Tribal representatives pointed out that Yakama Tribal members are documented to be the highest risk population affected by Hanford contaminants. They identified two reports to be referenced in end state analysis as documentation of significant exposure pathways and risk factors for Yakama Nation Tribal members:

- Columbia River Basin Fish Contaminant Survey, 1996-1998, United States Environmental Protection Agency, Office of Environmental Assessment, EPA 910/R-02-006, July 2002

- A Risk-Based Screening Analysis for Radionuclides to the Columbia River from Past Activities at the U.S. Department of Energy Nuclear Weapons Site in Hanford, Washington, Department of Health and Human Services, Centers for Disease Control and Prevention, RAC Report No. 3-CDC – Task Order 7 – Final, John E. Till, November, 2002.

The ensuing discussion pointed out that the contaminants contributing to the risk identified in the EPA study are heavy metal and organic contaminants. The study does not identify Hanford as a significant contributor of these contaminants. This study also indicates that the potential cancer risks from consuming fish collected from the Hanford Reach due to radionuclide content were similar to cancer risks from consuming fish collected from the upper Snake River outside of the region influenced by Hanford. However, the EPA study included only limited measurements of a few radionuclides in Columbia River fish. The Yakama Nation supports a comprehensive analysis of radionuclides in Columbia River sediments from Hanford operations.

Tribal representatives also stated that a defensible end state requires a credible Yakama Tribal risk scenario. To date, no risk scenario which can be applied to Yakima Nation Tribal members has been developed. Development of such a scenario is a complex undertaking, as evidenced by the risk studies cited, each of which were multi-million dollar, multi-year efforts conducted by specialists in the appropriate disciplines.

The Yakama Nation proposes a cooperative approach with DOE to arrive at the Hanford end states which complies with Treaty rights and protects Tribal members at risk levels no greater than those established for other populations (1×10^{-4} to 1×10^{-6} lifetime risk).

The discussion also touched on removing the reactor discharge pipelines from the river. The Yakama are concerned that removing the pipelines will impact salmon spawning and other aspects of the ecology of the river. As such they would like to understand the risks associated with leaving the pipelines in place and unless they are significant they would like to see them left in place to reduce disturbance of the river ecosystem. They also agreed that the reactors could stay in place to allow for decay of radionuclides that remain in the cores. At some point though, they need to be removed from the River Corridor for disposal.

In the end the Yakamas reiterated that if DOE honors the Tribes treaty rights and applies a meaningful risk scenario for the Yakama lifestyle they will support the DOE end states.

4.0 Hazard-Specific Discussion

This chapter describes the specific hazards at the Hanford Site and is organized by the major areas at Hanford: 100 Areas, 200 Areas and 300 Area (including key waste sites located in the 600 Area). In September 1996, the 1100 Area of the Site was cleaned up and deleted from the NPL. This chapter also describes the potential exposure pathways (conceptual site models) for both the current baseline end state and the end state vision.

Hazards at the Hanford Site can be grouped in two broad categories:

- **Near-term (safety-related) hazards** – where hazards with potentially large consequences could result from the release of radionuclides and chemical contaminants in the current or remediation phase. The major exposure pathway to receptors is via the air. Near-term releases are characterized by a relatively low likelihood of occurrence but moderate-to-high consequences. These hazards affect directly involved workers, co-located workers, and potentially the public and ecosystem receptors. Examples of these hazards include the larger inventories of radionuclides such as the cesium and strontium capsules stored in the Central Plateau, the plutonium inventory at PFP, the transuranic waste drums at the Central Waste Complex and former safety issue tanks. Current systems and procedures are in place to safely manage the risk posed by these materials and to minimize the potential for accidents that could lead to adverse consequences.

- **Long-term (environmental and human health) hazards** – where harm results from transport of radionuclide and chemical contaminants through the groundwater to human and ecological receptors or directly to future site uses. Long-term risks are characterized by a relatively high likelihood of occurrence but releases occur over a long time. The time frame of concern is primarily post-closure (e.g., 100s or 1,000s of years in the future). Examples of these hazards include the past releases of contaminants to the soil column in both the 100 and 200 Areas and existing groundwater plumes that discharge to the Columbia River.

In considering hazards, it is also important to understand the additional hazards that can be caused during remediation activities to workers and to ecological receptors through physical disruption of natural habitats.

Since the beginning of the Environmental Management mission at the Hanford Site in 1989, the highest priority has been given to reducing and eliminating the near-term risk contributors. These hazards represent the dominant source terms for near-term, safety-oriented risk assessments at the Hanford Site. These hazards are reduced and eliminated through removal to the 200 Area away from the Columbia River and population sources, through stabilization to less

Risk and Hazard

Risk is generally described as the product of the consequences and the likelihood of a receptor being exposed to a hazard. To understand risk it is necessary to understand the hazard source (e.g., quantity, toxicity), the likelihood of its release, the potential transport pathways (e.g., air, soil groundwater), and the specific exposure mechanisms for potential receptors (e.g., inhalation, ingestion).

hazardous forms, and through shipment off site for final disposition. Some of the most significant reductions in near-term hazards that have been achieved to date include:

- The spent nuclear fuel stored in the K Basins has been removed and placed in safe, dry storage in the 200 Area.
- In February 2004, PFP plutonium stabilization activities were completed.
- As of the end of FY 2001, all tank safety issues were resolved including the flammable gas and high heat issues, the two most problematic issues.
- During 2001 through 2002, the largest radiological inventories in the 300 Area were removed including the 324 Facility B Cell cleanout, removal of 13 million curies of isotopic heat sources (the German logs), and removal of other spent nuclear fuel.
- Significant hazards were removed from PUREX and B Plant in 1997 and 1998, respectively, resulting in less costly surveillance and maintenance.

Substantial progress has also been made to lower the risk posed by long-term hazards by reducing the potential for further environmental releases and by reducing the driving forces for prior environmental releases. These hazards represent the dominant sources for current and potential environmental contamination that can pose a threat to ecological receptors and to future human receptors. These hazards are reduced or eliminated by implementing treatment systems, including some removal actions, and by reducing the mobility and potential driving forces for transport through the environment. Some of the most significant progress in eliminating long-term hazards has been made in the following areas:

- Early in 2004, interim stabilization of all 149 single-shell tanks was completed by removal of pumpable liquid.
- From 2002 to 2004, extensive interim actions were implemented to minimize natural and manmade infiltration (e.g., water line leaks) into the vadose zone within tank farms to halt potential remobilization of previously leaked contaminants.
- Groundwater remediation was initiated in the 100 Areas for chromium in 1997 and for strontium-90 in 1995 to reduce the potential impact on the Columbia River ecosystem.
- Vapor extraction for the carbon tetrachloride plume in the 200 Areas (200-ZP-1 Operable Unit) was initiated in 1996 and continues to remove contaminant mass from this plume.
- From 1990 to 1995, liquid discharges to the 200 Areas soil column were reduced by ~23 billion liters (6 billion gallons) per year, thus reducing new sources of contamination and eliminating a key driving force for previous vadose zone and groundwater contamination.

The following sections summarize the remaining hazards in the 100 Areas, 200 Areas, and 300 Area. The potential exposure pathways are also described for both the current baseline end state and the end state vision.

4.1 100 Areas

The 100 Areas are located on the Columbia River shoreline, where nine nuclear reactors operated from 1944 to 1987. The nine plutonium production reactors are ~48 kilometers (30 miles) from Richland in the northern portion of the Hanford Site along the south bank of the Columbia River. The reactor cores range from ~85 to 823 meters (~280 to 2,700 feet) from the river bank. They are located close to the river to support the large quantities of cooling water required for operation.

4.1.1 Summary of Existing Hazards in the 100 Areas

Table 4.1 summarizes the existing hazards in the 100 Areas. DOE manages the risks posed by these hazards in order to protect the workers and the public. Managing the hazard is done on a graded approach that depends on the severity of the hazard. Monitoring and access controls are the primary method to ensure protection of workers and the public. Integrated safety management systems are in place to ensure protection of the workers during cleanup activities. The top priority hazards in the 100 Areas are the following in descending order of their relative importance:

- **K Basin sludge**. The K Basin sludge poses the most significant risk to workers and the public. The N Reactor fuel that was once stored in the K Basin storage pools has recently been transferred to a safer dry storage configuration in the Central Plateau. Safety management systems and procedures are in place to manage the risk posed by this material and to minimize the potential for accidents that could lead to adverse consequences.
- **Existing groundwater plumes that release contaminants to the Columbia River**. Several areas have groundwater contaminated with hexavalent chromium plumes, resulting from previous liquid discharges that upwell into the Columbia River at levels that exceed ambient water quality criteria for the protection of aquatic species. In addition, there is a strontium-90 plume at 100-N Area that exceeds drinking water standards by a factor of ~1,000. Active pump-and-treat systems and passive treatment system are in place to shrink the size of groundwater plumes and reduce potential releases to the Columbia River. Controls are in place to prevent consumptive use of groundwater.
- **Former production reactors**. Nine former production reactors include de-fueled graphite cores with a significant inventory of radionuclides. Current activities include reducing the footprint of these facilities and placing the reactor cores in interim safe storage for up to 75 years to allow decay of radionuclides until final disposition. Reactors awaiting interim safe storage are in a surveillance and maintenance program to minimize the potential for accidents that could lead to adverse consequences.
- **Subsurface contamination**. Liquid waste disposal sites and burial grounds have contributed to subsurface contamination. Depth of contamination ranges from the surface to groundwater. These sites are being excavated as much as 4.6 meters (15 feet) below grade to maximize potential future surface uses. Contaminated soil is trucked to the Central Plateau for disposal. Sites awaiting excavation are under a surveillance and maintenance program to minimize the spread of contamination.

Table 4.1. Summary of Existing Hazards in the 100 Areas

Material Category	Current Hazard
Surface	
K Basin Sludge	• K Basin sludge and debris (200,000 curies). Approximately 50 m^3 (65.4 yd^3 require packaging for removal with less than 0.5 m^3 of fuel pieces contributing the majority of this source term. The basins are currently not known to be leaking but have leaked in the past.
Surplus Production Reactors	• Nine surplus production reactors. Radioactive inventory contained in the core includes tritium (~98,000 curies); carbon-14 (~37,000 curies); chlorine-36 (~270 curies); cobalt-60 (~74,000 curies); cesium-137 (~270 curies); and uranium-238 (about 0.01 curies). The dose to workers from cobalt-60 and cesium-137 is one of the main drivers leading to the decision to place the reactor cores into interim safe storage for 75 years. Radioactive inventory in the core is not leaking.
Ancillary Facilities	• Ancillary facilities supported operations and maintenance of reactors. There were a total of 250 ancillary facilities in the 100 Areas with the remaining facilities located primarily at 100-N (59), KE/KW. Hazards range from industrial to potential contamination with radiological constituents, i.e., fission and activation products, metals, inorganic, organic compounds both volatile and nonvolatile.
Subsurface	
Liquid Waste Sites	• As of 1978, the deactivated 100 Area liquid waste sites contained a total radioactive inventory of 4,400 curies. The principal radionuclides remaining in the waste sites were reported to be tritium, carbon-14, cobalt-60, nickel-63, strontium-90, cesium-137, europium 152, europium-154, europium-155, and plutonium-239/240. DOE (1994) reported a 1988 inventory of about 10,000 curies of radionuclides (cobalt-60, strontium-90, ruthenium 106, cesium-134, cesium-137, and plutonium-239) in the two main 100-N Area liquid waste sites. Additional non-radioactive contaminants, such as sodium dichromate, are also common in the liquid waste sites. Liquid waste sites are the main contributor to groundwater contamination in the 100 Area due to the high volumes of disposal (see groundwater discussion below).
Solid Waste Burial Grounds	• Forty-five sites are estimated to have over 1 million m^3 (1.3 million yd^3) of solid, low-level radioactive waste associated with reactor operations. Waste containing plutonium or any other alpha emitters, cobalt-60 in amounts greater than 1 millicurie/gram, or beryllium was packaged and shipped to the 200 Area for burial in designated trenches. The main radionuclides are tritium, carbon-14, cobalt-60, nickel-63, strontium-90, cesium-137, silver-108m, europium-152, europium-154, and europium-155. Because disposal records prior to the late 1960s were not detailed, the estimates of the radionuclide inventory are uncertain and largely drawn from evaluations of analogous sites. The predominant radionuclides anticipated in the 45 burial grounds (compiled) are: tritium ~19,000 curies; cobalt-60, ~3,000 curies; nickel-63 ~2,000 curies; strontium-90 <10 curies; cesium-137 <10 curies; and silver-108m ~60 curies. Of the 45 burial grounds, there is one potential contributor (118-K-1) to groundwater contamination (tritium). Pieces of nuclear fuel were found during excavation of two large burial grounds in the B/C Area, a discovery that emphasizes the uncertainty associated with burial ground contents.
Groundwater	
Groundwater	• The most prominent contaminants in 100 Areas groundwater are tritium, strontium-90, hexavalent chromium, and nitrate. These contaminants originated primarily from disposal cribs and trenches, condensate cribs. Other sources include leaks from the 100-K Area East fuel storage basin, leaks from the 183-H basin and leaking retention basins. Because these sites are close to the Columbia River, these contaminants have been detected in springs that discharge to the river. Hexavalent chromium and strontium-90 have been detected above the National Ambient Water Quality Standards at isolated points on the river bottom where the groundwater upwells into the river prior to being diluted by the river.

Figures 4.1a through 4.1f display maps of the hazards in each of the 100 Areas. Conceptual models were developed for this document to describe the pathways these hazards could come in contact with a receptor. Conceptual models for the current state, current baseline end state, and end state vision are discussed in Section 4.1.3.

4.1.2 Exposure Pathways and Potential Implications of the End State Vision

Table 4.2 summarizes the assumptions for land use, exposure scenarios and pathways for determining risk based cleanup levels, remediation goals, and institutional controls (including final barriers if any) for both the current baseline end state and the end state vision. Most of the current interim action RODs (ROD 1996a, 1999a, 1999b, 1999c) for waste sites in the 100 Areas preceded the issuance of the ROD (64 FR 61615) for the CLUP. These RODs established cleanup goals based on a surrogate "rural residential farmer" exposure scenario in order to allow for unrestricted future surface use. In addition, the RODs protected against future degradation of groundwater. Subsequently, the CLUP established land use for the 100 Areas as conservation/preservation. The CLUP land-use scenario and the Hanford Reach National Monument designation do not envision large scale residential land use or groundwater use (current or future). There could be future isolated residents that support the National Monument for fire fighting or a ranger. These residents would not be placed on top of former waste sites.

As described in Section 3.5, the interested public voiced their opinion during a 100 Area End State Workshop that there is great uncertainty with regards to future activities beyond 50 years or after the government relinquishes control of the land. If the 100 Areas ever moves away from government control, the possibilities for future activities increase greatly, including the possibility of residential communities and hotels. However, there was general consensus at the workshop that the conservation and preservation type activities were preferred in order to protect the unique shrub steppe habitat. For purposes of the end state vision, it is assumed that the 100 Areas will remain in federal control in perpetuity. The intent of the end state vision is to align the remediation goals with an exposure scenario that is consistent with the CLUP (DOE 1999a) land-use designation while incorporating stakeholder input where possible.

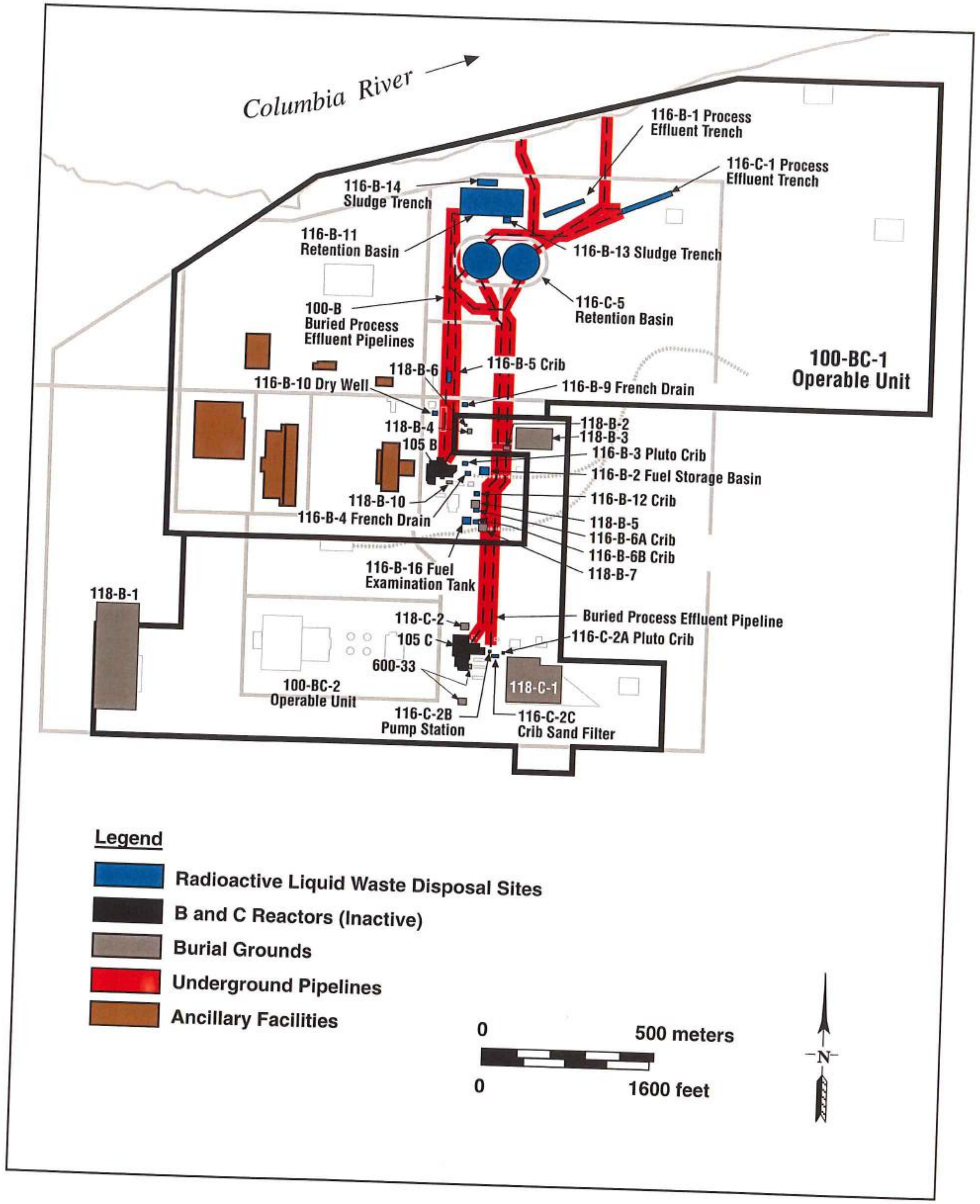

Figure 4.1a. 100-B/C Area Hazards

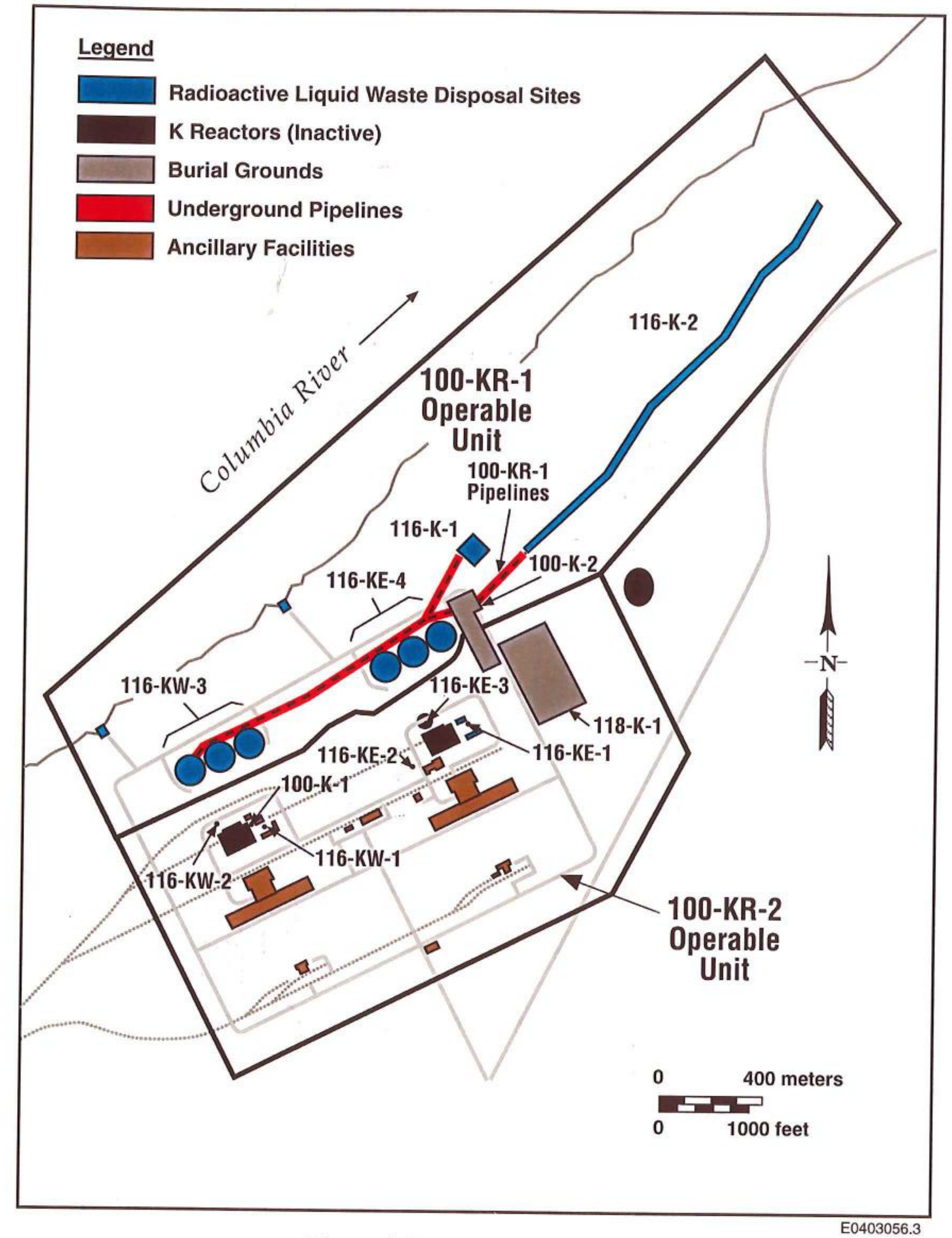

Figure 4.1b. 100-K Area Hazards

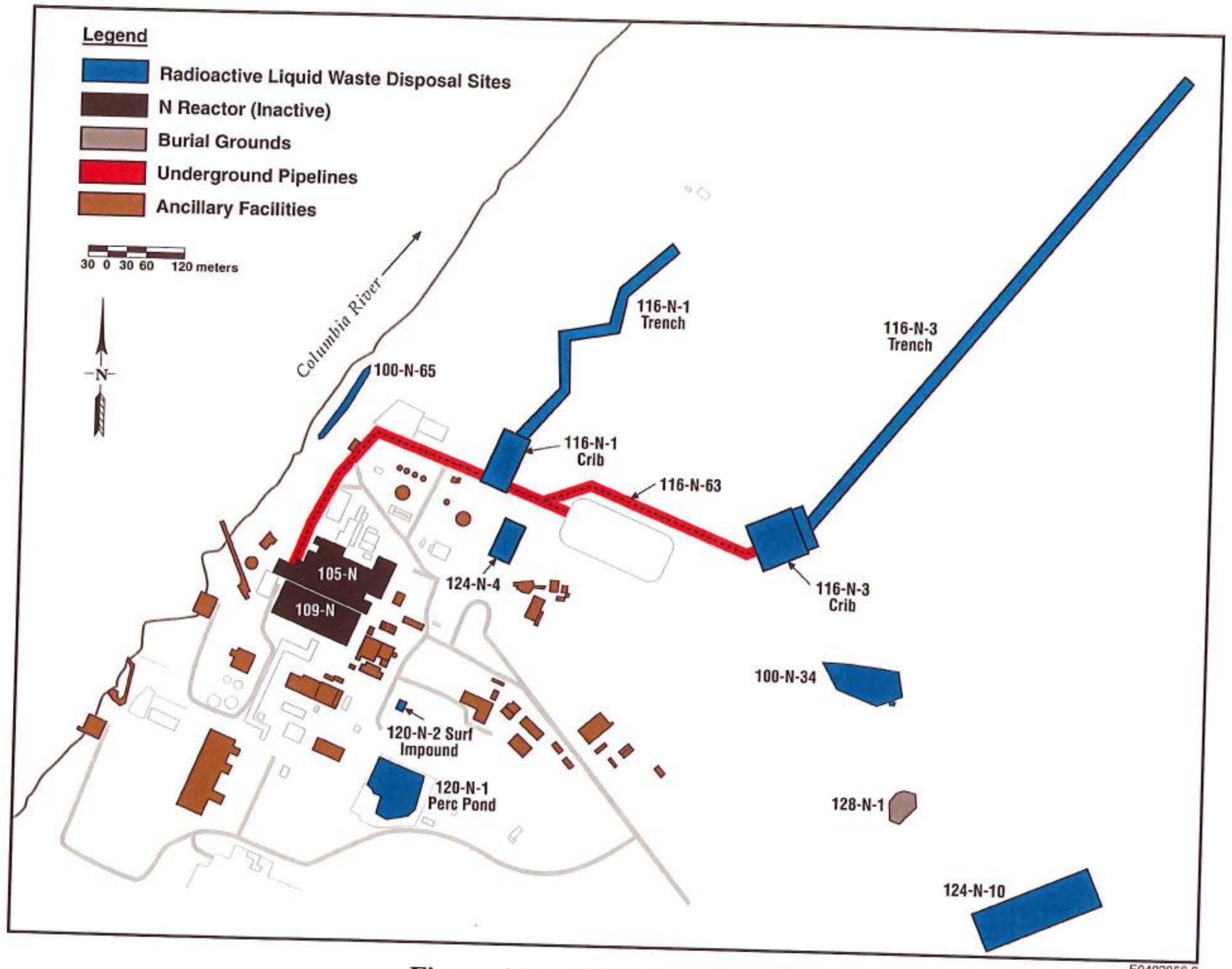

Figure 4.1c. 100-N Area Hazards

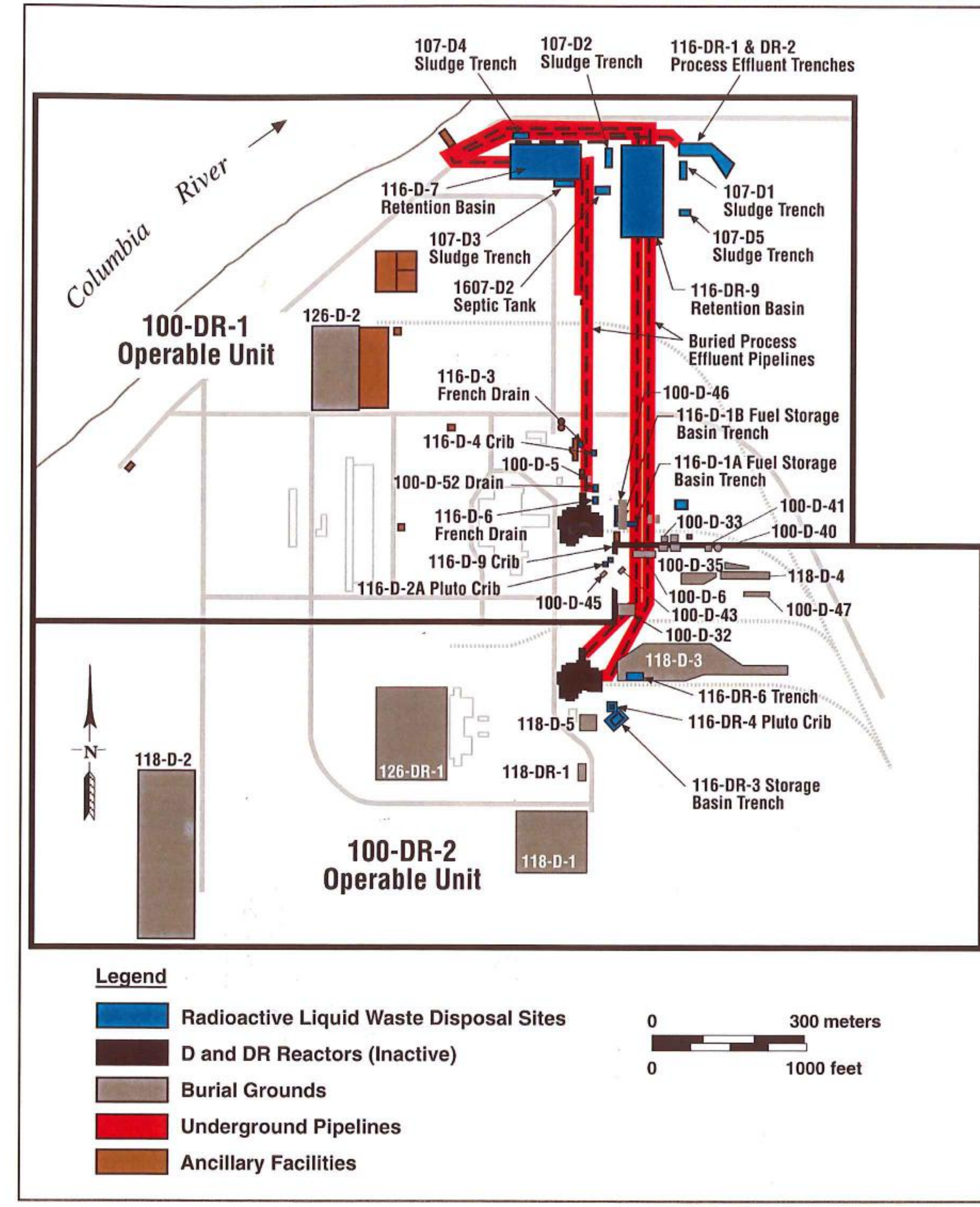

Figure 4.1d. 100-D Area Hazards

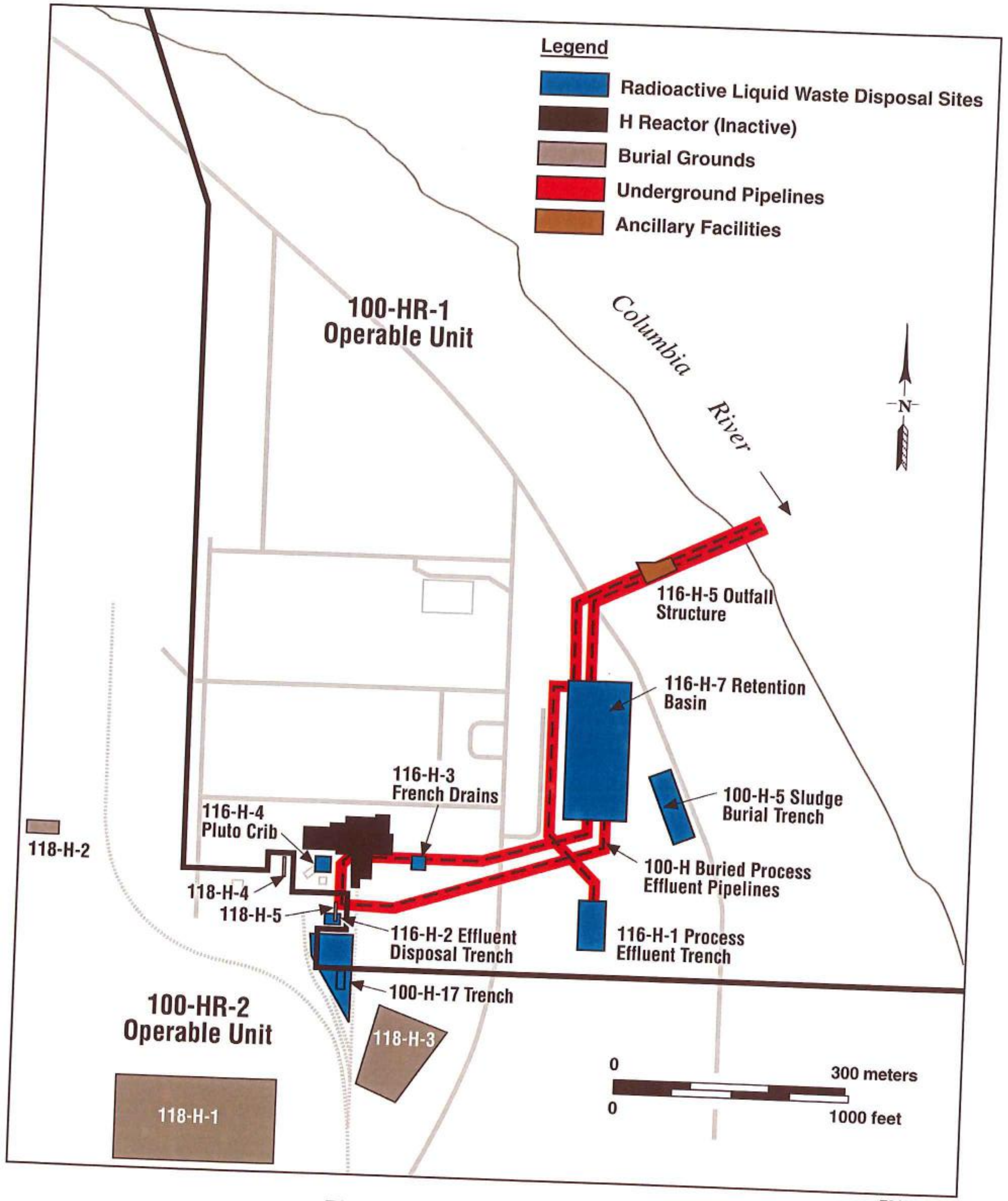

Figure 4.1e. 100-H Area Hazards

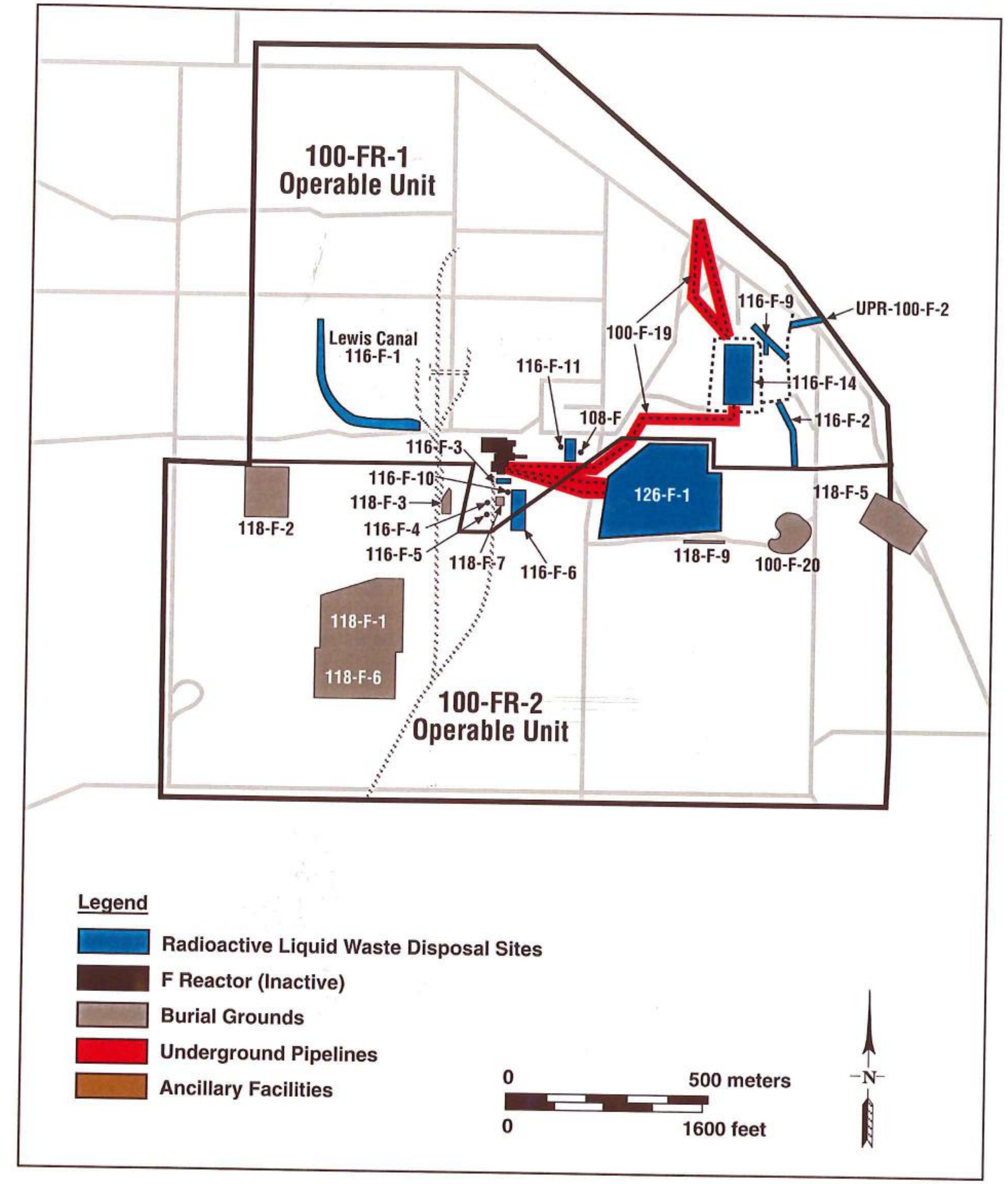

Figure 4.1f. 100-F Area Hazards

Table 4.2. 100 Areas – Overview and Comparison of Current and End State Assumptions for Land Use, Exposure Scenarios, Risk Protection Goals, and Potential Institutional Controls

	Current Baseline End State	End State Vision[a]
Land Use and Key Assumptions	**Unrestricted surface use**	**Conservation Preservation** (consistent with CLUP and National Monument Designation) Restricted land use: with recreational activities, non-resident park ranger activities and tribal activities
Exposure Scenarios for Determining Cleanup Levels	**Rural residential farmer scenario**: • Exposure from soils due to direct contact, inhalation and external radiation to a depth of 4.6 m (15 ft) • Ingestion of vegetables, meat, and milk • Potential for soil excavation to 3.6 m (12 ft) for dwelling basement construction • 92.7 cm (36.5 in.) of annual irrigation and precipitation (used to evaluate mobilization of contaminants below 4.6 m (15 ft) and potential for degradation of groundwater). Future groundwater under the waste site is used as drinking water and irrigation for crops. • No decay of radionuclides	**Recreational Scenario** • Exposure from soils due to direct contact, inhalation, and external radiation from surface use • No food ingestion • No soil excavation, but possible animal intrusion • No groundwater use for drinking water or irrigation; incidental contact only • Decay of radionuclides **Non-Resident Park Ranger (TBD)** **Tribal Uses (proposed activities)**: • Hunting • Fishing • Gathering • Sweat lodge use • Materials and food use
Risk Protection Metrics/Goals	• 15 mrem/yr from radionuclides to restricted surface user (approximately $3x10^{-4}$ risk based on EPA guidance) • $1x10^{-6}$ risk from other contaminants • Source removal to promote restoration of groundwater to beneficial drinking water use, if practicable, based on 4 mrem/yr from MCL radionuclide concentrations • Excavation depth also protects deep rooting plant pathway and may provide adequate protection of other ecological resources	• CERCLA risk range $1x10^{-4}$ to $1x10^{-6}$ risk from other contaminants • Source containment or removal and treatment, if practicable, only where needed to promote restoration of groundwater to beneficial drinking water use, based on 4 mrem/yr from MCL radionuclide concentrations • Protection of ecological resources
Cleanup Actions		
Surface	• Remedial actions taken as needed to protect human health and ecological resources for this land-use scenario. • Human health based cleanup must be verified to be adequately protective of ecological resources.	• Remedial actions taken as needed to protect human health and ecological resources for this land-use scenario
Subsurface	• Waste sites excavated to depth of 4.6 m (15 ft)	• Cap-in-place or removal to achieve risk goals
Groundwater	• Remedial actions taken to prevent groundwater degradation, protect the River and return to beneficial drinking water use if practicable	• Same as Current Baseline End State
Institutional Controls	• Restrictions in place to preserve land uses and prevent use of groundwater. • Prevention of excavation below 4.6 m (15 ft). • Continued groundwater monitoring as required by CERCLA 5-year reviews.	• Restrictions to preserve land uses and prevent use of groundwater • Continued groundwater monitoring • Prevention of excavation into capped-in-place waste sites • Surveillance and maintenance of disposal sites and barriers

(a) Specific scenarios are still being developed and will be peer reviewed by EPA Region X.

4.1.3 100 Area Conceptual Site Model Description

Major hazards for the current state of the waste disposal sites in the 100 Area are noted in Table 4.1. One way to demonstrate how these hazards are managed is to build a conceptual site model to show the contaminants primary release mechanisms, transport pathways, exposure routes, and receptors (people or biota). The conceptual site models depict how potential receptors are protected by either blocking or breaking pathways that lead to exposure. The method used to block or break a pathway is how a hazard is managed in order to be protective of a receptor. Sometimes it is necessary to use more than one method to block a pathway. Pathways that are blocked have the potential to fail and still have an exposure. For example, a fence may block entry into a site but does not prevent a trespasser from climbing the fence. Pathways that are broken do not have the potential for exposure. For example, complete removal of a waste site breaks the transport pathway to a receptor from the waste site.

This section displays conceptual site models in Figures 4.1g through 4.1o for three types of hazards in the 100 Area: (1) liquid and solid disposal sites, (2) cocooned and not cocooned production reactors, and (3) ancillary facilities. Each type of hazard is evaluated for the current state, the current baseline end state, and the end state vision. Both the current baseline end state and end state vision are post cleanup scenarios.

4.1.3.1 100 Area Waste Disposal Sites – Current State

The liquid waste sites and burial grounds in the 100 Area are inactive and in a stabilized state. The location of the majority of remaining waste sites and burial grounds are shown in Figures 4.1a through 4.1f. Most of the larger sites have already been remediated in accordance with interim action RODs. Remediated sites are discussed in the current baseline end state. Waste sites that have yet to be remediated are discussed in this section. The principal radionuclides remaining in the waste sites were reported to be tritium, carbon-14, cobalt-60, nickel-63, strontium-90, cesium-137, europium 152, europium-154, europium-155, and plutonium-239/240. DOE (1994) reported a 1988 inventory of about 10,000 curies of radionuclides (cobalt-60, strontium-90, ruthenium 106, cesium-134, cesium-137, and plutonium-239) in the two main 100-N Area liquid waste sites. Additional non-radioactive contaminants, such as sodium dichromate, are also common in the liquid waste sites. Residual contamination from liquid waste sites can migrate through the vadose zone to groundwater. This transport pathway is shown in all of the figures depicting conceptual site models. Liquid waste sites are the main contributor to groundwater contamination in the 100 Area due to the high volumes of disposal.

The most prominent contaminants in 100 Area groundwater are tritium, strontium-90, hexavalent chromium, and nitrate. These contaminants originated primarily from disposal cribs and trenches, and condensate cribs. Other sources include leaks from the 100-K Area East fuel storage basin, leaks from the 183-H basin, and leaking retention basins. Because these sites are close to the Columbia River, these contaminants have been detected in springs that discharge to the river. Hexavalent chromium and strontium-90 have been detected above the National Ambient Water Quality Standards at isolated points on the river bottom where the groundwater upwells into the river prior to being diluted by the river. Active groundwater pump-and-treat systems and an in situ treatment wall is treating or slowing the migration of chromium (VI) to the river. There is also a pump-and-treat system in 100-N Area for the strontium-90 plume. This pump-and-treat system is generally not productive. The current state conceptual site model does not take credit for these treatment systems. The treatment systems are examined in the end state conceptual site models.

Burial grounds in the 100 Area contain solid and low-level radioactive waste associated with reactor operations. The main radionuclides are tritium, carbon-14, cobalt-60, nickel-63, strontium-90, cesium-137, silver-108m, europium-152, europium-154, and europium-155. Because disposal records prior to the late 1960s were not detailed, the estimates of the radionuclide inventory are uncertain and largely drawn from evaluations of analogous sites. Excavation of some burial grounds may reduce some of this uncertainty with the remainder of the burial grounds.

Figure 4.1g shows the conceptual site model for the current state for waste disposal sites that have yet to undergo any remediation (liquid and solid). The following represents the actions and control barriers DOE is taking now to either block or break the exposure transport pathway to the receptor and ensure protection to the workers, public and the environment.

4.1.3.2 Control Barriers for Waste Disposal Sites, Current State

Most major waste sites yet to be remediated have been stabilized with a layer of soil (overburden). A surveillance and maintenance program monitors the overburden to ensure there is no spread of contamination from wind or fire. As shown in Figure 4.1g, the overburden blocks the transport pathway from the near surface to air and protects the receptor that could potentially inhale contamination from the air transport pathway. The surveillance and maintenance program also applies an herbicide to the overburden to block the transport pathway of deep rooted plants potentially bringing up contamination to the surface and exposing the ecological receptors.

Institutional controls and safety procedures are applied to onsite workers and onsite public receptors. For example, to prevent accidental or inadvertent disturbances of the overburden on a waste site and to prevent direct exposures to contaminants in the waste site, institutional controls are applied (i.e., no consumptive use of groundwater, badge requirements, fences, barricades) and integrated safety management systems are in place (i.e., training, work controls, signs, onsite permit requirements for digging, etc.). These institutional control barriers are substantial and costly but necessary for blocking the exposure transport pathway to the onsite worker and onsite public from contamination that may be in the surface, near surface, subsurface, and groundwater (see Figure 4.1g). Though not shown in the figure, safety procedures also help protect the onsite workers during active remediation. Additional programs are in place to monitor groundwater, air releases, and the environment to ensure existing controls are working.

4.1.3.3 Control Barriers for Waste Disposal Sites, Current Baseline End State

The current baseline end state will have excavated the waste sites down to 4.6 meters (15 feet) to protect most surface users, including a hypothetical resident farmer. Excavations could go below 4.6 meters (15 feet) if needed to prevent future groundwater contamination above drinking water standards. Burial grounds will be excavated. The current baseline is in accordance with the current 100 Area Interim Action RODs. Figure 4.1h depicts excavation and backfill of the excavated waste sites as barrier #1. A yet to be completed final ROD(s) will require additional remedial actions and/or institutional controls if they are needed to meet remedial action objectives, including being protective of human health and the environment. Residual contamination in the deep vadose zone (below 4.6 meters [15 feet]) will be left behind for most of the liquid waste sites where contamination migrated through the vadose zone to groundwater. The principal radionuclides remaining in the deep vadose zone may be some combination

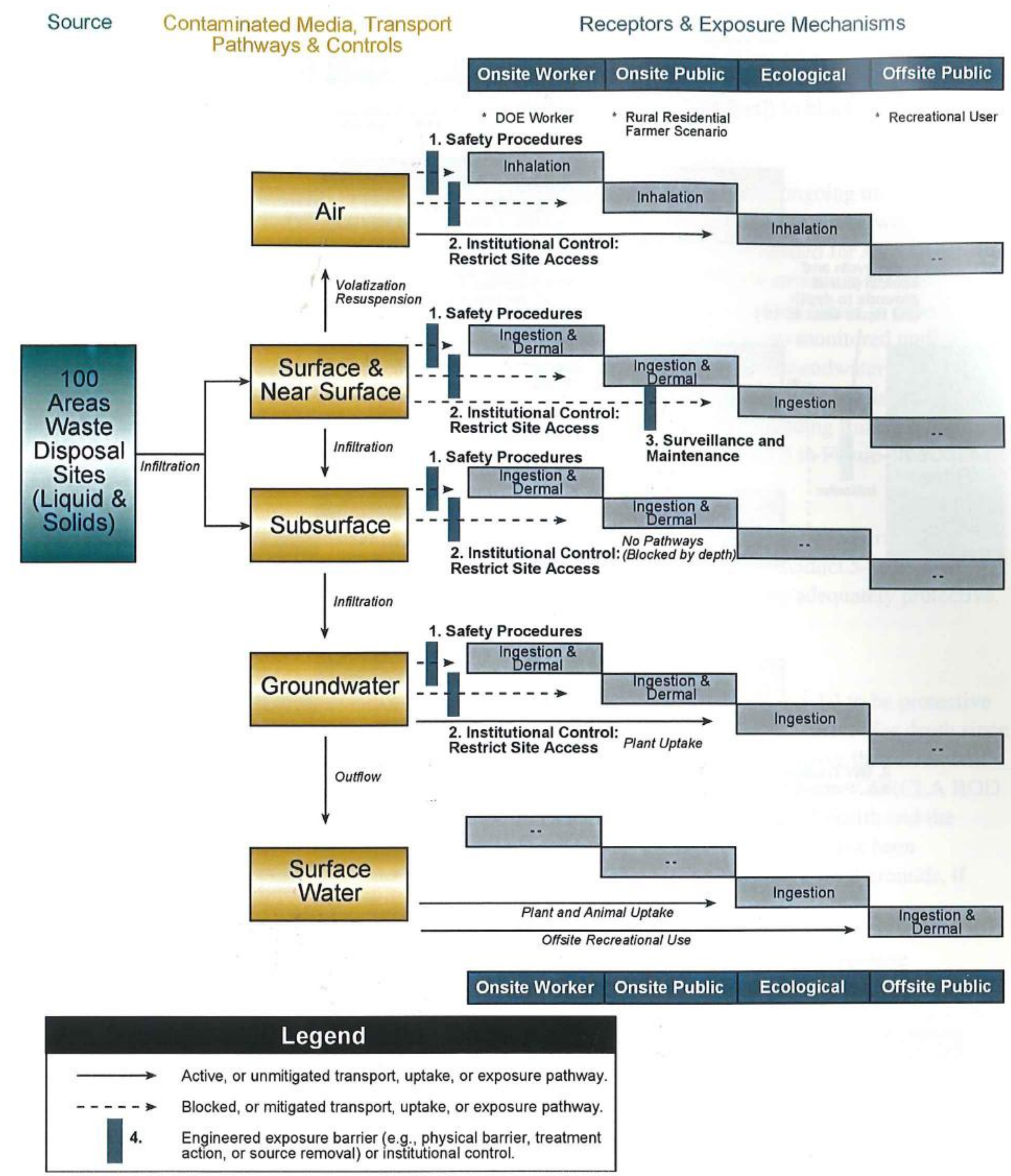

Figure 4.1g. 100 Area Waste Disposal Sites – Current State

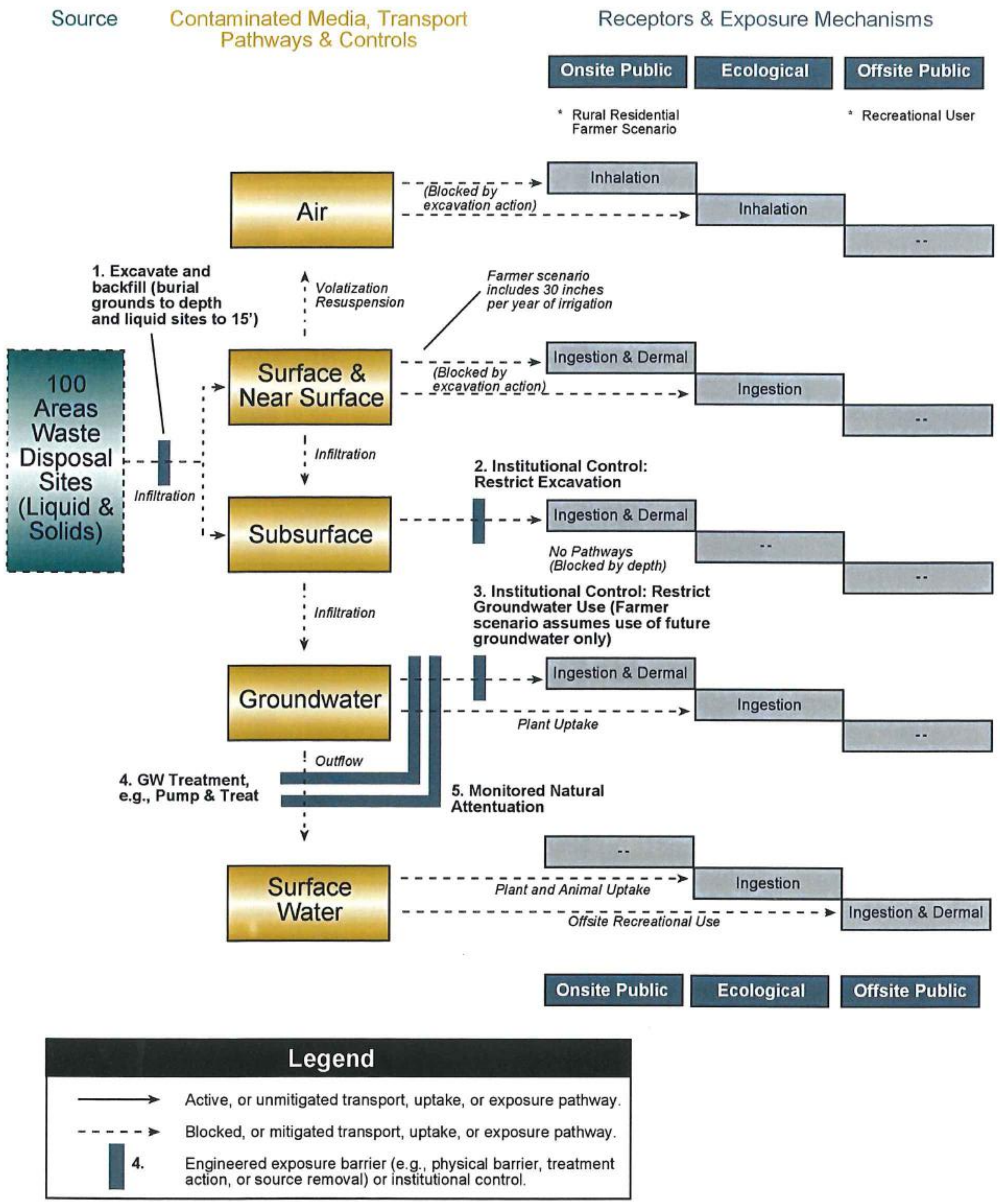

Figure 4.1h. 100 Area Waste Disposal Sites – Current Baseline End State

of tritium, carbon-14, cobalt-60, nickel-63, strontium-90, cesium-137, europium 152, europium-154, europium-155, and plutonium-239/240. The short-lived radionuclides will decay away over time. The major non-radionuclide contaminant is sodium dichromate. Barrier #2 in Figure 4.1h is an institutional control to prevent digging into the deep vadose zone (below 4.6 meters [15 feet]) to block the exposure transport pathway where contamination is present.

Groundwater pump-and-treat operations and an in situ treatment wall will be ongoing until chromium plumes meet remedial action objectives of a future CERCLA ROD. A strontium-90 plume will remain in groundwater and the deep vadose zone for up to 300 years, the amount of time needed for sufficient radioactive decay. There may also be an ongoing treatment system to minimize strontium-90 from reaching the Columbia River if one is found to be successful. Other plumes that are closer to meeting remedial action objectives or plumes that cannot be technically remediated may be monitored until the remediation objectives are met through natural attenuation of the contaminant. Groundwater institutional controls will continue to be needed to limit the use of groundwater until contamination levels are reduced to meet the remedial action objectives of a future CERCLA ROD. Decisions regarding final groundwater institutional controls and groundwater treatment or monitoring (barriers 3, 4, and 5 in Figure 4.1h) will be made via a CERCLA ROD.

A relatively small federal presence (compared to today's federal presence) will be required to implement the longer term actions required by DOE or future CERCLA RODs and to conduct 5-year post remediation CERCLA ROD reviews to ensure the remedies and controls are being adequately protective.

4.1.3.4 Control Barriers for Waste Disposal Sites, End State Vision

The end state vision would have excavation of waste sites (barrier #1 in Figure 4.1i) to be protective of surface uses and the environment. Protection of the environment may be the new driver for depth since surface use for the designated conservation/preservation land use would be less intrusive then a resident farmer. The exact depth required for excavation would need to be determined in a future CERCLA ROD based on what would meet the remedial action objects, including protection of human health and the environment. The majority of sites requiring excavation down to 4.6 meters (15 feet) have been completed. Burial grounds are the majority of sites left requiring deep excavation. Burial grounds, if excavated, are totally removed regardless of the depth.

An infiltration barrier over the large burial grounds cuts the transport pathway for exposure (barrier #2 in Figure 4.1i). There are 45 burial grounds in the 100 Area. Seven of these burial grounds are large, contain short-lived radionuclides, and are at least 15.2 meters (50 feet) above groundwater. It may be more economical to cap these seven burial grounds in place than to excavate them. There is process knowledge on these burial grounds; however they have not been fully characterized, leaving some uncertainty with regards of their content. Of the 16 large burial grounds, excavation has begun at two of them and both have contained pieces of spent nuclear fuel, which increases the uncertainty of what might be found in the remainder of the large burial grounds.

The remainder of the barriers (#3 through #6) depicted in Figure 4.1i are similar to the current baseline end state. Barrier #3, institutional controls, would also apply to any intrusion barriers constructed over burial grounds to ensure they remain functional. Similar to the current baseline end state, the institutional controls would be included in a future CERCLA ROD and 5 year CERCLA ROD reviews would be conducted to ensure remedies and controls are adequately protective.

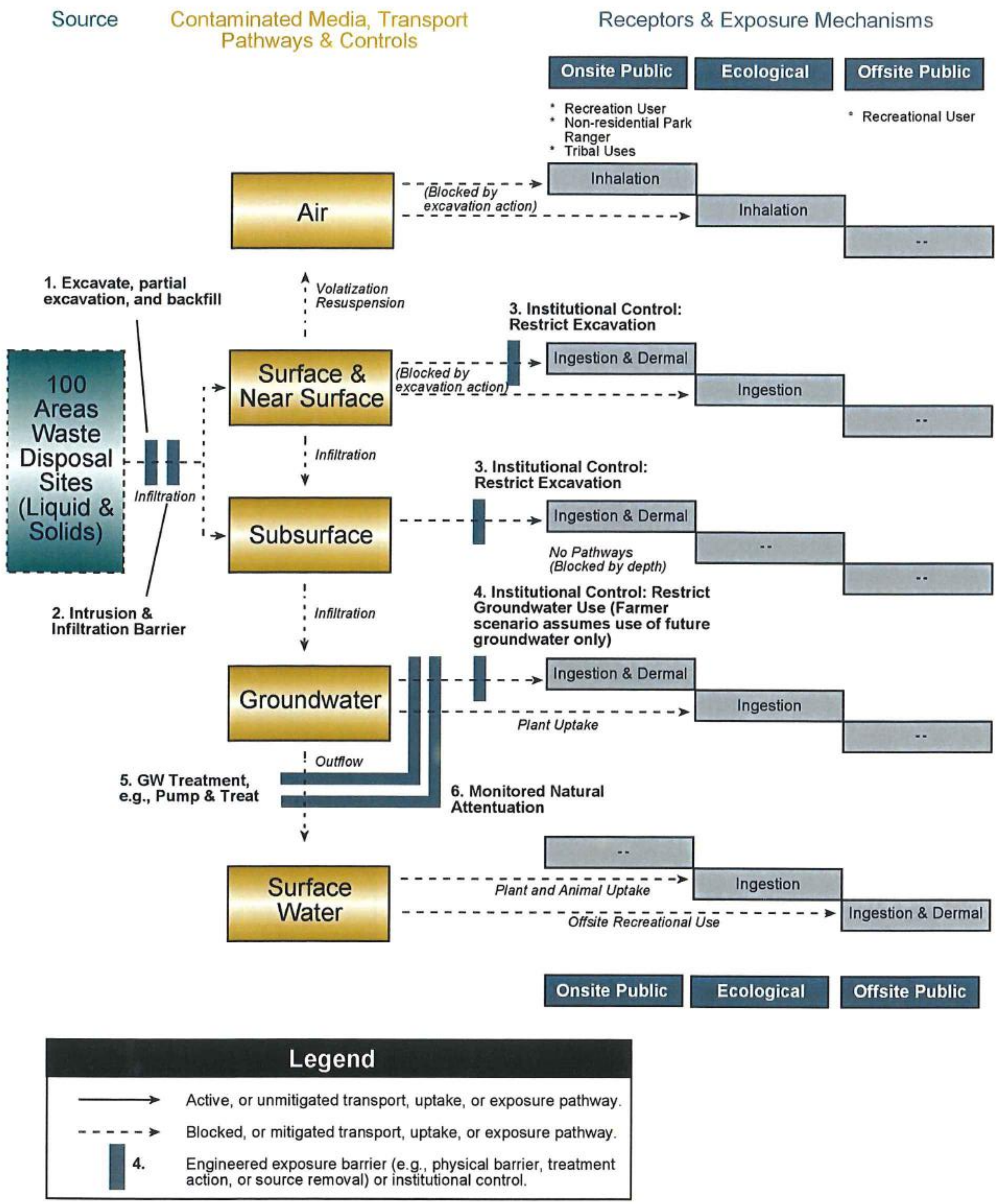

Figure 4.1i. 100 Area Waste Disposal Sites – End State Vision

4.1.3.5 Control Barriers for Former Production Reactors, Current State

The 100 Area have nine surplus production reactors located 85 to 823 meters (280 to 2,700 feet) from the banks of the Columbia River. Locations of each reactor core can be found in Figures 4.1a through 4.1f. Radioactive inventory contained in the reactor core includes tritium (~98,000 curies); carbon-14 (~37,000 curies); chlorine-36 (~270 curies); cobalt-60 (~74,000 curies); cesium-137 (~270 curies); and uranium-238 (~0.01 curies). The dose to workers from cobalt-60 and cesium-137 is one of the main drivers leading to the decision in the surplus reactor environmental impact statement (58 FR 4690) to place the reactor cores into interim safe storage for 75 years. Radioactive inventory in the core is not leaking. Five of the reactors have been or are nearly completed with the cocooning process for long-term storage to allow radioactive decay for up to 75 years prior to final disposition of the reactor cores. Figure 4.1j shows the cocooning process as barrier #1 to break the transport pathway for contamination. The cocooning process reduces the footprint of the reactor building by 80% down to the core and the shield walls. All openings are sealed and a 75-year slanted roof is installed over the building. Every 5 years the cocooned reactors are entered for monitoring purposes.

N, KE, KW, and B Reactors have yet to be cocooned. Fuel from N Reactor was stored in the KE and KW Reactor basins. The fuel from the K Basins has been removed and transported to the 200 Areas for dry storage. K Basin sludge and debris (200,000 curies) still requires removal prior to the cocooning of the KE and KW Reactors. Approximately 50 cubic meters (65.4 cubic yards) require packaging for removal with less than 0.5 cubic meters of fuel pieces contributing the majority of this source term. The K Basins are currently not known to be leaking but have leaked in the past. N Reactor has been deactivated and is awaiting the cocooning process. B Reactor has been proposed as a museum. There is good local support for the museum; however, a caretaker needs to be found. If no caretaker is found, B Reactor will also most likely be cocooned. Reactors that have not undergone cocooning require more extensive surveillance and maintenance to monitor and prevent the spread of contamination from the facility. Figure 4.1j shows surveillance and maintenance as barrier #2 to break the transport pathway for contaminants.

Safety procedures and institutional controls are applied to onsite workers and onsite public receptors. For example, to prevent people from accidentally walking into a radiological contamination zone within a building that may cause direct exposures to contaminants, institutional controls are applied (i.e., badge requirements, locked doors) and integrated safety management systems are in place (i.e., training, work controls, signs). These institutional control barriers and safety procedures are substantial and costly but necessary to ensure safety. Figure 4.1j depicts how safety procedures and institutional controls (barriers #3 and #4) block the transport pathway for contaminants. Though not shown in the figure, safety procedures also help protect the onsite workers during active remediation.

Additional programs are in place to monitor groundwater (barrier #6 in Figure 4.1j). Groundwater monitoring is not established for each reactor but there are groundwater wells in the general vicinity of each reactor.

4.1.3.6 Control Barriers for Former Production Reactors, Current Baseline End State

Eight or all nine reactors, depending on B Reactor museum support, will be cocooned (barrier #1 in Figure 4.1k) and awaiting removal to the Central Plateau for 75 years to allow for sufficient decay (barrier #2 in Figure 4.1k). N Reactor would need a decision document to transport its core to the Central

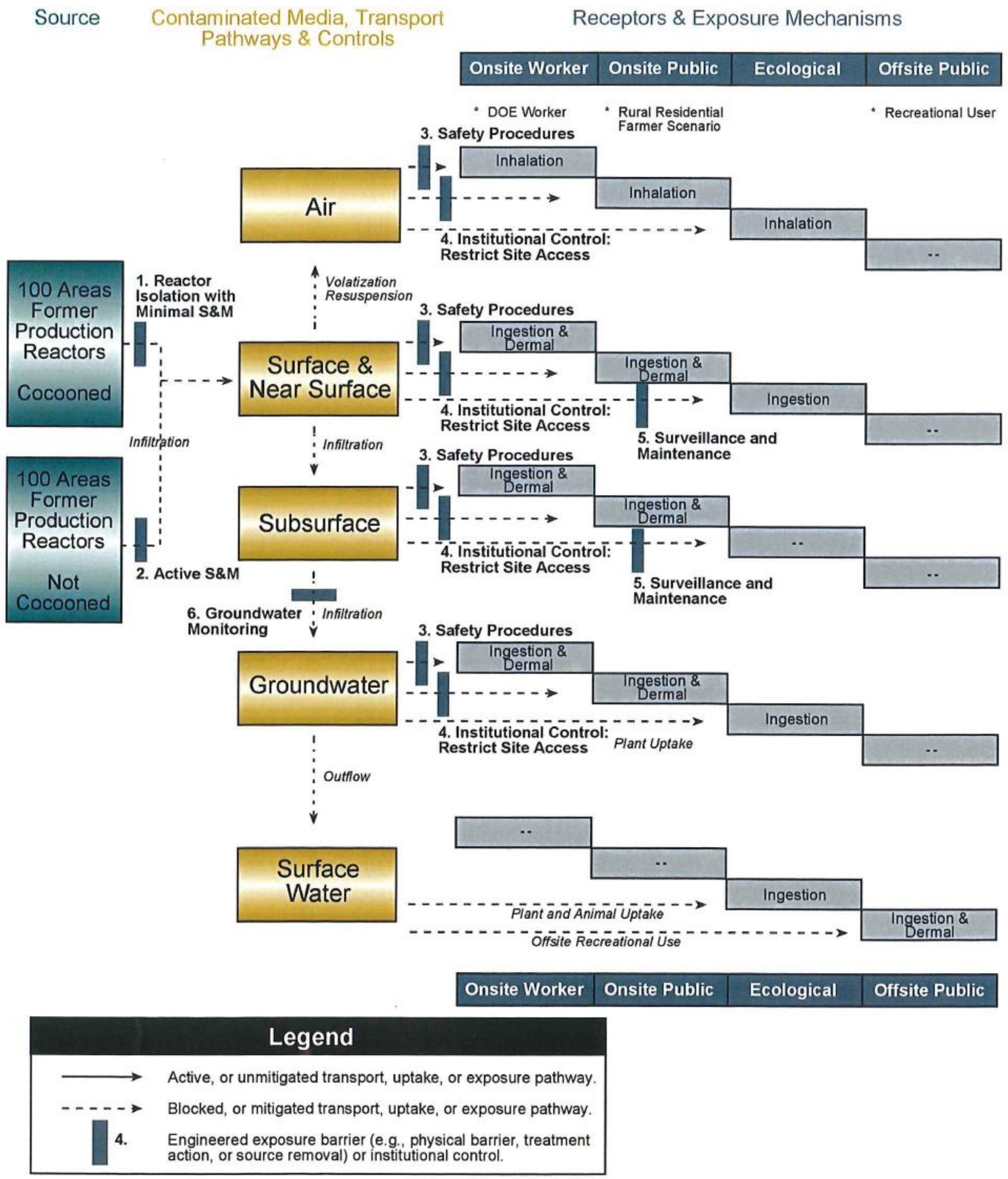

Figure 4.1j. 100 Areas Former Production Reactors – Current State

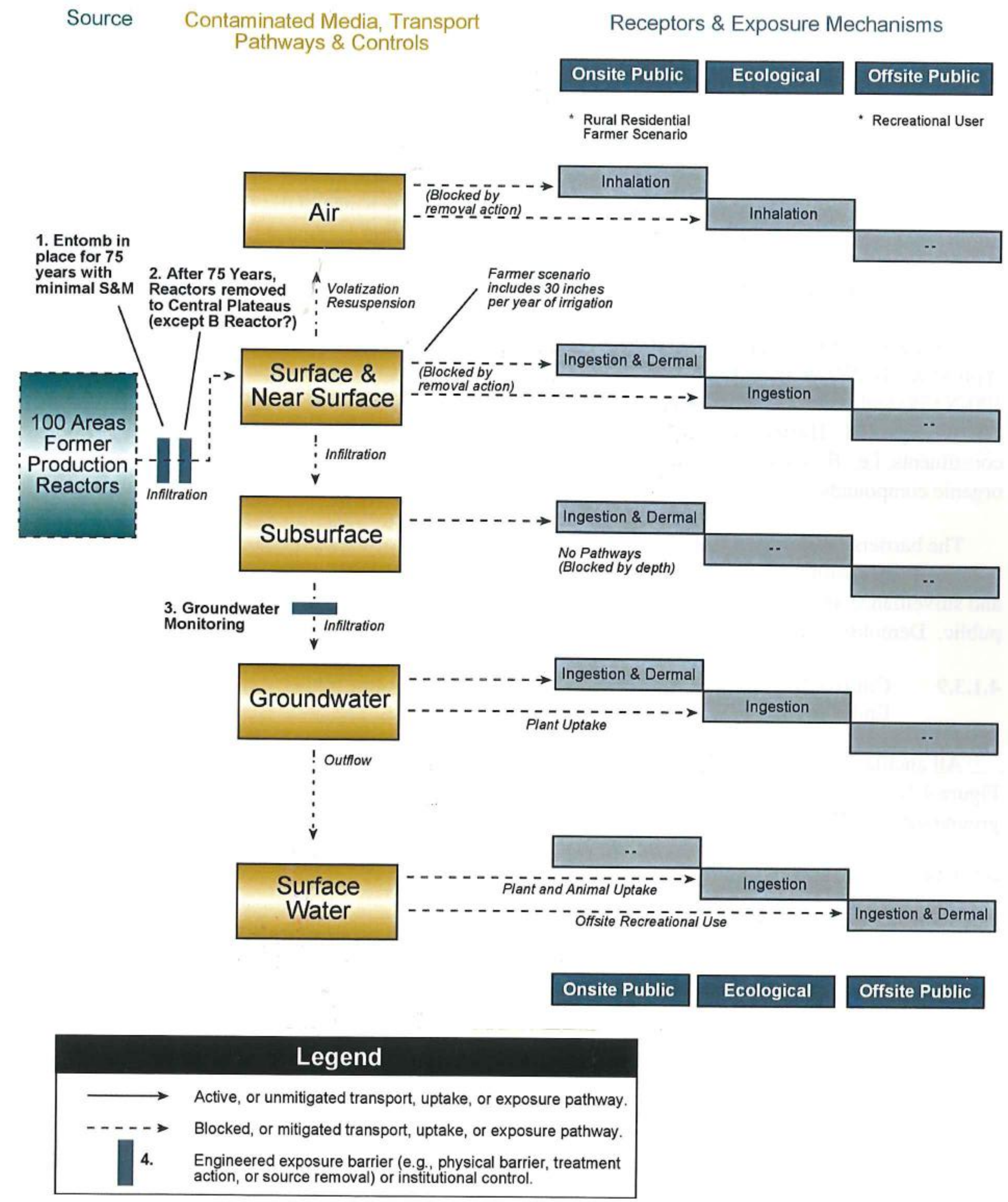

Figure 4.1k. 100 Areas Former Production Reactors – Current Baseline End State

Plateau. Each cocooned reactor would be entered periodically to be inspected. The time period between entries can be adjusted based on experience. Groundwater would be monitored (barrier #3 in Figure 4.1k) to ensure there is no spread of contamination through the vadose zone to groundwater.

4.1.3.7 Control Barriers for Former Production Reactors, End State Vision

The end state has the reactors staying in the 100 Area indefinitely. Barrier #1 in Figure 4.11 is the cocooning of the reactors and the indefinite surveillance and maintenance of the reactor blocks. The only additional activity required would be that every 75 years the roof needs replacing.

4.1.3.8 Control Barriers for 100 Areas Ancillary Facilities and Structures, Current State

Ancillary facilities supported operations and maintenance of reactors. There were a total of approximately 250 ancillary facilities in the 100 Areas with the remaining facilities located primarily at 100-N (59) and 100-K Areas. Locations of the majority of ancillary facilities can be found in Figures 4.1a through 4.1f. Hazards range from industrial to potential contamination with radiological constituents, i.e., fission and activation products, metals, inorganics, volatile organic compounds, and organic compounds.

The barriers blocking the transport pathways of contaminant reaching the receptors are very similar to those described with the reactor cores as shown in Figure 4.1m. Safety procedures, institutional controls, and surveillance and maintenance are the primary means of protecting the onsite worker and offsite public. Demolition and removal of the facilities is discussed in the end state sections below.

4.1.3.9 Control Barriers for 100 Areas Ancillary Facilities and Structures, Current Baseline End State

All ancillary facilities in the 100 Area will be demolished and removed as shown by barrier #1 in Figure 4.1n. Contamination may be left behind if it is determined not to impact groundwater. Barrier #2, groundwater monitoring, will ensure that residual contamination does not impact groundwater.

4.1.3.10 Control Barriers for 100 Areas Ancillary Facilities and Structures, End State Vision

The end state is identical to the current baseline end state; however, it may be determined that a few facilities may be able to be entombed or cocooned similar to the reactor cores. This is illustrated as barrier #2 in Figure 4.1o.

4.2 300 Area

The 300 Area is one of the four NPL areas at Hanford, encompasses ~1.35 square kilometers (~0.52 square mile), is adjacent to the Columbia River, and is ~1.6 kilometers (~1 mile) north of the Richland city limits.

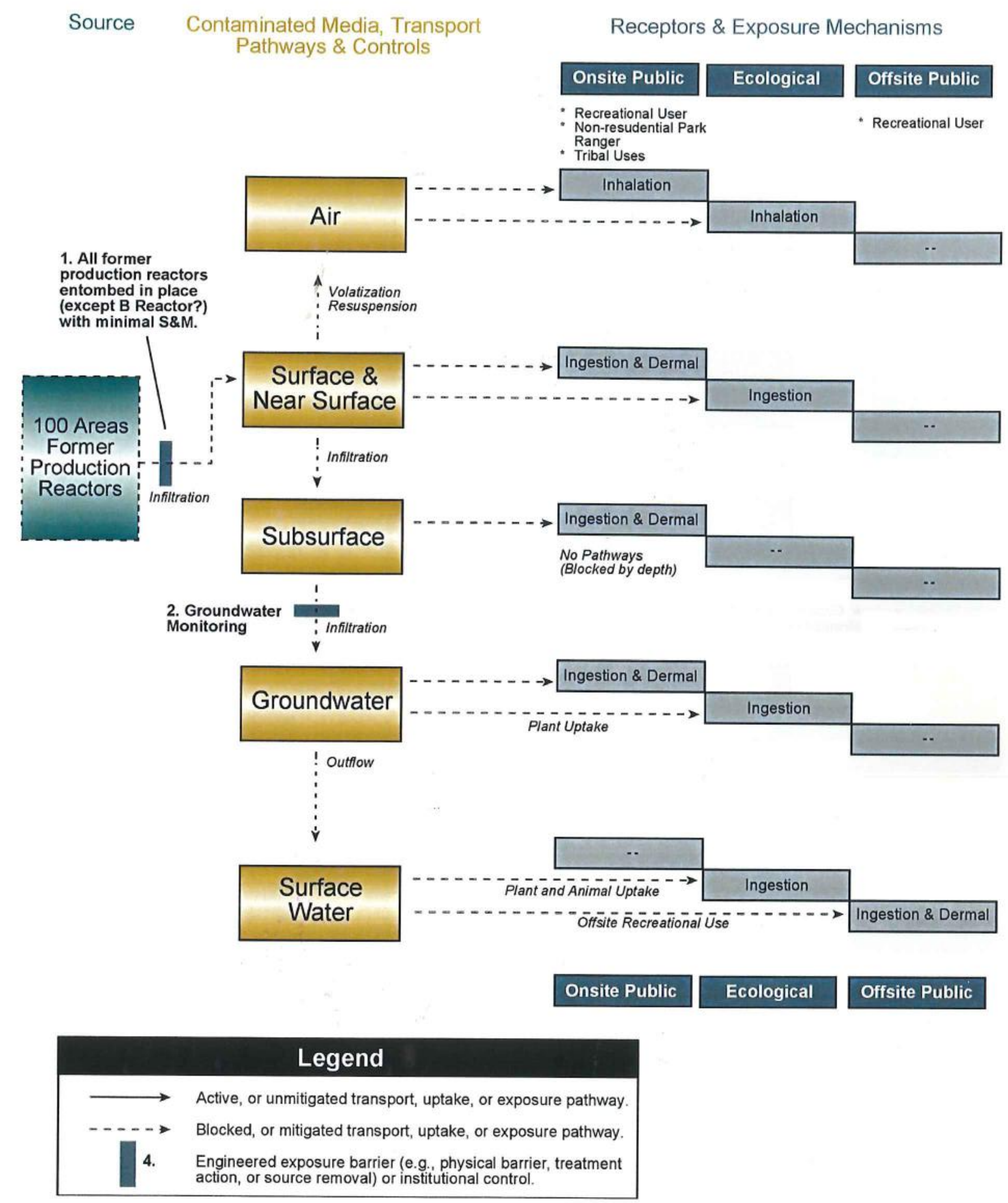

Figure 4.11. 100 Areas Former Production Reactors – End State Vision

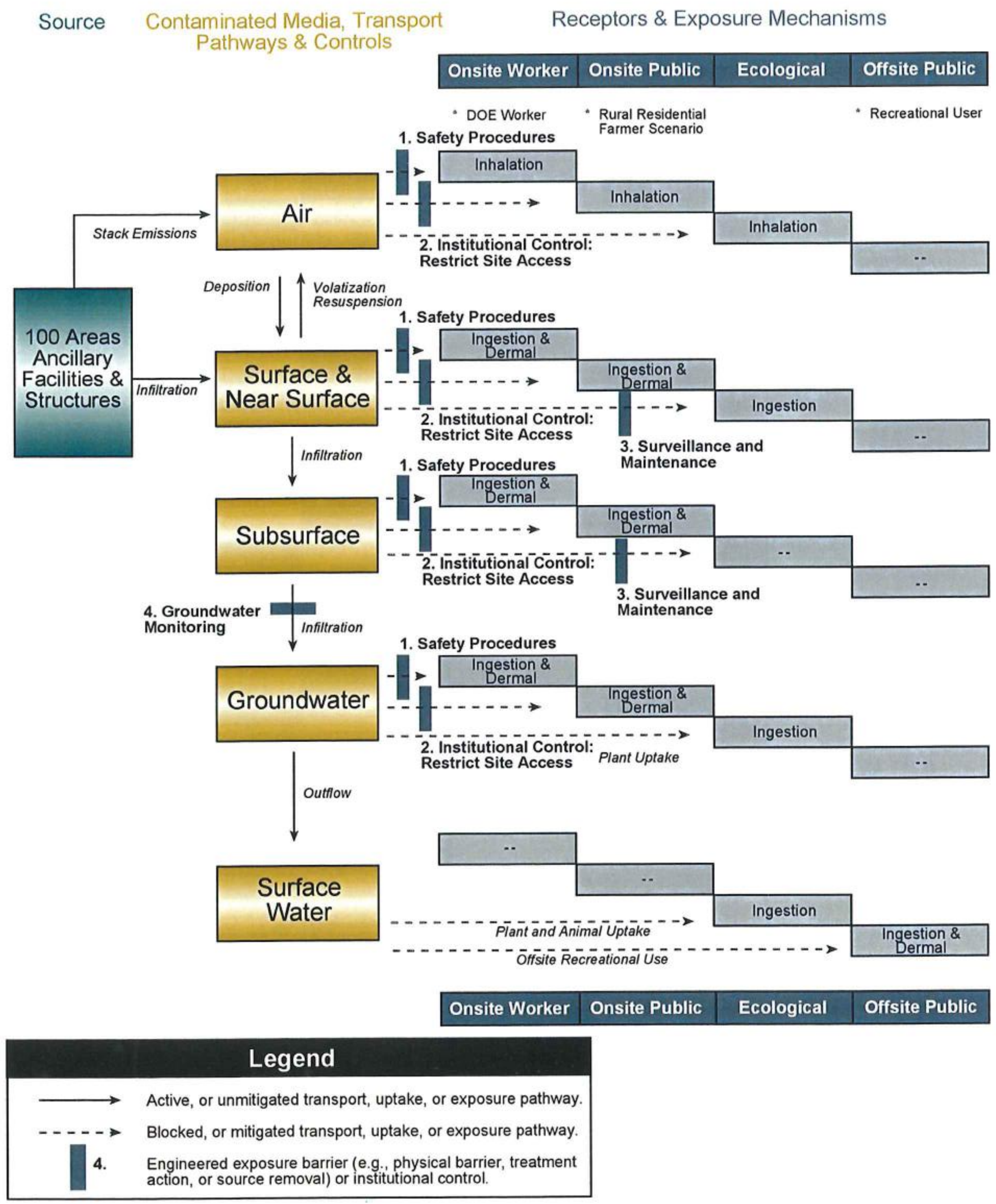

Figure 4.1m. 100 Areas Ancillary Facilities and Structures – Current State

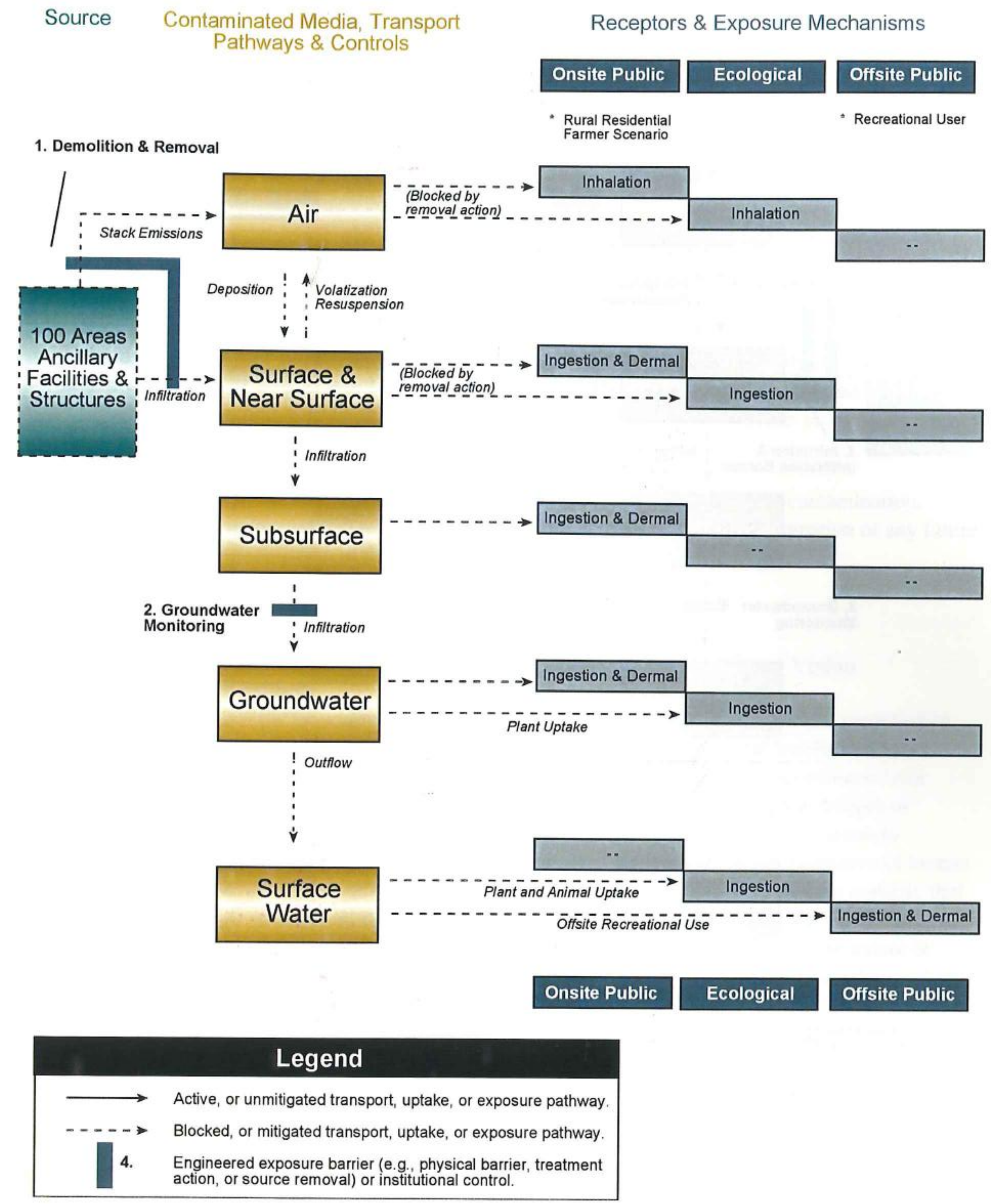

Figure 4.1n. 100 Areas Ancillary Facilities and Structures – Current Baseline End State

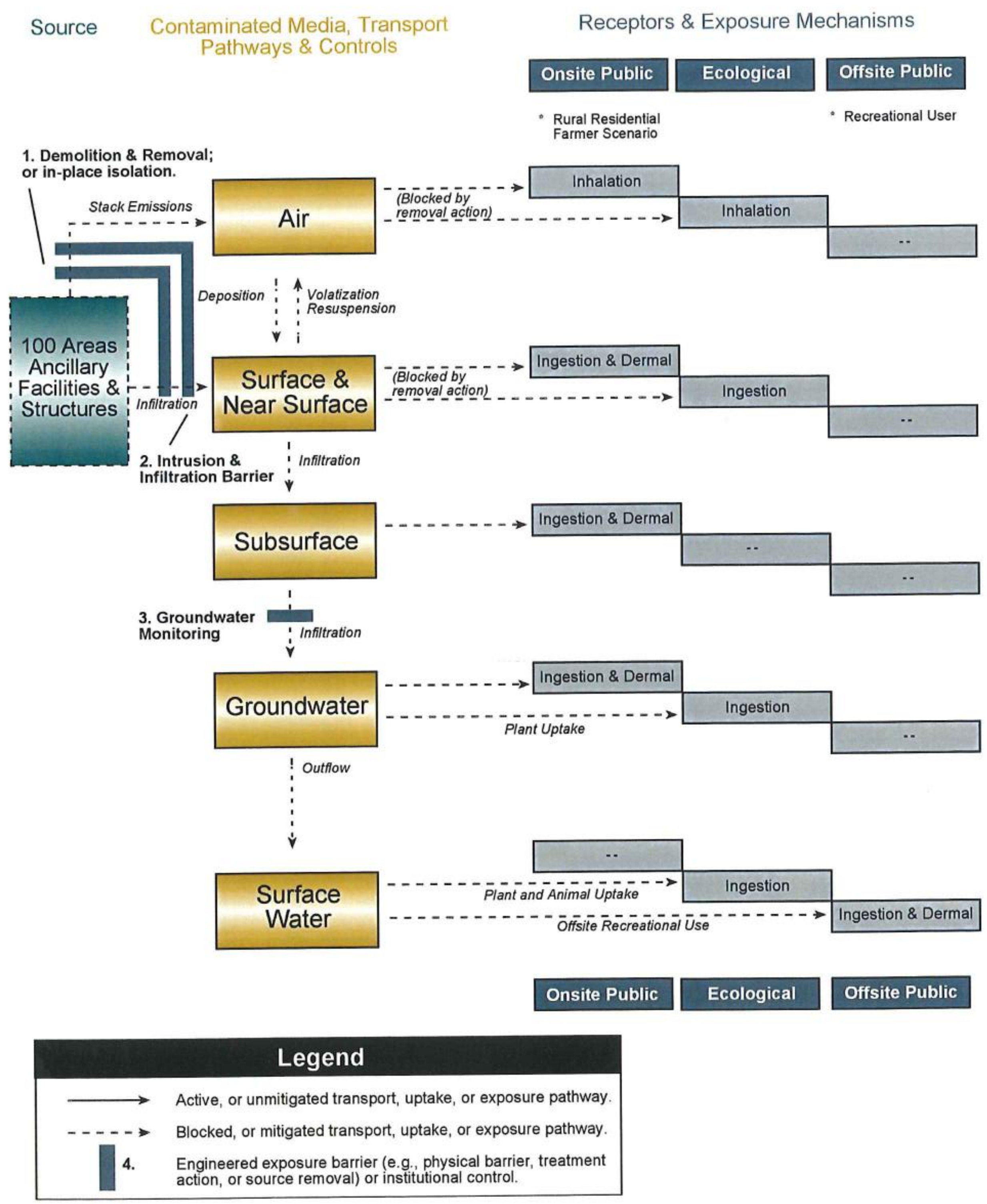

Figure 4.1o. 100 Areas Ancillary Facilities and Structures – End State Vision

4.2.1 Summary of Existing Hazards

Table 4.3 summarizes the existing hazards in the 300 Area. The top priority hazards in the 300 Area are the following:

- **324 and 327 facilities**. The current radiological inventory is estimated to be 65,000 and 1,500 curies, respectively.
- **Solid waste burial grounds**. 618-10 and 618-11 are large burial grounds with low- to high-activity waste including ~10,000 cubic meters (13,079 cubic yards) of suspect transuranic contaminated waste.
- **Existing groundwater plumes**. The most prominent contaminant in the groundwater underlying the 300 Area is uranium, which does intersect the Columbia River. In the vicinity of the 618-11 burial ground, tritium reached its highest concentration on the Hanford Site at 4 million pCi/L in 2002, but this plume does not reach the Columbia River.
- **Former liquid disposal sites**. The sites were original sources for groundwater contamination. Removing the hazard posed by groundwater contamination necessitates the elimination of any future sources of new contamination to the groundwater.

Figure 4.2a displays the hazard map for the 300 Areas.

4.2.2 Exposure Pathways and Potential Implications of the End State Vision

Table 4.4 summarizes the assumptions for land use, exposure scenarios and pathways, remediation goals, and institutional controls (including final barriers if any) for both the current baseline end state and the end state vision. The current ROD (ROD 1996b) uses the default *Model Toxics Control Act* (WAC 173-340) industrial scenario as the exposure scenario that assumes excavation to a depth of 4.6 meters (15 feet). Under the end state vision, a 300-Area-specific industrial exposure scenario (allowed by WAC 173-340) will be developed to determine what clean up levels are protective of human health. The intent of the end state vision is to align the remediation goals with an exposure scenario that is site-specific to the 300 Area. The implications to changing the exposure scenario may be that excavations, if needed, may be less the current 4.6 meters (15 feet). It is difficult to expand on the extent of differences until the site-specific industrial scenario is developed. Details of the current baseline end state and end state vision conceptual model exposure pathways are described below.

Table 4.3. Summary of Hazards in the 300 Area

Material Category	Current Hazard
Surface	
Facilities	• The 300 Area has 220 facilities that will be demolished. The hazards for the 300 Area are waste embedded in facilities in ductwork, concrete, piping, paint, equipment, insulation, cracks, crevices, and other places exist in multifaceted variety. Given the multitude of missions, processes, materials, isotopes, and other substances used in 300 Area facilities over the years, a comprehensive list is not possible in this venue. • The 324 Building is the former Waste Technology Engineering Laboratory. The building contains two major hot cell complexes for irradiated materials and cold side demonstrations of nuclear waste processes. Current fissile inventory has been reduced to only what is known to be held up as contamination in glove boxes, hot cells, and ventilation system ducting. The estimated inventory of radionuclides is 65,000 curies. • The 325 Building is the Radiochemical Processing Laboratory. This facility is an active radiochemical analytical laboratory. It contains an estimated in-process inventory of ~6,200 curies of tritium and ~440 curies of plutonium. An additional inventory of ~7,400 curies of plutonium-238 is contained in a non-dispersible form (mostly in solid ceramic radioisotope thermal generators built for use with NASA spacecraft). • The 327 Building is the former Post Irradiation Testing Laboratory. The building contains ten hot cells, a water fuel storage fuel basin, and a water transfer basin leading into A Cell. It also contains a dry storage carousel for holding samples from fuel and reactor material testing and examination programs. The facility is assumed to contain 1,500 curies of material including less than 200 grams of plutonium.
Subsurface	
Liquid Waste Sites	• There are 120 liquid waste disposal sites. Prior to 1994, liquid waste was discharged to a series of unlined ponds and process trenches just north of the 300 Area. The primary contaminant in the 300 Area is uranium from the fuel fabrication processes. However, numerous other potential contaminants exist for individual waste sites based on the history of their use and operation.
Solid Waste Burial Grounds	• There are eight burial grounds remaining in the 300 Area, including 618-10 and 618-11. • The 618-10 and 618-11 burial grounds contain three categories for waste disposal; <10 Ci/ft^3 (low activity), 10 to 1,000 Ci/ft^3 (moderate-activity), and above 1,000 Ci/ft^3 (high activity). The low activity waste was primarily disposed of in trenches, while moderate and high activity wastes were disposed in vertical pipe units and caissons and sometimes to trenches in concrete/lead-shielded drums. 618-11 is a known contributor of tritium in groundwater. These burial grounds include 10,000 m^3 (13,079 yd^3) of suspect transuranic contaminated waste. • The 618-7 burial ground includes hundreds of 113.5-L (30-gal) iron drums of Zircaloy chips stored in water to mitigate their pyrophoric attributes. • The general content burial grounds received a broad spectrum of chemical and radiological waste as well as solid waste and debris. None appear to be impacting groundwater. The 300 Area burial grounds have a greater amount of uncertainty with regard to their contents in comparison to the 100 Area burial grounds. For example the 618-4 burial ground unexpectedly encountered 1,500 drums of uranium chips in oil during excavation.
Groundwater	
Groundwater	• The most prominent contaminant in groundwater is uranium. • A plume of trichloroethene is attenuating naturally, and concentrations remain below MCLs. • Tritium in groundwater near 618-11 burial ground is the highest onsite (4 million pCi/L in 2002). Tritium has migrated from the 200 Area below MCLs into the 300 Area.

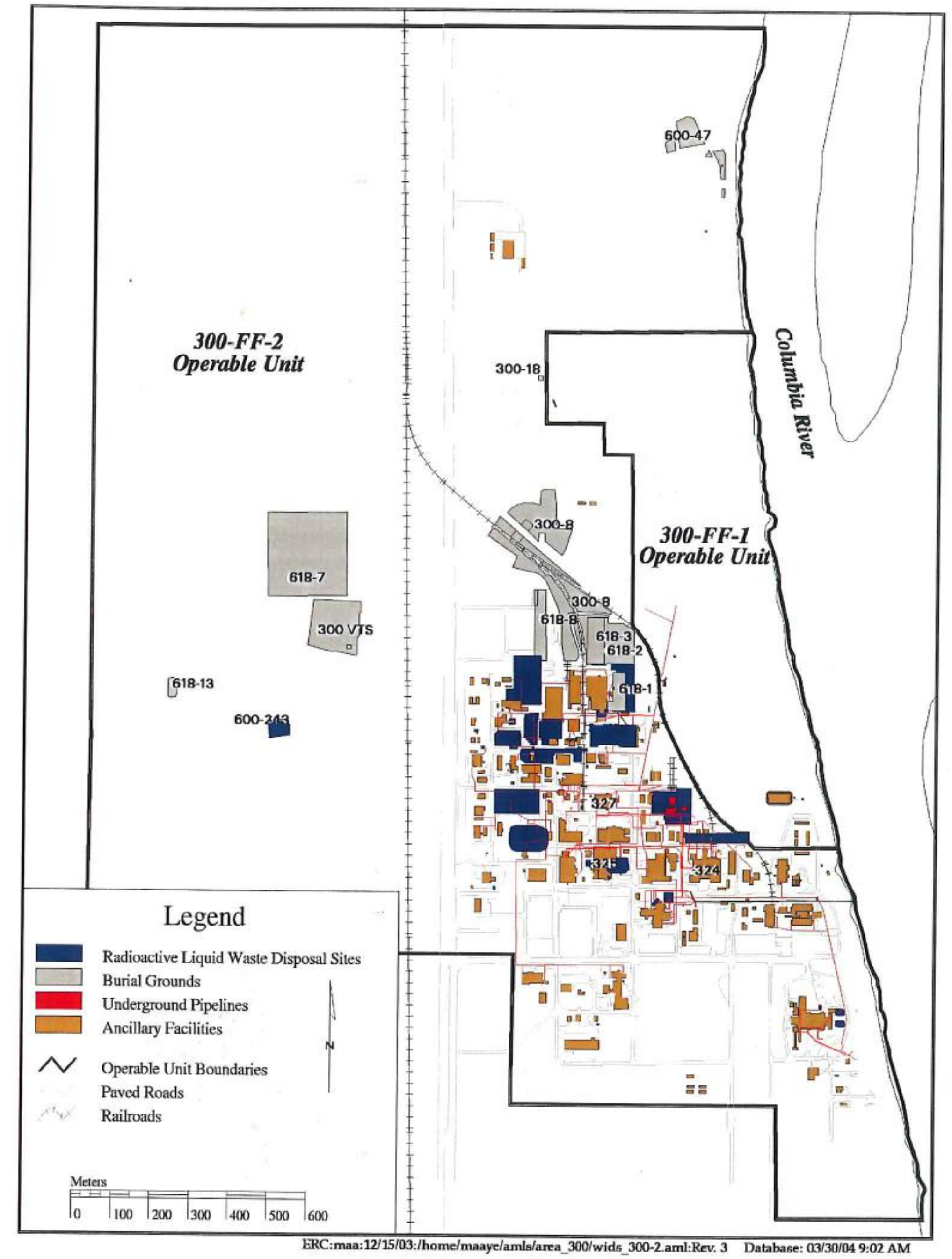

Figure 4.2a. Hazard Map for the 300 Areas

Table 4.4. 300 Areas – Overview and Comparison of Current and End State Assumptions for Land Use, Exposure Scenarios, Risk Protection Goals, and Potential Institutional Controls

	Current Baseline End State	End State Vision
Land Use and Key Assumptions	Industrial use	Industrial use
Exposure Scenarios for Determining Cleanup Levels	MTCA default industrial scenario (4.6 m [15 ft] excavation) Human health based cleanup must be verified to be adequately protective of ecological resources.	Site-specific industrial scenario and ecological assessment as basis for final ROD
Risk Protection Metrics/Goals	• 15 mrem/yr. from radionuclides to industrial worker ($3x10^{-4}$ risk based on EPA guidance) • $1x10^{-6}$ risk from other contaminants • Source removal to promote restoration of groundwater to beneficial drinking water use, based on 4 mrem/yr from MCL radionuclide concentrations [dose limit for hypothetical drinking water pathway] • Excavation depth also protects deep rooting plant pathway and may provide adequate protection of other ecological resources.	• CERCLA risk range $1x10^{-4}$ to $1x10^{-6}$ risk from other contaminants • Source containment or removal and treatment if practicable only where needed to promote restoration of groundwater to beneficial drinking water use, based on 4 mrem/yr from MCL radionuclide concentrations • Protection of ecological resources
Cleanup Actions		
Surface	• Remedial actions taken as needed to protect human health and ecological resources for this land-use scenario.	• Same
Subsurface	• Waste sites excavated to depth of 4.6 m (15 ft)	• Install surface barrier or remove to achieve risk goals
Groundwater	• Remedial actions taken to prevent groundwater degradation, protect the River and return to beneficial drinking water use if practicable	• Same
Institutional Controls	• Restrictions in place to preserve land uses and prevent use of groundwater. • Prevention of excavation below 4.6 m (15 ft).	• Restrictions in place to preserve land uses and prevent use of groundwater. • Prevention of excavation into waste sites with surface barriers. • Surveillance and maintenance of disposal sites and surface barriers.

4.3 200 Areas

4.3.1 Summary of Hazards

Table 4.5 summarizes the existing hazards in the 200 Areas. Figures 4.3a and 4.3b show hazards in the 200 West and East Areas. The top priority hazards in the 200 Areas are the following in descending order of their relative importance:

- **Radioactive mixed waste tanks**. The 200 Area Core Zone contains 149 single- and 28 double-shell tanks distributed among 18 tanks farms (Figure 4.3c). The tanks contain about ~2.04E+008 liters (>53 million gallons) of liquid, sludge, and saltcake waste. These tanks contain 200 million curies of radioactivity.

- **Plutonium from the Plutonium Finishing Plant**. Approximately 17 metric tons (18.7 tons) of bulk plutonium-bearing material has been stabilized and repackaged into ~2,200 specification 3013 cans awaiting final disposition to Savannah River Site and ~2,400 pipe overpack containers that will be shipped to WIPP. The disposition of these materials to a consolidated storage location for long-term storage is not expected until after 2007.

- **Waste Materials stored in facilities at the Central Waste Complex**. In 2003, ~8000 cubic meters (10,000 cubic yards) of transuranic-mixed, mixed low-level waste, and low-level waste was stored at the Central Waste Complex pending stabilization, treatment, or shipment to a final disposal location. There is continual through-put which currently is rapidly decreasing the mixed low-level waste in storage and increasing the amount of transuranic-mixed waste in storage based on currently available treatment, disposal, and shipment capabilities.

- **Cesium and strontium capsules are currently stored in the Central Plateau**. Less than 2,000 cesium/strontium capsules are currently being stored in basins. These capsules contain ~130 million curies of cesium-137 and strontium-90 removed from concentrated tank waste to reduce heat generation in underground storage tanks. Efforts are underway to move these capsules from the water-filled basin to dry storage pending final disposition.

- **Spent nuclear fuel stored in the Canister Storage Building**. Approximately 75% of the spent nuclear fuel in the entire DOE complex is stored at Hanford. Most of this fuel, nearly 2,086 metric tons (2,300 tons) is stored in the Canister Storage Building. Other spent nuclear fuel from FFTF is also planned for storage within the 200 Areas pending shipment and final disposal at the Nuclear Waste Repository.

- **Former liquid disposal sites that were original sources for groundwater contamination**. Of the ~1,000 past-practice waste sites on the Central Plateau, there are over 400 liquid waste sites that received liquid from 200 Area operations. Current and potential impacts to groundwater are dominated by releases from waste sites that received liquid waste. These waste sites included ponds, ditches, cribs, trenches, and injection or reverse wells. The major radioactive hazards associated with these sites include plutonium, uranium, strontium-90, cesium-137, iodine-129, and technetium-99. The chemical hazards associated with these liquid waste sites include volatile organics such as carbon tetrachloride, concentrated acids including nitric acid, and other organic compounds.

Table 4.5. Summary of Hazards in the 200 Areas

Material Category	Current Hazard
Surface	
Nuclear Materials	• Storage facilities located within the Plutonium Finishing Plant (PFP) and Central Waste Complex (CWC) currently store ~17 metric tons (18.7 tons) of stabilized plutonium-bearing materials. The disposition of these materials to a consolidated location for long-term storage is not expected until after 2007 • Approximately 75% of the Spent Nuclear Fuel (SNF) in the entire DOE complex is stored at Hanford. Most of this SNF, nearly 2,086 metric tons (2,300 tons) will be stored in the Central Plateau. Other SNF from the Fast Flux Test Facility is also planned for storage within the 200 Areas pending shipment and final disposal at the Nuclear Waste Repository. • Less than 2,000 cesium/strontium capsules are currently being stored in the Central Plateau. These capsules contain ~130 million curies of cesium-137 and strontium-90 removed from concentrated tank waste to reduce heat generation in underground storage tanks. Efforts are underway to move these capsules from the water-filled storage to dry storage pending final disposition. • Approximately 8,000 m^3 (10,463 yd^3) of transuranic/mixed low-level waste (TRU/MLLW) stored at CWC pending stabilization, treatment, or offsite shipment.
Nuclear Production Facilities	• Five irradiated nuclear fuel reprocessing facilities were used to recover 64,000 kg (141,095 lb) of plutonium from SNF. These facilities are massive structures with thick concrete walls to shield the workers from the highly radioactive chemical processing operations and residual contamination. Currently, four of these five facilities, PUREX, Reduction-Oxidation (REDOX), B Plant, and U Plant are in long-term surveillance and maintenance while T Plant remains active as a storage and processing facility for remote-handled (RH) TRU/MLLW. Final disposition of these facilities is expected to include collapsing the upper levels and isolating the facility remnants from the environmental with earthen barriers. • The PFP facilities were used to purify, process, and produce various plutonium product materials. These facilities contain extensive plutonium contamination within glove boxes, ducting systems, piping and other process vessels. Current plans are to demolish the PFP to slab-on-grade pending a future decision on the final disposition.
Ancillary Facilities	• More than 900 ancillary facilities were constructed to support irradiated nuclear fuel processing operations. These support facilities were contaminated with a variety of hazardous and radioactive substances including acids, metals, other organic and inorganic chemicals and radioactive fission and activation products.
Subsurface	
Liquid Waste Sites	• Over 400 liquid waste sites received liquid from 200 Area operations. These waste sites included ponds, ditches, cribs, trenches, and injection or reverse wells. The composition of the waste streams disposed to these sites varied widely from lightly contaminated steam condensate and cooling water to highly concentrated process and tank waste. The major radioactive hazards associated with these sites include plutonium, uranium, strontium-90, cesium-137, iodine-129, and technetium-99. The chemical hazards associated with these liquid waste sites include volatile organics such as carbon tetrachloride, concentrated acids such as nitric acid, and other organic compounds.

Table 4.5. (contd)

Material Category	Current Hazard
Solid Waste Burial Grounds	• Nearly 100 landfills were constructed within the 200 Area to dispose of solid, low-level radioactive, and TRU waste. Approximately 15,000 m^3 (19,619 yd^3) of this waste is retrievably stored TRU waste that is scheduled to be exhumed and packaged for shipment to WIPP. Much of the low-level radioactive solid and hazardous waste was generated during reprocessing or from other DOE sites is to be isolated from the accessible environment using surface barriers.
Radioactive Mixed Waste Tanks	• Within the 200 Area Core Zone are 18 tank farms containing 149 single-shell tanks, 28 double-shell tanks, and ancillary facilities. The tanks are below ground and contain ~ 2.04E+008 L (>53 million gal) of liquid, sludge and saltcake waste. The tanks contain ~200 million curies of radioactivity and other hazardous metals and chemicals. Most of the tanks are beyond their design life and 67 have leaked or are assumed to have leaked ~ 3.8 million L (1 million gal). Some of this leaked waste has reached the groundwater that flows to the Columbia River. Additional leaks are likely to occur, presenting a hazard to the public and the environment as the contaminated groundwater moves away from the Core Zone. The long-term hazards are primarily via the groundwater pathway and by intruders digging into the waste after institutional control is lost. • Airborne releases are also a hazard. Currently, workers are exposed to chemical vapors that are occasionally emitted from the tanks. Radioactive airborne releases with potential to reach off site could occur if, as a result of a leak in a pressurized transfer line, waste was sprayed into the air.
Groundwater	
Groundwater	• 200 East Area. Plumes beneath the 200-PO-1 Operable Unit resulting from discharges from the PUREX Plant; principle contaminants include tritium, nitrate, and iodine-129. These plumes extend from 200 East Area to the shoreline of the Columbia River where this groundwater discharges into the river. • 200 East Area. Plumes beneath the 200-BP-5 Operable Unit resulting from discharges of highly contaminated tank and process waste to the soil; principle contaminants include the mobile contaminants technetium-99 and nitrate as well as strontium-90, cesium-137, and plutonium that are far less mobile. • 200 West Area. Plumes beneath the 200-UP-1 Operable Unit resulting from REDOX and U Plants liquid discharges; includes a plume containing tritium, nitrate, and iodine-129 located near the REDOX Plant and a second plume near U Plant containing elevated concentrations of uranium, technetium-99, and nitrate. • 200 West Area. Plumes beneath the 200-ZP-1 Operable Unit resulting from discharges from the PFP. Carbon tetrachloride has spread well beyond the area surrounding PFP and contaminated much of the groundwater beneath 200 West Area. • The primary receptors that are potentially at risk due to contaminated groundwater are biota in the Columbia River that reside in the areas of groundwater upwelling and plants in the riparian zone that have roots down to groundwater. The tritium and iodine-129 plumes from 200 East Area pose a hazard for an estimated 150 years, by which time the tritium will have decayed to below drinking water standards and the iodine-129 will have dispersed to below drinking water standards. Other contaminant plumes are expected to remain beneath the Core Zone through effective source control and groundwater remedial action.

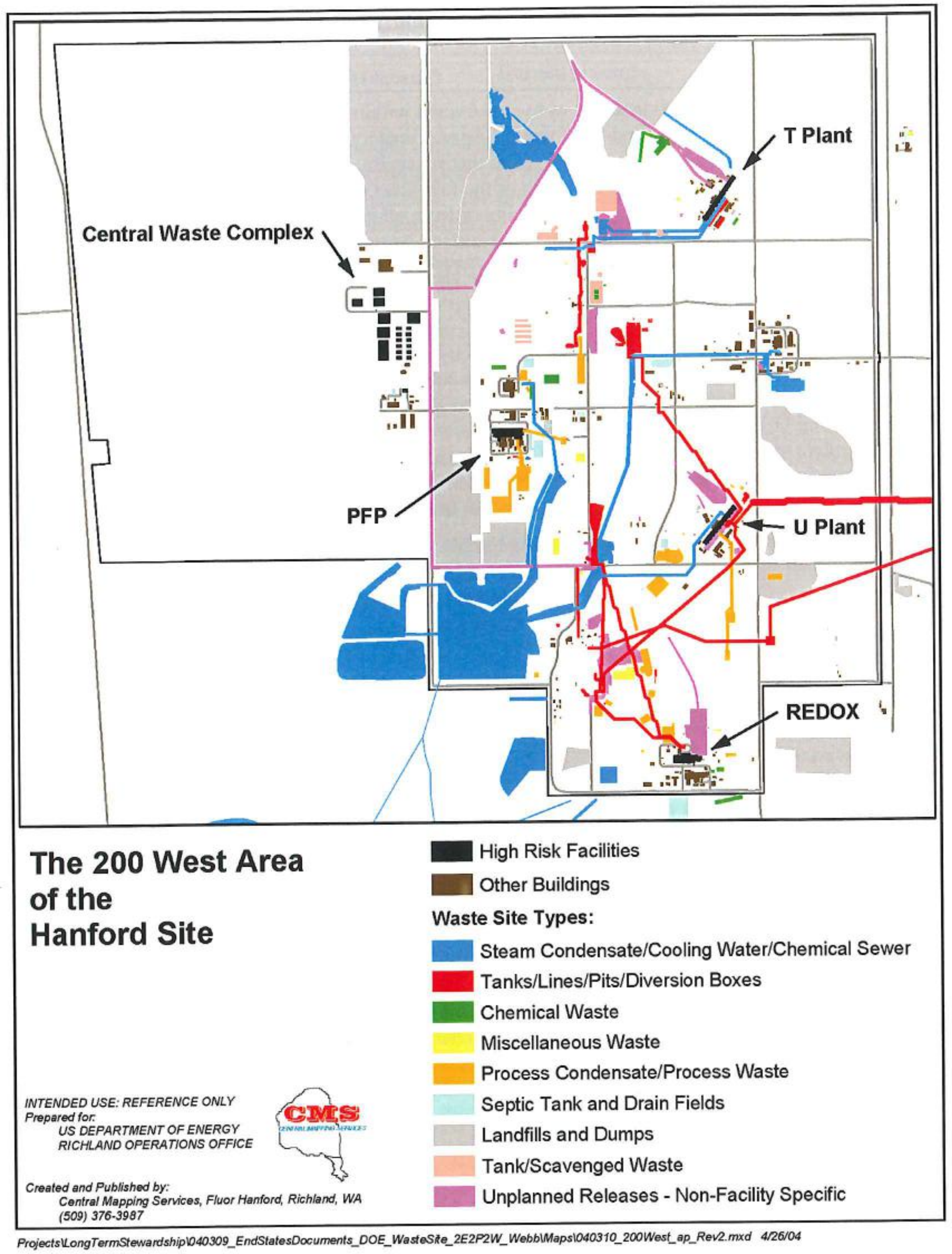

Figure 4.3a. 200 West Area Hazard Map

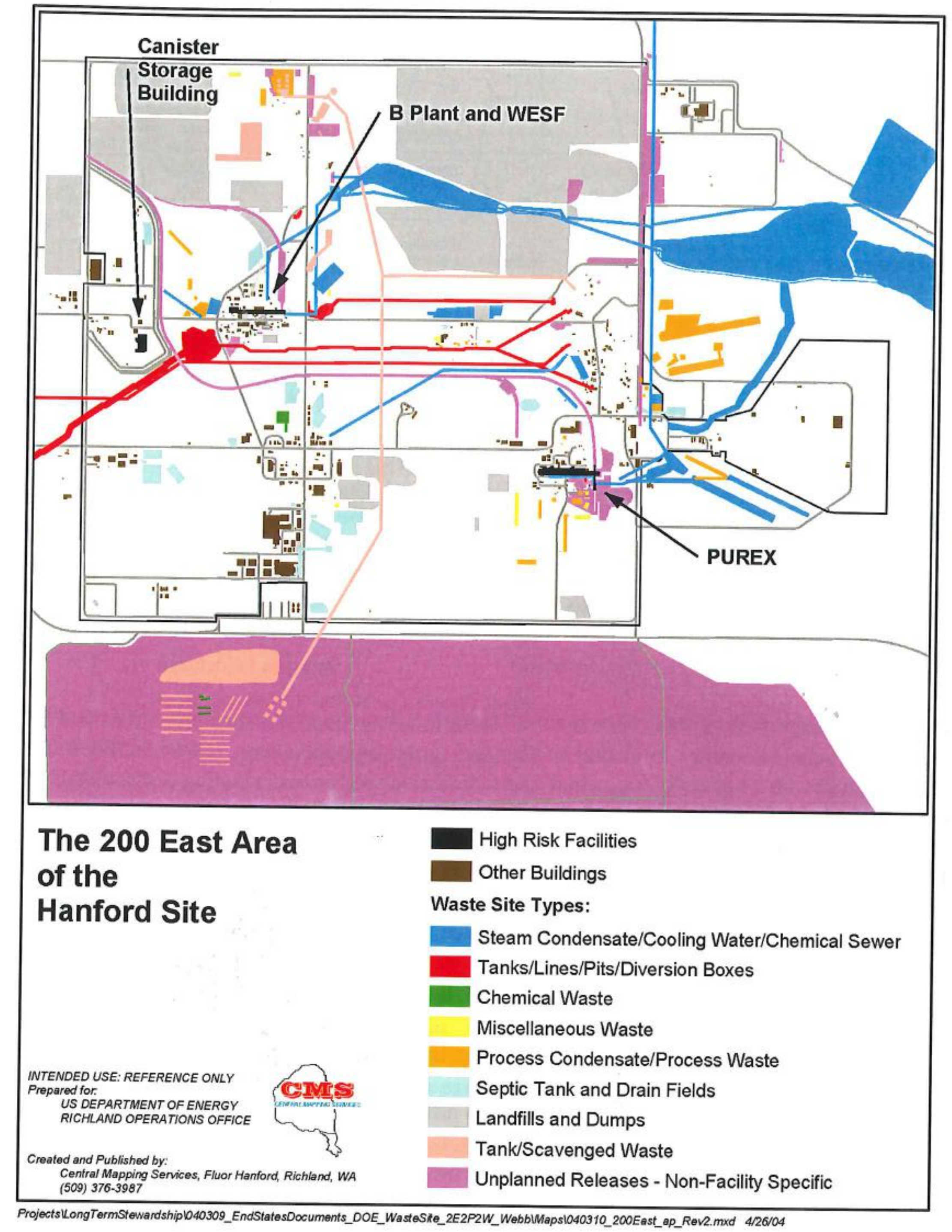

Figure 4.3b. 200 East Area Hazard Map

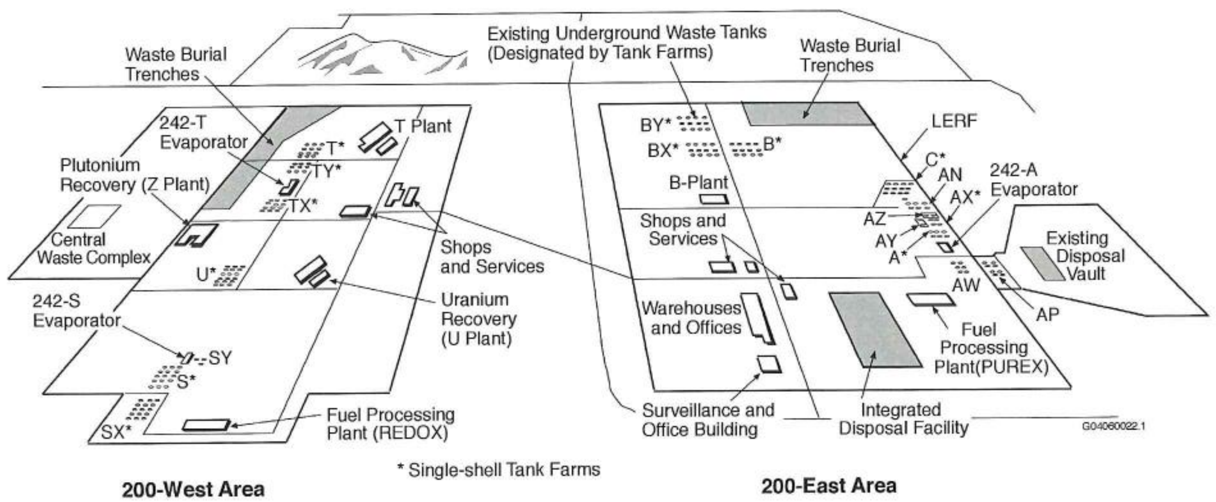

Figure 4.3c. Tank Farm Map

- **Solid waste burial grounds**. Nearly 100 landfills were constructed within the 200 Areas to dispose of solid, low-level radioactive, and transuranic waste. Approximately 15,000 cubic meters (19,619 cubic yards) of this waste is retrievably stored transuranic waste that is scheduled to be exhumed and packaged for shipment to WIPP. Much of the low-level radioactive solid and hazardous waste was generated during reprocessing or from other DOE sites is to be isolated from the accessible environment using surface barriers.

- **Former production facilities**. Nine hundred facilities, including five canyon facilities and PFP, were constructed to conduct irradiated nuclear fuel processing operations. These facilities are contaminated with a variety of hazardous and radioactive substances including acids, metals, other organic and inorganic chemicals, and radioactive fission and activation products.

- **Existing groundwater plumes with contaminants slowly moving toward the Columbia River**. There are four primary groundwater plumes (and operable units) underlying the 200 Areas. These plumes contain the following contaminants at levels that exceed drinking water standards: tritium, iodine-129, technetium-99, uranium, nitrate, and carbon tetrachloride. Far less mobile strontium-90, cesium-137, and plutonium are present in the soil, but are not a major threat to the groundwater.

4.3.2 Exposure Pathways and Potential Implications of the End State Vision

Within the 200 Areas, the exposure pathways will differ between areas inside the Core Zone and areas outside of the Core Zone. Table 4.6 summarizes the assumptions for land use, exposure scenarios and pathways, remediation goals, and institutional controls for both the current baseline end state and the end state vision for areas outside of the Core Zone. Table 4.7 provides this information for areas inside of the Core Zone.

Table 4.6. 200 Areas Waste Sites Overview and Comparison of Current and End State Assumptions for Land Use, Exposure Scenarios, Risk Protection Goals, and Potential Institutional Controls – Outside Core Zone

	Current Baseline End State	End State Vision
Land Use and Key Assumptions	Conservation	Conservation/Preservation
Exposure Scenarios for Determining Cleanup Levels	**Recreational user** • Exposure from soils due to direct contact, inhalation, and external radiation • No soil excavation, but possible animal intrusion • Groundwater is not used for drinking water **Occasional Native American use scenario** • Exposure from soils and biota due to direct contact, inhalation, external radiation and ingestion • No soil excavation, but possible intrusion of plants and animals then consumed or used • No groundwater use assumed **Residential scenario** • Exposure from soils due to direct contact, inhalation, and external radiation • Potential for soil excavation to 4.6 m (15 ft) for construction activities • Groundwater is not used for drinking water **Biological receptor** • Exposure from soils due to direct contact, ingestion, inhalation, and external radiation • Exposure to 4.6 m (15 ft) • Exposure to contaminated biota	**Recreational user** • Exposure from soils due to direct contact, inhalation, and external radiation • No soil excavation, but possible animal intrusion • Groundwater is not used for drinking water **Occasional Native American use scenario** • Exposure from soils and biota due to direct contact, inhalation, external radiation and ingestion • No soil excavation, but possible intrusion of plants and animals then consumed or used • No groundwater use assumed **Biological receptor** • Exposure from soils due to direct contact, ingestion, inhalation, and external radiation • Biologically active zone to 4.8 m (16 ft) • Exposure to contaminated biota
Risk Protection Metrics/Goals	• 10^{-4} to 10^{-6} risk range under CERCLA; 15 mrem/yr from radionuclide equates to 3×10^{-4} • Ecological screening per EPA 8-step process using WAC-173-340-900, Table 749-3 and BDAC BCGs as screening levels • Source containment or removal to protect human health, the environment, and the groundwater	• 10^{-4} to 10^{-6} risk range under CERCLA • Ecological screening per EPA 8-step process using WAC-173-340-900, Table 749-3 and BDAC BCGs as screening levels • Source containment or removal to protect human health, the environment, and the groundwater

Table 4.6. (contd)

	Current Baseline End State	End State Vision
Cleanup Actions		
Surface	• Remedial action taken as needed to protect human health and ecological resources for this land-use scenario • Includes surface barriers, removal, or use of existing soil cover with institutional controls and monitored natural attenuation	• Remedial action taken as needed to protect human health and ecological resources for this land-use scenario • Includes surface barriers, removal, or use of existing soil cover with institutional controls and monitored natural attenuation
Subsurface	• Remedial actions taken to prevent groundwater degradation and protect river • Includes surface barriers with institutional controls or removal, treatment as needed, and disposal	• Remedial action taken as needed to protect groundwater degradation and protect the river; also protects human health and ecological resources • Includes surface barriers with institutional controls or removal, treatment as needed, and disposal
Groundwater	• Remedial actions taken to prevent groundwater degradation and protect river • Includes surface barriers with institutional controls or removal, treatment as needed, and disposal	• Remedial actions taken to prevent groundwater degradation and protect river • Includes surface barriers with institutional controls or removal, treatment as needed, and disposal
Institutional Controls	• Restrictions in place to preserve land uses and prevent use of groundwater. • Continued groundwater monitoring as required by CERCLA 5-year reviews. • Prevention of excavation into waste sites with surface barriers. • Surveillance and maintenance of disposal sites and surface barriers.	• Restrictions in place to preserve land uses and prevent use of groundwater. • Continued groundwater monitoring as required by CERCLA 5-year reviews. • Prevention of excavation into waste sites with surface barriers. • Surveillance and maintenance of disposal sites and surface barriers.

Table 4.7. 200 Areas Waste Sites Overview and Comparison of Current and End State Assumptions for Land Use, Exposure Scenarios, Risk Protection Goals, and Potential Institutional Controls – Inside Core Zone

	Current Baseline End State	End State Vision
Land Use and Key Assumptions	Industrial Land Use	Exclusive Industrial Land Use
Exposure Scenarios for Determining Cleanup Levels	**Industrial worker** • Exposure from soils due to direct contact, inhalation, and external radiation • Potential for soil excavation to 4.6 m (15 ft) for construction activities • Groundwater is not used for drinking water **Inadvertent intruder** • Exposure to soils due to direct contact, inhalation, and external radiation • Soils are taken from a borehole, spread on the surface in a 200 m^2 (239 y^2)garden, and used by a residential intruder; no groundwater consumption is assumed **Biological receptor** • Exposure from soils due to direct contact, ingestion, inhalation, and external radiation • Exposure to 4.6 m (15 ft) • Exposure to contaminated biota	**Nuclear industrial worker** • Exposure ≤5 rem/year whole body from soils due to direct contact, inhalation, and external radiation • Potential for soil excavation to 4.6 m (15 ft) • No groundwater use assumed **Non-nuclear industrial worker** • Exposure ≤100 mrem/year from soils due to direct contact, inhalation, and external radiation • Potential for soil excavation to 4.6 m (15 ft) • No groundwater use assumed **Inadvertent intruder** • Exposure to soils due to direct contact, inhalation, and external radiation • Soils are taken from a borehole, spread on the surface in a 200 m^2 (239 y^2)garden, and used by a residential intruder; no groundwater consumption is assumed **Biological receptor** • Exposure from soils due to direct contact, ingestion, inhalation, and external radiation • Biologically active zone to 4.8 m (16 ft) • Exposure to contaminated biota
Risk Protection Metrics/Goals	• 10^{-4} to 10^{-6} risk range under CERCLA; 15 mrem/yr from radionuclide equates to 3 x 10^{-4} • Ecological screening per EPA 8-step process using WAC-173-340-900, Table 749-3 and BDAC BCGs as screening levels • Source containment or removal to protect human health, the environment, and the groundwater	• 10^{-4} to 10^{-6} risk range under CERCLA • Ecological screening per EPA 8-step process using WAC-173-340-900, Table 749-3 and BDAC BCGs as screening levels • Source containment or removal to protect human health, the environment, and the groundwater
Cleanup Actions		
Surface	• Remedial action taken as needed to protect human health and ecological resources for this land-use scenario • Includes surface barriers, removal, or use of existing soil cover with institutional controls and monitored natural attenuation	• Remedial action taken as needed to protect human health and ecological resources for this land-use scenario • Includes surface barriers, removal, or use of existing soil cover with institutional controls and monitored natural attenuation

Table 4.7. (contd)

	Current Baseline End State	End State Vision
Subsurface	• Remedial actions taken to prevent groundwater degradation and protect river • Includes surface barriers with institutional controls or removal, treatment as needed, and disposal	• Remedial action taken as needed to prevent groundwater degradation and protect the river; also protects human health and ecological resources • Includes surface barriers with institutional controls or removal, treatment as needed, and disposal
Groundwater	• Remedial actions taken to prevent groundwater degradation and protect river • Includes surface barriers with institutional controls or removal, treatment as needed, and disposal	• Remedial actions taken to prevent groundwater degradation and protect river • Includes surface barriers with institutional controls or removal, treatment as needed, and disposal
Institutional Controls	• Restrictions in place to preserve land uses and prevent use of groundwater. • Continued groundwater monitoring as required by CERCLA 5-year reviews. • Prevention of excavation into waste sites with surface barriers. • Surveillance and maintenance of disposal sites and surface barriers.	• Restrictions in place to preserve land uses and prevent use of groundwater. • Continued groundwater monitoring as required by CERCLA 5-year reviews. • Prevention of excavation into waste sites with surface barriers. • Surveillance and maintenance of disposal sites and surface barriers.

Release and transport of contaminants from closed tank farms can result from two primary mechanisms: (1) the infiltration of water (natural recharge) into disposal systems leading to the slow release of residual contaminants from their final waste form, and (2) inadvertent intrusion into disposal sites if institutional controls were lost. The potential exposure routes for these mechanisms are shown in Figure 4.3d. For the infiltration mechanism, exposure could occur to a human receptor at the nearest point of groundwater use. For the direct human intrusion mechanism, there would be direct exposure to contaminants and potentially secondary exposure depending on the assumptions for an intruder scenario.

The principal difference in the remediation and control actions between the current baseline end state and the end state vision results from the assumption that the Core Zone remains industrial exclusive use and, therefore, there is no expected groundwater consumption adjacent to tank farm boundaries. The offsite public receptor is located outside of the Core Zone. Thus, there is one additional institutional control in the end state vision, #4 (see Chapter 5) – no onsite groundwater use. This assumption is consistent with all other cleanup actions within the Core Zone of the Central Plateau. The expected impact of this control is that the expected tank waste retrieval amount could be less than the current assumption of 99%.

There are no pathways shown for ecological receptors as the depth of disposal, including final barriers, is expected to be less than 4.6 meters (15 feet). Potential ecological pathways and additional exposure scenarios will be evaluated in 200 Area risk assessments.

4.4 400 Area

The Fast Flux Test Facility (FFTF) is a 400-megawatt (thermal) liquid-metal (sodium) cooled fast neutron flux nuclear test reactor. The facility is located in the 400 Area of the Hanford Site. In addition to the FFTF, the 400 Area also includes the Fuels and Materials Examination Facility and ~80 other facilities, ~10 remaining waste sites, underground structures, and contaminated pipelines.

4.4.1 400 Area Current Baseline End State

Risk to the public, workers, and environment will be reduced by removing contamination from the waste sites and disposing of the material in Environmental Restoration Disposal Facility. A disposition path for the sodium used to cool the FFTF during operation needs to be resolved. DOE-RL's current baseline assumes sodium hydroxide will be utilized by the Waste Treatment Plant. Facilities in the 400 Area will be deactivated, decontaminated, decommissioned, and demolished. The FFTF reactor will be placed into interim safe storage.

4.4.2 400 Area End State Vision

The end state vision for the 400 Area is the same as the current end state.

4.5 Overview of Hanford's Plans for Conducting Risk Assessments

Numerous risk assessments are currently underway and are planned for the Hanford Site. Collectively, these risk assessments will provide a quantitative assessment of end state alternatives. As these risk assessments are conducted, they will influence cleanup decisions and refine the end state vision for the Site.

A compilation of Hanford Site risk assessments is contained in DOE/RL-2005-37, Rev. 0 ("Status of Hanford Site Risk Assessment Integration, FY 2005"). More than fifty individual risk assessments were identified covering all areas of the Site and ranging in scale from individual waste site assessments to comprehensive ecological and human health assessments for the entire Site. Table 4.8 summarizes the major risk assessments that are underway or planned for the separate areas of the Site, and for the Site as a whole. This table describes the scope and the anticipated schedule, although theses schedules are subject to change.

Table 4.8. Summary of Hanford Site Risk Assessments (from DOE/RL-2005-37, Rev. 0)

Area Risk Assessment Title	Scope	Status/Schedule
Site-Wide		
Composite Analysis	Evaluates the potential long-term human health impact from combined radionuclide releases to groundwater, surface water and air from all sources following closure of the Hanford Site. Supports low-level waste disposal authorizations by ensuring that separate disposal and closure actions do not collectively exceed DOE standards. Examines several end state alternatives.	The CA is required to be updated every 5 years or more often when warranted by changes in plans. Next update: Summer 2006.
100 Area		
River Corridor Baseline Risk Assessment • 100 B/C Pilot • 100 Area Component • Columbia River Component	Evaluates impact to human health and the environment to support final decision making and completion of the CERCLA process for the 100 Area waste site operable units.	Elements of these risk assessments are underway. Completion is expected in FY ~2007 with the River Component expected somewhat later.
River Corridor Groundwater Risk Assessments	Evaluates impact to human health and the environment to support final decision making and completion of the CERCLA process for the 100 Area groundwater operable units.	Elements of these risk assessments are underway. Completion is expected in FY ~2009 – 2010.
200 Area		
Central Plateau Waste Site Risk Assessments	Assess the human health and ecological risk where a remedy will result in residual contamination at a site to support CERCLA decision making for Plateau waste sites. These assessments evaluate alternative remedies for waste sites.	Risk assessments have been completed for several Operable Units and are underway for most other Operable Units. Completion is expected in FY 2008.
Central Plateau Groundwater Risk Assessments	Assess the human health and ecological risk of existing groundwater contamination and evaluate the effectiveness and merits of alternative remedies to support CERCLA decision making.	Risk assessments for 200 West Area plumes are scheduled for 2006 – 2007. Risk assessments for 200 East Area plumes are scheduled for 2007 – 2008.
Canyon Facility Risk Assessments	Assess the human health and ecological risk where a remedy will result in residual contamination at a facility to support CERCLA decision making for the five Canyon Facilities on the Central Plateau.	Risk assessment for the U Plant Canyon was completed in FY 2005. Risk assessments for other canyons are TBD.
Integrated Disposal Facility Performance Assessment	Per DOE Order 435.1 develops and maintains a performance assessment of the IDF that includes disposal of ILAW, failed melters, LLW, and MLLW.	Initial draft performance assessment completed in FY 2005. Updates to be provided as necessary to support Disposal Authorization.
Single-Shell Tank Performance Assessment (and tank closure risk assessments)	Assesses the long-term environmental and human health effects of the planned closure of tank farm Waste Management Areas (WMAs) to support RCRA Closure Plans. Includes assessment of all potential final sources in each WMA: past leaks, ancillary equipment, tank residuals, retrieval leak loss, and adjacent waste sites.	Initial draft performance assessment to be completed and available for external review in early FY 2006. Updates to be provided as necessary to support WMA closure actions.
Tank Closure Environmental Impact Statement	Assesses the environmental and human health effects of a broad range of closure end states for tank farms including a "no action" alternative, landfill closure alternatives, and clean closure alternatives.	This EIS is currently underway. Expected completion is during FY 2006 – 2007.
300 Area		
River Corridor Baseline Risk Assessment – 300 Area Component	Evaluates impact to human health and the environment to support final decision making and completion of the CERCLA process for the 300 Area NPL waste sites.	Elements of this risk assessment are underway. Completion is expected in FY ~2007.
300 Area Groundwater Risk Assessment (300-FF-5)	Evaluates impact to human health and the environment to support final decision making and completion of the CERCLA process for the 300 Area NPL groundwater operable unit.	This risk assessment is planned to start in FY 2006 with completion expected during FY 2007.
400 Area		
FFTF Environmental Impact Statement	This EIS evaluates a broad range of final disposition end points for the FFTF complex.	This risk assessment is currently underway and is planned for completion during FY 2007.

Table 4.8. (contd)

5.0 Discussion of Alternatives

The purpose of this section is to describe how existing Hanford-specific cleanup decisions and strategies may vary from the DOE Policy (455.1, *Use of Risk-Based End States*). This analysis evaluates existing cleanup decisions and planned actions reflected in the *Integrated Hanford Baseline Description* (DOE 2004b), in relation to land-use determinations for Hanford.

Identification of an alternative does not in itself mean that DOE will seek to renegotiate a cleanup decision document. DOE will examine the alternative, consider the views of Tribal Nations, stakeholders, and regulatory agencies, and weigh the pros-and-cons of proposed changes to cleanup agreements. If DOE decides to pursue an alternative that involves activities regulated under RCRA or CERCLA, such changes would be pursued through the appropriate procedures defined in the Tri-Party Agreement (Ecology et al. 1989) which contains further provisions for public involvement. If the Tri-Party Agreement is not applicable or binding, DOE may pursue changes under its independent CERCLA authority.

The building blocks for developing a vision for the Hanford Site have been accumulating since the cleanup mission was initiated. Risk in planning goes back to the development of the Tri-Party Agreement by DOE, EPA, and Ecology. The CLUP (DOE 1999a) and the Presidential order creating the Hanford Reach National Monument (65 FR 37253), which together identifies land uses following site cleanup, provide a catalyst to re-evaluate the current cleanup baseline and Tri-Party Agreement milestones to assure that the baseline will be in agreement with the land-use plans.

The following sections present eight alternatives between the current baseline plans and the cleanup that would result if driven by the Hanford Site End State Vision. Three workshops were held to obtain public input on end uses for the 100, 200, and 300 Areas with the idea that the input provided by participants would shape the alternatives. A workshop on the 100 Areas was held on June 23 and 24, 2004. A workshop on the 200 Areas was held on August 11 and 12, 2004, and a workshop on the 300 Area was held May 19, 2005. The 300 Area workshop was scheduled so that DOE could complete the first phase of its re-evaluation of the 300 Area groundwater remedy and the city of Richland could complete a study of the redevelopment potential for the 300 Area. Information from both studies assisted stakeholders in understanding the issues and allowed a constructive dialogue. DOE-RL and DOE-ORP have revised the alternatives on 100, 200 and 300 Area actions in response to the workshops.

5.1 Background

As discussed in the previous chapters, the end state vision initially assumed that future land uses for Hanford will be the land uses decided upon in the CLUP. The end state workshops provided additional detail on potential uses of the land to be considered in developing the alternatives. These land uses are consistent with the creation of the Hanford Reach National Monument. The end state vision is also aligned with the following EPA guidance about the role of land-use decisions in the CERCLA remedy selection process:

- *Land Use in the CERCLA Remedy Selection Process* (the Superfund Land Use Directive, OSWER 9355.7-04, EPA 1995a)

- *Reuse Assessments: A Tool To Implement The Superfund Land Use Directive* (OSWER 9355.7-06P, EPA 1995b)

A variety of EPA guidance documents provide additional discussions on how land-use decisions are used in the CERCLA process. Published regulatory guidance and DOE Policy 455.1 recognizes that the regulatory agencies do not establish future land use at CERCLA sites; the agencies are to use appropriate determinations by established land-use authorities. Authority to make future use plans at DOE facilities was assigned to the Secretary of Energy by Congress in the *National Defense Authorization Act for Fiscal Year 1997* (Public Law 104-201), requiring the Secretary of Energy to develop a future use plan for Hanford.

The EPA land-use guidance states that, to the extent possible, EPA is to use readily available information to assess future land use. At sites where land-use decisions have already been determined and documented, a simple review to confirm the information may be all that is necessary. The Hanford CLUP (DOE 1999a) serves as the basis of Hanford's land-use planning. This Congressionally mandated land-use plan was formally developed using the process established by NEPA. See Chapters 2 and 3 for a detailed discussion about the Hanford lands and the CLUP land-use decisions.

The reasonably anticipated land use is important for determining the types and frequency of exposures that could occur to exposed persons and ecological receptors from any residual contamination and the resulting risks. The degree of cleanup necessary, including any controls or barriers to prevent exposure, is determined in the CERCLA remedy selection process. Cleanup must be adequately protective of humans and ecological resources and also meet (unless waived) applicable or relevant and appropriate requirements imposed under environmental laws. Potential cleanup alternatives that meet the foregoing threshold criteria are further evaluated for long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness, compared to the cost and implementability of the potential remedy. Remedy selection also considers state and community acceptance of potential alternatives.

The Hanford Site End State Vision is not a decision document or a CERCLA remedy selection document, and it does not provide an evaluation of all CERCLA remedy selection criteria. It focuses on anticipated future land use as a primary factor in developing cleanup alternatives that are adequately protective based on risk as a perspective to look at cost-effective means that can be implemented to achieve site closure. The vision also helps in obtaining EPA, state, and community feedback from stakeholders, including Tribal Nations to understand issues that affect the degree of acceptance of a final closure that implements the Hanford Site End State Vision.

5.2 Descriptions of Alternatives

Table 5.1 summarizes the identified alternatives and the impacts, and recommendations for each one. The table also summarizes the stakeholder input obtained on each alternative at the public workshops and the revised vision based on DOE's interpretation of input from the workshops. A number of potential alternatives were considered and Table 5.1 only contains those that DOE believes should be pursued at this time.

In some cases, the current and planned actions identified in the table are clear because they are required by existing cleanup decisions. In other cases, the current and planned actions are more conceptual or reflect what is perhaps ingrained thinking based on the outcome of interactions over the years with the regulatory agencies and stakeholders. Thus, it should be recognized that as discussions continue and planning becomes more certain, the current and planned actions could become more aligned with a risk-based approach and with the end state vision.

Similarly, in some alternatives, costs and other impacts are possible to categorize and estimate. In others, cost estimates or other factors may only be known to an order of magnitude or qualitatively and, therefore, the impact from the alternative is also fairly conceptual and qualitative.

The recommendations serve to identify tasks that DOE believes should be implemented in pursuit of the end state vision reflected in the alternative. These are tasks that DOE believes will help better quantify impacts and address barriers, and will also help focus ongoing planning and regulatory and community consultation on risk-based decision making tied to anticipated future land uses.

Any alternatives that are pursued by DOE will be done through the existing decision-making processes that involve regulatory agencies, stakeholders, and Tribal Nations, as appropriate.

Alternative 1. Clean up the 100 Area waste sites to achieve remedial action objectives that are based on CLUP (DOE 1999a) conservation and preservation land-use exposure scenarios.					
Current Baseline	**End State Vision – April 2004 Draft Document**	**Impacts (scope, cost, schedule, risk) – April 2004 Draft Document**	**Input from End State Workshops and Other Issues for Alternative Implementation**	**DOE Revised End State Vision Based on Input from End State Workshops**	**Recommendations for Implementing Alternative**
• Unrestricted surface use. • Exposure scenario based on rural residential use – Farming with 36.5 inches of annual irrigation and precipitation • Future groundwater used for drinking. • Achieves 15 mrem/yr (approximately $3x10^{-4}$ risk based on EPA guidance) and $1x10^{-6}$ risk from other contaminants; hazard index less than 1 for non-carcinogenic toxic constituents. • Assumed to be protective of ecological resources. • No decay of radionuclides. • Excavate waste sites to at least 4.6-m (15-ft) depth and to bottom of burial grounds and dispose at ERDF. • Return groundwater to beneficial drinking water use, based on 4 mrem/yr (MCL) for radionuclides, if practicable. • Transfer post remediation land to other federal agency to manage as part of the National Monument.	• Cleanup based on conservation and preservation land use exposure scenarios for recreational, non-resident park ranger and tribal activities, including fishing. • No groundwater use for drinking water or irrigation until reach MCLs (4mrem/yr). • Meet CERCLA risk range (10^{-4} to 10^{-6} risk) for radionuclides and other contaminants and protect ecological resources for CLUP land uses. • Radionuclide decay assumed. • Containment and/or monitoring of some waste sites instead of excavation. • No further degradation of groundwater. • Restore groundwater to beneficial drinking water use if practicable. • Transfer post remediation land to other federal agency to manage as part of the National Monument or Wildlife Refuge.	• 550 waste sites including 45 solid waste burial grounds in 100 Area. • 217 waste sites including 7 burial grounds excavated so far under interim action Records of Decision. • Over 4.2 million metric tons (4.7 million U.S. tons) excavated. • More than 247,750 truckloads of waste have been disposed at ERDF. • Transportation risk calculated to be $2 x 10^{-2}$ fatalities – for 100 and 300 Area campaigns so far: no fatalities; 1 significant transportation incident involving movement of material and equipment. Under current and planned actions: • 212 more waste sites and 38 burial grounds are expected to require excavation; approximately 120 facilities must be dispositioned. Under End State Vision: • Estimated 14 burial grounds could be closed by containment for about $77 million. 31 other burial grounds are estimated to cost $65M to remove.	100 Area End State Workshop Summary: • For the next 50 years, or so long as federal entity controlling the land activities will be consistent with National Monument designation and CLUP, but include resident ranger. Further out in time broader range of activities envisioned as possible or reasonable for risk and exposure analysis, but are not endorsed. These include residential and agricultural use, hotel, commercial, and industrial use, oil and gas leasing, etc. • Additional characterization data to support the end state Vision containment and/or monitoring remedies decisions could be extensive in order to sufficiently reduce uncertainty to obtain regulatory approvals. • The regulatory agencies will not consider changing the RODs to evaluate capping in place. • Washington State regulations require 10^{-5} cumulative risk and 10^{-6} individual risk for non-radionuclide contaminants.	• Cleanup based on conservation and preservation land use exposure scenarios for recreational, resident park ranger and tribal activities, including fishing for the next 50 years. Beyond 50 years unlimited use is anticipated. • Meet CERCLA excess cancer risk range (10^{-4} to 10^{-6}) for radionuclides and other carcinogens and protect ecological resources. Future land uses listed in the CLUP do not influence the ecological exposure scenarios. • Meet CERCLA hazard indices (HQ<1) for toxic contaminants and be protective of ecological resources. • Implementation of the Interim Action RODs will be adequate as final remedies for the source operable units. • Monitoring will be required whenever waste are left in place to verify robustness of remedial action. • No further degradation of groundwater above drinking water standards and restore groundwater to beneficial drinking	• The recommendation for burial grounds and waste sites is to continue implementing the current RODs for interim action. It is not deemed cost-effective to pursue the end state vision option for waste sites and burial grounds based on the facts presented here and the amount of resistance DOE will receive from regulatory agencies and community. • Expedite final risk assessments and final RODs. Develop pathway analysis and exposure factors for the 100 Area CLUP identified land-use scenarios. In addition, analyze multiple scenarios considering input from the 100 Area End State Workshop.

Alternative 1. Clean up the 100 Area waste sites to achieve remedial action objectives that are based on CLUP (DOE 1999a) conservation and preservation land-use exposure scenarios.					
Current Baseline	**End State Vision – April 2004 Draft Document**	**Impacts (scope, cost, schedule, risk) – April 2004 Draft Document**	**Input from End State Workshops and Other Issues for Alternative Implementation**	**DOE Revised End State Vision Based on Input from End State Workshops**	**Recommendations for Implementing Alternative**
		• Lower worker and transportation risks for containment vs. excavation. • Costs could increase for long term monitoring and maintenance and periodic review to determine continuing remedy protectiveness. • Characterization costs could be significantly higher than excavation cost for some sites. • Land where waste left in place may go to Office of Legacy Management if unacceptable to other federal agency.	• How to balance the remediation risks to workers and risks from transportation with the potential long-term environmental impact needs to be better understood. • See Section 3.5.5 for additional Tribal input	water use when practicable. Follow process outlined in state and federal regulations to establish protective limits ARARS cannot be met. • Transfer post remediation unrestricted use land to other federal agency to be managed as part of the National Monument or Wildlife Refuge.	

Alternative 2. Cleanup the 300 Area Waste Sites to achieve remedial action objectives that are based on CLUP (DOE 1999a) industrial land-use exposure scenarios.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
• Cleanup based on industrial land use. (The 300-FF-2 scenario assumes the worker spends 1,500 hours a year indoors and 500 hours a year outdoors, corresponding to a 250 day/yr, 8-hour workday.) • Achieves 15 mrem/yr (approximately $3x10^{-4}$ risk based on EPA guidance) and $1x10^{-5}$ risk from other contaminants; hazard index less than 1 for non-carcinogenic toxic constituents. • Assumed to be protective of ecological resources. • No decay of radionuclides. • Excavate waste sites to at least 4.6 m (15 ft) depth based on future industrial excavations - and dispose at ERDF. • Return groundwater to beneficial drinking water use, based on 4 mrem/yr (MCL) for radionuclides, if practicable.	• Cleanup based on industrial land-use exposure scenarios with controlled excavation. • No groundwater use for drinking water or irrigation (the 300 Area is connected to the city of Richland water supply). • Meet CERCLA risk range (10^{-4} to 10^{-6} risk) for radionuclides and other contamination and protect ecological resources for CLUP land uses. • Radionuclide decay assumed. • Containment and/or monitoring of some waste sites/ burial grounds instead of excavation. • No further degradation of groundwater. • Restore groundwater to beneficial drinking water use if practicable	• 195 waste sites including 13 solid waste burial grounds associated with 300 Area. • So far, 69 waste sites and 5 burial grounds excavated under a final and an interim action ROD. • Over 709,000 U.S. tons excavated. • At ERDF, more than 38,160 truckloads of waste have been disposed. • Transportation risk calculated to be 6.6 x 10^{-3} fatalities – for 100 and 300 Area campaigns so far: no fatalities; 1 significant transportation incident involving movement of material and equipment. Under current and planned actions: • 119 more waste sites and 8 burial grounds are expected to require excavation. Cost estimates of $450M for burial grounds and waste sites. 618-7, 10, and 11 estimated to cost $325M. • Cost estimate does not include onsite disposal costs. • Requires removal of 150 buildings over 40 of the waste sites. A total of approximately 220 facilities must be properly dispositioned. Under the End State Vision:	• 300 Area End State Workshop Summary • A broad range of activities are envisioned for the area currently known as the industrialized 300 Area and the surrounding region. The proximity to the Columbia River and the city of Richland makes this area attractive to many people for a broad range of uses. • Current land use plans identify this region for industrial reuse, but a study recently completed by the city of Richland suggests that industry is not interested in reoccupying this land. • Future land used identified during the workshop included a number of industrial uses, as well as recreational uses and a range of other ideas. • See Section 3.5.5 for additional Tribal input	• Cleanup based on industrial land-use exposure scenarios with controlled excavation. • Remediated sites will be backfilled to support unlimited surface use (irrigation and groundwater use may be restricted, based on success of future groundwater cleanup activities) where practicable. To date, this has been accomplished whenever possible by backfilling the excavated waste sites first with excavated material that is below the standard for industrial use (267pCi/g uranium if there was any) and finishing with clean fill from a borrow site. DOE will continue this practice in the future where practicable. • The outcome of the River Corridor risk assessment, the final remedy for groundwater, the 5-year review of land use decisions and the data gathered during the early stages of cleanup will be considered along with public input before final 300 Area site remedies are identified.	• Continue remediation of waste sites to industrial standards as required under the current interim action Record of Decision. • The risk assessment for the River Corridor will be completed to support final remedial decisions. The outcome of the River Corridor risk assessment, the final remedy for groundwater, the 5-year review of land use decisions and the data gathered during the early stages of cleanup will be considered along with public input before final 300 Area site remedies are identified.

Alternative 2. Cleanup the 300 Area Waste Sites to achieve remedial action objectives that are based on CLUP (DOE 1999a) industrial land-use exposure scenarios.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
		• Lower worker and transportation risks for containment vs. excavation. • Costs could increase for long-term monitoring and maintenance and periodic review to determine continuing remedy protectiveness. • Characterization costs could be significantly higher than excavation cost for some sites. • The buildings over waste sites are still anticipated to be demolished in the end state vision, but complete removal may not be needed.		Re-evaluate the natural attenuation decision for the uranium plume at the 300 Area and develop a proposed plan/focused feasibility study to determine if other more effective groundwater remedial alternatives are available to meet cleanup goals. Work to meet the goals of no further degradation of groundwater above drinking water standards and restore groundwater to beneficial drinking water use when practicable. Follow process outlined in state and federal regulations to establish protective clean up goals if groundwater cannot be restored in a reasonable time frame	

Alternative 3. Cleanup the Central Plateau waste sites to achieve remedial action objectives that are based on CLUP (DOE 1999a) industrial exclusive and conservation/preservation land-use exposure scenarios.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
• Industrial land use and conservation/preservation land use for the Central Plateau inside/outside Core Zone, respectively. • Possible animal intruder and human intruder after 150 years. • No groundwater use for drinking water or industrial use - incidental contact only. • Protect ecological resources for this land use. • 15 mrem/yr from radionuclides ($3x10^{-4}$ risk based on EPA guidance). • $1x10^{-4}$ to $1x10^{-6}$ risk from other contaminants. • Meet DOE performance assessment criteria - 100 mrem/yr in unrestricted areas (near boundary of waste disposal site). • Radionuclide decay assumed. • Remove treat and dispose for some wastes sites, others receive cover only to achieve regulatory compliance or a combination of remove treat and dispose along with a cover. • TRU waste in retrievable storage will be retrieved, treated and shipped to WIPP.	• Core Zone Industrial Exclusive land use for radiation workers, industrial workers, and authorized visitors. • Outside Core Zone, same as 100 Area conservation/ preservation land-use exposure scenarios - excluding fishing and adding mining for borrow soil. • No groundwater use for drinking water or irrigation. • Meet CERCLA risk range of 10^{-4} to 10^{-6} risk for radionuclides and other contaminants. Protect ecological resources for CLUP land uses. • Radionuclide decay assumed. • Small isolated waste sites may be removed and consolidated to optimize placement of surface barriers. • Containment and/or monitoring of some waste sites instead of excavation. • TRU waste in retrievable storage will be retrieved, treated and shipped to WIPP. • Groundwater degradation is adequately controlled to protect the river and to return to beneficial drinking water use if practicable.	• Central Plateau is ~194 km^2 (75 mi^2). • 64.7 km^2 (25 mi^2) Core Zone contains the 200 Area - reserved for waste management and disposal. • Approximately 1,000 waste sites including 132 burial grounds/landfills/dumps within the Central Plateau; 69 waste sites including 29 landfills/ dumps are outside the Core Zone. • 15,000 m^3 (19,619 ft^3) of suspect transuranic waste stored in retrievable trenches. About 8,600 m^3 (11,248 yd^3) of TRU/M and MLLW stored at CWC. • One waste site remediated within the Core Zone and no interim action or final RODs for the Central Plateau waste sites. <u>Under current and planned actions</u>: • Assumes 32% of the waste sites will have surface barriers (Modified RCRA C or Hanford Barrier) • 40% of the waste sites removed and disposed. • 28% under natural attenuation or no action. • Cost estimate of these actions is over $1.5 billion.	<u>Central Plateau End State Workshop Summary</u> <u>Significant common themes for burial sites:</u> • First and foremost is protecting the groundwater. Address the high risks first. • There should be an aggressive plan to develop technology for remediation for the contamination that could get to the groundwater (particularly the Tc-99). • We should allow for "nature doing its job" over reducing the footprint in <u>certain</u> cases (Gable Mountain as an example where there is an active and healthy ecosystem there. Also there is low risk if there is a failure in institutional controls). This includes maintaining the appropriate institutional controls during a predetermined time period. Emphasis on "certain". Need good data and characterization. Need to consider human and ecological risk, and look holistically.	• Central Plateau cleanup activities and use of Core Zone to support cleanup of other areas will be ongoing for next 50 years. • A Central Plateau Core Zone will be a permanent waste management area and will remain under federal control for Industrial Exclusive land use (radiation workers, industrial workers, and authorized visitors) for the next 150 years or as long thereafter as federal government retains control of Central Plateau. • Outside Core Zone consider establishing buffer area between Core Zone and remainder of Central Plateau to adequately protect human health and the environment from Core Zone industrial uses. Buffer area could also have industrial uses compatible with Core Zone uses. • After cleanup is complete the buffer area will shrink and land use will be similar to the 100 Area. • Outside the buffer area cleanup will be consistent with the 100 Area conservation/preservation land-use exposure scenarios - excluding fishing, but adding mining for	• Finalize integration strategy, such as the 200 Area zone approaches currently being developed, to expedite development of overall Central Plateau regulatory and ROD strategy. • Only pursue interim actions based on current, not future, ecological or human health risks and river water quality protection. • Implement February 2004 "Hanford Site Groundwater Strategy" for the groundwater protection, monitoring and remediation aspects of this alternative. • Expedite development of the risk assessment methodology and sampling and analysis plans for the development of the final RODs. • Explore future industrial uses for Core Zone and potential Buffer Area around Core Zone compatible with DOE industrial exclusive as means to assure effectiveness and duration of institutional controls through human presence.

Alternative 3. Cleanup the Central Plateau waste sites to achieve remedial action objectives that are based on CLUP (DOE 1999a) industrial exclusive and conservation/preservation land-use exposure scenarios.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
• Prevent groundwater degradation, protect the river and return to beneficial drinking water use if practicable. • Central Plateau Core Zone remain under DOE control for waste management activities for the foreseeable future.	• Use integration strategy to optimize and prioritize cleanup activities within discreet 200 Area zones (e.g., Canyon Zones). • Groundwater points of compliance set at points where groundwater treatment and restoration is determined to be practicable and to monitor progress towards protection and restoration goals of CERCLA, RCRA, and AEA. • Institutional controls to prevent intrusion or modification to caps. • Central Plateau Core Zone remain under DOE control for waste management activities for the foreseeable future.	<u>Under the End State Vision</u>: • Use evaporative transport barriers for 32% of waste sites with expected cost savings of 25% or more. • Fewer waste sites will require remove, treat, and dispose, and more sites will apply natural attenuation or no action. • Lower worker and transportation risks for containment vs. excavation. • Costs for long-term monitoring and maintenance and periodic review to determine continuing remedy protectiveness could increase. • Characterization costs could be significantly higher than excavation cost for some sites. • Risk to future Hanford Site workers and visitors not expected to change. • Source removal actions taken only if action will significantly improve groundwater quality or the practicability of treatment. • Contaminants are not expected to significantly impact river water quality or pose an unacceptable risk in the 100 or 300 Areas.	<u>Land use and timeline considerations for exposure scenarios:</u> • Active Remediation until about 2050 for waste management and facility cleanup, tank waste vitrification, ERDF, US Ecology, Facilities/ Tanks decommissioning. • Should consider shrinking a Core Zone especially into smaller sub-zones that would release areas such as between the 200-East and 200-West Areas. • Need to better define area outside Core Zone – what is needed to supplement Core Zone as buffer or for institutional controls enhancement? • Active management of engineering controls and institutional controls expected for 100 years thereafter – probably can control land uses. • Institution(s)/handoffs must be determined. • Tribes recognize need for Federal jurisdiction in Core Zone. • ICs will fail at undefined time beyond that, so any use possible (Same as 100 Area).	borrow soil for caps. • No groundwater use for drinking water or irrigation in Core Zone and buffer area for at least 150 years of active controls. • Meet CERCLA risk range of 10^{-4} to 10^{-6} risk for radionuclides and other contaminants. • Meet CERCLA hazard indices (HQ<1) for radionuclides and other toxic contaminants and be protective of ecological resources. • Radioactive decay will occur and should be accounted for in the risk estimation process. • Remove and consolidate small waste sites to optimize placement and minimize the number of surface barriers. • Monitoring will be required whenever waste are left in place to verify robustness of remedial action. • Strive to meet the goals of no further degradation of groundwater above drinking water standards and restore groundwater to beneficial drinking water use when practicable. Follow process outlined in state and federal	• Implement this alternative and Alternatives 5 and 6 consistent with an integration strategy, such as the 200 Area zone approach for Central Plateau.

Alternative 3. Cleanup the Central Plateau waste sites to achieve remedial action objectives that are based on CLUP (DOE 1999a) industrial exclusive and conservation/preservation land-use exposure scenarios.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
			• Remedies should be sufficiently robust as to prevent intrusion by "realistic" future intruders (i.e., if ICs fail). • The area outside of the Core Zone should be used to establish a buffer zone around Core Zone. It is expected that this buffer zone will shrink and be eliminated over time. Conflicting input for exposure scenarios: • Need for robust remedies versus reversible remedies. • ICs that prevent access versus encourage access. General considerations for exposure scenarios: • Population will continue to increase – will increase value and demand for land for productive uses. • Configuration after facility and tank clean up, e.g., cap size/location affects Core Zone size. • Continue to characterize source and risk. • Groundwater should be cleaned for future resource. • Mineral exploration possible – drilling. • Buried waste a future resource? • US Ecology closes – 2064	regulations to establish protective clean up goals if groundwater cannot be restored in a reasonable time frame • Retrievably stored suspect TRU waste will be retrieved, treated, and the TRU portion shipped to the WIPP. The low level portion of the retrieved waste will be treated and disposed of on-site. Wastes containing transuranic materials buried pre-1970 will be managed per CERCLA decisions • Groundwater degradation is adequately controlled to protect the river and to return to beneficial drinking water use if practicable. • Use integration strategy to optimize and prioritize cleanup activities within discrete 200 Area zones (e.g., Canyon Zones). • Groundwater points of compliance set at points where groundwater treatment and restoration is determined to be practicable and to monitor progress towards protection and restoration goals of CERCLA, RCRA, and AEA. • Institutional controls to prevent intrusion or modification to caps.	

Alternative 3. Cleanup the Central Plateau waste sites to achieve remedial action objectives that are based on CLUP (DOE 1999a) industrial exclusive and conservation/preservation land-use exposure scenarios.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
			• 5-year reviews needed – do not preclude further cleanup. • New technologies will come in 50 years, 100 years, etc., horizons. Other issues: • Additional characterization data to support the end state vision containment and/or monitoring remedies decisions could be extensive in order to sufficiently reduce uncertainty to obtain regulatory approvals. • The regulatory agencies will not consider changing the RODs to evaluate capping in place. • Washington State regulations require 10^{-5} cumulative risk and 10^{-6} individual risk for other contaminants. • How to balance the remediation risks to workers and risks from transportation with the potential long-term environmental impact needs to be better understood. • See Section 3.5.5 for additional Tribal input		

Alternative 4. Stabilize high radioactivity material in the 200 Area onsite and allow radioactive decay prior to final disposition.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
• Land use, exposure scenarios and risk goals same as Alternative 3. • Ship ~2000 metal capsules of cesium-137 and strontium-90 to a geologic repository by 2020. • Continued capsule storage under water until disposition. • Central Plateau Core Zone remains under DOE control for waste management activities for the foreseeable future. • Store estimated 50 cubic meters of K Basin radioactive sludge in special containers in 200 Area until shipped to WIPP for disposal. • Decontaminate the K-Basin as necessary to coincide with cocooning of reactors in 2012. • Transfer post remediation 100 Area land to U.S. Fish and Wildlife Service to manage as part of the National Monument.	• Land use, exposure scenarios and risk goals same as Alternative 3. • Place cesium and strontium capsules in dry storage in the 200 Area. • After 50 years of decay, a final disposition pathway will be made. • Strontium capsules are anticipated to meet onsite disposal criteria prior to the end of the EM cleanup mission. • Cesium capsule activity is expected to exceed onsite disposal WAC - disposition decision will be made prior to the end of the EM mission. • Central Plateau Core Zone remain under DOE control for waste management activities for the foreseeable future. • After removal of spent fuel from K-Basin, less than 0.5 m^3 (0.65 yd^3) of fuel pieces will be removed from the sludge, stabilized and stored similar to the fuel. • Stabilize remaining ~50 m^3 (65 yd^3) of sludge using in-container solidification processes similar to those used in commercial nuclear power plant waste management operations. • Directly dispose sludge	• Approximately 2,000 cesium-137 and strontium-90 capsules stored in a Central Plateau pool. • Capsules have high radiation levels making near term disposition uncertain. • K-Basin sludge is highly radioactive because it contains less than 0.5 m^3 (0.65 yd^3) of fuel pieces in the sludge. • 2,300 tons of K-Basin highly contaminated fuel packaged and stored in 200 Area. Under current and planned actions: • Current pool storage of capsules runs about $5M per year. • Sludge disposal at WIPP is estimated to require 1,000 containers. • Decontaminating K-Basin and removal of equipment will not occur for 5 or more years. • Decontaminating K-Basin poses significant worker exposure potential. Under End State Vision: • Capsule storage in 200 Area is consistent with the CLUP exclusive industrial land use. • Placing capsules in interim dry storage costs about $50M. • Dry storage maintenance	• Central Plateau End State Workshop Summary • The land use and timeline considerations listed above for Alternative 3 are relevant to the vision for the cesium and strontium capsule storage and disposition. They are also relevant to the management of removed K-Basin sludge in an Industrial Exclusive 200 Area Core Zone. • The 100 Area End State Workshop input for the Vision for Reactor Cores in Alternative 7 is relevant to K-Reactor after removal of sludge and decontamination of K-Basins. • There are regulatory issues and Ecology has serious concerns with on-site disposal of strontium capsules. Other issues: • How to balance the remediation risk to workers and risk from transportation with the potential long-term environmental impact needs to be better understood. • Capsule disposal at Yucca Mountain repository requires a license application or license amendment. • Cesium/strontium inventory is regulated under RCRA and is stored in a RCRA facility. Mutual	• Land use, exposure scenarios and risk goals same as Alternative 3. • Continue storage of cesium and strontium capsules in wet storage in the WESF in the 200 Area in the near term (up to 5 years). • Place cesium and strontium capsules in dry storage in the 200 Area until the cesium capsules can be sent to a geological repository and strontium capsules can be disposed of in the Central Plateau in accordance with waste acceptance criteria and CERCLA decision documents • Final disposition pathway for capsules may be made beyond 50 years, depending on future Industrial Exclusive land use and institutional controls for the Core Zone that would be effective for at least 150 years, per Alternative 3. • There are regulatory issues and Ecology has serious concerns with this on-site disposal alternative • Central Plateau Core Zone remains under DOE control for waste management activities for the foreseeable future.	• Factor this alternative into the current Tri-Party discussions related to these decisions. • Discussions must include consideration of final disposal for capsules in the 200 Area Core Zone. • Discussions should consider CLUP identified land-use scenarios for the 100 Areas and 200 Areas affected, as appropriate, and consider short-term risks to workers and risks involved in transportation and disposal activities in addition to long term costs. • Evaluate the waste regulatory requirements that apply to capsules. • Develop permit application for dry storage of capsules.

Alternative 4. Stabilize high radioactivity material in the 200 Area onsite and allow radioactive decay prior to final disposition.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
	after stabilization at WIPP or onsite if waste acceptance criteria met. • Grout remaining equipment and material in place and then cut up and moved to a disposal facility in the 200 Areas. • Transfer post remediation 100 Area land to U.S. Fish and Wildlife Service to manage as part of the National Monument.	costs estimated at less than $1M per year. • Long-term safe dry storage of the capsules will facilitate future disposition. • K Basin sludge would not have to be stored in T Plant in special containers for over 10years. • Grouting sludge will result in much of the sludge and K Basin equipment being acceptable for either WIPP or onsite disposal. • Grouting significantly reduces worker risk posed by removing, handling and storing the debris and untreated sludge. It also lowers transportation risks. • Stabilized product provides safer handling. • Avoids extensive deactivation of K Basin. • K Basin removal could occur earlier than the cocooning of K Reactors. • Consistent with industrial exclusive land use for the 200 Area. • Risk to future Hanford Site workers and visitors and potential groundwater impacts are not expected to change.	agreement on the conditions of a long-term storage permit is not achieved. • See Section 3.5.5 for additional Tribal input	• After removal of spent fuel from K Basin, less than 0.5 m^3 (0.65 yd^3) of fuel pieces will be removed from the sludge, stabilized and stored similar to the fuel. • Stabilize K-Basin sludge and dispose at WIPP or in a 200 Area Core Zone (if less than 100 nCi/g) in accordance with waste acceptance criteria and CERCLA decision documents • Grout remaining equipment and material in place and then cut up and move to a disposal facility in the 200 Area.	

Alternative 5. In-place disposal via CERCLA of contaminated materials within the Central Plateau Core Zone.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
• Inside Core Zone is industrial land use and outside the Core Zone is conservation/preservation land use. • Partial demolition of canyon buildings to canyon deck. Existing contaminated equipment size reduced, placed in canyon cells and grouted or removed to other disposal location. • PFP removed to slab and equipment, debris, and plutonium holdup packaged and disposed at WIPP or onsite if meets WAC. Potential subsurface contamination remediated under same approach as adjacent waste sites. • PUREX tunnels filled with grout. • Soil surface barrier placed over demolished canyons to limit infiltration and to prevent human and animal intrusion. • Large portions of underground piping removed for disposal on site or at WIPP. • No groundwater use for drinking water or industrial use - incidental contact only. • 15 mrem/yr from radionuclides ($3x10^{-4}$ risk based on EPA guidance). • $1x10^{-4}$ to $1x10^{-6}$ risk from	• Core Zone industrial exclusive land use for radiation workers, industrial workers, and authorized visitors. • Outside Core Zone, meet same objectives as 100 Area for conservation/ preservation land-use exposure scenarios - excluding fishing, and with mining for borrow soil. • Contaminated equipment from the Canyon/PFP and additional waste and adjacent facility demolition debris as well as small isolated waste sites disposed within or near the Canyon/PFP facilities to the extent practicable. Grout to fill void spaces. • Demolish PFP to concrete structures surrounding RMC/RMA glovebox lines and PRF to lower canyon structure. Leave in place PFP equipment and structure. • Remove ~0.1 metric tons (0.11 tons) of plutonium hold-up material from PFP. • Grout contaminated equipment in PUREX tunnel and leave in place. • Strategically place surface	• About 900 excess facilities inside and outside Core Zone, including 5 canyons and PFP must be properly dispositioned. • Approximately 17 metric tons (18 tons) of bulk plutonium-bearing material from PFP packaged into ~2,200 Specification 3013 containers and ~2,400 pipe overpack containers. Under current and planned actions: • Long-term institutional controls may be needed for capped areas and for wastes disposed onsite. Under End State Vision: • Less demolition of key facility structures and more contaminated material disposed onsite. • Leave in place PFP equipment and structure lowering costs and shortening schedule. Savings could approach $500M. • If the canyon footprint is not covered by a surface barrier, 2.3 million m^3 (3 million yd^3) of borrow source material or ~200,000 truck trips eliminated and avoiding associated ecological and worker risks. • Up to 35,000 m^3	Central Plateau End State Workshop Summary Common themes: • Maintain a Core Zone in the 200 Area where site-wide contamination is consolidated. • Minimize the size of the Core Zone. • Deal with the highest-risk facilities first, and make decisions regarding whether to leave or demolish facilities based on risk. • Leave "robust" facilities (e.g., the canyons) in place if the contamination is contained to a similar degree as it would be in an engineered waste disposal facility. • It makes little sense to demolish facilities and move them to ERDF if they can be made safe where they are. • Demolish less robust facilities that cannot be placed in a configuration that would be protective of the environment. Since PFP is a high-risk facility and its construction makes demolition relatively easy, then get rid of the building and the equipment inside it now. Recent success and lessons learned with 233-S demolition could be utilized.	• Land use in and outside a Core Zone, activity timelines, exposure scenarios and risk goals same as Alternative 3. • Use canyon facilities that are robust as engineered waste disposal facilities. • Dispose small waste sites within or near the canyon/PFP facilities to optimize barriers and or cap sizes. Grout to fill void spaces. • Grout in place contaminated equipment in PUREX tunnels. • Disposition buried pipelines in place in the Central Plateau using the RCRA and CERCLA processes, by remove-treat-dispose, or stabilize in place. • Demolish PFP to slab-on-grade. Remove equipment, debris and plutonium hold-up material from PFP and dispose at WIPP or onsite in accordance with waste acceptance criteria and CERCLA decision documents. • Remove ~0.1 metric tons (0.11 tons) of plutonium hold-up material from PFP. • For canyon facilities that will be demolished rather	• Finalize integration strategy, such as the 200 Area zone approaches currently being developed, to expedite development of overall Central Plateau regulatory and ROD strategy. • Implement this alternative and Alternatives 3 and 6 consistent with integration strategy for Central Plateau. • Determine whether any existing canyon facilities could serve as robust, engineered waste disposal facilities. • Develop waste acceptance criteria for waste to be left inside or placed in canyons for disposal. • Develop criteria for characterizing pipelines and for determining which pipelines may be safely left in place. • U Plant regional closure project could serve as a prototype to address this approach. Some alignment may be needed to fully incorporate recent risk based opportunities. • Use lessons learned from the decision process and field work to improve remediation approaches on the remaining canyon facilities. • Develop sampling

Alternative 5. In-place disposal via CERCLA of contaminated materials within the Central Plateau Core Zone.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
other contaminants. • Prevent groundwater degradation, protect the river, and return to beneficial drinking water use if practicable. • Protect ecological resources for this land use. • Radionuclide decay assumed. • Central Plateau Core Zone remain under DOE control for waste management activities for the foreseeable future	barriers to provide groundwater protection and prevent human and animal intrusion for a maximum number of facilities/waste sites and most efficient use of raw materials. • Engineer barrier to minimize or eliminate the need for a surface cap. • Stabilization and in place disposal of 643 km (400 mi) of buried pipelines with some sections (hot-spots) removed and disposed onsite as necessary. • No groundwater use for drinking water or -industrial use - incidental contact only. • Meet CERCLA risk range of 10^{-4} to 10^{-6} risk for radionuclides and other contaminants. Protect ecological resources for CLUP land uses. • Radionuclide decay assumed. • Use integration strategy to optimize and prioritize cleanup activities within discreet 200 Area zones (e.g., canyon zones). • Prevent groundwater degradation, protect the river and return to beneficial drinking water use if practicable. • Institutional controls to prevent intrusion or	(45,778 yd^3) of grout or fill material will be needed to fill the additional void space above the canyon deck for each canyon. • In place disposal of some portions of buried pipelines has significant potential cost and schedule savings. • Significant risk avoidance to the workforce during remediation. • Risk to future Hanford Site workers and visitors and potential groundwater impacts are not expected to change. • Institutional controls, long-term monitoring, maintenance and periodic review to determine continuing remedy protectiveness not expected to change.	• Additional waste can be disposed in the canyon facilities because the general feeling is that they will be as protective as, or even more protective than, ERDF. • Both PUREX tunnels and disposition of buried pipelines was not discussed at the workshops and will require additional public involvement during regulatory decision process. • People had serious doubts about the effectiveness and duration of institutional controls. • Develop Waste Acceptance Criteria (WAC) for any waste left inside or waste imported into the canyon buildings. • Evaluate current worker risks (radiation/chemical exposure, industrial accidents, and maintenance activities) for specific remedial alternatives and compare those risks with the risks that remaining wastes could pose to future generations and the environment. • There is a need for a comprehensive remedial action work plan for the Central Plateau that integrates all	than left as engineered waste disposal facilities, strategically place surface barriers to where and as appropriate based on engineering analysis and ARARs to provide groundwater protection and prevent human and animal intrusion for a maximum number of facilities/waste sites and most efficient use of raw materials. • Radioactive decay will occur and should be accounted for in the risk estimation process. • Monitoring will be required whenever waste are left in place to verify robustness of remedial action. • Strive to meet the goals of no further degradation of groundwater above drinking water standards and restore groundwater to beneficial drinking water use when practicable. Follow process outlined in state and federal regulations to establish protective clean up goals if groundwater cannot be restored in a reasonable time frame.	approach for underground piping targeted to depth, location and type of contaminants carried to identify sections that must be removed.

Alternative 5. In-place disposal via CERCLA of contaminated materials within the Central Plateau Core Zone.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
	modification to caps. • Central Plateau Core Zone remains under DOE control for waste management activities for the foreseeable future.		components in a logical, cost-effective, and protective manner and includes life-cycle costs as well as the pros and cons of remedial alternatives. • There is a need to conduct comprehensive interviews of retired workers to take advantage of their vast process knowledge. • There is a need for cap monitoring systems to ensure cap performance and mitigation action plans for potential future problems. Other Issues: • Regulatory agencies have expressed a preference to remove, treat, and dispose of underground piping. • Regulatory agencies, Tribal Nations and stakeholder acceptance of onsite disposal of some types of wastes may be low. • Characterization requirements have not been mutually agreed to. • See Section 3.5.5 for additional Tribal input		

Alternative 6. Retrieve tank waste and close tank farms based on risk consistent with CLUP (DOE 1999a) industrial exclusive land use and integration of RCRA and CERCLA.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
• Tanks are considered RCRA TSD units. • TPA requires that waste be retrieved to the extent "technically possible" before considering "risk based" retrieval per TPA criteria. • Currently assumed that 99% removal is possible. • High-level waste portion will be stabilized in glass logs and disposed in geologic repository. • Low-level mixed waste portion stabilized in form approved by State and disposed in 200 Area. • Remaining residues will be stabilized to meet RCRA land disposal restriction delisting criteria and AEA low-level waste disposal criteria. • Fill tank void space to isolate stabilized waste residuals and prevent tank subsidence. • Remove/demolish ancillary facilities to grade and fill void spaces. • Surface barrier placed over tank farms for long term mitigation of contaminant movement in groundwater and human intrusion. • Barrier construction	• Same as current end state, except: • Meet criteria for exclusive Industrial land-use exposure scenarios for industrial and radiation workers and authorized visitors as described in Alternative 3. • Tank waste retrieved to extent required for closure under RCRA landfill closure and integration with CERCLA requirements. • Central Plateau Core Zone remain under DOE control for waste management activities for the foreseeable future.	• 149 single-shell and 28 double-shell tanks distributed among 18 tanks farms. • 2.04e+008 L (54 million gal) of liquid, sludge and salt cake waste. • Most tanks beyond design life. • 67 tanks have leaked 3.7 million L (1 million gal) of waste with some reaching groundwater. • Additional leaks highly likely. • Chemical vapors released from tanks potentially exposing workers. • Potential for significant radioactive airborne releases. End State Vision compared to current and planned actions: • The end state vision will be based on the conclusion of the Hanford Tank Closure EIS. Various approaches are evaluated, both more and less rigorous than the current baseline. • Less waste treated and disposed. For example, if 90% of waste retrieved rather than 99%, cost savings would be ~$3 billion	Central Plateau End State Workshop Summary • DOE-ORP has agreed with the stakeholder request to use the Tank Closure EIS as a basis for public dialog on the end state for the tanks.	• Tank waste should be retrieved and the tank farms closed based on regulatory requirements (RCRA and CERCLA) and considering risk. • The tank closure EIS is being prepared to evaluate the tradeoffs among a series of alternative actions leading to a range of end states. The EIS will evaluate various waste retrieval levels, treatment techniques and closure approaches. • The range of waste retrieval options include: – None (no action alternative) – 90 percent (potential cost benefit level) – 99 percent (current TPA baseline) – 99 percent (conservative clean closure) • The range of waste treatment options include: – None (no action alternative). – Pretreated and vitrified as high level waste and low activity waste in the Waste Treatment Plant. – Same as above except some waste treated as TRU and some treated by supplemental ther-	• Complete the Tank Closure EIS expeditiously with a Record of Decision that allows the closure permitting process to begin. • Finalize integration strategy, such as the 200 Area zone approaches currently being developed, to expedite development of overall Central Plateau regulatory and ROD strategy. • Implement this alternative and Alternatives 3 and 5 consistent with integration strategy for Central Plateau. • Determine impact of tank waste residuals in concert with expediting the final remediation approach for the Central Plateau. • DOE studies should include tank farm closure pathway analysis and exposure factors for CLUP identified land-use scenarios: industrial exclusive for the 200 Area Core Zone and conservation/preservation outside of the Core Zone.

Alternative 6. Retrieve tank waste and close tank farms based on risk consistent with CLUP (DOE 1999a) industrial exclusive land use and integration of RCRA and CERCLA.

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
coordinated with adjacent 200 Area waste site barrier construction. • Implement effective institutional controls and monitoring for indefinite period into future. • Central Plateau Core Zone remain under DOE control for waste management activities for the foreseeable future		• Less waste retrieved and treated: cost savings ~$1.5-$2B • 10% reduction in number of HLW canisters: cost savings ~$0.5 billion for RPP and $0.4 billion repository fee • 10% reduction in ILAW: cost reduction ~ 0.4 billion • Waste treatment completed ~2 years sooner. • Worker dose is expected to be reduced ~10% (1,100 person-rem). • Risk to future Hanford Site workers and visitors is not expected to change. • Risk avoidance to the workforce and would lower transportation risks. • Sources of groundwater contamination will be removed to the extent practicable, but areas and levels of contamination could become higher before attenuation occurs. • Protection of river water quality will not change.		mal or non-thermal techniques (current baseline). – All waste treated as high-level waste. • The range of closure options include: – No closure. – Landfill closure with some tank residuals (current TPA baseline). – Varying levels of contaminated soil removal. – Clean closure including removal of tanks and soil.	

Alternative 7. Leave reactor pipelines in the Columbia River and reactor cores in place based on CLUP (DOE 1999a) conservation and preservation land use exposure scenarios

Current Baseline	End State Vision – April 2004 Draft Document	Impacts (scope, cost, schedule, risk) – April 2004 Draft Document	Input from End State Workshops and Other Issues for Alternative Implementation	DOE Revised End State Vision Based on Input from End State Workshops	Recommendations for Implementing Alternative
• Allow decay of activation products in covered reactor cores for 75 years. • Demolish reactors down to shield walls and install 75-year roof ("cocooning"). • Remove reactor remains after 75 years for disposal in 200 Area Core Zone. • Institutional controls until removal of reactor cores. • Draft Explanation of Significant Differences proposes leaving reactor cooling water discharge pipelines in place in river, with removal and disposal in ERDF undertaken if any pipeline segments break away and wash up on the shoreline.	• Meet criteria for conservation and preservation land use exposure scenarios for 100 Area as described in Alternative 1. • Reactor cores decay in place. • Reactor pipelines left in place.	Nine reactor facilities along Columbia River will be decommissioned and cocooned. • Approximately 2,700 m (8,858 ft) of large reactor piping in the river bed. Under current and planned actions: • Pipeline characterization indicates that contamination within CERCLA risk range for rural resident scenario while the pipelines remain in the river. Hypothetical scenario involving pipelines segments washing up on the shoreline shows potential for unacceptable risk under river recreationist scenario. • Reactors would potentially be completely demolished and transported for disposal in 200 Area, in accordance with current EIS. Under the End State Vision: • Leaving pipelines in place poses lower worker and ecological risks than from removal and waste transportation. • Leaving reactor cores in place poses lower worker risks than from removal and waste transportation. • Costs for long-term	100 Area End State Workshop Summary for Reactors • B Reactor has important historical value and if funded a museum strongly supported. Keep in safe configuration for same period as cocooned reactors, and will need access restrictions. The other reactor cores can be left in place for up to 75 years, once cocooned, to allow for radioactive decay, but do 5 year reviews of condition. Don't presume final disposition or technology, but make and execute decision in future before EM leaves Site. Funding for a future decision to move cores must be assured. Participants were split on ultimate end state. May prove safe to leave, but other factors, such as interference with other 100 Area land uses, may drive removal. Tribal members want cores, including B reactor, ultimately moved. Include new technology review in 5-year reviews. Single piece move should be avoided if possible.	• Meet criteria for conservation and preservation land use exposure scenarios for 100 Area as described in Alternative 1. • Cocoon eight of nine reactors and leave in place to decay for up to 75 years. DOE will make a final decision on whether to cut up and move reactor cores to Central Plateau after sufficient decay has occurred. The decision will be made prior to cleanup completion. This delay will require a commitment of future funds toward the final decision. • Keep the B Reactor in its current configuration until funding is secured to support a museum. Should the support not materialize, B Reactor will follow the path described for the other reactors. Cocooning of B Reactor would be finished with the remainder of the 100 Area cleanup completions and no later than the end of the River Corridor Contract period. • Leave the reactor pipelines in the Columbia River if risk levels are protective and ARARs are complied	• DOE-RL recommends that eight of nine reactors be cocooned and left in place to decay. DOE should make a final decision on whether to cut up and move reactor cores to Central Plateau after sufficient decay prior to cleanup completion and commit future funds toward the final decision. • DOE-RL should continue to keep B Reactor in its current configuration until funding is secured to support a museum. Should the support not materialize by October 2006 we recommend that B Reactor follow the same path as described above in number 1. Cocooning of B Reactor would be finished with the remainder of the 100 Area cleanup completions. • DOE-RL recommends the decision for the reactor pipelines in the river should be made in a final CERCLA ROD.

Alternative 7. Leave reactor pipelines in the Columbia River and reactor cores in place based on CLUP (DOE 1999a) conservation and preservation land use exposure scenarios					
Current Baseline	**End State Vision – April 2004 Draft Document**	**Impacts (scope, cost, schedule, risk) – April 2004 Draft Document**	**Input from End State Workshops and Other Issues for Alternative Implementation**	**DOE Revised End State Vision Based on Input from End State Workshops**	**Recommendations for Implementing Alternative**
		monitoring and maintenance and periodic review to determine continuing remedy protectiveness would continue after 75 years.	• 100 Area End State Workshop Summary for Pipelines: pipelines are trash in the River and must be removed unless outweighed by worker risk and ecological damage during removal. If left in place, stabilize to minimize physical hazard in long term. • See Section 3.5.5 for additional Tribal input	with and removal results in additional impact. Stabilize the pipelines if required. This evaluation will be part of the final ROD (2008) via the CERCLA process.	

New Alternative. IROD requires monitored natural attenuation for meeting groundwater restoration goals; evaluate alternatives to pump-and-treat remediation technology to reduce flux of strontium-90 to the Columbia River					
Current Baseline	**End State Vision – April 2004 Draft Document**	**Impacts (scope, cost, schedule, risk) – April 2004 Draft Document**	**Input from End State Workshops and Other Issues for Alternative Implementation**	**DOE Revised End State Vision Based on Input from End State Workshops**	**Recommendations for Implementing Alternative**
• IRODS require monitored natural attenuation for meeting groundwater restoration goals; use pump-and-treat remediation technology to reduce flux of strontium-90 (Sr-90) to the river. • Evaluate alternative technologies to reduce flux of Sr-90 to the river; evaluate ecological risk and remove hydrocarbon free product in wells when present. • Natural attenuation by radioactive decay of 30-year half-life, Sr-90 will achieve drinking water maximum concentration levels (MCLs) in groundwater in about 250 years.	• No alternative was proposed for Sr-90 in April 2004 Draft.	• No alternative was proposed for Sr-90 in April 2004 Draft. Thus, the impacts are for the new revised end state Vision alternative. • The pump-and-treat system was installed in 1994 and consists of 4 extraction wells (3 in operation) and 2 injection wells (1 in operation), and a treatment skid operating at a rate of 227 L (60 gal) per minute. • Monitoring for Sr-90 in the groundwater since installation shows no appreciable changes in plume geometry. Under current and planned actions: • The cost of operation of the current system is about $800K per year. • The cost of evaluating other technologies is approximately $800K in FY2004, $1M in 2005, and $1.5 M in 2006. • A treatability test plan will be completed in June 2005, with implementation of the selected technology in 2006.	100 Area End State Workshop Summary • Split in opinions between those who agree that if risk is low and treatment is ineffective as described, then spend dollars on other cleanup needs and those who want pristine cleanup of groundwater. Will need engineering evaluation to consider further. • Oregon, some environmental groups, and tribal representatives have concerns over DOE's characterization of the pump-and-treat system as a failure. In their opinion, the pump-and-treat has been generally successful at keeping strontium from entering the river. Other stakeholders agree that the pump-and-treat system has been ineffective and inefficient. • Therefore, public consensus may be difficult to obtain for terminating the pump-and-treat system.	• The strontium-90 ground water plume at 100-N will attenuate through radioactive decay and efforts will be made to reduce the flux of strontium-90 to the Columbia River • Continue implementing the 100-NR 01/02 interim action record of decision for soils and groundwater. Focus on implementing a groundwater remedial alternative that is more effective and efficient than pump-and-treat for reducing the flux of strontium-90 to the Columbia River. Utilize established CERCLA processes to modify the ROD for groundwater decisions. • Proceed with the planned tests for assessing alternative technologies designed to reduce flux of strontium-90 to the river (in-situ permeable reactive barrier technology and phytoremediation) • Put pump-and-treat system in cold standby during tests and continue groundwater monitoring of plume.	DOE-RL recommends the following: • Pursue monitored natural attenuation as the final record of decision for that portion of the plume identified in the ITRD remedial options evaluation report that is not expected to reach the Columbia River. • Proceed with the planned ecological risk assessment. • Proceed with the planned tests for assessing alternative technologies designed to reduce flux of Sr-90 to the river (in situ permeable reactive barrier technology and phytoremediation). • Put pump-and-treat system in cold standby during tests and continue groundwater monitoring of plume. • Evaluate the new technologies for effectiveness in reducing flux of Sr-90 to the river, including human and ecological risk reduction return for the cost of implementing alternative(s) as compared to pump-and-treat and monitored natural attenuation options. • Utilize established CERCLA processes to determine ROD.

New Alternative. IROD requires monitored natural attenuation for meeting groundwater restoration goals; evaluate alternatives to pump-and-treat remediation technology to reduce flux of strontium-90 to the Columbia River					
Current Baseline	**End State Vision – April 2004 Draft Document**	**Impacts (scope, cost, schedule, risk) – April 2004 Draft Document**	**Input from End State Workshops and Other Issues for Alternative Implementation**	**DOE Revised End State Vision Based on Input from End State Workshops**	**Recommendations for Implementing Alternative**
		Under the End State Vision: • Costs for operation and maintenance of treatment system would be eliminated. Some costs would be incurred in keeping system in cold standby for use if restart deemed necessary because attenuation objectives not met. • If alternative technologies still must be evaluated, the costs and schedule for the evaluation is not expected to change. • Cost for monitoring groundwater and river may increase to verify that monitored natural attenuation objectives are being met. • Schedule for restoration, primarily due to radioactive decay, would be unchanged because current system is ineffective in lowering Sr-90 flux to the Columbia River.	• The Sr-90 concentrations in the groundwater plume at 100-N are 1,000X drinking water standards. On the basis of concentration, the Sr-90 plume is viewed by many stakeholders as the worst plume in the 100 Area; hence, there is a reluctance to agree to passive remedial technologies at this site. • Environmental risk assessments have not been completed. The data quality objective process for these assessments has been initiated. Establishment of acceptable levels of environmental contamination will be difficult and controversial. • More information on the technical implementability of possible technologies for reducing flux to the river is needed to better understand practicability of treatment and to improve acceptability of monitored natural attenuation. • Tribal representatives and Oregon have expressed concerns on stopping the pump-and-treat system, so their level of acceptability of this approach is deemed to be low.	Maintain monitored natural attenuation in the final ROD for that portion of the plume that is not expected to reach the Columbia River. • Proceed with the planned ecological risk assessment. • Evaluate new technologies as they become available for effectiveness in reducing flux of strontium-90 to the river. • Preclude groundwater consumptive use at 100-N for 250 years by maintaining federal ownership. • Complete planned ecological risk assessment, human health risk assessment, and conduct field scale treatability studies for reducing contaminant flux to the river and reducing groundwater concentrations.	

6.0 References

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