioactive Dangerous Waste Landfill (NRDWL) and Solid Waste Landfill (SWL), Hanford Site, Richland, Washington* (DOE 2011b).

Deep vadose contamination does not pose a threat of direct exposure to surface users but does pose a threat to underlying groundwater. To ensure truly protective groundwater remediation, DOE may need to develop, test, and deploy methods to remediate deep vadose zone contamination. Consequently, DOE's deep vadose strategy is an integral part of Central Plateau groundwater cleanup. Both groundwater and deep vadose zone cleanup are discussed in the following sections.

4.3.3.1 Groundwater Cleanup Approach

A key element of the Central Plateau cleanup strategy and 2015 Vision is groundwater remediation and protection. Protection of the groundwater and ultimately the Columbia River is essential. The groundwater beneath the Central Plateau is currently divided into four operable units (Figure 4-2) for purposes of remedial investigation:

- The 200-PO-1 Operable Unit is located in the southern half of the 200 East Area and includes contaminant plumes of tritium, iodine-129, and nitrate.
- The 200-BP-5 Operable Unit is located in the northern half of the 200 East Area and includes contaminant plumes of uranium and technetium-99.
- The 200-UP-1 Operable Unit is located in the southern half of the 200 West Area and includes contaminant plumes of technetium-99 and uranium.
- The 200-ZP-1 Operable Unit is located in the northern half of the 200 West Area and includes a large plume of carbon tetrachloride and smaller plumes of technetium-99, chromium, hexavalent chromium, trichloroethylene, nitrate, tritium, and iodine-129.

Treatment systems have been installed and are being expanded to contain and remediate groundwater in the 200 West Area. DOE expects to simplify and streamline the regulatory decision process for final groundwater remedy selection by issuing one record of decision to encompass both 200-BP-5 and 200-PO-1 Operable Units in the 200 East Area. Key elements of DOE's Central Plateau groundwater cleanup strategy include:

- Protect the Columbia River.
- Implement treatment systems to contain contaminant plumes within the Central Plateau.
- Restore groundwater to beneficial use, unless restoration is determined to be technically impracticable.
- Obtain a remedy decision and implement treatment for the 200-UP-1 Groundwater Operable Unit in the 200 West Area.
- Continue investigation in the 200 East Area (200-BP-5 and 200-PO-1 Operable Units) and develop feasibility study(s) and record of decision(s) for 200 East Area groundwater remediation.
- Develop, test and deploy remedies for deep vadose zone contamination that poses a threat to groundwater quality (see Section 4.3.3.2).

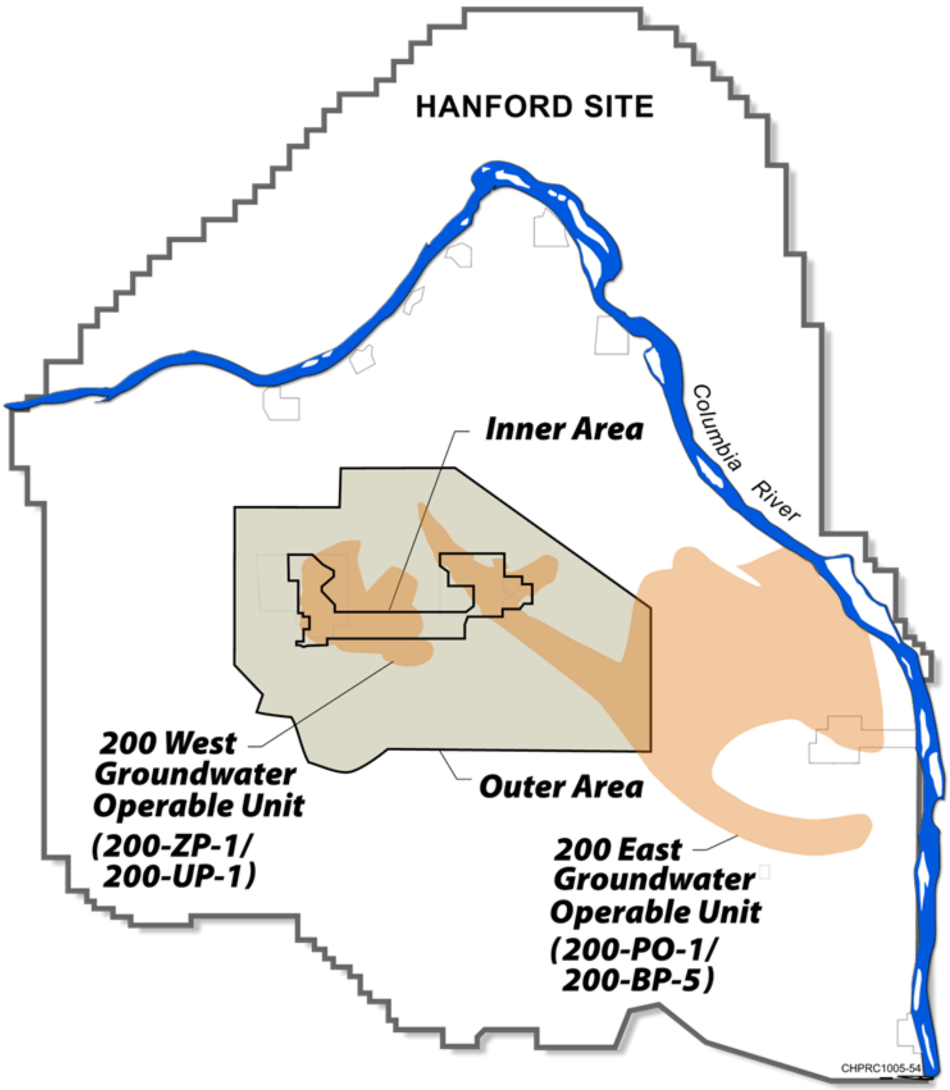

Figure 4-2. Groundwater Operable Units on the Central Plateau

Since the mid-1990s, the 200 West Area groundwater operable units, 200-UP-1 Operable Unit (EPA 1997) and 200-ZP-1 Operable Unit (EPA 1995b), have had interim pump-and-treat systems that attack the highest concentration portions of the plumes. DOE's strategy to enhance the existing interim pump-and-treat systems reflects the need to improve containment of contamination and to return the aquifer to drinking water standards. DOE is implementing this strategy through a record of decision (200-ZP-1 Operable Unit, DOE 2008d and EPA 2008). In 2011, DOE completed construction on the new 200 West treatment system for the 200-ZP-1 Operable Unit that includes sufficient capacity to also treat the technetium-99 plume within the 200-UP-1 Operable Unit and space for future expansion to include treatment of a uranium plume in 200-UP-1 Operable Unit. This facility covers an area equivalent to more than two football fields and is one of the largest groundwater treatment facilities in the DOE complex. The facility is expected to be fully operational in the summer of 2012. This treatment system is anticipated to be used for 25 years with the intent of removing 95% of the mass of carbon tetrachloride currently in the aquifer. Analyses supporting the record of decision for 200-ZP-1 indicate that an additional 100-year period of monitored natural attenuation will be needed for contaminant levels to reach cleanup levels. The Tri-Party Agencies have agreed to address the 200-UP-1 Operable Unit remedy decision with a separate record of decision.

DOE is scheduled to continue investigations and make remedy decisions for the 200 East Area groundwater plumes through a consolidated remedial investigation/feasibility study and proposed plan. The consolidated remedial investigation/feasibility study and proposed plan will result in a combined record of decision for the East Area 200-BP-5 and 200-PO-1 Operable Units in 2016. For the 200-PO-1 Operable Unit, the likely response will be to monitor the existing iodine, tritium, and nitrate plumes to ensure that these plumes decay or attenuate to levels below drinking water standards within a reasonable timeframe. Some of these plumes have reached the Columbia River (e.g., tritium and iodine). The rate and concentration of these contaminants entering the river are such that there are no adverse impacts to human health or the environment. For the 200-BP-5 Operable Unit plumes of uranium and technetium-99, treatment options will be investigated to contain these plumes within the plateau and return the groundwater to drinking water standards. A draft treatability test plan has been prepared (DOE 2011f.) and implementation will begin in 2012. The intent of the test is to determine whether a sufficient groundwater pumping rate can be sustained to reduce the mass and remediate the technetium-99 and uranium groundwater plumes in the area. Another potential outcome of the test is the design and implementation of an interim action that would contain the groundwater plume pending selection of a remedy.

4.3.3.2 Deep Vadose Zone Cleanup Approach

The deep vadose zone is defined as the region beyond the reach of near-surface treatment technologies (e.g., excavation or barrier). Deep vadose zone contamination presents unique characterization and remediation challenges. Although contaminants in the deep vadose zone pose no direct exposure hazard to humans, these contaminants do serve as possible sources of contamination to the underlying groundwater system. Consequently, long-term protection of Hanford groundwater may require remediation/control of deep vadose zone contaminants.

The scope of deep vadose zone contamination areas (Figure 4-3) goes beyond the 200-DV-1 Operable Unit. Past releases from single-shell tank farms (e.g., Waste Management Areas B-BX-BY, C, T, S-SX) are known to be present in the deep vadose zone and have already affected groundwater quality (DOE 2011c.). Other known deep vadose zone sites include the BC Cribs and U Cribs, both of which are assigned to the 200-WA-1 Operable Unit. Deep vadose zone characterization, treatability testing, and remedy evaluation/selection at these and other locations with the Inner Area of the Central Plateau. Deep vadose zone remediation was initiated in 1992 to remove carbon tetrachloride in 200 West Area using a soil vapor extraction system. Since treatment began, more than 80,000 kilograms of carbon tetrachloride have been successfully removed (DOE 2011c). This system complements the 200 West Area groundwater pump-and-treat system.

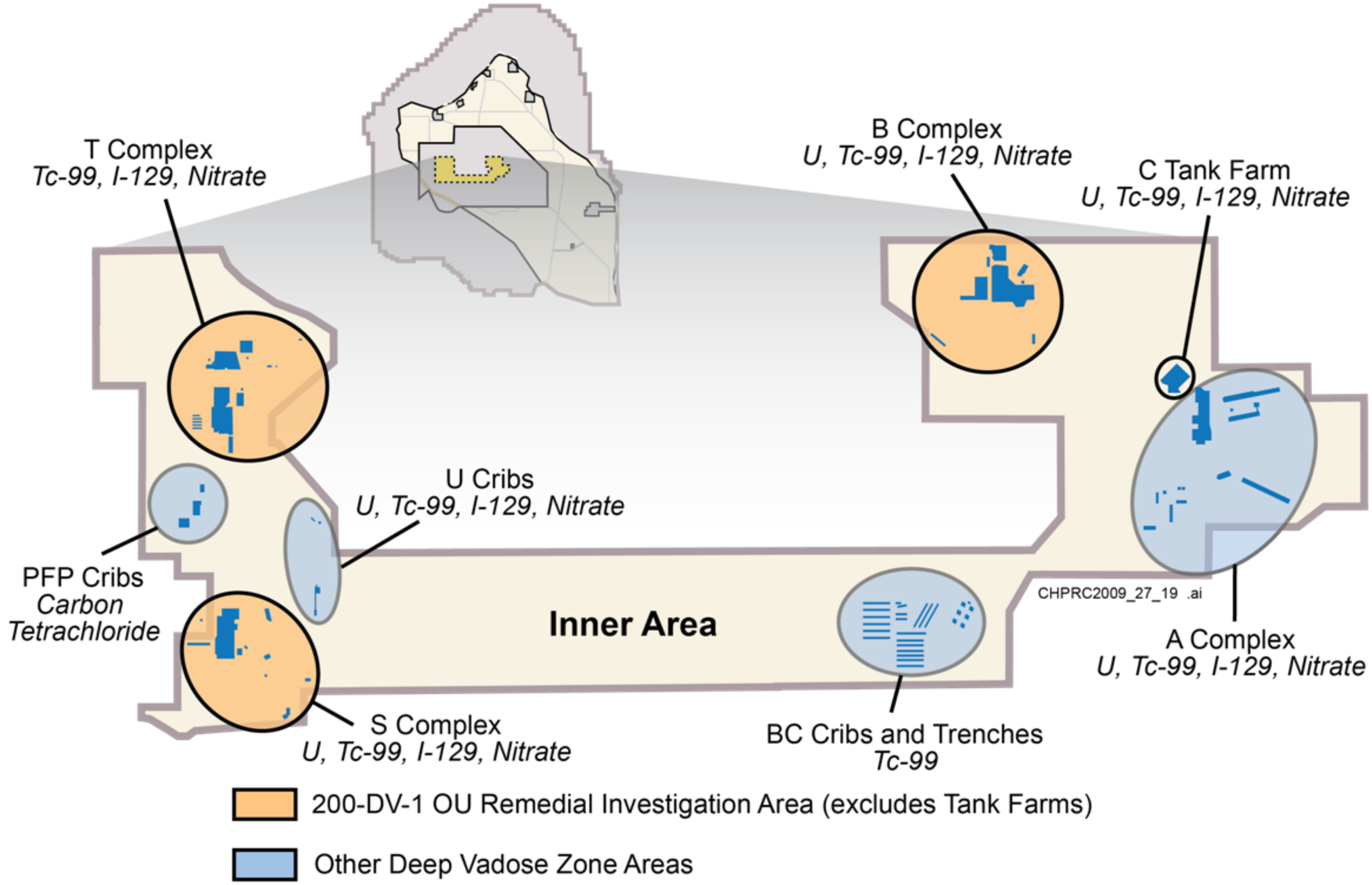

Figure 4-3. Deep Vadose Zone Problem Areas and Contaminants of Concern

Characterization and remediation of deep vadose zone contamination are complicated by the following factors:

- Low moisture content of the sediments.
- Difficult to access because of depth.
- Complex hydrogeologic, geochemical, and microbial environments with considerable lateral spreading of contaminants.
- Limited availability and effectiveness of traditional characterization tools and remediation methods, e.g., surface barriers.

These and other issues make the deep vadose zone contamination one of the most challenging remediation problems at the Hanford Site.

DOE has initiated a series of treatability tests to identify and evaluate potential approaches to deep vadose zone contamination. These tests (DOE 2008b) focus on technologies to remediate deep technetium-99 and uranium. The results from this test will be described in the treatability test report, which will be completed in June 2012. Based on the B Area Conceptual Site Model (Serne et al. 2010) evaluated for the Deep Vadose Zone (200-DV-1) operable unit, DOE initiated a treatability test in August 2011 to remove technetium-99- and uranium-contaminated water from the deep vadose zone. Additional tests have been planned for sequestration of uranium to immobilize the subsurface uranium at the U Cribs or other uranium-contaminated sites in the Inner Area

DOE's deep vadose strategy for protecting groundwater includes a defense-in-depth approach that provides multiple layers of protection. This defense-in-depth approach includes the following elements:

- Implementation of ***appropriate surface remedies*** (e.g., excavation or infiltration barriers) to mitigate the potential impacts of deep vadose zone contamination.
- Inclusion of an ***integrated groundwater and vadose zone monitoring system*** that is designed to provide early warning of significant contaminant movement or impact to groundwater.
- Implementation of ***groundwater treatment systems*** that can expand to handle emerging plumes, when necessary.
- Continued investment in ***treatability tests*** to evaluate potential approaches to remediate deep vadose zone contamination.
- Sustained investment in ***advanced science and technology solutions*** to tackle deep vadose zone challenges including characterization, prediction, remediation, and monitoring.
- Periodically revisit the ***effectiveness of remedies*** and possible changes in environmental conditions through the CERCLA five-year review process.

DOE has committed to initiate a series of treatability tests to identify and evaluate potential approaches to deep vadose zone contamination (DOE 2008b). If viable technologies are developed here or elsewhere, then remedies could be selected and implemented across broad regions of the Central Plateau in a manner analogous to groundwater remedy selection.

To complement these treatability tests, in 2010 the DOE created the Deep Vadose Zone Applied Field Research Initiative (PNNL 2011). This initiative will support long-term protection of water resources across the DOE complex by resolving the major challenges posed by deep vadose zone contamination. The overall vision of the Deep Vadose Zone Applied Field Research Initiative is to provide a technical basis to quantify, predict, and monitor natural and post-remediation contaminant discharge from the vadose zone to the groundwater and to facilitate developing in situ solutions that limit this discharge and protect water resources. The initiative is to develop solutions in the following four areas:

- In situ characterization and monitoring – develop advanced subsurface monitoring techniques to assess performance of remedial actions and contaminant threat to water resources.
- Controlling processes – quantify coupled hydrologic, geochemical, and microbial processes controlling moisture flux, contaminant movement, and remediation process efficacy.
- Remedial design – perform fundamental and applied research supporting design of surface and subsurface remediation techniques.
- Predictive modeling and data integration – simulate integrated processes controlling moisture flux, contaminant transport, and remedial performance.

Additional information on Hanford's deep vadose work and the Applied Field Research Initiative is available at http://www.hanford.gov/page.cfm/DeepVadoseZone.

4.4 Ongoing Waste Management

The Central Plateau contains the primary waste management facilities that support cleanup. These treatment, storage, and disposal facilities will continue to be used and, in some cases, expanded from current capabilities, e.g., disposal of immobilized low-activity waste from tank waste processing or systems for treatment of contaminated groundwater. It is DOE's intent to consolidate these services within the central portion of the plateau consistent with the *Hanford Comprehensive Land-Use Plan* record of decision (64 FR 61615).

The following operations are part of Hanford's continuing waste management functions:

- **Package, certify, and ship transuranic waste**. Transuranic waste will be shipped to the Waste Isolation Pilot Plant in New Mexico throughout cleanup. This waste results from the retrieval of stored waste and from transuranic-contaminated materials that are newly generated as a result of cleanup operations. Activities are underway to develop and implement new retrieval capabilities for difficult to handle items such as larger packages, failed containers, and highly radioactive waste. Engineering work is also underway to identify processing and disposal capabilities needed to deal with waste streams that currently do not have a defined treatment or disposal pathway.
- **Operate solid low-level waste and mixed low-level waste disposal facilities**. Waste disposal facilities including solid waste burial grounds (mixed waste trenches), the Integrated Disposal Facility, and ERDF will continue to operate.
- **Operate liquid waste treatment and disposal facilities**. Liquid effluents are generated by numerous processes and facilities at Hanford. Treatment of these effluents is provided by the Effluent Treatment Facility and Liquid Effluent Retention Facility. Modifications to these facilities may be required to support future operation of the Waste Treatment Plant.

- **Safely store used fuel and nuclear materials**.
  - Hanford will continue to operate the Canister Storage Building and other facilities for management of used fuel and nuclear materials that will eventually be removed to off-site locations.
  - Nearly 2,000 cesium and strontium capsules are currently stored under water inside the Waste Encapsulation and Storage Facility adjoining the B Plant canyon facility. If B Plant is selected as the next canyon facility for final dismantlement, after U Plant, then cesium and strontium capsules would need to be removed prior to starting that work. One option would be to move the capsules to dry storage on site pending final disposition.
  - Some of these materials are yet to be generated, e.g., immobilized high-level waste from Hanford's tanks and to date, final off-site disposition of these wastes is uncertain. Therefore, safe management of these materials may be required for decades. Any new waste management or disposal facilities that are needed to support mission completion (e.g., for completion of the tank waste mission) should be located within the Inner Area of the Central Plateau where possible.
- **Operate other waste management facilities to support cleanup activities**. Additional support facilities include the Waste Receiving and Processing Facility, Central Waste Complex, 222-S Laboratory, and the Waste Sampling and Characterization Facility.

As these facilities complete their missions, they will undergo final remediation through RCRA treatment, storage, and disposal unit closure, or deactivation/decommissioning per DOE or CERCLA requirements.

Waste disposal decisions, both for low-level and mixed low-level waste, will be supported by performance assessments that meet DOE requirements (DOE Order 435.1), and in some cases, RCRA permit requirements (e.g., for an Integrated Disposal Facility).[21] The disposal and closure conditions are intended to ensure that these sources do not pose a future threat to the groundwater. In addition to performance assessments for individual disposal facilities, DOE is required to maintain a composite analysis[22] (per DOE Order 435.1) that is intended to ensure that the cumulative impact from Hanford Site disposal and closure actions comply with DOE performance criteria for radiological exposure. This analysis will draw upon the results of other remediation, closure and disposal decisions.

4.5 Central Plateau at Cleanup Completion

Some hazardous and radioactive material will remain on the Central Plateau after cleanup actions have been implemented. For example, current decisions that leave contamination on the Central Plateau include the ERDF record of decision (EPA 1995a), the U Canyon record of decision (EPA 2005), and the 200-PW-1/3/6 and CW-5 record of decision (EPA 2011). Although many Central Plateau cleanup

[21] DOE is currently preparing the *Tank Closure & Waste Management EIS* (DOE 2009d). Among other things, this EIS evaluates on-site disposal alternatives, including the Integrated Disposal Facility, for Hanford's low-level waste and mixed low-level waste.

[22] After completion of the *Tank Closure and Waste Management EIS*, DOE plans to update the Composite Analysis by building upon the EIS's cumulative impact analysis.

decisions remain to be made, DOE anticipates that additional decisions will leave contamination in the Central Plateau, consistent with the use of the Inner Area for long-term waste management. Accordingly, institutional controls will be required after completion of cleanup for as long as potential hazards exist.

Cleanup of Hanford's Central Plateau will take decades to complete. Completion of Central Plateau cleanup will be dependent upon completion of tank waste treatment (see Section 5.0). Current planning shows completion of cleanup for the Central Plateau by the FY 2050 timeframe. The CERCLA five-year review process will provide a continuing mechanism to ensure that remedial actions, including institutional controls, have been successfully implemented and are protective. In addition, RCRA post-closure care requirements will need to be met.

DOE anticipates seeking site completion status for the Central Plateau in accordance with CERCLA closeout procedures for NPL Sites (EPA 2000) when Central Plateau groundwater meets drinking water standards for key contaminants, all cleanup remedies are implemented, and institutional controls are in place. A final close-out report will be developed that describes how Central Plateau cleanup was accomplished and will provide overall technical justification for site completion.

You may find more detailed information about Central Plateau cleanup and remediation in the following resources:

- Records of decision and 5-year CERCLA reviews can be accessed at the EPA Region 10 site: http://yosemite.epa.gov/R10/CLEANUP.NSF/sites/Hanford
- DOE Hanford Site web site at http://www.hanford.gov
- *Hanford Story* video series: http://www.hanford.gov/page.cfm/HanfordStory.

5.0 Tank Waste Cleanup Completion Strategy

In 1998, Congress established the DOE Office of River Protection (ORP) at the Hanford Site in Washington state to safely retrieve and treat Hanford's tank waste and close the tank farms to protect the Columbia River. At the Hanford Site, DOE-ORP is responsible for managing all aspects of tank waste storage, waste retrieval, treatment, construction of facilities, interim storage of immobilized waste, waste disposal, and tank closure.

The tank farms (see Figure 4-1) include 177 underground storage tanks (149 single-shell tanks and 28 double-shell tanks) containing approximately 55 million gallons of chemically hazardous radioactive waste from past nuclear processing operations. Sixty-seven of Hanford's tanks have, or are suspected to have, collectively leaked up to 1 million gallons of waste into the ground. The tanks were built between 1943 and 1986. The first tanks were built with a single carbon steel wall and floor that was covered by a dome and outer shell made of concrete (single-shell tanks). Beginning in 1968, tanks were built with two carbon steel liners along the walls and floor and a single steel dome liner, thus 'double-shell' tanks.

Summary of Tank Waste Cleanup Progress (through FY 2011)

- Tank safety issues resolved – 60 tanks removed from Congressional Safety Watch List (1994 – 2001).
- Interim stabilization of 149 single-shell tanks completed in 2004 – safely removed more than 3 million gallons of remaining pumpable liquid.
- As of September 2011, retrieval of 11 single-shell tanks has been started or completed including initial use of the first-of-a-kind Mobile Arm Retrieval System., Six of these tanks meet the TPA retrieval goal.
- Interim measures put in place to mitigate the effects of past tank leaks including construction of an interim barrier at T Tank Farm, the largest past tank leak. An additional interim barrier was installed over the TY Tank Farm in 2010.
- Construction of Waste Treatment Plant complex underway. The overall project is about 60% complete.

DOE-ORP is responsible for retrieving and treating Hanford's tank waste and for closing tank farms to protect the groundwater on the Central Plateau and thereby protect the Columbia River. This includes the following activities (DOE 2011e):

- Protecting human health and safety and the environment by safely storing tank waste until it is retrieved for treatment and by mitigating the impacts from past releases of tank waste to the ground.
- Constructing and operating the WTP, which will vitrify both the high-level and the low-activity portions of the tank waste.
- Developing and potentially deploying additional treatment capability to safely treat the remainder of the low-activity waste that exceeds the capacity of the WTP capacity currently under construction.
- Deploying interim storage capacity for the immobilized high-level waste pending determination of the final disposal pathway.
- Disposing of packaged immobilized low-activity waste onsite.
- Closing the single-shell and double-shell tank farms, ancillary facilities, and associated waste management and treatment facilities.
- Optimizing the overall mission by resolving the technical and programmatic uncertainties; upgrading the tank farms to provide a steady, well-balanced feed to the WTP; and performing

trade-offs of the required amount and type of supplemental treatment and pretreatment, and the amount of immobilized high-level waste and immobilized low-activity waste.

The current strategy for tank waste cleanup is anchored by the Tri-Party Agreement (Ecology et al. 1989) and the Consent Decree (2010) and associated Tri-Party Agreement modifications. The requirements of the Consent Decree went into effect when it was filed on October 25, 2010. The success criteria for meeting these agreements are detailed in DOE-ORP's System Plan (DOE 2011e) and in Table 5-1. The River Protection Project System Plan is available online at http://www.hanford.gov/files.cfm/RPP%20SP%20rev%205.pdf.

Table 5-1. Tank Waste Cleanup Metrics and Dates

Metric	Complete By
Complete C Tank Farm retrievals (10 tanks)	September 2014
Close Waste Management Area C	June 2019
Waste Treatment Plant "hot start"	December 2019
Waste Treatment Plant "initial operations"	December 2022
Complete nine single-shell retrievals beyond C Tank Farm	September 2022
Complete all single-shell tank retrievals	December 2040
Close all single-shell tank farms	January 2043
Complete tank waste treatment	December 2047
Close all double-shell tank farms	September 2052

Figure 5-1 shows the tank waste processing flow diagram. DOE-ORP maintains the River Protection Project System Plan (DOE 2011e) that describes the detailed elements of the treatment system and establishes the technical basis for aligning and integrating all elements of program scope. The cornerstone of the DOE-ORP tank waste cleanup project at Hanford is the WTP. Efforts are underway to design, build, and commission the WTP with overall progress greater than 60% at the end of FY 2011. The WTP will use a proven technology − called vitrification − to immobilize chemical and radioactive waste from the tanks in a sturdy form of glass to isolate it from the environment. The WTP project is an unprecedented engineering and construction undertaking.

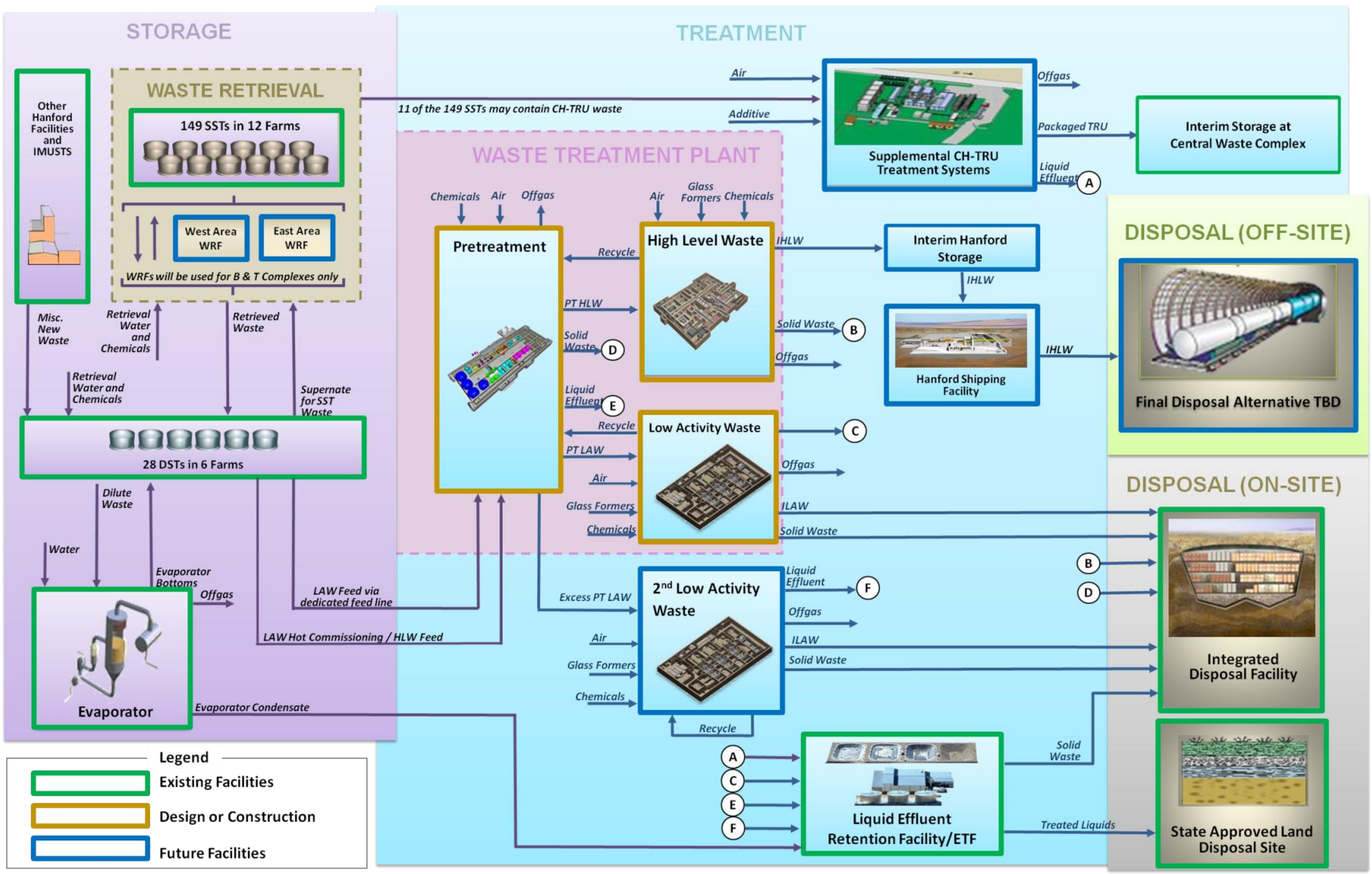

Figure 5-1. Tank Waste Treatment Flow Diagram (from Figure 1-7. DOE 2011e)

5.1 Key Challenges for Tank Waste Cleanup

Hanford's biggest challenge is 55 million gallons of radioactive waste stored in 177 underground tanks. Sixty-seven of these tanks have or are suspected to have leaked up to 1 million gallons of waste. Releases from some single-shell tank farms have reached groundwater. DOE expects the impact from these releases to increase in the future unless near-term actions are taken. Today, actions [see Section 5.2.3] are being taken to slow the movement of the contaminants. DOE is also recovering the contaminants once they reach groundwater. More work is needed to permanently mitigate the threat from tank waste. The most important step in fixing this problem is to retrieve the waste from single-shell tanks and put it into safer double-shell tanks. Then, the waste must be fed to the WTP for treatment and converted into solid glass waste forms (vitrification). Retrieval and treatment of tank waste will remain the most important and difficult task facing completion of cleanup for several decades to come. Completion of tank waste cleanup has faced many challenges in the past and will continue to face challenges in the future. The following paragraphs identify the key challenges for tank waste cleanup:

1. Continue to Safely Store Waste in Single-Shell and Double-Shell Tanks

- **What is the challenge?** Lengthening the tank mission (DOE 2011e) until almost 2050 increases the importance of maintaining safe storage of waste in single-shell and double-shell tanks. The single-shell tanks have exceeded their intended design lives (~25 years) and 67 single-shell tanks have or are suspected to have leaked in the past. Four double-shell tanks have exceeded their original design lives, and the remaining 24 double-shell tanks will do so before tank waste treatment is scheduled to be complete.
- **Where are we today?** DOE-ORP actively maintains programs to ensure the integrity of both double-shell and single-shell tanks. These efforts include structural analyses to evaluate and confirm tank structural integrity; analyses of tank corrosion and tank liner degradation to assess future leak potential and to identify methods to prevent leaks (e.g., adjustments to tank chemistry to control corrosion); and improved methods for leak monitoring and mitigation. Refer to Section 5.2 for more details about safe storage.

2. Successfully Retrieve Waste and Feed Waste to Treatment

- **What is the challenge?** Based on retrieval system experience, waste in some tanks will be difficult to retrieve. Use of multiple technologies may be required in a single tank to meet retrieval requirements, including retrieval rates needed to maintain feed delivery for treatment purposes. Single-shell tanks that have previously leaked may present additional challenges. Also, the potential exists for a single-shell tank to leak during retrieval operations. In this event, retrieval may be halted and a different retrieval method deployed.
- **Where are we today?** DOE-ORP is continuing to evaluate and deploy improved retrieval methods, is developing leak monitoring and response methods, and is evaluating the leak integrity status of single-shell tanks. Refer to Section 5.3 for more details about retrieving waste.

3. Deploy and Start Up Waste Treatment System

- **What is the challenge?** Commissioning and startup of the WTP facilities and supporting feed delivery infrastructure is an enormous very complex undertaking and, based on analogous projects, could require six or more years to accomplish. This undertaking requires installation of tank farm upgrades to support waste feed delivery. Commissioning and startup of each of the WTP facilities – Balance of Facilities, Low-Activity Waste Facility, Analytical Laboratory, Pretreatment Facility, and High-Level Waste Facility – are individually challenging and collectively complex.

- **Where are we today?** ORP will implement sequential rather than simultaneous startup actions – Balance of Facilities, Low-Activity Waste Facility, and Analytical Laboratory followed by the Pretreatment and High-Level Waste Facilities, while still supporting initial WTP operations by 2022. This approach allows stepwise transition from the WTP construction to commissioning phase and creates a learning period. ORP is evaluating the potential of moving from Low-Activity Waste Facility commissioning to glass production prior to start of commissioning of the more complex WTP Pretreatment and High-Level Waste Facilities. Before pursuing this strategy, the Department of Ecology will be presented this case for discussion.

4. **Optimize Overall Mission Completion (by adding treatment capacity and resolving technical and programmatic uncertainties)**

- **What is the challenge?** To achieve current commitments, extra capacity will be needed to treat low-activity waste in addition to the facilities currently under construction. Potential options for providing this increased capacity, as evaluated in the *Tank Closure and Waste Management EIS* (DOE 2009d) include addition of a second low-activity waste vitrification plant or use of alternate immobilization technology such as bulk vitrification or steam reforming. In addition to low-activity waste immobilization, supplemental pretreatment capacity may also be required to mitigate the issue of excessive sodium. The throughput of the overall treatment system is affected by the amount of waste that can be captured in the vitrified high-level waste form (waste loading). Waste loading is sensitive to the presence of non-waste elements, such as aluminum. Aluminum can be reduced in the high-level waste feed by adding sodium hydroxide, but increases in sodium content increase the amount of low-activity waste to be immobilized, which can also lengthen the time needed complete the mission. Sodium is also added to double-shell tanks for corrosion control and is used in a pretreatment step called caustic leaching.

- **Where are we today?** To tackle this challenge, DOE-ORP is evaluating options in the *Tank Closure and Waste Management EIS* (DOE 2009d) including enhanced waste loading for low-activity and high-level waste forms, expansion of low-activity waste immobilization capacity, and methods of blending or pre-conditioning waste fed to the treatment plant to improve operational efficiency. DOE-ORP is also upgrading the tank farms to provide a steady, well-balanced feed to the WTP and is evaluating trade-offs of the required amount and type of supplemental treatment and pretreatment to support efficient mission completion.

5. **Maintain and Upgrade Treatment of Secondary Waste to Meet Throughput and Safe Disposal Requirements**

- **What is the challenge?** The current Effluent Treatment Facility is inadequate to treat the projected liquid secondary waste stream that will be generated by the WTP. This liquid secondary waste stream will also contain contaminants (e.g., iodine-129 and technetium-99) that pose a long-term threat to groundwater and will need to be contained within a suitably robust waste form.

- **Where are we today?** DOE will need to upgrade the Effluent Treatment Facility to handle the quantity and compositions of liquid secondary waste generated at the WTP. Secondary waste forms will need to be investigated and developed to ensure that these materials can be safely disposed of. The *Tank Closure and Waste Management EIS* (DOE 2009d), which is expected to be finalized in the near future, addresses ETF upgrades as well as disposal of secondary waste. A record of decision will provide the decision to proceed with these actions.

6. Reach Timely Tank Closure Decisions and Meet Closure Requirements

- **What is the challenge?** Current commitments call for closure of the first tank farm, C Tank Farm, in 2019. To accomplish this, (1) C Tank Farm retrievals need to be completed, (2) a record of decision based on the final *Tank Closure and Waste Management EIS* (DOE 2009d) must be published, (3) DOE and Washington state regulatory approval of closure plans must be achieved, and (4) closure actions specified in those closure plans must be completed. Achieving these milestones will require close and continuing cooperation between DOE and Ecology.

- **Where are we today?** To facilitate this process, DOE and Ecology must complete a joint process to develop a performance assessment for C Tank Farm. This performance assessment will provide a tool for both parties to evaluate the merits of closure actions. In addition, DOE and Ecology have initiated a closure demonstration project that will evaluate prototype actions related to tank farm closure. This demonstration is also intended to resolve regulatory challenges to enable timely tank closure.

5.2 Safe Storage

Protecting human health and safety and the environment is the top priority for tank waste cleanup. Ultimately, removal of waste from tanks and placing it into a stable glass waste form will provide lasting health and environmental protection. Over time, DOE has systematically reduced the safety risk and the environmental risk of tank waste. These activities began with the resolution of urgent safety issues for some tanks that had the potential for large uncontrolled releases of tank waste due to sudden temperature or pressure rises. Next, DOE maintains a tank integrity program to ensure that aging tanks can continue to safely store their contents as the retrieval and treatment activities move forward. DOE completed removal of pumpable liquid from all single-shell tanks in 2004. This action, plus stopping the use of underground transfer lines, has limited the potential for future leaks to the ground from these tanks. Finally, over the past decade, DOE has taken steps to mitigate the impact of those past releases by reducing the forces that can cause waste to move toward groundwater and by removing contaminants that have reached the groundwater.

5.2.1 Congressional Tank Safety Watch List Closed in 2001

The congressional watch list (Wyden Watch List 1990) was named for Senator Ron Wyden of Oregon, who authored the law in the early 1990s requiring DOE to evaluate the most dangerous of 177 large underground radioactive waste tanks at the Hanford Site. The law required identification of tanks having the potential for release of high-level waste from uncontrolled increases of temperature and pressure.

Based on this safety evaluation, DOE identified five problem areas that could result in releases of high-level waste:

- Generation of flammable gases
- Presence of flammable organic liquid chemicals
- Presence of mixtures of organic compounds which in the presence of inorganic nitrates could explode if heated above 200 °C
- Presence of potentially explosive ferrocyanide
- High-heat levels generated by certain types of waste posed an additional risk.

A total of 60 tanks had been added to the list since January 1991, and some tanks were listed for more than one safety issue. The final safety issue (flammable gas) was resolved for 24 tanks in 2001. Based on the experience gained in resolving these issues, DOE continues to maintain a margin of safety for its nuclear operations at the single and double shell tanks.

5.2.2 Maintain Tank Integrity

DOE recognizes that single-shell tanks will be required to safely store waste beyond their original intended life. The intent of this portion of the tank waste mission is to safely store tank waste until it is retrieved. A double-shell tank integrity program has been in place since the mid-1990s. Recently, DOE-ORP initiated a similar integrity program for single-shell tanks to review the structural and leak integrity of single-shell tanks and to develop a way to minimize further degradation of the single-shell tanks. Development of the integrity program for the single-shell tanks has been enhanced by the use of a panel of experts from academia and industry that DOE-ORP uses to provide recommendations and oversee the program.

DOE-ORP actively maintains the integrity of both double-shell and single-shell tanks. These efforts include structural analyses to evaluate and confirm tank structural integrity; analyses of tank corrosion and tank liner degradation to assess future leak potential and to identify methods to prevent leaks (e.g., adjustments to tank chemistry to control corrosion); and improved methods for leak monitoring and mitigation. An in-depth structural analysis has been performed for the double-shell tanks and a similar effort is currently underway for the single-shell tanks. The double-shell tank integrity program uses ultrasonic-testing devices to measure the thickness of the tank liner and look for cracks to ensure that the tank liners are not being compromised due to corrosion.

Development work is underway to deploy a new technology to supplement ultrasonic-testing devices that would allow more surface area of the tank liners to be examined. This new technology is called an Electromagnetic Acoustic Transducer. Probes are used within select double-shell tanks to monitor corrosion or the potential for corrosion. Inspection of both the single-shell and double-shell tanks using a camera inserted into the tanks is also performed. Single-shell tanks are continually surveyed to ensure that the concrete domes retain their strength. A deflection in the dome would indicate structural distress. Work to obtain samples of the concrete on select single-shell tanks in order to test the in place properties of the concrete is underway. Samples from the dome of one tank have been tested and plans to obtain samples from the sidewall of another tank are being developed.

Single-shell tanks, which are known to have leaked in the past, are currently being re-evaluated to determine failure modes and possible common causes of failure. This work is important to ensure safe and environmentally sound completion of the Hanford cleanup mission. This work examines past monitoring data from inside and outside of the tanks to determine the location and nature of past releases. In many cases, DOE can determine that past releases were from transfer lines or overfill events and not from leaks of the tank shell itself. This information helps guide selection of a waste retrieval method that will not cause further harm to the environment.

5.2.3 Mitigate the Potential for Future Tank Waste Releases to Soil

Sixty-seven of Hanford's single-shell tanks have, or are suspected to have, released up to 1 million gallons of waste to the soil. Additional releases have occurred from underground transfer lines. DOE recognized that new leaks could occur as long as liquid waste was stored in single-shell tanks. DOE pumped drainable liquid out of single-shell tanks and transferred it to double-shell tanks – a process known as ***interim stabilization***. Following legal action by the state of Washington in 1998, a formal Consent Decree (1999) was put in place to accelerate the completion of interim stabilization actions for 29 listed single-shell tanks. This work was completed in 2004 after 3 million gallons of liquid had been removed from those final 29 tanks. This milestone and the prior resolution of safety issues provided significant reductions in the threat posed by tanks to public health and the environment.

DOE continues to monitor the tank contents – solids, sludge-like material, and interstitial liquid – for changes that could indicate new releases to the environment. DOE also maintains an active effort to re-examine past tank leak events to better understand the mechanism of the leak, its magnitude, location and extent of contamination. This effort is often important for determining whether a past release was due to a failure of the tank liner or was the result of an overfill event or failure of a transfer line leading to or from a tank. Knowing the mechanism of a past release is important for determining the potential of a tank to leak during subsequent waste retrieval efforts. If a tank's liner is known to have failed, then a dry retrieval method will be used to minimize the potential for more releases during retrieval. More information about the "leak assessment process" is available at http://www.hanford.gov/page.cfm/inventoryassessment.

5.2.4 Mitigate the Impact of Past Tank Waste Releases to Soil

Interim actions have been, and may continue to be, taken to mitigate past releases from the single-shell tank system. Past releases have recently affected groundwater and pose a continuing threat to groundwater quality in multiple locations of the Central Plateau. These releases occurred from the earliest operation of the single-shell tanks and waste transfer systems. The potential for continued leaks has been mitigated by the removal of pumpable liquid from single-shell tanks, which was completed in 2004. Today, waste and liquid levels inside of tanks are monitored to verify the containment integrity of the tanks.

Interim actions to mitigate the impacts of past releases are of three types:

1. Controls on natural and man-caused water influx into the farms that could force contamination residing in the soil to move toward the groundwater. These controls have included cutting and capping water lines, installing berms to prevent water run-on during periods of heavy rainfall or rapid snowmelt, and sealing of leaking well covers.

2. Placement of interim barriers over tank farm locations that constitute the greatest threat due to substantial waste losses which reside high in the soil column and are subject to continuing migration due to natural infiltration into and through areas of contamination. These barriers collect rainfall and snowmelt and move the water away from the tank farm surface. Two such barriers have been installed to date - one covering four tanks in T Tank Farm that includes the largest known single-shell tank release from tank T-106 and the other over the entire TY Tank Farm including a significant neighboring subsurface pipeline spill. Performance of interim barriers is being assessed and additional barriers are being evaluated.

3. Direct remediation or removal of contaminants. In 2007, groundwater extraction wells were installed downgradient of T Tank Farm to treat technetium-99 associated with past releases from the tank farm and neighboring waste sites. Also, in 2011 extraction wells were located downgradient of S and SX Tank Farms that tie into the 200 West Groundwater Treatment System. This tie-in will prevent technetium-99 releases in this vicinity from spreading and will provide active treatment for this plume.

In addition to these actions, the emerging deep vadose testing and remedy development (see Section 4.5) may be used to mitigate and remediate past tank farm releases. The desiccation test applied to BC cribs and trenches may have applicability to tank farms, possibly in combination with surface barriers. Also, a high flow rate extraction test showed the potential to remove pore water with entrained contaminants. As these deep vadose zone remediation methods are demonstrated at Hanford, their use in mitigating past tank leaks will be carefully evaluated.

5.3 Retrieval of Tank Waste

Prior to start of full WTP operations, tank waste retrieval is limited by the amount of available unused space in double-shell tanks and potential interim pretreatment capacity. As agreed to in the Consent Decree (2010), ORP is focusing its immediate attention on retrieval activities in C Farm followed by retrieval from the A-AX farms. DOE intends to focus waste retrieval activities on the closure of C Tank Farm. The retrieval efforts at C Tank Farm will provide additional experience to develop and optimize retrieval technologies and will help retain a proficient work force to support the beginning of retrieval operations when the WTP begins operating. This phase of retrieval will provide valuable insights into the cost-effectiveness of alternative retrieval methods, new information regarding the composition of remaining tank residuals, and information regarding the structural integrity of the emptied tanks.

The initial tank retrieval sequence has been agreed upon and calls for completion of retrieval from Waste Management Area C by September 30, 2014 (Table 5-2). As required by the Consent Decree (2010), DOE in consultation with the state of Washington, has selected nine additional single-shell tanks where waste will be retrieved by December 31, 2022. This next series of tanks will enable completion of retrieval of the single-shell tanks in the A and AX Tank Farms. The sequence and schedule for retrieving the remaining single-shell tanks will be the subject of future negotiations between DOE and the state of Washington under milestones in the Tri-Party Agreement.

Table 5-2. Waste Retrieval at Waste Management Area C Tanks

Current Status and Expected Retrieval Completion of Waste Management Area C Tanks			
Through 2011	2012	2013	2014
C-103 [a] C-106 [b] C-201 [a] C-202 [a] C-203 [a] C-204 [a]	C-107 [c, d] C-108 [c, d] C-109 [c, d] C-110 [c, d]	C-111[c, d] C-112 [c]	C-101 [c] C-103 [c] C-104 [c] C-105 [c]

Notes:
[a] Remaining residual volume meets Tri-Party Agreement goal.
[b] Remaining volume exceeds Tri-Party Agreement goal; retrieval may be complete pending approval per Tri-Party Agreement Appendix H.
[c] Subject to retrieval completion requirements in the Consent Decree (2010).
[d] Retrieval has been initiated.

Both the Tri-Party Agreement and, for a designated subset of tanks, the Consent Decree (2010) define requirements for the extent of waste retrieval from Hanford's single-shell tanks. Several retrieval technologies may need to be applied to meet these requirements. In general, the extent of retrieval is such that tank residues are not to exceed 360 cubic feet in 100 series tanks (75-foot diameter) and 30 cubic feet in 200 series tanks (20-foot diameter). Those residual volumes represent 1% of the average volume of waste stored in the respective tank series and correspond to the 99% minimum retrieval goal established for retrieval from single-shell tanks. [23]

Hanford currently has developed and applied multiple retrieval methods including sluicing using supernatant liquid double shell tanks, chemical dissolution methods that break down hard to remove solids, and dry retrieval methods such as vacuum retrieval. A Mobile Arm Retrieval System (MARS, see text box) has been developed and deployed to make it easier and more efficient to apply several retrieval methods within a given tank.

5.4 Tank Waste Treatment

The cornerstone of the DOE-ORP tank waste cleanup project at Hanford is the WTP. Efforts are underway to design, build, and commission the WTP. The WTP will use a proven technology − called vitrification − to immobilize chemical and radioactive waste from the tanks in an exceptionally sturdy form of glass to isolate it from the environment. The WTP project is an unprecedented engineering and construction undertaking (Figure 5-2).

[23] Extent of retrieval is subject to the provisions in Appendix H of the Tri-Party Agreement (Ecology et al. 1989).

Figure 5-2. Aerial Photo of Waste Treatment and Immobilization Plant from the Southeast (August 2011)

The WTP is a 65-acre complex with three major nuclear facilities, an analytical laboratory, office space, support facilities, and utilities. Started in 2001, the WTP is expected to be completed in 2019. The five major components of the WTP are:

- Pretreatment Facility – Separates tank waste into high-level and low-activity fractions.
- High-Level Waste Facility – Vitrifies high-level waste; the facility has the capacity to process all the high-level waste output from the Pretreatment Facility.
- Low-Activity Waste Facility – Vitrifies the low-activity waste; the facility has the capacity to accept approximately 50 percent of the low-activity waste output from the Pretreatment Facility.
- Analytical Laboratory – Tests the quality of the glass.
- Balance of Facilities – Includes more than 20 support facilities.

This section describes DOE-ORP's dual focus on (1) treatment system startup and (2) optimized completion of the treatment mission.

5.4.1 Treatment System Startup -- Integrated WTP Commissioning, Feed Delivery and Startup

WTP construction and deployment is at a key pivot point for tank waste treatment – the transition from construction to system commissioning and startup. This transition requires:

- **Upgrades to the existing tank farm infrastructure to support reliable and efficient delivery of waste feed to WTP**. Tank farm infrastructure upgrades will provide tank waste retrieval, transfer, staging, and characterization capability to provide waste for WTP treatment that conforms to the Waste Acceptance Criteria. DOE-ORP is evaluating low-activity waste hot operations prior to completion of the WTP Pretreatment Facility. Part of the evaluation requires the tank farm contractor to evaluate treatment of tank waste supernatant to remove solids and cesium, deliver feed directly to the Low-Activity Waste Vitrification Facility using hose-in-hose transfer lines, and manage resulting liquid effluents. Prior to pursuing this strategy, the Ecology will be presented this case for discussion.
- **Transition from WTP construction to commissioning and startup of key facilities**. This transition will put in place an interim system to receive waste feed allowing low-activity waste vitrification prior to completion of the WTP Pretreatment Facility. Following completion of the Pretreatment and High-Level Waste Vitrification Facilities, the WTP will be fully integrated to pretreat and vitrify tank waste into low-activity waste and high-level waste glass waste forms.
- **Development and deployment of glass product and secondary waste treatment, storage and disposal systems**. These systems are needed to store high-level waste glass canisters on an interim basis pending the availability of a permanent repository, dispose of low-activity waste glass canisters in the Integrated Disposal Facility, and treat and dispose of secondary solid waste and liquid effluent from WTP operations.

To facilitate these transitions, ORP is evaluating a sequential commissioning and startup approach that seeks to achieve low-activity waste hot operations as soon as practical, while still supporting full WTP operations by 2022 as required by the Consent Decree (2010). Early startup of the Low-Activity Waste Vitrification Facility takes advantage of the earlier completion of construction for Low-Activity Waste Vitrification Facility, Analytical Laboratory, and Balance of Facilities compared to the Pretreatment Facility and High-Level Waste Vitrification Facility. This approach makes the immobilized low-activity waste product available much sooner than would occur with a simultaneous commissioning and startup approach. One benefit is that it allows facility personnel to gain experience with the lower hazard radioactive materials in the Low-Activity Waste Vitrification and Analytical Laboratory Facilities in advance of the higher hazard Pretreatment Facility and High-Level Waste Vitrification Facility. Another benefit of this approach is that it provides time to implement lessons learned and process optimization, including integration of tank farm feed delivery and WTP waste processing, prior to operating facilities at maximum throughput.

Focusing on early startup of Low-Activity Waste Vitrification Facility includes the following work elements:

- Modify WTP commissioning plans to support phased facility hot commissioning.

- Temporarily modify the interface between the tank farm and Low-Activity Waste Vitrification Facility to allow receipt of tank waste and return of liquid effluent to tank farms using hose-in-hose-transfer-lines.
- Deploy an at-tank interim pretreatment system that prepares tank waste for delivery to and treatment by the Low-Activity Waste Vitrification Facility. This pretreatment system would be retained in a standby condition following initial low-activity waste glass production until the permanent WTP pretreatment systems are fully functional to give additional assurance of feed delivery to the Low-Activity Waste Vitrification Facility.
- Use a single melter at reduced throughput to produce initial immobilized low-activity waste product and to gain early treatment experience.
- Provide glass and secondary waste handling systems including disposal of immobilized low-activity waste product in the Integrated Disposal Facility, disposal of packaged solid secondary waste in the mixed waste burial ground, and return of secondary liquid waste to tank farms.

A key theme through 2020 will be successful development and deployment of a well-integrated feed delivery and treatment system that supports the transition to timely and efficient full-scale operations of the tank waste treatment system.

5.4.2 Tank Waste Treatment Mission Completion

DOE-ORP is constructing the WTP, which will safely treat all of the high-level waste fraction[24] contained in the tank farms, and will immobilize approximately one-half of the low-activity waste in the WTP Low-Activity Waste Vitrification Facility. DOE is evaluating other technologies to treat the remaining output and optimize completion of cleanup activities. DOE is currently preparing the *Tank Closure and Waste Management EIS* (DOE 2009d) to, among other things, evaluate reasonable alternatives for supplemental treatment of tank waste and for closure of single-shell tanks.

Figure 5-1 shows the flow diagram for the total tank waste treatment system. The blue boxes show potential future facilities that are not yet under construction. As described in the previous section, the initial focus is on startup of the treatment system so that feed delivery and treatment interfaces are developed as soon as possible and so that low-activity waste glass production can begin as soon as practical. The following bullets summarize the new facilities that are needed to support completion of the tank waste treatment mission (see DOE 2011e for additional technical detail). Each of the options discussed below will be subject to the outcome of the *Tank Closure and Waste Management EIS* (DOE 2009d) record of decision.

- **Waste Retrieval Facility**. Waste retrieved from single-shell tanks is transferred to double-shell tanks. For B and T Complex Tank Farms, however, double-shell tanks are a substantial distance away, so the waste retrieved would first be transferred to a Waste Retrieval Facility. The Waste

[24] The term high-level waste refers to the fraction of the tank waste containing most of the radioactivity that will be immobilized into glass and disposed at an off-site repository; the term low-activity waste refers to the fraction of the tank waste that will be immobilized into glass and disposed on site.

Retrieval Facility can provide several important functions: (1) it will allow recycling of supernate during waste retrieval, thus minimizing the generation of waste during retrieval and (2) it also can decouple single-shell tank retrievals from near-term limits of double-shell tanks storage space. Because of the considerable distance to the nearest double-shell tanks, a Waste Retrieval Facility will provide sufficient pumping capacity to transfer waste slurries with high solids loadings to the available double-shell tanks. An enhancement to the Waste Retrieval Facility concept is under consideration whereby the Waste Retrieval Facility could also blend or condition the retrieved waste to provide a more uniform feed to WTP.

- **Supplemental Transuranic Treatment Facility**. Twenty tanks (17 single-shell and 3 double-shell tanks) contain waste that DOE could potentially designate using DOE Order 435.1 as transuranic waste, i.e., waste that does not meet the definition of high-level waste under the *Nuclear Waste Policy Act*, but does meet the definition for transuranic waste in the *Waste Isolation Pilot Plant Land Withdrawal Act*. A subset of these tanks, 11 single-shell tanks, contains waste that could be handled as "contact-handled" transuranic waste. This material could be stored on the Hanford Site at the Central Waste Complex until final disposition is determined. The benefit of handling this waste as transuranic waste is that it could allow tank waste retrieval to continue even if double-shell tanks are full, i.e., before WTP processes the backlog of waste stored in double-shell tanks.

- **Supplemental Treatment – Second Low-Activity Waste Facility**. The existing Low-Activity Waste Vitrification Facility has the capacity to treat approximately 40-50% of the output from the Pretreatment Facility. Additional capacity has always been envisioned to treat the remainder. DOE-ORP's baseline planning assumption is that a second Low-Activity Waste Vitrification Facility will be built. However, the supplemental immobilization treatment project is evaluating that option and alternatives include cast stone, fluidized bed steam reforming, and bulk vitrification (see DOE 2011e for additional details).

- **Immobilized High-Level Waste Storage and Shipping**. Hanford will require a place to store the canisters of immobilized high-level waste that will be produced by the WTP. Also, shipping to a national repository will be required once such a facility becomes available. Several options for storage and shipping are under consideration. The storage facility will need to be ready to receive immobilized high-level waste canisters when the WTP High-Level Waste Vitrification Facility starts operation in about 2018. Because the development of the national geologic repository has been put on hold, the storage facility will need to be expandable to accommodate this uncertain schedule. Figure 5-3 shows a picture of both the immobilized high-level waste canisters and immobilized low-activity waste containers. The immobilized low-activity waste containers would be disposed of in the Integrated Disposal Facility, if DOE makes that decision in the record of decision based on the final *Tank Closure and Waste Management EIS* (DOE 2009d).

- **Secondary Waste (Liquid Effluent) Treatment Upgrade.** Once the WTP begins operating, secondary liquid waste will be generated that will require treatment. Currently, the Liquid Effluent Retention Facility and the Effluent Treatment Facility are available on the Central Plateau to treat liquid effluents. With the addition of secondary waste streams from WTP, an additional treatment step, i.e., solidification may be required to produce an acceptable waste form for disposal at the Integrated Disposal Facility.

Figure 5-3. High-Level Waste Canister (left)and Low-Activity Waste Container (Right)

5.5 Tank Farm Closure

The overall objective of closing the tank farms is to protect human health and the environment and protect the groundwater on the Central Plateau. Closure of tanks and tank farms is being evaluated in the forthcoming *Tank Closure and Waste Management EIS* (DOE 2009d). The single-shell tank closure process is described in Tri-Party Agreement (Ecology et al. 1989), Appendix I, Section 3.1. As described in Appendix I, waste management areas will be closed in coordination with other closure and cleanup activities on the Central Plateau. Also, closure of the single-shell tank system will be done in a manner that integrates the requirements of RCRA treatment, storage, and disposal facility closure; RCRA corrective action; the AEA; and the Central Plateau CERCLA remedial actions.

Closure of the tank farms will incorporate the following actions:

- Implement remedies for all contaminated media, including vadose zone and groundwater that has been impacted by past tank farm releases. AEA, RCRA and CERCLA requirements need to be met. Groundwater remedy decisions will be reached through the CERCLA process. DOE intends to also use the CERCLA process to reach remediation decisions for vadose zone regions on the Central Plateau, including soil that has been affected by past releases from the single-shell tank system.
- Investigate and remediate transfer lines that connect tank farms with separations facilities, former liquid discharge sites, and other tank farms.

- If landfill closure is supported by the Tank Closure and Waste Management EIS record of decision, the final closure configuration for tank farms may involve a surface barrier. The optimal size of the surface barrier may extend beyond the physical boundaries of the tank farm, and non-tank farm waste sites could fall within the footprint of the barrier. Selecting the remedy for those waste sites will be coordinated with final closure of the tank farm through the geographic approach to cleanup.

DOE is using the 16 tanks in Waste Management Area C to develop the prototype approach for closure of single-shell tanks. Completion of tank waste retrieval for this farm is projected for 2014. In parallel, DOE will conduct a prototype closure demonstration for this tank farm that will identify and resolve decision pathways and interface requirements for all elements within the tank farm. This demonstration is also intended to resolve regulatory challenges to enable timely tank closure. The lessons learned from this prototype closure effort will be applied to closure of the remaining tank farms.

Tank Waste Closure and Waste Management Environmental Impact Statement

DOE is preparing an environmental impact statement (EIS) that, among other things, is evaluating options for closing Hanford's single-shell tanks and for treating the waste retrieved from those tanks (DOE 2009d). A broad range of tank closure options are defined and evaluated. These options range from "no action" to "clean closure." Clean closure could require much more extensive waste retrieval than is currently planned and complete removal of tanks, nearby equipment, and underlying contaminated soil. A record of decision resulting from this EIS will allow DOE to move forward with tank closure.

To support future closure decisions, the DOE-ORP is developing a performance assessment for Waste Management Area C. This effort is supported by a series of cooperative technical exchanges among DOE and its contractors, the Nuclear Regulatory Commission, Washington State Department of Ecology, EPA, Tribal Nations, the State of Oregon, and Hanford stakeholder representatives. The intent of the performance assessment is to provide a comprehensive understanding of the long-term performance of the closure system to ensure that closure actions are protective of the human health and the environment.

5.6 Coordination with Central Plateau

Coordination is necessary to successfully complete the cleanup mission at the tank farms and the Central Plateau. The primary areas where coordination will be required between the Tank Waste Cleanup component and the Central Plateau Cleanup component are listed below:

- Disposal of immobilized low-activity waste.
- Treatment and disposal of secondary waste from WTP and supplemental treatment operations.
- Remediation of past releases from tank farms in coordination with adjacent waste sites.
- Treatability testing of deep vadose zone remediation for past tank farm and non-tank farm releases to ensure long-term protection of groundwater.
- Maintenance of site access controls to provide a public safety buffer during WTP and other waste management operations.
- Investigation and remediation of transfer lines that cross waste management area boundaries.

- Coordination of the final closure configuration for tank farms with remediation of adjacent waste sites.
- Conduct of pre- and post-closure groundwater monitoring for tank farms and adjacent facilities.

You may find more detailed information about Tank Waste cleanup and remediation in the following resources:

- *River Protection Project System Plan*, ORP-11242, Revision 6. http://www.hanford.gov/files.cfm/RPP%20SP%20rev%205.pdf (DOE 2011c).
- *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, DOE/EIS-0391, (DOE 2009d) October 2009.
- DOE Office of River Protection web site at http://www.hanford.gov/orp
- Hanford Vitrification Plant web site at http://www.hanfordvitplant.com
- *Hanford Story* video series: http://www.hanford.gov/page.cfm/HanfordStory.

6.0 Long-Term Stewardship

Because the completion of cleanup will not result in the total elimination of all contamination (radiological and/or hazardous), long-term stewardship activities will be required for portions of the Hanford Site to ensure protection of human health and the environment. At the conclusion of the cleanup activities, residual contamination will remain, both in surface disposal facilities and in subsurface media.

This section describes the key elements of post-cleanup activities including the Hanford Long-Term Stewardship Program, maintenance of institutional controls, and conduct of CERCLA five-year reviews.

6.1 Current Status

DOE-RL has completed the *Hanford Long-Term Stewardship Program Plan* (DOE 2010b), which describes the Hanford Long-Term Stewardship Program to manage post-cleanup obligations at the Hanford Site in a safe and cost-effective manner to protect human health and the environment. Development of the *Hanford Long-Term Stewardship Program Plan* (DOE 2010b) included feedback from the Tribal Nations and the Hanford Advisory Board, as well as other stakeholders. The plan describes the program responsibilities and how geographic areas of the site will be transitioned into the DOE-RL Long-Term Stewardship Program once active cleanup has been completed. The plan also defines the program responsibilities for management of the Hanford Site resources, such as cultural, biological and natural resources through the *Hanford Comprehensive Land-Use Plan* (DOE 1999) and its implementing procedures and controls.

The first segment of land has been transitioned into the Hanford Long-Term Stewardship Program and the program has evolved from a conceptual process to an active program. The active cleanup of the 100-F/IU-2/IU-6, Segment 1 (Segment 1) geographic area was completed and land management responsibilities transitioned to the long-term stewardship program in September 2011 (Figure 6-1)[25]. The transition of Segment 1 is the first of several segments of the River Corridor to be completed and transitioned into the program. Segment 2 has completed cleanup and will be transitioned to long-term stewardship in 2012. The anticipated sequence and timing for completing cleanup of River Corridor land segments is shown in Figure 6-1.

6.2 Challenges for Long-Term Stewardship

Long-term stewardship, including institutional controls continues to be a topic of high interest to the Hanford communities, stakeholders and Tribal Nations. The Hanford Advisory Board has issued at least six letters of advice to the Tri-Parties[26] related to these topics. The Board's advice has been based on consistent principles of – permanent retrieval, treatment and disposal of all production mission hazards, and to protect and preserve human, biological, natural, and cultural resources in a manner that does not impose a burden on future generations.

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[25] A CERCLA record of decision is expected for this area in the 2013 time frame. DOE anticipates this decision will confirm that the cleanup actions taken to date are protective and no further cleanup actions will be required.

[26] See Hanford Advisory Board Advice #63, #132, #141, #180, #190, and #230, for examples. Hanford Advisory Board advice documents can be found at http://www.hanford.gov/?page=453.

Figure 6-1. Sequence for Transition of River Corridor Land Segments to Long-Term Stewardship

Implementation of long-term stewardship functions, including institutional controls, is required as soon as areas of the Hanford Site have completed cleanup actions. These functions transition from the cleanup program to the Hanford Long-Term Stewardship Program as cleanup is completed per CERCLA and RCRA decision for specific geographic areas. These functions will need to be maintained for as long as areas of the site remain potentially hazardous to human health and the environment. These functions must address significant challenges to demonstrate long-term fiscal viability and minimization of the liability to future generations. An additional challenge is to provide coordination and transition among completion of cleanup, completion of natural resource damage assessment and restoration actions, and initiation of long-term stewardship functions.

6.3 Hanford Long-Term Stewardship Program

DOE is committed to maintaining the protection of human health and the environment and to managing its post-cleanup obligations in a safe and cost-effective manner as described in the *Hanford Long-Term Stewardship Program Plan* (DOE 2010b). Remediated geographic areas of land will transition into the long-term stewardship program when required cleanup activities are completed. As DOE completes cleanup of segments of land at the Hanford Site, these areas will transition into long-term stewardship rather than wait until cleanup is accomplished for the entire site.

DOE-RL will manage the long-term stewardship program until all DOE Office of Environmental Management missions at the Hanford Site are complete. When cleanup at the site is complete, it is anticipated that the DOE Office of Legacy Management will assume responsibility for the Hanford Site. In the interim, DOE-RL will manage a long-term stewardship program in a manner consistent with Legacy Management's goals, policies, and procedures.

One of the two key objectives for long-term stewardship is to ensure the post cleanup requirements of CERCLA and RCRA cleanup decisions are implemented. The land will be prepared for potential future uses consistent with designations in the Hanford Comprehensive Land-Use Plan record of decision (64 FR 61615).

The other key objective of long-term stewardship includes consideration of the Hanford Site‘s unique biological, natural, and cultural resources, which include the following items:

- Surface water, groundwater, land, natural gas, minerals, and other natural resources.
- Fish, wildlife, and plant populations and their habitats.
- Prehistoric archaeological sites.
- Native American sacred and ceremonial places.
- Historical and cultural resources.

DOE is building a dynamic program that will be updated as needed to address emerging issues and lessons learned, implement new technologies, and incorporate requirements from future Hanford Site regulatory cleanup decision documents. Ultimately the long-term stewardship program is designed to ensure continued protection of human health and the environment and to manage and protect important resources. Development of this program continues to be enhanced by ongoing dialogue with Tribal

Nations and stakeholders. It is important that this dialogue continues as Hanford Site cleanup progresses and areas of the site transition to long-term stewardship.

Information management is an important component of the Hanford Long-Term Stewardship Program. It is critical for the program to ensure that the requisite records and data generated during the cleanup mission, necessary to support long-term stewardship and required under the regulatory process, is preserved and available for the future in a timely, cost-effective, and understandable manner. Information management is required to ensure the Hanford Long-Term Stewardship Program will have ready access to complete and accurate information about the cleanup activities, and the associated requirements, including DOE's regulatory obligations.

Local, regional, state and interest groups, and Tribal Nations will be involved in the development of an effective long-term stewardship plan. In addition, DOE is committed to developing roles for Tribal Nations to conduct long-term stewardship functions and to provide complementary, and lasting, capabilities for long-term environmental and ecological monitoring.

6.4 Institutional Controls

Institutional controls generally include non-engineered restrictions on activities and access to land, groundwater, surface water, waste sites, waste disposal areas, and other areas or media that contain hazardous substances, to minimize the potential for human exposure to the substances. Common types of institutional controls include procedural restriction for access, fencing, warning notices, permits, easements, deed notifications, leases and contracts, and land-use controls.

Institutional controls will be required for some areas of the Hanford Site including:

- River Corridor – Potential institutional controls may be needed to restrict activities that disturb soils that are deeper than 15 feet below the surface, ensure interim safe storage of reactors until they are removed, and restrict groundwater use until contaminant levels drop below drinking water standards.
- Central Plateau – Institutional controls will be needed for waste disposal sites, canyon facilities, and other areas where access restrictions will be required and groundwater use will remain restricted until contaminant levels drop below drinking water standards.

Institutional controls are considered to be integral components of remedial alternatives that rely on land-use controls to ensure protectiveness of remedies. Institutional controls are evaluated along with remedial alternatives and are selected in records of decision along with the remedial action.

The Hanford Site maintains a site-wide institutional control plan (DOE 2009c) that describes the institutional controls for the current CERCLA remediation actions. This plan describes how DOE will implement and maintain the operable unit-specific institutional controls specified in CERCLA decision documents. The plan is updated as new CERCLA decisions are reached that contain requirements for institutional controls for the affected waste sites. Continuing maintenance of necessary institutional controls is an important element of the long-term stewardship function at the Hanford Site.

6.5 CERCLA Five-Year Reviews

CERCLA five-year reviews are conducted for sites cleaned up under CERCLA when hazardous substances, pollutants, or contaminants remain above levels that allow for unlimited use and unrestricted exposure. Five-year reviews seek to answer the following questions (EPA 1995c):

- Is the remedy functioning as intended by the decision documents?
- Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?
- Has any other information come to light that could call into question the protectiveness of the remedy?

The CERCLA review does not reconsider remedial cleanup decisions; it is an evaluation of the implementation and performance of the current cleanup strategy to determine if the remedy is or will be protective. The review determines if the measures taken are still successful in protecting workers, the public, and the environment. Long-term stewardship activities, primarily institutional controls, are one component to be considered in the five-year review. The five-year review also evaluates current and future protectiveness relative to remedial actions that are ongoing.

The review may conclude that the remedy is protective and that no further action is necessary; alternatively, it may conclude that further evaluation is needed, may recommend certain actions to improve the efficiency of a remedy, or may recommend changes in the remedy. This review process can also provide a forum for introducing new information and/or how changes in assumptions will be managed in the future. If cleanup decisions are required to be revisited, the applicable regulatory process is to be followed.

The first five-year review was completed in 2001 by the EPA (EPA 2001). The second was completed by DOE in 2006 (DOE 2006). The third five-year review (DOE 2011d) was completed in November 2011. The review included evaluation of the long-term stewardship components of the remedies, such as existing institutional controls in place to prevent exposure to the public and the environment. DOE-RL will conduct the CERCLA five-year reviews and submit the reports to the EPA for its review of the protectiveness determination made by DOE-RL.

7.0 The Post-Cleanup Future

The amount of cleanup completed or nearing completion – particularly in the Columbia River Corridor (which will be mostly complete in 2015), and in the buffer zone lands of the Hanford Reach National Monument (finished in 2011 with ARRA funds) – is driving a new conversation at the Hanford Site and the surrounding communities. This conversation includes such questions as (1) What will happen to land where cleanup has been completed? (2) How could Hanford Site resources (e.g. land, infrastructure, equipment, facilities) be used after cleanup to support the surrounding communities and lessen their economic dependence on Hanford Site cleanup funding?

In December 2010, as part of the *National Defense Authorization Act*, Congress directed DOE to evaluate the feasibility of establishing energy parks. Hanford was identified as a potential energy park because large tracts of land could be made available and because of community interest in producing clean and renewable energy products and services. In early 2011, DOE started a department-wide Asset Revitalization Task Force. The Task Force reasoned that a broader approach was more appropriate because the type of assets potentially available to communities at the completion of cleanup at the various DOE Environmental Management sites offer more types of beneficial reuse than just energy parks.

7.1 DOE's Asset Revitalization Initiative

DOE's Asset Revitalization Initiative Task Force included representatives from major DOE sites including Hanford, as well as key DOE Headquarters offices such as the National Nuclear Security Administration, Office of Nuclear Energy, Office of Energy Efficiency and Renewable Energy, and the Office of Management and Administration. In August 2011, this Task Force recommended that DOE should:

- Take advantage of experience gained from other sites/areas within the DOE complex that already host multiple agencies/missions or host public/private partnerships on federal land.
- Work closely with local communities to find the best reuse of properties (local entities have advocated for a wide variety of uses, including clean energy development, manufacturing, reindustrialization, open space, nature preserves, and recreation areas).
- Host dialogues between DOE program offices and sites to showcase assets at DOE sites that could host or support demonstration projects.
- Organize informational meetings with private-sector clean energy and high-tech manufacturing communities and the sites (including the local DOE office, the national lab, and the Community Reuse Organization) to introduce possible end uses of DOE properties scheduled for completion.
- Work with partners to expand project financing options (e.g. local government bonds, other federal agencies, investment banks, venture capitalists).
- Evaluate opportunities to conduct large-scale demonstration projects on DOE sites.
- Work with other federal agencies to implement joint sustainability projects on DOE sites.
- Evaluate and remove unnecessary lease and deed restrictions that impede asset revitalization at the sites.

- Make revitalization a part of long-term planning for sites and program offices. Require them to integrate across program offices for project support and demonstrations.

The Asset Revitalization Task Force Charter and final report can be found on the DOE webpage, at http://energy.gov/articles/department-energy-announces-next-steps-asset-revitalization-initiative. The effort is now moving into the implementation phase, with each site pursuing elements that are consistent with its own guiding land-use documents, available resources, and community aspirations.

At the Hanford Site, future activities will be consistent with the *Hanford Comprehensive Land-Use Plan* (DOE 1999) (discussed in Chapter 2) that identifies specific land-use designations for different areas of the Hanford Site after cleanup is complete. Figure 7-1 shows the land-use designations. The white and blue regions within the red circle depict the areas designated for potential development of industrial, research, and development opportunities. The Hanford Site is unique among the national cleanup sites because of its diversity of resources and possibilities for the future. Within its 586 square miles, the Hanford Site contains the Hanford Reach National Monument and other large tracts of land set aside for conservation/preservation, areas along the Columbia River that will be clean and available for recreation, and a National Historic Landmark at the B Reactor. It also contains about 60 square miles set aside for industrial development that is close to the City of Richland, which gives it access to critical infrastructure such as rail, electrical utilities, river barging, and a proposed future natural gas line being evaluated by DOE to support cleanup efforts. The *Hanford Comprehensive Land-Use Plan* (DOE 1999) also designates a 20-square-mile area for conducting basic or applied research. This area allows for the development and use of research and development facilities, such as the Laser Interferometer Gravitational Wave Observatory (LIGO), which could require substantial buffer zones for operation. Research and development facilities not requiring large areas for operation could also be located within this area.

7.2 The Post-Cleanup Future

Returning cleaned up Hanford land to beneficial uses is a key component in completing DOE’s work at the Hanford Site – whether that use is for area Tribal Nations to practice traditional cultural activities, for residents to enjoy areas along the river for the first time since the 1940s, for community leaders to encourage businesses to locate here, or to preserve open spaces in perpetuity, which are all consistent with the *Hanford Comprehensive Land-Use Plan* (DOE 1999). And while that work is just beginning in earnest, four areas are emerging from early expressions of interest.

- **Access to Hanford Land for Tribal Cultural Uses**. The Wanapum Tribe, Confederated Tribes and Bands of the Umatilla Indian Reservation, Yakama Nation, and Nez Perce Tribe all used parts of the Hanford Site prior to its settlement by farmers and ranchers and eventual closure by the government for the Manhattan Project in 1943. It is DOE’s intent to consult with these area Tribal Nations to see what parts of the site they would have an interest in having regular access to for cultural activities consistent with established future land-use designations.

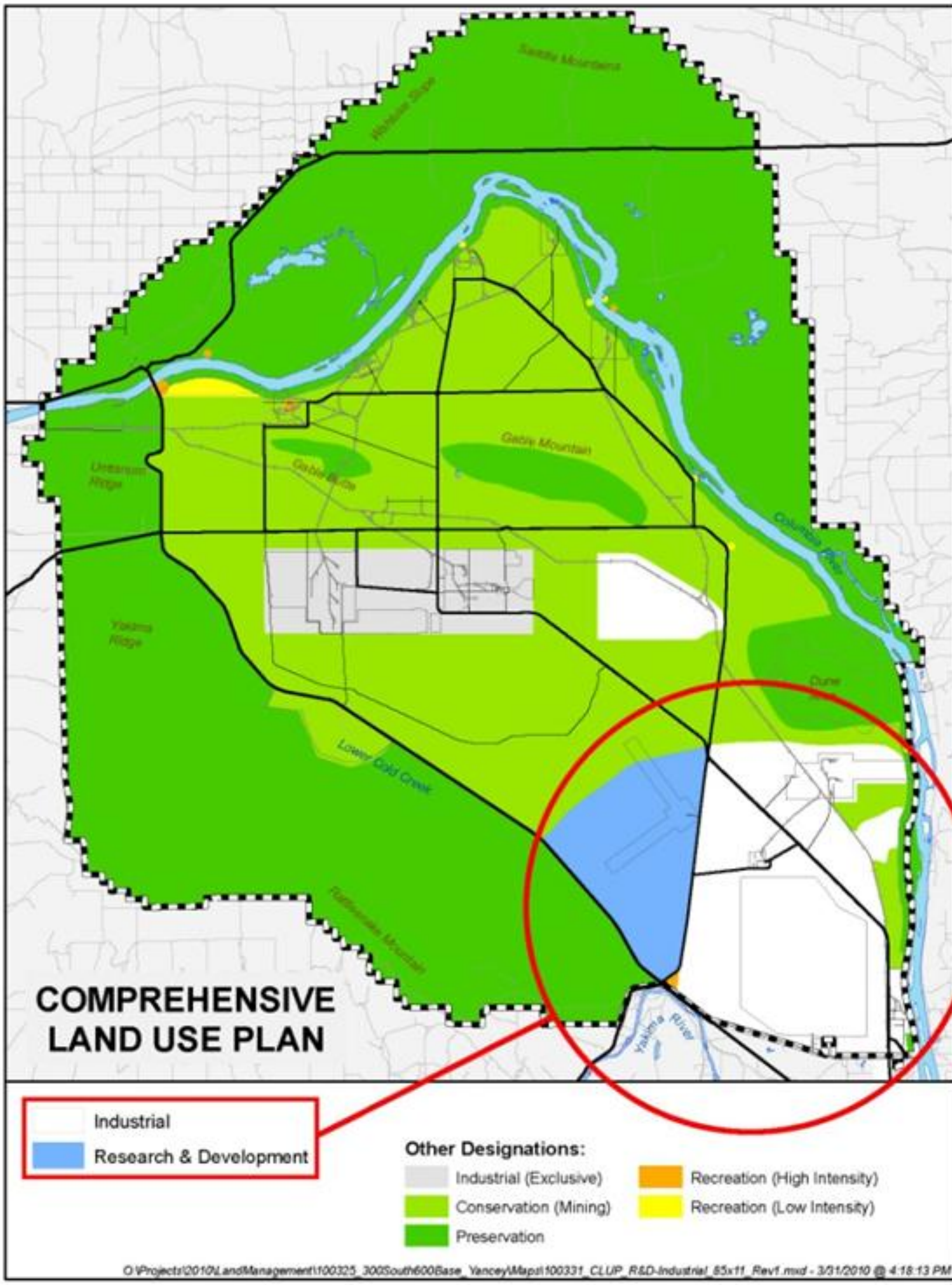

Figure 7-1. Land-Use Designations from Hanford's Comprehensive Land-Use Plan

- **Creation of a Heritage Tourism Industry**. In 2011, the U.S. Secretary of Interior recommended to Congress that Hanford's B Reactor National Historic Landmark, along with properties in Oak Ridge, Tennessee, and Los Alamos, New Mexico, be named to a new unit of the National Park Service commemorating the Manhattan Project. The B Reactor is already drawing large crowds via DOE's public access program – more than 7,000 visitors from around the country and the world in 2011. In addition, the Tri City Visitor and Convention Bureau, area historians, elected officials, and others are interested in expanding visitor opportunities on the Hanford Site to create a heritage trail that would also include the pre-Manhattan Project structures from the towns of Hanford and White Bluffs, the Bruggeman Warehouse, and other historic structures.
- **Use of River Shore Lands for Recreation**. No public access has been allowed to the Columbia River shoreline bordering the Hanford side of the river since the U.S. government took over the area in 1943. However, with cleanup of the majority of the 220-square-mile Columbia River Corridor on track to be complete by 2015, most of the land will be safe for public access in the near future. Because the first quarter-mile of the shoreline from the river inland is included in the Hanford Reach National Monument, the degree of access will be guided in part by the U.S. Fish and Wildlife Service's Comprehensive Conservation Plan Environmental Impact Statement (USFWS 2008). Several areas along the Columbia River are designated for recreation and new boat launch and camp sites are envisioned.
- **Use of the Lands Set Aside for Industrial Use**. As major cleanup projects near completion, there is a heightened focus in the community on transitioning the local economy away from its dependence on Hanford cleanup funding. A key asset is seen to be the availability of the large tracts of industrial land at the site – much of which was never used for the production mission and is close to city infrastructure. The large size of these tracts of land makes the industrial zone unique in the state of Washington. Community leaders are also looking to leverage the knowledge, expertise, and training of workers no longer needed at the site to serve compatible industries that could provide high-wage jobs.

7.3 Transferring Land out of DOE Ownership

Rather than deal entirely in leases, local elected officials and economic development leaders have indicated it is advantageous to acquire some of this land so they can be in a stronger position to recruit new companies to the area. Accordingly, the first land transfer request was sent by the Tri Cities Development Council (TRIDEC) on behalf of the Cities of Richland, Kennewick, Pasco, and West Richland and the Ports of Benton and Pasco to DOE-RL in May 2011. TRIDEC is the Hanford Community Reuse Organization on matters including transfers of real property .[27] TRIDEC requested a total of 1,641 acres in two locations in the southern portion of the industrial area. In 2012, DOE will begin the environmental and other reviews necessary to support decision making on the TRIDEC request.

[27] A Community Reuse Organization is defined in 10 CFR 770.4 (Transfer of Real Property at Defense Nuclear Facilities for Economic Development) and is a "governmental or non-governmental organization that represents a community adversely affected by DOE work force restructuring at a defense nuclear facility and that has the authority to enter in and fulfill the obligations of a DOE financial assistance agreement." TRIDEC was designated as the Hanford site's Community Reuse Organization in the mid 1990s and continues to act in this capacity.

The only lands DOE-RL may consider for transfer at this time are those designated for industrial use in the Hanford Comprehensive Land-Use record of decision (64 FR 61516) and that are cleared for release based on environmental reviews. DOE will continue working with the Community Reuse Organization as a central point of contact for the area’s land transfer requests. Should an initial land transfer be made, a second land transfer request will only be considered upon evidence of successful use of the previously transferred lands.

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Appendix A

Hanford's 2015 Vision

Appendix A

Hanford's 2015 Vision

DOE-RL has developed a road map for finishing the cleanup activities on the 220-square-mile River Corridor portion of the Hanford Site by the year 2015. Called the 2015 Vision,[1] the cleanup projects extend along the shore of the Columbia River from north of Richland to the far boundary of the site near Highway 240 and the Vernita Bridge. The work includes cleanup of the 300 Area (the manufacturing and laboratory parts of the site) and the 100 Area (the reactors along the river). In addition, the 2015 Vision calls for completion of work in other areas of the site to protect groundwater, reduce safety hazards and further shrink the footprint of the site.

Hanford's 2015 Vision continues to drive Hanford's most immediate cleanup priorities. These priorities include:

- Completion of most cleanup actions within the River Corridor to eliminate hazards near the Columbia River and to significantly reduce the active cleanup footprint.
- Install groundwater treatment systems in both the River Corridor and Central Plateau to put Hanford on a path to meet groundwater cleanup standards.
- Complete removal and remediation of the Plutonium Finishing Plant, Hanford's highest hazard nuclear facility, to reduce the safety hazard and eliminate the continuing cost of required safety systems.

Table A-1 shows the primary performance measures and goals that have been set. These performance measures are used to routinely monitor and communicate the progress of cleanup efforts.

Cleaning up the high-priority facilities and burial grounds associated with the 2015 Vision will also allow some adjacent, lower-priority projects to be done at the same time. In doing so, Hanford's cleanup dollars can go further, resulting in cleanup work being done more effectively and efficiently.

As projects are completed along the River Corridor, the need for utilities, road maintenance, and surveillance will be reduced in those areas. Put another way, achieving this vision will free up money that can be used toward cleaning up other places at Hanford that are not associated with the River Corridor project.

When the River Corridor projects are cleaned up, workers can shift their attention to the Central Plateau region of Hanford. This part of the site, consisting of the 200 East, 200 West, and 200 North Areas, is home to a majority of Hanford's solid waste burial grounds and underground liquid waste storage tanks. It makes up about 75 square miles of the Site, which will be the last area of Hanford that will be cleaned up.

Figure A-1 shows the anticipated cleanup activities that are elements of *Hanford's 2015 Vision*.

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[1] The Vision can be found on the web at http://www.hanford.gov/page.cfm/2015VISION .

Table A-1. 2015 Vision Key Performance Measures

Performance Measure[(1)]	Goals
Footprint Reduction	• Total Hanford Site – Footprint reduced from 586 to 75 sq. miles • Hanford Reach National Monument – 290 sq. miles remediated • River Corridor – 220 sq. miles remediated • Central Plateau Outer Area – 20 sq. miles remediated
River Corridor Cleanup	• Reactors demolished, cocooned or dispositioned – 10 production reactors[(2)] • Facilities demolished – 522 • High nuclear hazard facilities or waste sites remediated – 20 • Hot cells removed – 18 • Waste sites remediated – 1,012 • Waste and debris removed, treated and disposed at the Environmental Restoration Disposal Facility – 16.8 million tons
K Reactor Area	• Spent fuel treated and removed to Central Plateau – 2,300 tons • K East fuel storage basin demolished • Sludge settler tubes retrieved and sampled – 10 • Sludge engineered containers sampled and analyzed – 6 • K-West sludge removed from River Corridor – 27 cubic meters • Knock-out pot sludge sorted – 150 liters • Multi-canister overpacks shipped to Canister Storage Building – 9
Plutonium Finishing Plant	• Special nuclear material shipped offsite – 100% • Slightly irradiated fuel shipped to Canister Storage Building – 100% • Glove boxes removed – 238 • Facilities demolished – 46 • Asbestos piping removed – 24,000 feet • Vacuum piping removed – 5,500 feet • Process transfer lines removed – 1,154 feet • Highly contaminated pencil tanks removed – 196
Groundwater Remediation	• River Corridor treatment system capacity – 2,500 gallons per minute • Central Plateau treatment system capacity – 2,500 gallons per minute
Other Remediation	• FFTF systems deactivated – 100% • 618-10 Burial Ground remediated • 618-11 Burial Ground remediated

Notes:
(1) Not all performance measures for the 2015 Vision are shown in this table.
(2) This measure includes demolition of the 309 experimental reactor. Disposition for B Reactor is defined as its designation as a National Historic Landmark and museum.

Figure A-1. Elements of *Hanford's 2015 Vision*

How to get Information about Hanford Cleanup

To find information about upcoming public involvement activities, such as public meetings or documents for public review and comment, visit the Hanford Events Calendar at http://www.hanford.gov/

To find out more about Hanford cleanup and environmental compliance, information is maintained at these locations:

Tri-Party Agreement Administrative Record
2440 Steven Center, Room 1101
PO Box 950, Mail Stop H6-08
Richland, WA 99352
Phone: (509) 376-2530; Fax: (509) 376-4989
Hours: 9:00- 11: 30 am and 1:00 – 3:30 pm
Office closed every other Friday
http://www2.hanford.gov/arpir/

The Tri-Party Agreement Administrative Record site is the body of documents and information that are considered or relied upon to arrive at a final decision for remedial action or hazardous waste management.

DOE Public Reading Room
Washington State University Tri-Cities Campus
Consolidated Information Center, Room 101L
2770 University Drive
Richland, WA 99352
Phone: (509) 372-7443; Fax: (509) 372-7444
http://reading-room.pnl.gov/

The DOE Public Reading Room collection includes technical reports, administrative materials, factsheets, and handouts. The catalog is searchable via the Internet.

The following Internet sites also are available for information:

- Hanford Declassified Document Retrieval System provides a catalog of declassified documents regarding Hanford. http://www2.hanford.gov/DDRS/
- Electronic Freedom of Information Act (FOIA) Reading Room has information to meet the requirements of FOIA that certain kinds of documents to be made available to the public for inspection and copying. http://www.hanford.gov/?page=69
- Hanford Advisory Board site makes available information about their activities to provide informed recommendations and advice to the U.S. Department of Energy (DOE), the US Environmental Protection Agency (EPA), and the Washington Department of Ecology (Ecology) on selected major policy issues related to the cleanup of the Hanford site. http://www.hanford.gov/page.cfm/hab
- CERCLA 5-year review site provides the actual text of the 2001 and 2006 review. http://www.hanford.gov/page.cfm/CERCLA
- Hanford Site Environmental Report provides information about environmental monitoring on the Hanford Site. http://hanford-site.pnl.gov/envreport/

The Tri-Party Agencies also have contacts that are listed below:

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825 Jadwin, MSIN A7-75
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Phone: 509-376-7501; Fax: 509-376-1563
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US Environmental Protection Agency
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ENERGY