# APPENDIX R
# CUMULATIVE IMPACTS: ASSESSMENT METHODOLOGY

> This appendix describes the cumulative impacts methodology for the U.S. Department of Energy *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*. The appendix is organized into sections on (1) regulations and guidance, (2) previous studies, (3) history of land use at the Hanford Site and in surrounding regions, (4) future land use at the Hanford Site, (5) future land use in surrounding regions, (6) approach to cumulative impacts analysis, (7) uncertainties, (8) selection of resource areas for analysis, (9) resource area methodologies, (10) spatial and temporal considerations, (11) past and present actions, and (12) selection of reasonably foreseeable future actions. The results of the cumulative impacts analysis are presented in Chapter 6. Supporting information for the short-term cumulative impacts analysis is presented in Appendix T; long-term, in Appendix U. The details of inventory development and end states for the cumulative groundwater modeling are described in Appendix S.

The Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (NEPA) (40 CFR 1500–1508) define cumulative impacts as impacts on the environment that result from the proposed actions when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions (40 CFR 1508.7). Thus, the cumulative impacts of an action on a resource (e.g., land, air, water, soil) ecosystem or human community comprise the effects of that action and all other activities affecting that resource no matter what entity (Federal, non-Federal, or private) is taking the action (EPA 1999:2).

Cumulative impacts are analyzed for activities occurring at the Hanford Site (Hanford). Under the Fast Flux Test Facility (FFTF) Decommissioning Entombment and Removal Alternatives, Idaho options were evaluated for management and disposition of the FFTF remote-handled special components and bulk sodium. These options involve shipping the remote-handled special components to the proposed Idaho National Laboratory (INL) Remote Treatment Facility for treatment and the bulk sodium to the existing INL Sodium Processing Facility for processing to produce a caustic sodium hydroxide solution, which would be returned to Hanford for reuse in the Waste Treatment Plant (WTP) pretreatment processes. Construction of these facilities was, or would be, largely unrelated to the processing of materials from Hanford. The additional materials processing would not contribute substantially to the cumulative impacts of activities at INL because (1) there would be no marked increase in daily effluent emissions from, or waste generation by, the facilities; (2) sodium hydroxide, produced at INL's Sodium Processing Facility, would be returned to Hanford for use in processing tank waste; (3) hazardous and radioactive wastes would not be disposed of at INL; and (4) impacts of the activities would be small. Accordingly, only the cumulative impacts of transporting materials and waste to and from INL are evaluated in this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)*. Cumulative impacts of activities at INL have been evaluated in the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995a:C-4.6.7-1) and *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems* (DOE 2005a:4-65).

## R.1 REGULATIONS AND GUIDANCE

Cumulative impacts analysis in U.S. Department of Energy (DOE) NEPA documents is governed by the CEQ regulations (40 CFR 1500–1508) and the DOE NEPA implementing procedures (10 CFR 1021). Additional guidance on how to conduct such analyses was obtained from *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997) and *Consideration of Cumulative Impacts in EPA Review of NEPA Documents* (EPA 1999).

As noted, cumulative impacts on the environment result from proposed actions when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over an extended period of time. They can also result from the spatial or temporal crowding of environmental perturbations. That is, increased environmental impact can be expected when a second perturbation occurs at a site before that site can fully rebound from the effects of the first.

While there is no universally accepted framework for cumulative impacts analysis, eight general principles (CEQ 1997:8) have gained acceptance and thus inform the methodology adopted for this *TC & WM EIS*. These principles are based on the premise that any resource, ecosystem, or human community can experience stress, and that for each there are thresholds, or levels of stress, beyond which conditions degrade. The following is a summary of the CEQ's eight principles of cumulative effects analysis:

1. Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions. This includes all actions that affect the same resources.

2. Cumulative effects are the total effect, including both direct and indirect effects, on a given resource, ecosystem, or human community of all actions taken, no matter who (Federal, non-Federal, or private entity) has taken the actions. Effects from individual activities may interact to cause additional effects not apparent when looking at individual effects one at a time.

3. Cumulative effects need to be analyzed in terms of the specific resource, ecosystem, or human community being affected, rather than from the perspective of the proposed actions. Analyzing cumulative effects involves developing an understanding of how the resources are susceptible to effects.

4. It is not practical to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those effects that are truly meaningful. The boundaries for evaluating cumulative effects should be expanded to the point at which the resource is no longer affected significantly.

5. Cumulative effects on a given resource, ecosystem, or human community are rarely aligned with political or administrative boundaries. Cumulative effects analysis of natural systems must use natural boundaries, and analysis of human communities must use actual sociocultural boundaries to ensure that all effects are included.

6. Cumulative effects may result from accumulation of similar effects or from the synergistic interaction of different effects. Accordingly, the cumulative effect can in some cases be greater than the sum of the individual effects.

7. Cumulative effects may last for many years beyond the life of the action(s) that caused the effects. Radioactive contamination is an example. Cumulative effects analysis must involve application of the best science and forecasting techniques.

8. Each affected resource, ecosystem, and human community must be analyzed in terms of its capacity to accommodate additional effects, based on its own time and space parameters. The most effective cumulative effects analysis focuses on what is needed to ensure long-term productivity or sustainability of the resource.

In *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements* (known as *The Green Book*) (DOE 2004a:1, 2, 19, 20), DOE expands on the CEQ instruction (40 CFR 1502.2(b)) by stating that impacts should be discussed in proportion to their significance and that this sliding-scale approach applies to all *Green Book* recommendations. *The Green Book* stipulates use of the sliding scale for impact identification and quantification and provides the following basic recommendations:

- Quantify impacts consistent with the sliding-scale approach and available information.
- Provide sufficient information so the validity of analytical methods and results can be reviewed.
- Acknowledge uncertainty and incompleteness in data and how they may affect significance in the analysis.
- Do not quantify impacts when they are virtually absent.
- Define and compare impacts in their appropriate context using both relative and absolute information.
- Define, where possible, the actual impact on health or the environment, not just contaminant concentrations or release rates.

Included in *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997:49–57) is discussion of various techniques for analyzing cumulative effects. Implicit in that discussion is the idea that there is no one appropriate method for such an analysis.

## R.2 PREVIOUS STUDIES

Cumulative impacts at Hanford were evaluated in the *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (*TWRS EIS*) (DOE and Ecology 1996) and the *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement (Hanford Comprehensive Land-Use Plan EIS)* (DOE 1999a). Presented in Table R–1 is a breakdown of the resource areas addressed in those evaluations. While the entries attest to evaluation of certain areas in both documents, they do not necessarily reflect evaluations at the same level of detail.

**Table R–1. Resource Areas Evaluated in Recent Major Hanford Cumulative Impacts Analyses**

| Resource Area | *TWRS EIS*[a] | *Hanford Comprehensive Land-Use Plan EIS*[b] |
|---|---|---|
| Land resources | X | X |
| Noise and vibration | – | X |
| Air quality | X | X |
| Geology and soils | – | X |
| Water resources | – | X |
| Ecological resources | X | X |
| Cultural resources | – | X |
| Socioeconomics | X | X |
| Public health and safety—normal operations | X | X |
| Occupational health and safety | – | X |
| Long-term groundwater quality | X | – |

[a] DOE and Ecology 1996:5-237–5-251.

[b] DOE 1999a:5-65–5-72.

**Key:** *Hanford Comprehensive Land-Use Plan EIS=Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement; TWRS EIS=Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement.*

## R.3 HISTORY OF LAND USE AT THE HANFORD SITE AND IN SURROUNDING REGIONS

This section provides information on past land use in the region to illustrate how the land and its resources have changed since European-American colonization. Such information helps determine the impacts of past actions.

The 151,775-hectare (375,040-acre) Hanford Site is in the Columbia Basin Ecoregion, an area historically including over 6 million hectares (14.8 million acres) of steppe and shrub-steppe vegetation extending across most of central and southeastern Washington and portions of north-central Oregon. In the early 1800s, the dominant plant in the Hanford area was big sagebrush underlain by perennial Sandberg's bluegrass and bluebunch wheatgrass. Many places on Hanford are fairly free of nonnative species and extensive enough to retain characteristic populations of shrub-steppe plants and animals absent or scarce in developed areas of the ecoregion. Hanford's location provides important connectivity with other undeveloped portions of the ecoregion (Neitzel 2005:4.73). Washington State considers pristine shrub-steppe habitat as a priority habitat because it is scarce in the state and important to several state-listed wildlife species (WDFW 2007). Sagebrush communities are also considered a Level III resource under the *Hanford Site Biological Resources Management Plan* (DOE 2001a). Impacts on such resources should be avoided or minimized; however, when avoidance and minimization are not possible, rectification or compensatory mitigation is recommended (DOE 2002a:4.7).

In prehistoric and early historic times, American Indians of various tribal affiliations heavily populated the area along the Columbia River in eastern Washington, including the area occupied by Hanford, and some of their descendants still live in the region (DOE 2000a:3-125). When Euro-American explorers arrived in the early 1800s, people presently referred to as "the Wanapum" (the River People) were observed inhabiting numerous villages and fishing camps scattered throughout this segment of the mid-Columbia River. Neighboring groups known today as the Yakama, Umatilla, Cayuse, Walla Walla, Palus, Nez Perce, and Middle Columbia Salish frequented the area to trade, gather resources, and conduct other activities. Many descendants of these tribes and bands are affiliated with the Wanapum, Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Umatilla Reservation, Nez Perce Tribe of Idaho, or the Confederated Tribes of the Colville Reservation (Neitzel 2005:4.102, 4.103). Present-day tribal members retain traditional secular and religious ties to the region, and many have knowledge of their cultural ceremonies and lifeways (DOE 2000a:3-125).

Under separate treaties signed in 1855, the land area of much of what is now eastern Washington, Oregon, and Idaho was ceded to the United States by a number of regional American Indian tribes. The land area includes land occupied by Hanford. Under these treaties, the tribes retained the right to fish in usual and accustomed places. Tribal fishing rights are recognized on rivers within the ceded lands, including the Columbia River, which flows through Hanford. In addition to fishing rights, the tribes retained under the treaties the privilege to hunt, gather roots and berries, and pasture horses and cattle on open and unclaimed lands. It is the position of DOE that Hanford, like other ceded lands that were settled or used for specific purposes, is not open and unclaimed land. While reserving all rights to assert their respective positions regarding treaty rights, the tribes are participants in DOE's land use planning process, and DOE considers tribal concerns in that process.

American Indian traditional cultural places within Hanford include, but are not limited to, a wide variety of places and landscapes: archaeological sites, cemeteries, trails and pathways, campsites and villages, fisheries, hunting grounds, plant-gathering areas, holy lands, landmarks, important places in American Indian history and culture, places of persistence and resistance, and landscapes of the heart (Neitzel 2005:4.104). Culturally important localities and geographic features include Rattlesnake Mountain, Gable Mountain, Gable Butte, Goose Egg Hill, Coyote Rapids, and the White Bluffs portion of the Columbia River. The Wanapum resided on land that is now part of Hanford until 1942, when the site was established, then moved to Priest Rapids (DOE 1987).

Lewis and Clark were among the first European Americans to visit the Hanford region during their 1804–1806 expedition. They were followed by fur trappers, military units, and miners. It was not until the 1860s that merchants set up stores, a freight depot, and the White Bluffs Ferry on the Hanford Reach, and gold miners began to work the gravel bars. Cattle ranches opened in the 1880s, and farmers soon followed. Land use began to change as settlers populated the area (Neitzel 2005:4.104). By the beginning of the twentieth century, much of the area was used for farming and grazing (DOE 1999a:4-1, 4-3). The Grand Coulee Dam was built on the Columbia River in the 1940s, and the Columbia Irrigation Project brought more water for farming. The population then increased in Franklin County, across the Columbia River from Hanford (DOE 2004a:21).

Several small, thriving towns, including Hanford, White Bluffs, and Ringold, grew up along the riverbanks in the early twentieth century. The accessibility of these communities to outside markets expanded with the arrival of the Chicago, Milwaukee, St. Paul, and Pacific Railroad branch line in 1913. These towns, and nearly all other structures, were razed after the U.S. Government acquired the land for the original Hanford Engineer Works in 1943 (part of the Manhattan Project). Although agriculture and livestock production were the primary activities within the region and in Hanford at the beginning of the twentieth century, these activities ceased at the site when it was acquired by the Government (Neitzel 2005:4.73, 4.104). Today, remnants of homesteads, farm fields, ranches, abandoned military installations, and other buildings can be found throughout Hanford. Nearly 5,200 hectares (13,000 acres) of abandoned agricultural lands remain on the site (DOE and Ecology 1996:4-37).

During the Manhattan Project and Cold War era, numerous nuclear reactors and associated reprocessing facilities were constructed at Hanford. The reactor sites cover over 900 hectares (2,300 acres) of land. All reactor buildings still stand, although many ancillary support structures have been removed (DOE and Ecology 1996:4-37; Neitzel 2005:4.107).

Hanford is owned and used primarily by DOE, but portions are owned, leased, or administered by other Government agencies. Only about 6 percent of the land area has been disturbed and is actively used, leaving mostly vacant land with widely scattered facilities (Neitzel 2005:4.144).

Currently, land use within the Hanford vicinity includes wildlife protection areas and areas used for urban and industrial development, recreation, military training, irrigated and dryland farming, and grazing. At the time of the 2002 Census of Agriculture, Benton, Franklin, and Grant Counties had a total of 949,772 hectares (2,346,912 acres) of land in farms. Of that farmland, 72 to 77 percent was used as cropland, 18 to 24 percent was pastureland, and 4 to 5 percent had other uses (USDA 2002). In 2006 land committed for the Conservation Reserve Program of the U.S. Department of Agriculture included 49,067 hectares (121,246 acres) in Benton County, 47,819 hectares (118,163 acres) in Franklin County, and 34,756 hectares (85,882 acres) in Grant County (USDA 2006:275).

Residential, commercial, and industrial land uses are predominant in the Tri-Cities area (Richland, Kennewick, and Pasco) southeast of Hanford and around other cities near the southern boundary of Hanford, including Benton City, Prosser, and West Richland (USDA 2003).

## R.4 FUTURE LAND USE AT THE HANFORD SITE

This section contains a description of the land use planning at Hanford. An understanding of expected future land use at Hanford sets the stage for reasonably foreseeable actions that may occur.

On May 15, 1989, DOE, the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) signed a comprehensive agreement for cleaning up Hanford. The Hanford Federal Facility Agreement and Consent Order (Ecology, EPA, and DOE 1989), or Tri-Party Agreement, is an agreement for achieving compliance with the remedial action provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the treatment, storage, and disposal unit regulations and corrective action provisions of the Resource Conservation and Recovery Act (RCRA). The Tri-Party Agreement (1) defines and ranks CERCLA and RCRA cleanup commitments, (2) establishes responsibilities, (3) provides a basis for budgeting, and (4) establishes aggressive goals for site remediation, with enforceable milestones to ensure compliance. Compliance with the Tri-Party Agreement necessitates that DOE consider future land use at Hanford.

Recognizing the need for a comprehensive land use plan, DOE issued the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a) in September 1999; this document provides the framework within which future use of lands and resources at Hanford would occur. The overall *Hanford Comprehensive Land-Use Plan* as adopted by the Record of Decision (ROD) (64 FR 61615) is to accomplish the following for Hanford:

- Protect the Columbia River and associated natural and cultural resources and water quality.
- Wherever possible, locate new development, including cleanup- and remediation-related projects, in previously disturbed areas.
- Protect and preserve the natural and cultural resources for the enjoyment, education, study, and use of future generations.
- Honor treaties with American Indian tribes as they relate to land uses and resource uses.
- Reduce exclusive-use zone areas to maximize the amount of land available for alternative uses while still protecting the public from inherently hazardous operations.

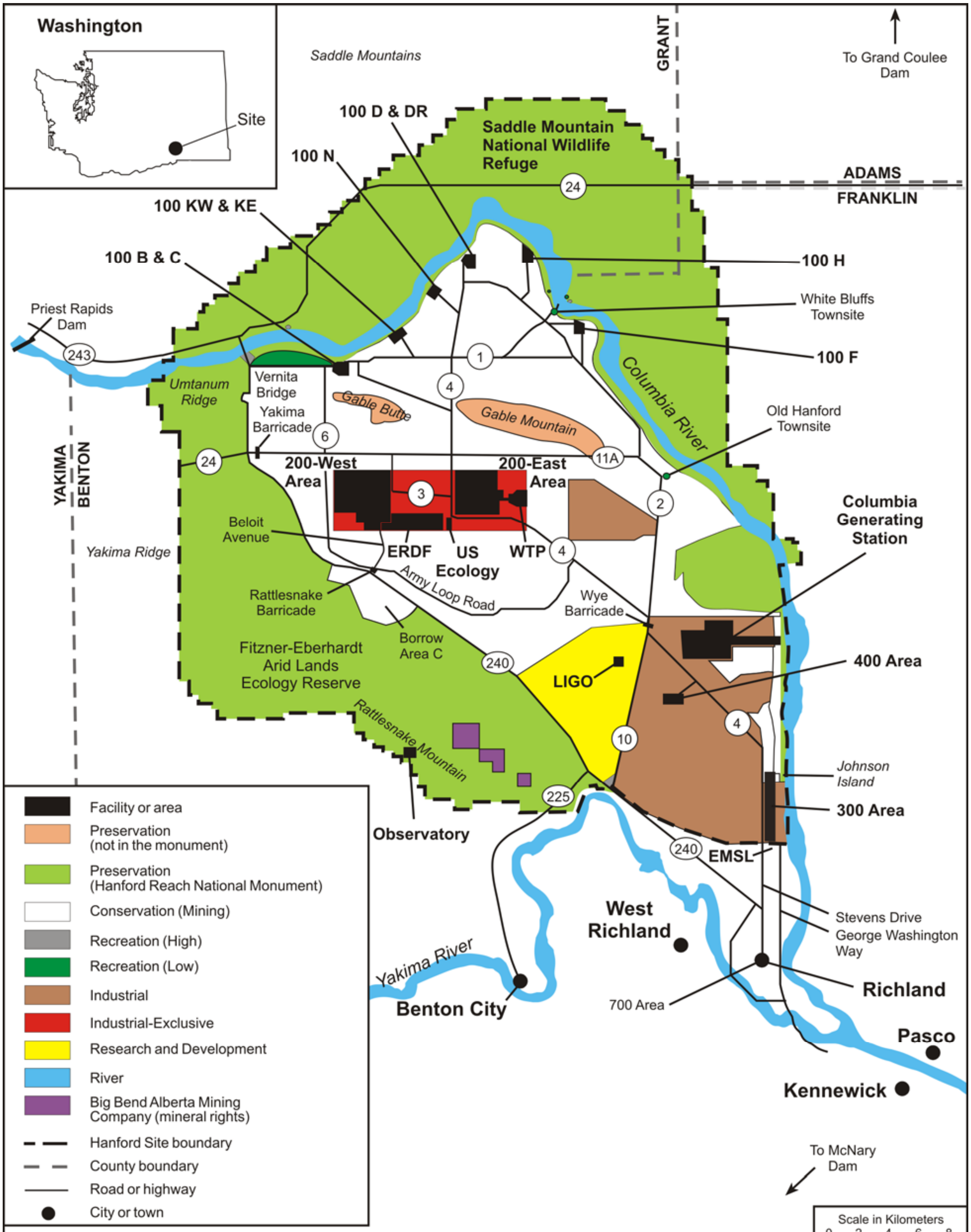
- Allow access for other uses (e.g., recreation) outside of active waste management areas, consistent with the land use designation.
- Ensure that a public involvement process is used for amending the *Hanford Comprehensive Land-Use Plan EIS* and land use designations to respond to changing conditions.
- As feasible and practical, remove pre-existing, nonconforming uses.
- Facilitate cleanup and waste management.

These *Hanford Comprehensive Land-Use Plan EIS* policies are intended to provide for the protection of environmental and cultural resources; the siting of new development, utility, and transportation corridors; and economic development (DOE 2008a:2-6).

Figure R–1 shows the generalized land use at Hanford as developed in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a) and modified by establishment of the Hanford Reach National Monument (65 FR 37253). DOE anticipates multiple uses of Hanford, including consolidation of waste management activities in the Central Plateau; industrial development in the eastern and southern portions, including the 400 Area; increased recreational access to the Columbia River; expansion of the Saddle Mountain National Wildlife Refuge to include all of the Wahluke Slope; and management of the Fitzner-Eberhardt Arid Lands Ecology Reserve by the U.S. Fish and Wildlife Service (USFWS) (64 FR 61615).

Important areas within the Preservation land use designation include the 78,900-hectare (195,000-acre) Hanford Reach National Monument, which incorporates a portion of the Columbia River corridor (65 FR 37253). The area known as the Hanford Reach includes the quarter-mile strip of public land on either side of the last free-flowing, nontidal segment of the Columbia River in the United States (DOE 2000a:3-91). The USFWS (with DOE as a cooperating agency) prepared the *Hanford Reach National Monument Comprehensive Conservation Plan and Environmental Impact Statement, Adams Benton, Grant and Franklin Counties, Washington* (USFWS 2008) for all lands within the monument. Alternative E, selected as the preferred alternative in that environmental impact statement (EIS), attempts to strike a balance between resource protection and the level of public use and access the USFWS believes the public will expect.

Since the issuance of the *Hanford Comprehensive Land-Use Plan EIS* and ROD, numerous actions have been taken and decision documents issued pertaining to Hanford that potentially could impact the land use plan. A supplement analysis to the *Hanford Comprehensive Land-Use Plan EIS* was recently prepared to help inform DOE's determination of whether that EIS remains adequate, or whether a new EIS or supplement to the existing EIS should be prepared (DOE 2008a:Summary-1, Summary-2). The supplement analysis concludes that the information on land use developed since issuance of the *Hanford Comprehensive Land-Use Plan EIS* continues to support the land use designations and stated policies of the land use plan (DOE 2008a:Summary-3). DOE has not identified significant changes in circumstances or substantial new information since 1999 that would affect the basis for its decisions as documented in the *Hanford Comprehensive Land-Use Plan EIS* ROD (64 FR 61615).




**Key:** EMSL=Environmental and Molecular Sciences Laboratory; ERDF=Environmental Restoration Disposal Facility; LIGO=Laser Interferometer Gravitational-Wave Observatory; WTP=Waste Treatment Plant.

**Source:** Modified from DOE 1999a:3-18; 2000a:3-89.

**Figure R–1. Generalized Land Use at the Hanford Site**

The *Hanford Site End State Vision* (DOE 2005b) describes a postcleanup condition for Hanford. That end state is based on the land use plan contained in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a). The following paragraphs describe the end-state vision for the 100, 200, and 300 Areas:

**100 Areas.** Contamination in the 100 Areas will be remediated according to 50-year conservation and preservation land use exposure scenarios for recreational, resident park ranger, and tribal activities, including fishing. Unlimited use is anticipated after 50 years. Remediation of waste sites consistent with the current CERCLA Interim Action RODs will continue. There will be no further degradation of the quality of groundwater that is currently above drinking water standards, and groundwater quality will be restored when practicable (DOE 2005c:iv).

Eight of nine reactors will be cocooned and left in place to decay for up to 75 years. B Reactor was recently designated a National Historic Landmark (DOE and DOI 2008). Therefore, B Reactor will not be decommissioned and moved to the Hanford Central Plateau for disposal as analyzed in the *Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington* (DOE 1989, 1992) and assumed in this *TC & WM EIS*. DOE will make a final decision on whether to cut up and move the eight reactor cores to the Central Plateau after sufficient decay has occurred. Reactor pipelines will be left in place in the Columbia River if risk levels are protective and removal would result in additional impacts. The pipelines will be stabilized if required (DOE 2005b:vi).

**200 Areas.** A Central Plateau Core Zone will be designated as a permanent waste management area to remain under Federal control for the next 150 years or longer. A buffer area will be maintained between the Core Zone and the remainder of the Central Plateau during cleanup operations. After Core Zone cleanup is complete, the buffer area will be reduced, and land use between the Core Zone and the Columbia River will be similar to that in the 100 Areas **(**DOE 2005b:v).

Waste sites in the Core Zone will be addressed through the CERCLA process consistent with Industrial-Exclusive, Conservation, or Preservation land use scenarios identified in the land use plan and within the timeframe identified in the *Hanford Comprehensive Land-Use Plan EIS* ROD (at least 50 years). Waste sites will be remediated and monitored to achieve human health and environmental protection goals under CERCLA. Small waste sites will be removed and consolidated to optimize placement and minimize the number of surface barriers. Disposition of buried pipelines in the Central Plateau will be achieved through the RCRA and CERCLA remove-treat-dispose of or stabilize-in-place processes. Canyon buildings that are robust will be used as engineered waste disposal facilities. Equipment, debris, and plutonium holdup material will be removed from the Plutonium Finishing Plant (PFP) and disposed of at the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, or on site in accordance with waste acceptance criteria and CERCLA decision documents. The PFP will be demolished to slab-on-grade (DOE 2005b:v, vi).

Retrievably stored suspect transuranic (TRU) waste will be retrieved and treated, and the TRU waste portion will be shipped to WIPP. The low-level radioactive waste (LLW) portion of the retrieved waste will be treated and disposed of on site. Radioactive waste buried before 1970 containing TRU materials will be managed per CERCLA decisions (DOE 2005b:v).

Groundwater contamination across the Central Plateau Core Zone will be managed in accordance with the *Hanford Site Groundwater Strategy: Protection, Monitoring, and Remediation* (DOE 2004b; 2005b:v).

**300 Area.** Waste sites in the 300 Area will be remediated to achieve remedial action objectives based on Industrial land use exposure scenarios. Remediation of waste sites to industrial standards will continue as required under the current CERCLA Interim Action RODs. Remediated sites will be backfilled to support unlimited surface use where practicable, and, depending on the success of future groundwater cleanup activities, irrigation and groundwater use may be restricted. DOE will work to meet the goals of no further degradation of the groundwater that is currently above drinking water standards and restoration of groundwater quality when practicable (DOE 2005b:iv).

The *Plan for Central Plateau Closure* (Fluor Hanford 2004) presents a strategic approach to closing the Central Plateau area of Hanford. That approach addresses nearly 4,000 items requiring closure action consistent with Hanford's environmental restoration mission. It divides the Central Plateau into 22 geographic zones organized around significant processing and waste management facilities, then organizes the major constituents of those zones into five logically grouped closure elements: canyons, underground tanks, waste sites, structures, and wells. The *Plan for Central Plateau Closure* provides the framework for integrating ongoing operations with the closure of facilities no longer used, all with a view to closing the Central Plateau by 2035. Primary objectives are to demolish structures; remove or stabilize contaminants; and establish institutional controls, such as postclosure groundwater care, consistent with long-term stewardship. The ultimate goals are to minimize risks to groundwater and return the Central Plateau to a state that supports the ecosystem (Fluor Hanford 2004:ES-2). The plan is based on the following assumptions (Fluor Hanford 2004:ES-3, ES-4):

- The Central Plateau will remain under institutional control for the foreseeable future.
- Ninety-five percent of the plutonium currently present on Hanford will be removed and shipped off site.
- Contaminated materials and soils will be left in place, unless removal and disposal are more cost-effective.
- Barriers over contaminated structures and waste sites will effectively minimize biointrusion and reduce the transport rate of contaminants to the groundwater.

This approach represents the first planning effort to identify the full range of actions that must be accomplished to close the Central Plateau and position DOE to complete its environmental management mission (Fluor Hanford 2004:ES-9).

The waste site closure element of the *Plan for Central Plateau Closure* focuses on 884 sites, including cribs, ponds, ditches, retention basins, burial grounds, pipelines, and areas of unplanned releases (i.e., areas in which liquid or solid waste contaminated with radioactive materials or hazardous chemicals were disposed of or released). In compliance with CERCLA, remedial actions are being taken at waste sites in groups of operable units as established by the Tri-Party Agreement. The closure approach for these waste sites involves a combination of the following actions:

- Removing, treating, and disposing of contaminated materials, especially soil
- Taking no action for sites that represent minimal hazard
- Maintaining the existing soil cover
- Capping with protective barriers where required to protect groundwater or mitigate intrusion (Fluor Hanford 2004:ES-5, ES-6)

The structures closure element of the *Plan for Central Plateau Closure* consists of 955 varied structures, including offices, shops, trailers, and water tanks, as well as large processing, storage, or handling facilities such as the PFP. The closure approach for structures is as follows:

- Demolish aboveground structures.
- Fill voids in belowground structures.
- Stabilize the surface.
- Cap with protective barriers where required to protect groundwater or mitigate intrusion (Fluor Hanford 2004:ES-6).

The wells closure element for the *Plan for Central Plateau Closure* includes 1,968 groundwater or vadose zone wells that have been used for monitoring and characterization and are noncompliant with applicable regulations or will not be needed following closure. These wells will be closed to eliminate a pathway for migration of contamination to the groundwater. The closure approach for wells is to decommission through filling or demolition (Fluor Hanford 2004:ES-6).

The canyon closure element for the *Plan for Central Plateau Closure* includes the five major defense production facilities originally designed for fuel-reprocessing operations. Four of the five—U Plant, B Plant, the Plutonium-Uranium Extraction (PUREX) Plant, and the Reduction-Oxidation Facility (S Plant)—are currently under surveillance and maintenance. The fifth—T Plant—is being used for waste management. The remedial action for each canyon will be evaluated using the CERCLA process (Fluor Hanford 2004:ES-4).

The Canyon Disposition Initiative is the result of the 1996 Agreement-in-Principle among the signatories of the Tri-Party Agreement to define the path forward for determining the final disposition for Hanford's five canyon buildings (i.e., B Plant, S Plant, T Plant, U Plant, and the PUREX Plant). The purpose of the initiative is to investigate the potential for using the canyon buildings as disposal sites for Hanford remediation waste, rather than demolishing the structures and transferring the resulting waste to the Environmental Restoration Disposal Facility (DOE 2004c:4).

The 221-U Facility is the first canyon building to be addressed under the Canyon Disposition Initiative. The selected remedy is to partially demolish 221-U, dispose of contaminated equipment and demolition debris inside and adjacent to the remaining structure, fill void spaces with grout, and cover the remnants with an engineered barrier (DOE 2005d). Disposition of 221-U is considered to be a pilot project for disposition of the remaining four canyon buildings. However, the complexity and costs for implementation could vary significantly for each building because of varying amounts, types, and locations of radiological contamination within the five canyon buildings (DOE 2004c:1, 4).

The PUREX tunnels in the 200-East Area contain equipment contaminated with approximately 2.8 million curies of various radionuclides and with other hazardous materials (DOE 2003a:552, 553). These tunnels will be managed as an RCRA storage unit until closure can be coordinated with the final closure plan for the PUREX Plant. The current DOE vision calls for the PUREX tunnels to be filled with grout and covered with a surface barrier (DOE 2005b:vi; Fluor Hanford 2004:A3-2). Final closure of the tunnels will require an evaluation of alternatives (Bergeron, Freeman, and Wurstner 2001:3.26).

Because most of the 300 Area is within the City of Richland's Urban Growth Boundary, Richland funded a *Preliminary Assessment of Redevelopment Potential for the Hanford 300 Area* (Richland 2005a). The recently issued *Supplement Analysis, Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (DOE 2008a) considered the City of Richland's *Preliminary Assessment of Redevelopment*

*Potential for the Hanford 300 Area* in its review of new information on land use considerations developed since the *Hanford Comprehensive Land-Use Plan EIS* was issued in 1999 (DOE 1999a). The supplement analysis concluded that no significant new information or changes in circumstances had developed since 1999 that would affect the basis for DOE's land use decisions as documented in the ROD for the *Hanford Comprehensive Land-Use Plan EIS* (64 FR 61615).

## R.5 FUTURE LAND USE IN SURROUNDING REGIONS

This section contains a description of the land use planning in the counties surrounding Hanford. An understanding of expected future land use and development provides the underpinnings for reasonably foreseeable actions that may occur in the region.

The 1990 Washington State Growth Management Act (RCW 36.70A.020) requires counties in the region around Hanford to have comprehensive plans. Cities and other government jurisdictions adopt comprehensive plans to serve as guides for future activities within their jurisdictions. These plans attempt to project 20 years into the future for land development, housing, infrastructure, and community services needs. Table R–2 describes the 13 broad goals described in the Washington State Growth Management Act that local governments must consider when developing their comprehensive plans.

The following plans exist for counties in the region around Hanford and for the Cities of Richland and Kennewick:

- *Adams County Comprehensive Plan* (ACPC 2005)
- *Benton County Comprehensive Land Use Plan* (BCPC 2003)
- *City of Richland Comprehensive Land Use Plan* (Richland 2002, 2005b)
- *City of Kennewick Comprehensive Plan 2006, Executive Document* (Kennewick 2006)
- *Franklin County Growth Management Comprehensive Plan* (Franklin County 2005)
- *Grant County Comprehensive Plan* (GCDCD 1999)
- *Kittitas County Comprehensive Plan* (Kittitas County 2001)
- *Klickitat County, Washington, Comprehensive Plan* (Dreyer 2007)
- *Plan 2015: A Blueprint for Yakima County Progress* (Yakima County 1998)
- *Walla Walla County Integrated Comprehensive Plan and EIS* (Walla Walla County 2007)

These plans are updated periodically. Generally, the plans encourage growth in urban growth areas (UGAs) and discourage growth outside these areas. A comprehensive plan is not a legally enforceable document; zoning is the enforceable means for controlling growth.

Under the Growth Management Act (RCW 36.70A), the Washington State Office of Financial Management has the responsibility to project population growth rates for local planning purposes. Population projections are used by cities and counties to identify the amounts and locations of rural land needed for conversion to urban use as urban growth occurs (BCPC 2003).

To set aside or designate lands necessary for future population growth (beyond those undeveloped lands already within city boundaries), the Growth Management Act requires counties to designate UGAs outside of, but adjacent to, the corporate boundary of each city. UGAs are the land areas that, though not currently within a city's corporate limits, are designated for conversion to urban use in the normal process of urban growth. UGAs must be large enough to accommodate 20 years of urban growth. The identification of amounts of land to be converted to urban use has important economic implications for both cities and counties (BCPC 2003).

**Table R–2. Washington State Growth Management Act Planning Goals**

| Goal | Description |
|---|---|
| Urban growth | Encourage development in urban areas where adequate public facilities and services exist or can be provided in an efficient manner. |
| Reduce sprawl | Reduce the inappropriate conversion of undeveloped land into sprawling, low-density development. |
| Transportation | Encourage efficient multimodal transportation systems that are based on regional priorities and coordinated with county and city comprehensive plans. |
| Housing | Encourage the availability of affordable housing to all economic segments of the population of this state, promote a variety of residential densities and housing types, and encourage preservation of existing housing stock. |
| Economic development | Encourage economic development throughout the state that is consistent with adopted comprehensive plans, promote economic opportunity for all citizens of this state, especially for unemployed and for disadvantaged persons, and encourage growth in areas experiencing insufficient economic growth, all within the capacities of the state's natural resources, public services, and public facilities. |
| Property rights | Private property shall not be taken for public use without just compensation having been made. The property rights of landowners shall be protected from arbitrary and discriminatory actions. |
| Permits | Applications for both state and local government permits should be processed in a timely and fair manner to ensure predictability. |
| Natural resources industries | Maintain and enhance natural-resource-based industries, including productive timber, agricultural, and fisheries industries. Encourage the conservation of productive forest lands and productive agricultural lands, and discourage incompatible uses. |
| Open space and recreation | Encourage the retention of open space and development of recreational opportunities, conserve fish and wildlife habitat, increase access to natural resource lands and water, and develop parks. |
| Environment | Protect the environment and enhance the state's high quality of life, including air and water quality, and the availability of water. |
| Citizen participation and coordination | Encourage the involvement of citizens in the planning process and ensure coordination between communities and jurisdictions to reconcile conflicts. |
| Public facilities and services | Ensure that those public facilities and services necessary to support development shall be adequate to serve the development at the time the development is available for occupancy and use without decreasing current service levels below locally established minimum standards. |
| Historic preservation | Identify and encourage the preservation of lands, sites, and structures that have historical or archaeological significance. |

**Source:** RCW 36.70A.020; Yakima County 1998:I-4.

The size of UGAs is not determined solely by the projected rate of population growth. Other possible considerations include a city's need for commercial- and industrial-zoned lands to meet the economic goals and objectives identified in its comprehensive plan. Land may also be deemed unsuitable as a UGA because of its value as natural resource land (i.e., agricultural, mineral, and forestland) or its value to local residents as a unique low-density rural community (BCPC 2003).

Of primary importance to the initial establishment and future expansion of UGAs into unincorporated areas is the projected need for additional lands in relation to the existing available supply of undeveloped land already inside a city's UGA. Equally important, however, is the maintenance of low-enough densities outside the UGA to enable its logical and cost-effective expansion in the distant future (30 to 70 years) (BCPC 2003).

The phenomenon of city boundary enlargement and expansion into rural county lands will continue with population growth. Designation of UGAs endeavors to set standards and mechanisms whereby legitimate needs for new urban lands are met while rural communities and natural resource lands are protected.

Cities can neither annex lands nor generally extend municipal services to lands outside of UGAs (BCPC 2003).

Because the majority of Hanford lies within Benton County and the majority of Hanford workers live in Benton County and the city of Richland, the following discussion concentrates on future land use in these regions.

**Benton County.** As described in *Benton County Sustainable Development Overall Economic Development Plan* (Benton County 2006), 263,049 hectares (650,000 acres) of the county are planned for agriculture and agribusiness, 2,045 hectares (5,053 acres) for commercial and industrial use, and 5,541 hectares (13,693 acres) for tourism and recreation. This does not include the 30,352 hectares (75,000 acres) and 4,346 hectares (10,740 acres) within Hanford designated for commercial/industrial and recreational use, respectively, in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a).

Historically, the Cities of West Richland, Richland, and Kennewick have aggressively pursued annexation of unincorporated lands, largely in response to the boom-and-bust cycles of Hanford. Between 1985 and 2003, 7,328 hectares (18,107 acres) were annexed even though each city still had over half its incorporated acreage undeveloped. Kennewick has 2,428 hectares (6,000 acres) of vacant or undeveloped land designated for low-density residential use; Richland, 8,789 hectares (21,719 acres); and West Richland has 5,520 hectares (13,641 acres), some actually designated for rural densities and lower (BCPC 2003).

**City of Richland.** The City of Richland recently released an updated *City of Richland Comprehensive Land Use Plan* (Richland 2005b). Although this plan is for the period ending in 2035, it contains few quantitative estimates of future changes. Therefore, the 1997 *City of Richland Comprehensive Land Use Plan,* as amended through December 10, 2002 (Richland 2002), was used to obtain the pertinent information. The 1995–2015 planning horizon of that plan (Richland 2002:ES 1-1–ES 1-5) reflects the following projected changes:

- Gain of 11,041 jobs
- Demand for 3,134 residential units requiring 170 hectares (420 acres) of the 1,281 hectares (3,165 acres) of currently vacant land
- Demand for an additional 490 hectares (1,212 acres) of vacant developable land
- Demand for an additional 42 hectares (104 acres) of parkland
- Growth in the student population of 1,504
- Falling level-of-service ratings on 19 roadway segments
- Increasing demand for irrigation water for landscaping as unused open space and agricultural land are converted to public facility and residential uses

Also indicated (Richland 2002:3-6) are the following changes in land use patterns expected between 1995 and 2015:

- Land designated for residential uses will increase from 31 to 33 percent of the total land area.
- Land designated for industrial uses will increase from 19 to 26 percent of the total land area. Most of this increase will be attributable to the addition of Hanford land.

- Land designated for agricultural uses will decrease from 21 to 3 percent of the total land area. Most of this decrease will result from the redesignation of lands in the Horn Rapids area from agricultural to Urban Reserve and public facility uses.

- Land designated for commercial uses will increase slightly to 6 percent of the total land area.

- Land designated for public facilities and open space will increase from 12 to 23 percent of the total land area.

- Land designated for Urban Reserve use will be approximately 8 percent of the total land area.

The UGA in the *City of Richland Comprehensive Land Use Plan, Final* (Richland 2002:3-4) covers an area of 8,954 hectares (22,125 acres). Of that area, 4,563 hectares (11,275 acres) are currently developed, and 4,391 hectares (10,850 acres) are vacant and available for future development.

Although changes will inevitably occur due to the pressures of continued population growth, land use in the region surrounding Hanford is not expected to change drastically during the upcoming decades. It is assumed that the largest land use in the region will continue to be agricultural, and that populations will increase mainly around the current urban areas (DOE 2004a:22).

## R.6 APPROACH TO CUMULATIVE IMPACTS ANALYSIS

A flowchart of the methodology used to estimate cumulative impacts is presented as Figure R–2. This flowchart, which incorporates the CEQ's eight principles of cumulative effects analysis (CEQ 1997:8), is divided into four phases: (1) selection of resource areas and appropriate regions of influence (ROIs), (2) selection of reasonably foreseeable future actions, (3) estimation of cumulative impacts, and (4) identification of monitoring and mitigation.

***Phase 1—Selection of Resource Areas and Appropriate ROIs.*** This phase concentrates on selecting resource areas most likely to incur meaningful cumulative impacts. Steps in this process include the following:

1a. Examine resource areas evaluated in recent Hanford NEPA documents, areas evaluated in this *TC & WM EIS* (see Chapter 4), and areas subjected to historically significant impacts to develop a list of resource areas likely to exhibit cumulative effects.

> **Region of Influence:**
> A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur.

1b. Identify the ROI—i.e., the spatial limits—for each resource area to be evaluated for cumulative impacts. ROIs are described in the introduction to Chapter 3 of this *TC & WM EIS* and are summarized in Section R.9.

***Phase 2—Selection of Reasonably Foreseeable Future Actions.*** In this phase, reasonably foreseeable future actions are examined and screened to determine which must be included in the cumulative impacts analysis. Steps in this process include the following:

2a. Identify future actions—Federal, non-Federal, or private—occurring in the ROI. Typical information sources include RODs, RCRA, CERCLA, NEPA, and Washington State Environmental Policy Act documents; the Tri-Party Agreement; permits and permit applications; and land use and development plans.

> **Reasonably foreseeable actions** are ongoing and will continue into the future, are funded for future implementation, or are included in firm near-term plans.

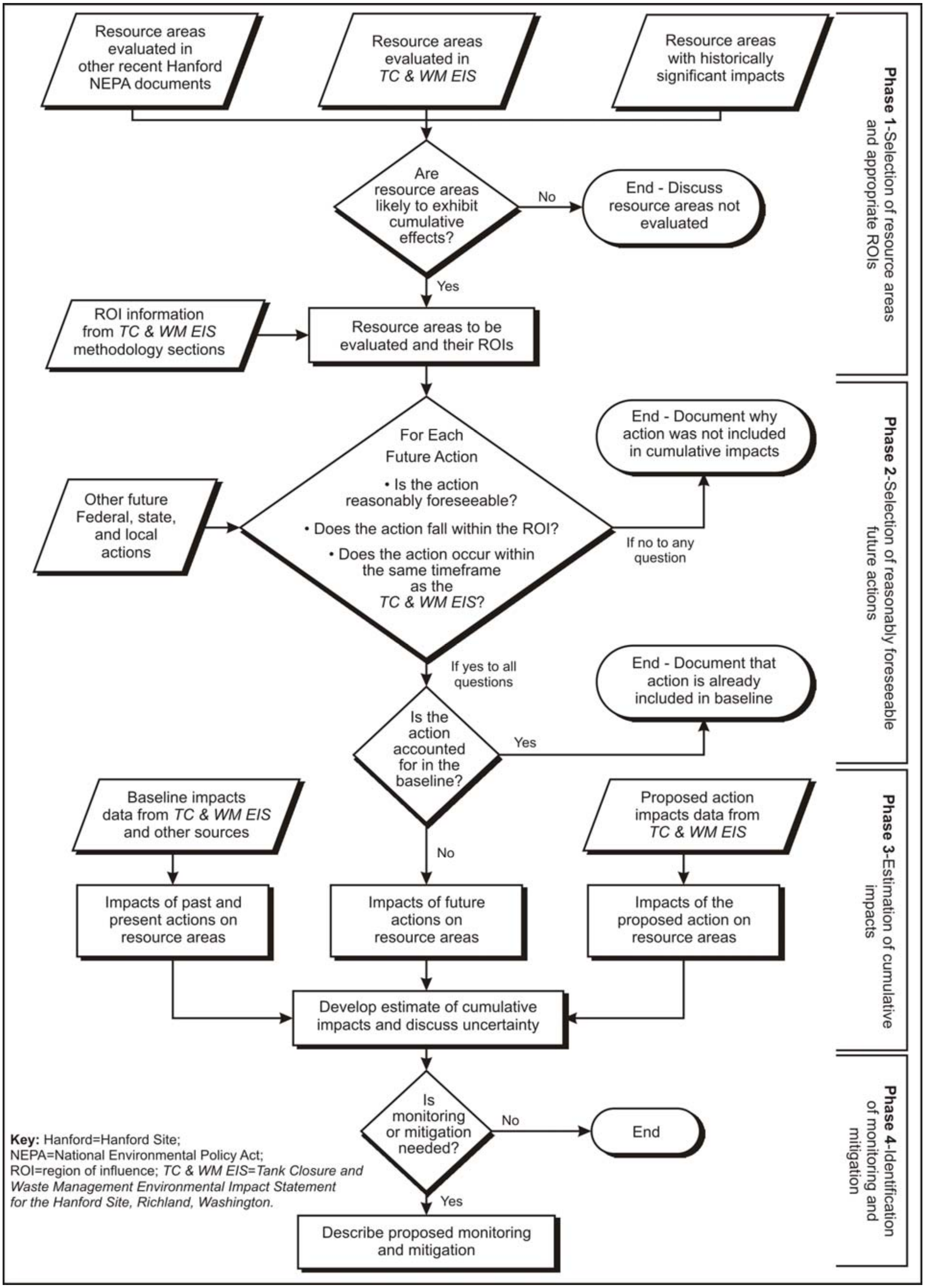



**Figure R–2. Flow Diagram for Identifying and Evaluating Cumulative Impacts**

2b. Examine each future action to determine whether the action is reasonably foreseeable, occurs within the ROI, occurs within the same timeframe as the *TC & WM EIS* action, and is not already accounted for in the baseline impacts.

2c. Retain for analysis future actions meeting the criteria listed in item 2b, and eliminate from further consideration future actions not meeting all those criteria.

***Phase 3—Estimation of Cumulative Impacts.*** In this phase, impact indicators for the proposed actions are added to baseline values and to values for reasonably foreseeable future actions to estimate cumulative impacts. Steps in this process include the following:

3a. Identify, and, to the extent possible, quantify baseline impacts. Baseline impacts (i.e., the level of degradation that a resource is currently experiencing) include effects of past and present actions. These impacts are generally those described in Chapter 3 of this *TC & WM EIS*. Present actions include cleanup activities that could reduce impacts of a past action, as well as actions that could add to the degradation of a resource. The importance of past actions to cumulative impacts is resource-specific. For example, past air pollutant releases would not affect the baseline (current) site air quality, whereas liquid releases to the ground could have a lasting effect and could impact the baseline. Therefore, only past actions continuing to have impacts on the resource are considered in the cumulative impacts analysis.

3b. Identify impacts of the *TC & WM EIS* Preferred Alternative and the combined *TC & WM EIS* alternative combinations from Chapter 4.

3c. Identify impacts of the reasonably foreseeable future actions identified in Phase 2. If quantitative data are available, incorporate the values into a quantitative or semiquantitative cumulative impacts analysis. If quantitative data are not available, use qualitative data.

3d. Aggregate the effects on each resource of past, present, and reasonably foreseeable future actions, including the proposed actions. Use aggregate effects to estimate cumulative impacts for each resource area. Determine the degree of impact using largely the same impact measures that were used for Chapter 4 of this *TC & WM EIS*.

The results of the cumulative impacts analysis are presented in Chapter 6. Supporting information for the short-term cumulative impacts analysis is presented in Appendix T; long-term, in Appendix U.

***Phase 4—Identification of Monitoring and Mitigation.*** In this phase, resultant estimates of cumulative impacts are examined to determine whether monitoring and/or mitigation activities are needed. Steps in this process include the following:

4a. Determine those resource areas where appreciable cumulative impacts are predicted.

4b. Describe measures that may be used to monitor or mitigate these potentially appreciable cumulative impacts.

## R.7 UNCERTAINTIES

Many uncertainties are inherent to the estimation of cumulative impacts. The uncertainties in the cumulative impacts described in this *TC & WM EIS* are largely the result of the following assumptions and conditions:

- Small changes in current activities are generally not documented and therefore not considered.

- Individual activities disturbing less than 40 hectares (100 acres) are generally not considered.
- Detailed information for many of the future activities considered in this cumulative impacts analysis is limited.
- Information on projects to be implemented 10 or more years in the future is limited.
- Future changes to laws and regulations cannot be considered.
- Future fluctuations and changes to the environment, including climate change and the effects of climate change on water resources, ecological resources, and man, are not considered.

The contribution of most of these assumptions and conditions to the determination of Hanford's cumulative impacts, is believed to be small, at least for the short term. Although not quantified, the chance that these assumptions and conditions would change the conclusions of the *TC & WM EIS* cumulative impacts analysis is unlikely. Given the extended duration of the analysis, resulting projections of long-term cumulative impacts are subject to a high degree of uncertainty.

As described in the previous sections, cumulative impacts were assessed by combining the potential effects of *TC & WM EIS* activities with the effects of other past, present, and reasonably foreseeable actions in the ROI. It must be noted, of course, that many actions occur at different times and locations across the ROI—e.g., the set of actions impacting air quality—and thus their impacts are not entirely cumulative. Therefore, this approach should yield a conservative estimate of cumulative impacts for the activities considered.

## R.8 SELECTION OF RESOURCE AREAS FOR ANALYSIS

Because of the comprehensive nature of this *TC & WM EIS*, cumulative impacts were evaluated for all resource areas except for the impacts of accidents on public and occupational health and safety. Except under an extremely unlikely catastrophic earthquake scenario, it is highly unlikely that accidents in separate facilities would occur at the same time and be close enough to each other to have appreciable additive effects.

## R.9 RESOURCE AREA METHODOLOGIES

This *TC & WM EIS* incorporates a range of methods for cumulative impacts because of differences in the anticipated significance of the impact on a given resource area, the availability of adequate data, and the specific needs of decisionmakers and the public.

In general, long-term impacts, including impacts on groundwater quality, were evaluated quantitatively (i.e., they were modeled). Analyses of short-term impacts were generally semiquantitative (i.e., simple addition of impact indicators) or qualitative (i.e., descriptions were based on non-numerical data). Where data were not uniformly available or comparable for a particular resource across its ROI, however, analysis entailed a combination of semiquantitative and qualitative methods. And with regard to those resource areas for which a detailed analysis was preferable but data were simply insufficient to support that level of analysis, the analysis was performed qualitatively. Table R–3 identifies, for each resource area, the method of analysis and the rationale for its application.

**Table R–3. Methods of Cumulative Impacts Analysis for Different Resource Areas**

| Resource Area | Region of Influence | Method of Analysis | Indicator | Note |
|---|---|---|---|---|
| **Short-Term Impacts** | | | | |
| Land use | Hanford and nearby offsite areas | Semiquantitative | Land area disturbed or occupied | Amount of land disturbed or occupied for other actions[a] is added to present a total. |
| Visual resources | Hanford and nearby offsite areas in the viewshed | Qualitative | Visual resource alteration in the viewshed | Resource area does not lend itself to a quantitative analysis. |
| Infrastructure | Hanford utility infrastructure | Semiquantitative | Utility use (electricity, fuel, and water) | Utility resources used for other actions[a] are added to present a site total. |
| Noise | Hanford, nearby offsite areas, and access routes to the site | Qualitative | Noise levels | Noise data are not likely to be available to perform a quantitative analysis. |
| Air quality | Hanford and nearby offsite areas within the airshed | Semiquantitative | Concentrations of criteria and toxic air pollutants | Air quality indicators for other actions[a] are added to present a conservative total, given that the values likely occur at different locations and at different times. |
| Geology and soils | Hanford and nearby offsite areas where geologic and soil resources may be affected | Semiquantitative | Volumes of geologic and soil resources used | Geologic and soil resources used for other actions[a] are added to present a total. |
| Water resources | Hanford and nearby offsite areas in the Columbia River and Yakima River watersheds | Semiquantitative<br><br>Qualitative | Amount of surface water and groundwater used<br><br>Surface-water and groundwater quality | Water use for other actions[a] is added to present a total. |
| Ecological resources | Hanford and nearby offsite areas with similar habitat | Semiquantitative<br><br>Qualitative | Sensitive habitat (e.g., shrub steppe) disturbed or occupied<br><br>Disturbance of threatened and endangered species | Amount of habitat disturbed for other actions[a] is added to present a total. |
| Cultural and paleontological resources | Hanford and nearby offsite areas that may contain significant cultural resources | Qualitative | Disturbance of National Register of Historic Places—listed or eligible—historic properties or archaeologic, American Indian, or paleontologic resources | Potential for cumulative impacts on cultural resources is discussed qualitatively. |
| Socioeconomics | Hanford and nearby counties where at least 90 percent of Hanford employees reside | Semiquantitative | Direct and indirect employment<br><br>Traffic from employee and truck trips | Employment and vehicle trips for other actions[a] are added to present a total. |

**Table R–3. Methods of Cumulative Impacts Analysis for Different Resource Areas *(continued)***

| Resource Area | Region of Influence | Method of Analysis | Indicator | Note |
|---|---|---|---|---|
| **Short-Term Impacts *(continued)*** | | | | |
| Public and occupational health and safety—normal operations | Hanford and offsite areas within 80 kilometers (50 miles) of the site | Semiquantitative | Population and MEI doses and LCFs from radiological air emissions and Hazard Indices for chemical air emissions | Public health indicators for other actions[a] are added to present a total. |
| | Occupational impacts limited to Hanford workers | | Worker doses and LCFs from radiological exposure and Hazard Indices for chemical exposure | Worker health indicators for other actions[a] are added to present a total, as resource is suitable for addition of impact indicators. |
| Public and occupational health and safety—transportation | Hanford roads and railroads and selected offsite transportation corridors to waste disposal facilities | Semiquantitative | Population and MEI doses, LCFs, and accident fatalities for transport crew and public along transportation routes | Transportation indicators for other actions[a] are added to present a total. |
| Waste management | Hanford waste management facilities and offsite facilities where Hanford waste is managed | Semiquantitative | Waste generation for TRU, low-level radioactive, mixed low-level radioactive, hazardous, dangerous, and nonhazardous wastes | Waste volumes/weights generated for other actions[a] are added to present a total. |
| **Long-Term Impacts** | | | | |
| Groundwater | Portions of the groundwater basin that may be adversely affected by *TC & WM EIS* activities; bounded by groundwater discharge locations along the Columbia River | Quantitative | Radionuclide and chemical contaminant concentrations | Analysis required by Settlement Agreement re: *State of Washington v. Bodman* (Civil No. 2:03-cv-05018-AAM). Analysis is per the Technical Guidance Document for *Tank Closure Environmental Impact Statement, Vadose Zone and Groundwater Revised Analyses*, Final Rev. 0, dated March 25, 2005 (DOE 2005d), due to "significance" of the resource area (groundwater) at Hanford. |
| Human health | Potential future onsite groundwater users and users of the Columbia River downstream from the site | Quantitative | MEI dose, LCFs, and Hazard Indices for drinking-water well user, resident farmer, American Indian resident farmer, and American Indian hunter-gatherer, and population dose, LCFs, and Hazard Indices for downstream surface-water users | Direct inputs are obtained from long-term groundwater modeling results. |

**Table R–3. Methods of Cumulative Impacts Analysis for Different Resource Areas *(continued)***

| Resource Area | Region of Influence | Method of Analysis | Indicator | Note |
|---|---|---|---|---|
| **Long-Term Impacts *(continued)*** | | | | |
| Environmental justice | Potential future onsite subsistence farmers and American Indian users, and users of the Columbia River downstream from the site | Quantitative | MEI dose, LCFs, and Hazard Indices for future onsite subsistence farmers and American Indians | Direct inputs are obtained from long-term groundwater modeling results. |
| Ecological risk | Plants and animals using Hanford and the Columbia River adjacent to and downstream from the site | Quantitative | Risk to indicator species at the shore of the Columbia River (terrestrial) and in the river (aquatic) | Direct inputs are obtained from long-term groundwater modeling results. |

[a] Other past, present, and future actions in the region of influence that may contribute to cumulative impacts. The proposed approaches for cumulative impacts described in this table are dependent on the availability of information for the other past, present, and reasonably foreseeable future actions. If numerical data are not available, qualitative cumulative impacts analyses will be performed.

**Key:** Hanford=Hanford Site; LCF=latent cancer fatality; MEI=maximally exposed individual; *TC & WM EIS=Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*; TRU=transuranic.

**Source:** Based on Chapter 3, Table 3–1.

## R.10 SPATIAL AND TEMPORAL CONSIDERATIONS

Cumulative environmental impacts—i.e., the impacts of all past, present, and reasonably foreseeable actions—have limits in space and time. For cumulative impact analysis, those recognized spatial limits help determine the specific geographic expanse (ROI) to be evaluated for each resource area. The ROIs used in the cumulative impacts analysis—many are the same as those described in the introduction to Chapter 3—are summarized in Table R–3.

To conclusively address the temporal limits of environmental impact, short- and long-term cumulative impact analyses were performed for each resource area. Short-term cumulative impacts are associated with the active project phase, extending through the applicable administrative control, institutional control, or postclosure care period. For this *TC & WM EIS*, short-term cumulative impacts are deemed to extend up to 188 years (2006 through 2193 under Tank Closure Alternative 2A). Long-term cumulative impacts extend beyond the active project phase, thus beyond the appropriate period of administrative control, institutional control, or postclosure care. For this EIS, long-term cumulative impacts are assessed for approximately 10,000 years into the future.

## R.11 PAST AND PRESENT ACTIONS

To determine the baseline impacts on a resource, the impacts of past and present actions must be identified. For most resource areas, baseline impacts were culled from information on the affected environment provided in Chapter 3 of this *TC & WM EIS*. For example, the current air quality in the ROI as described in Chapter 3 adequately reflects both past and present activities. In contrast, current resource use alone may not adequately account for past resource loss, and thus, may not be a good indicator of baseline impacts.

Past and present actions that may contribute to cumulative impacts include those conducted by government agencies, businesses, or individuals within the ROIs considered. Examples of past Hanford activities include operation of the fuel fabrication plants, production reactors, the PUREX Plant and other fuel reprocessing facilities, the PFP, and research facilities, as well as the treatment and disposal of waste. Current Hanford activities include site cleanup, waste disposal, and tank waste stabilization.

Examples of past and present offsite activities that may contribute to cumulative impacts include the clearing of land for agriculture and urban development, water diversion and irrigation projects, waste management, industrial and commercial development, mining, power generation, and the development of transportation and utility networks.

## R.12 SELECTION OF REASONABLY FORESEEABLE FUTURE ACTIONS

As described in *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997), Principle 1 of cumulative effects analysis reads, "Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions." Principle 2 reads, in part, "Cumulative effects are the total effect… of all actions taken, no matter who (Federal, non-Federal, or private) has taken the actions." Therefore, it is important to identify future actions that may appreciably degrade the resources or add to the impacts of the proposed actions, regardless of the agency or individual undertaking the actions.

The *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a) lays out the future vision for land use at Hanford. Both DOE and non-DOE actions may occur within the current Hanford boundaries. The major DOE activities will include continuation of site cleanup, waste consolidation and disposal, facility closure and decontamination and decommissioning, and the various high-level radioactive waste treatment and tank closure activities. Non-DOE actions are expected within the areas at Hanford set aside for industrial use, research and development, preservation, mining, and recreation (see Figure R–1).

**DOE Actions at Hanford**

The *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a) describes the major DOE activities that are occurring or would occur at Hanford to achieve the vision set forth in the *Hanford Comprehensive Land-Use Plan EIS*. The list of activities reflected in that plan was modified by eliminating those activities within the scope of this *TC & WM EIS* and those that have already been completed, and adding new activities planned for Hanford (72 FR 40135; DOE 2006a; DOE, EPA, and Ecology 2006, 2007; PHMC 2006a, 2006b; Poston et al. 2007). Present and future DOE activities at Hanford include the following:

- Cleanup and restoration activities across all areas of Hanford
- Decommissioning of surplus production reactors and their support facilities in the 100 Areas along the Columbia River[1]
- Deactivation of the PFP in the 200-West Area
- Actions to remove the sludge and decommission the K Basins in the 100-K Area
- U Plant regional closure
- Final disposition of the canyon buildings (i.e., B Plant, S Plant, T Plant, U Plant, and the PUREX Plant), PUREX tunnels, and other facilities in the 200 Areas, and cleanup of the Central Plateau to Industrial-Exclusive land use standards

[1] B Reactor was recently designated a National Historic Landmark (DOE and DOI 2008). Therefore, B Reactor will not be decommissioned and moved to the Hanford Central Plateau for disposal as analyzed in the *Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington* (DOE 1989, 1992) and assumed in this *TC & WM EIS*.

- Transport of sodium-bonded spent nuclear fuel from the Fast Flux Test Facility in the 400 Area to INL for treatment
- Excavation and use of geologic materials
- Continued disposal of waste in the Environmental Restoration Disposal Facility near the 200-West Area
- Implementation of the programmatic waste management decisions described in the RODs for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a)
- Retrieval of suspect TRU waste buried after 1970
- Cleanup and protection of groundwater
- Potential disposal of greater-than-Class C LLW
- Transport of TRU waste to WIPP

**Non-DOE Actions at Hanford**

The aforementioned review of documentation for data bearing on cumulative impacts also entailed consideration of non-DOE activities inside the Hanford boundary. These included Federal, state, or local initiatives; industrial or commercial ventures; utility or infrastructure construction and operation; and waste treatment and disposal. Specific non-DOE activities at Hanford include the following:

- Continued transport of U.S. Navy reactor plants via the Columbia River and disposal thereof in trench 218-E-12B in the 200-East Area
- Continued operation of the Columbia Generating Station (previously Washington Public Power Supply System, Nuclear Project No. 2)
- Continued operation of the US Ecology commercial LLW disposal site
- Management of the Hanford Reach of the Columbia River as a national monument and a national wildlife refuge

**Other Actions in the Region**

It was also necessary to consider activities outside Hanford but within the ROI. These included Federal actions, state and local development initiatives, industrial and commercial ventures, residential development, and infrastructure projects. Activities in the region surrounding Hanford include the following:

- Future land use in the region as described in city and county comprehensive land use plans
- Base realignment and closure and other U.S. Department of Defense activities
- Cleanup of toxic, hazardous, and dangerous waste disposal sites
- Columbia River and Yakima River water management, including the Black Rock Reservoir proposal

- Power generation and transmission line projects
- Wind energy projects
- Pipeline projects
- Transportation projects

For more information on anticipated future activities that could contribute to cumulative impacts, data were also collected from the Cities of Kennewick, Pasco, Richland, West Richland, and Yakima in Washington; the Counties of Adams, Benton, Franklin, Grant, Kittitas, Klickitat, Walla Walla, and Yakima in Washington; the Counties of Morrow and Umatilla in Oregon; and the Yakama Nation, the Nez Perce Tribe, and the Confederated Tribes of the Umatilla Indian Reservation. No additional major future actions were identified by the Cities of Richland or Pasco in Washington; Adams, Benton, Franklin, Grant, Kittitas, Klickitat, Walla Walla, or Yakima Counties in Washington; Umatilla County in Oregon; or the Confederated Tribes of the Umatilla Indian Reservation or Nez Perce Tribe (Adams 2007; Bailor 2007; D'Hondt 2007; Jennings 2007; Lamb 2007; Lilligren 2007a, 2007b; Patterson 2007; Prentice 2007; Rolph 2007; Shuttleworth 2007; Smith 2007; Torres 2007; Wendt 2007). Future activities that were identified for the region surrounding Hanford include the following:

- The 1,012-hectare (2,500-acre) South Ridge Development Zone in Kennewick, Washington, designated for mixed-use development over the next 5 to 10 years (Romine 2007).
- The 130-hectare (320-acre) Red Mountain Center mixed-use development area in West Richland, Washington, that broke ground in 2007 and is expected to be completed in 2010 (Gouk 2007).
- The annexation of approximately 648 hectares (1,600 acres) of land near the Apple Tree Golf Course by the City of Yakima for residential development over the next 5 to 10 years (Benson 2007).
- The 567-hectare (1,400-acre) Multi-Purpose Motor Speedway Project 4.8 kilometers (3 miles) west of Boardman, Oregon, that began construction in 2007. Future expansions could total 2,833 hectares (7,000 acres) over the next 10 years (McClane 2007; PNMP 2007).
- The 162-hectare (400-acre) multitenant industrial park for the Port of Morrow in Boardman, Oregon, that was expected to begin construction in 2007 (McClane 2007).
- The 648-hectare (1,600-acre) Destination Resort Complex mixed vacation-style residential development with golf course and marina along the Columbia River 4.8 kilometers (3 miles) west of Boardman, Oregon, that is expected to begin construction within 5 years (McClane 2007).
- The development of biofuels (including ethanol) facilities in Finley, Moses Lake, and Plymouth, Washington, and biodiesel facilities in Burbank, Ellensburg, Sunnyside, Toppenish, and Warden, Washington (Riggsbee 2007; WSU 2007).

Because of the distance from Hanford; the routine nature of most actions; and various zoning, permitting, environmental review, and construction requirements, most other actions are not expected to interact with Hanford activities to produce cumulative impacts.

Benton, Franklin, and Grant Counties had a total of 949,772 hectares (2,346,912 acres) of farmland in 2002 (USDA 2002). This farmland area is 65 percent of the 1,457,298 hectares (3,601,024 acres) of the total land area of these counties (WOFM 2007). Little growth in agriculture is expected through 2025 (WSTC 2006:B-8).

Many areas of the Columbia River Basin have the potential for natural gas accumulations in underground sediments. Although significant production has not occurred, small amounts of gas were produced from the Rattlesnake Hills Gas Field north of Richland. No oil or gas production wells have been completed in the state of Washington since 1962 (Lingley 2005), although state and Federal lands in the region around Hanford continue to be leased for natural gas exploration (WDNR 2007a).

As described in Chapter 3, sand, gravel, and basalt are the primary geologic resources extracted from the earth in the region around Hanford. There are many commercial surface mines in the region (WDNR 2006), and it is expected that mines will be expanded and new mines developed to satisfy the future need for these construction materials. Long-term cumulative impacts of these activities are not expected because the Washington State Surface Mine Reclamation Act (RCW 78.44) ensures that surface mines more than 1.2 hectares (3 acres) in size or with a highwall that is higher than 9.1 meters (30 feet) and steeper than 45 degrees are reclaimed (WDNR 2007b).

The Yakima Training Center is in central Washington in Yakima and Kittitas Counties, approximately 11 kilometers (7 miles) northeast of the city of Yakima (Army 2007:365). Land use at the center is separated into two major areas: the cantonment area (approximately 400 hectares [1,000 acres]) and the training areas (approximately 132,000 hectares [326,000 acres]) (Army 2007:367). The cantonment area, which includes residential, administrative, commercial, light industrial, and open spaces, is in the southwest corner of the installation (Army 2007:365). The training areas include a large maneuver area and a variety of large- and small-caliber live-fire ranges (Army 2007:355). Units from Fort Lewis and elsewhere use the Yakima Training Center to conduct maneuver and live-fire training, and then return home to their respective installations (Army 2007:355).

Construction activities planned for the foreseeable future at the Yakima Training Center include the following:

- Construction of a digital multipurpose range complex for fiscal year 2008
- Construction of an Armed Forces Reserve Center for fiscal year 2008
- Construction of a sniper field fire range for fiscal year 2010
- Construction of a multipurpose machine gun range for fiscal year 2011
- Construction of an aviation gunnery range for fiscal year 2011
- Construction of a fire station for fiscal year 2013
- Natural gas exploration and drilling (Army 2007:369)

In May 2005 the U.S. Department of Defense announced its latest round of base realignment and closure activities (AFIS 2005; BRAC 2005). These activities can impact areas around military facilities by reducing or increasing direct and indirect employment and activities that have environmental impacts. The Umatilla Army Depot is the only major military facility in the Hanford ROI to be closed. Closure of the depot and the associated loss of 884 regional jobs (512 direct and 372 indirect) (BRAC 2005:Ind-14, C-20) and reduction in activities will have inevitable environmental impacts. While the precise impacts of closure and reuse of the depot have not been evaluated, they will be the subject of future NEPA documentation. Because the depot is over 48 kilometers (30 miles) from the Hanford boundary, little in the way of cumulative impacts are expected.

The sites on EPA's National Priorities List (NPL) (also known as Superfund [Superfund Amendments and Reauthorization Act] sites) were reviewed to determine whether any could contribute to cumulative impacts at Hanford. Seven active NPL sites are in Hanford or within 80 kilometers (50 miles) of the site boundary. Three of these sites are the Hanford 100, 200, and 300 Areas. The closest of the remaining four NPL sites is the Pasco Sanitary Landfill near Pasco, Washington, approximately 19 kilometers (12 miles) southeast of the site boundary (EPA 2006a, 2006b). The State of Washington also actively pursues the cleanup of contaminated sites through the State Toxics Cleanup Program. Approximately

145 State of Washington sites are within 80 kilometers (50 miles) of Hanford, including 4 in Adams County, 19 in Benton County (6 in the city of Richland), 8 in Franklin County, 19 in Grant County, 7 in Kittitas County, 6 in Walla Walla County, and 82 in Yakima County (Ecology 2006a). In addition to being some distance from Hanford, most of the NPL and Washington State Toxics Cleanup Program sites are well into the control and cleanup process, and thus would not substantially contribute to cumulative impacts.

The Columbia River Water Management Act (RCW 90.90) requires Ecology to "aggressively pursue the development of water supplies to benefit both in-stream and out-of-stream uses." Ecology is in the process of developing a Columbia River Water Management Program to facilitate compliance with the legislation. No specific storage or conservation projects have been identified for implementation under the management program (Ecology 2007a:1).

The proposed Black Rock Reservoir, a water storage and electrical power generation project currently being evaluated for the Yakima River Basin, could have substantial environmental and economic effects on the region. This project could include the construction of a 160-meter-high (525-foot-high), central core rockfill dam, creating a reservoir with a active storage volume of 1,300,000 acre-feet. A pipeline would take water from the Columbia River upstream of Priest Rapids Dam, store it in the reservoir, and then discharge it to the Yakima River Valley. The total project construction cost is estimated at $4.5 billion, with an annual operating cost of 60.2 million. This reservoir would be approximately 8 kilometers (5 miles) west of Hanford's nearest boundary. Other alternatives to the Black Rock Reservoir that are being considered are the Wymer Dam and Reservoir Alternative, Wymer Dam Plus Yakima River Pump Exchange Alternative, Enhanced Water Conservation Alternative, Market-Based Reallocation of Water Resources Alternative, and Groundwater Storage Alternative. None of the alternatives has been identified as a preferred alternative (BOR and Ecology 2008:xvi, xxi, xviii, 2-37).

In December of 2008 Ecology issued the *Supplemental Draft Environmental Impact Statement, Yakima River Basin Water Storage Feasibility Study* (Ecology 2008). This document is a supplement to the January 2008 *Draft Planning Report/Environmental Impact Statement, Yakima River Basin Water Storage Feasibility Study, Yakima Project, Washington* (BOR and Ecology 2008), which evaluated alternatives for Yakima River Basin water storage, including construction and operation of a Black Rock Reservoir. Ecology prepared the supplemental draft EIS to evaluate an additional water supply alternative. The Integrated Water Resource Management Alternative included in the supplemental draft EIS includes four general elements to improve water resources in the Yakima River Basin—fish passage improvements, modification of existing operations and facilities, new storage, and fish habitat enhancement on mainstem rivers and tributaries. The analysis in the supplemental draft EIS is programmatic in nature. If the decision is made to implement this alternative, any individual projects that are carried forward will require additional environmental review when they are proposed (Ecology 2008:FS-1, FS-3).

The Priest Rapids Hydroelectric Project, consisting of the Priest Rapids and Wanapum Dams, is directly upstream of Hanford. The project occupies an estimated 1,256 hectares (3,104 acres) of Federal land managed by the U.S. Bureau of Reclamation, U.S. Bureau of Land Management, U.S. Department of the Army, USFWS, DOE, and Bonneville Power Administration. It also occupies an estimated 1,135 hectares (2,804 acres) of Washington State land (FERC 2006a:xvi). The project has operated since 1955 under a 50-year license with the Federal Energy Regulatory Commission. In anticipation of license expiration in 2005, the Grant County Public Utility District filed a relicensing application with the commission in October 2003 and an EIS was completed in 2006 (FERC 2006a; Grant County PUD 2003). In the future, the Grant County Public Utility District proposes to improve the project by installing advanced-design turbines, improving downstream fish bypass facilities, creating new programs to protect and enhance anadromous and resident fish and wildlife, and implementing additional cultural resources protections (Grant County PUD 2003:1, 2). It is expected that these improvements will reduce the impacts of operation of the Priest Rapids Hydroelectric Project to levels below those currently experienced. A 44-year license extension was granted for the project in April of 2008 (FERC 2008:58).

Information on power generation and transmission line projects was collected to determine whether major projects are planned for the region around Hanford (BPA 2005a, 2007a, 2007b, 2008; EFSEC 2007; RNP 2006). Long-term planning by the Bonneville Power Administration and the Pacific Northwest Electric Power Planning and Conservation Council suggests a need for up to 8,000 megawatts of electricity in the region over the next 10 years. To that end, a number of power generation projects have been proposed for the ROI (BPA 2003:2). Utility projects either proposed or recently completed include the following:

- Plymouth Generation Facility, a 306-megawatt natural-gas-fired turbine electricity-generating facility (Benton and BPA 2003; BPA 2007c, 2008)
- Wanapa Energy Center, a 1,200-megawatt gas and steam turbine electricity-generating facility (BIA 2004; BPA 2008)
- Wind projects, including Big Horn, Combine Hills II, Desert Claim, and Wild Horse (BPA 2007a, 2007c; EFSEC 2007, 2009)
- New transmission lines, including the 127-kilometer (79-mile), 500-kilovolt line between McNary and John Day Substations (BPA 2008)
- Transmission line upgrades, including the Tucannon River-to-North Lewiston Rebuild (BPA 2007b)

The Plymouth Generation Facility would be approximately 40 kilometers (25 miles) south of the Hanford boundary (Benton and BPA 2003); the Wanapa Energy Center, approximately 48 kilometers (30 miles) south (BIA 2004:3.6-4). These facilities would be approximately 64 kilometers (40 miles) from the 200 Areas. As of September 2008, both projects were on hold (BPA 2008).

Four wind projects would be within 80 kilometers (50 miles) of Hanford's boundary. The recently completed Big Horn Wind Project is approximately 72 kilometers (45 miles) southwest of Hanford's boundary. The proposed Combine Hills II Wind Project would be alongside the Combine Hills I Wind Project southeast of Hanford's boundary approximately 56 kilometers (35 miles) away. The recently completed Wild Horse Wind Project is approximately 56 kilometers (35 miles) northwest of Hanford's boundary (BPA 2007a; EFSEC 2007). The proposed Desert Claim Wind Project is approximately 72 kilometers (45 miles) northwest of Hanford's boundary (EFSEC 2009). In total, these wind projects involve the construction of 418 wind turbines that would generate 682 megawatts of electricity (EFSEC 2009; NPCC 2006).

Most transmission line projects are some distance from Hanford's boundary. The McNary–John Day transmission line would be approximately 40 kilometers (25 miles) from Hanford (BPA 2005a). As of September 2008, this project was on hold (BPA 2008).

In addition, information on water and gas pipeline projects was reviewed. No major water or gas pipeline projects are planned for the region around Hanford (FERC 2007a, 2007b).

Information on road and rail transportation projects was collected to determine whether major projects could impact the region around Hanford (WSDOT 2006, 2007, 2009a, 2009b; WFLHD 2006, 2007). Some of the more-substantial transportation projects in the region include the following:

- Adding 4.8 kilometers (3 miles) of additional lanes to State Route 240 between Kennewick and Richland (completed in 2007) (WSDOT 2007, 2009a)
- Widening 4.8 kilometers (3 miles) of State Route 17 in Moses Lake (completed in 2007) (WSDOT 2006, 2009a)
- Constructing a new 16-kilometer (10-mile) road between Interstate 82 and State Route 397 in the Finley area (completed in 2008) (WSDOT 2006, 2009b)
- Realigning approximately 823 meters (2,700 feet) of the Naches River channel away from U.S. Route 12 in Yakima (completed in 2008) (WSDOT 2006, 2009a)
- Adding 4 kilometers (2.5 miles) of passing lanes to State Route 240 in Hanford (to be completed in 2009) (WSDOT 2007)
- Widening 13 kilometers (8 miles) of U.S. Route 12 between McDonald Road and the city of Walla Walla, Washington (to be completed in 2009) (WSDOT 2006, 2009b)

Some of the major development activities planned in Richland over the next several years are described below. Future development beyond the next several years is, for the most part, speculative.

Pacific Northwest National Laboratory (PNNL) has selected a parcel of land just north of Horn Rapids Road to construct a new Physical Sciences Facility to replace that which will be lost in the 300 Areas. The parcel, referred to as the "Horn Rapids Triangle," is adjacent to PNNL's existing campus and the Tri-Cities Science and Technology Park (DOE 2004d). Construction of the Physical Sciences Facility began in 2007 and is expected to be completed in 2010 (PNNL 2007). In addition, ground was broken for the new PNNL Biological Sciences Facility and Computational Sciences Facility in 2008. These facilities are expected to be completed in 2009 (PNNL 2008).

Plans have been approved for Richland's Washington State University Tri-Cities (WSU-TC) campus to more than double in size over the next 10 years. The campus, which borders the Columbia River in North Richland, serves about 1,200 students (Richland 2004). WSU-TC partnered with PNNL to open a new Bioproducts, Sciences, and Engineering Laboratory at its North Richland campus in 2008 (WSU 2008).

The Kadlec Medical Center and Columbia Basin Community College opened a new health science building near the Kadlec Medical Center campus in 2006 (Trumbo 2006). The Kadlec Medical Center broke ground in 2006 on a $70 million expansion of its Richland campus, including a six-story tower (Kadlec 2008; Richland 2006:4). The new tower was completed in 2008 (Kadlec 2008). The hospital's workforce has been increasing rapidly, with 500 new employees added in the past few years (Richland 2004).

Ground was broken on the Hanford Reach National Monument Heritage and Visitors Center on December 5, 2003. The $40 million center will include interpretive galleries, office space, classrooms, and a 220-seat auditorium, and will focus on increasing understanding and appreciation of the history and resources of the Hanford Reach and the Columbia River (Richland 2004). Construction is scheduled to begin in 2009, with dedication expected in 2010 (The Reach 2008).

The Red Mountain American Viticultural Area (AVA), established in 2001, is a 1,781-hectare (4,400-acre) federally designated grape- and wine-producing region on the south-facing slope of Red Mountain. There are 10 wineries in the AVA, with about 283 hectares (700 acres) currently planted in wine grapes; 10 more wineries are likely to be constructed in the next 5 years. Visitor projections show that, by the year 2025, the Red Mountain AVA will attract approximately 175,000 wine-oriented visitors—a nearly ninefold increase over the current level. Elements of the Red Mountain AVA Conceptual Plan include the expansion of existing vineyard and winery operations; a number of new wineries; new visitor-oriented facilities, including recreation and interpretive experiences; and additional development of adjacent areas. When fully developed, it is estimated that approximately 20 to 30 additional wineries will be located in the AVA (Benton County 2006:B-14, G-3, G-4).

Table R–4 shows the activities examined as potential contributors to cumulative impacts at Hanford, the sources used, and why activities were or were not carried forward for cumulative impacts analysis. This determination follows the methodology documented in Figure R–2. Future activities that are speculative or not well defined were not carried forward for analysis. The activities and their end states considered in the cumulative groundwater modeling are described in Appendix S.

A number of actions are considered in the cumulative transportation risk analysis that are not listed in Table R–4. These other actions are listed in Appendix T, Table T–4, and include transportation of radioactive materials and wastes in the United States from DOE and non-DOE activities. The transportation risk analysis considers information from recently released DOE NEPA documents, including the *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement* (DOE 2008b), *Revised Draft Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center* (DOE and NYSERDA 2008), and *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2008c). These actions are not considered elsewhere in the cumulative impacts analysis because (1) they do not include activities at Hanford, (2) the activities that would occur at Hanford are already considered in the *TC & WM EIS* alternatives, or (3) insufficient information is available to analyze their contribution to cumulative impacts at Hanford.

**Table R–4. Activities Considered for the Cumulative Impacts Analysis**

| | | | Evaluation Criteria[b] | | | | |
|---|---|---|---|---|---|---|---|
| **Activity** | **Source Document** | **Completion Date[a]** | **Reasonably Foreseeable?** | **Within the Regions of Influence?[c]** | **Within the Timeframe of *TC & WM EIS*?** | **Accounted for in Baseline?** | **Considered in *TC & WM EIS* Cumulative Impacts[d]?** |
| **DOE Activities** | | | | | | | |
| Cleanup and restoration activities across all areas of the Hanford Site | • *Draft Hanford Remedial Action EIS and Comprehensive Land Use Plan* (DOE 1996a)[e]<br>• *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a)<br>• *Hanford Site End State Vision* (DOE 2005b)<br>• *Plan for Central Plateau Closure* (Fluor Hanford 2004)<br>• *River Corridor Closure Project, TPA Quarterly Review for Period: December 2006–February 2007* (DOE, EPA, and Ecology 2007)<br>• *CERCLA Five-Year Review Report for the Hanford Site* (DOE 2006a)<br>• *River Corridor Closure Project, March 2007 Monthly Performance Report* (WCH 2007)<br>• *Cumulative Impact Data for "Tank Closure and Waste Management EIS"* (CEES 2006) | 2146 (DOE 1996a:S-12, S-20)<br><br>2035 (DOE 2002a:8)<br><br>2035 (Fluor Hanford 2004:ES-8) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |

## Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b] | | | | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| | | | Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | |
| Changes in land use at Hanford | • *Final Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a)<br>• "ROD: *Hanford Comprehensive Land-Use Plan EIS*" (64 FR 61615)<br>• *Supplement Analysis, Hanford Comprehensive Land-Use Plan EIS* (DOE 2008a)<br>• "Amended ROD for the *Hanford Comprehensive Land-Use Plan EIS*" (73 FR 55824)<br>• *Hanford Site End State Vision* (DOE 2005b) | 2050 (64 FR 61615) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |
| Decommissioning of the eight surplus production reactors and their support facilities in the 100 Areas along the Columbia River[f] | • *Draft EIS, Decommissioning of Eight Surplus Production Reactors at the Hanford Site* (DOE 1989)<br>• *Addendum (Final EIS), Decommissioning of Eight Surplus Production Reactors at the Hanford Site* (DOE 1992)<br>• "ROD: *Decommissioning of Eight Surplus Production Reactors at the Hanford Site*" (58 FR 48509)<br>• *Surplus Reactor Final Disposition Engineering Evaluation* (DOE 2005c)<br>• *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a)<br>• "DOI Designates B Reactor as a National Historic Landmark" (DOE and DOI 2008) | 2080 (DOE 1989:3.52) | Yes | Yes (on site) | Yes | No (five of the eight reactors have already been cocooned) | Yes |

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b]: Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| Decommissioning of the N Reactor and support facilities | • *Surplus Reactor Final Disposition Engineering Evaluation* (DOE 2005c) | 2068 (DOE 2005c:19) | Yes | Yes (on site) | Yes | No | Yes |
| Safe storage of surplus plutonium at the Plutonium Finishing Plant in the 200-West Area until it can be shipped to the Savannah River Site for disposition | • *Storage and Disposition of Weapons-Usable Fissile Materials Final PEIS* (DOE 1996b)<br>• "ROD: *Storage and Disposition of Weapons-Usable Fissile Materials Final PEIS*" (62 FR 3014)<br>• *Surplus Plutonium Disposition Final EIS* (DOE 1999b)<br>• "ROD: *Surplus Plutonium Disposition Final EIS*" (65 FR 1608)<br>• "Amended ROD: Storage of Surplus Plutonium Materials at the Savannah River Site" (72 FR 51807) | 2010 (72 FR 51807) | Yes | Yes (on site) | Yes | Yes (ongoing activity) | No |
| Deactivation of the Plutonium Finishing Plant in the 200-West Area | • *EA, Deactivation of the Plutonium Finishing Plant, Hanford Site* (DOE 2003b)<br>• *FONSI, "EA, Deactivation of the Plutonium Finishing Plant"* (DOE 2003c)<br>• *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a) | 2009 (DOE 2002a:A-20)<br><br>2009 (DOE 2003c:5-7) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b]: Reasonably Foreseeable? | Evaluation Criteria[b]: Within the Regions of Influence?[c] | Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*? | Evaluation Criteria[b]: Accounted for in Baseline? | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| Actions to empty the K Basins in the 100-K Area and implement dry storage of the fuel rods in the Canister Storage Building in the 200-East Area | • *Draft EIS, Management of Spent Nuclear Fuel from the K Basins at the Hanford Site* (DOE 1995b)<br>• *Addendum (Final EIS), Management of Spent Nuclear Fuel from the K Basins at the Hanford Site* (DOE 1996c)<br>• "ROD: *Management of Spent Nuclear Fuel from the K Basins at the Hanford Site*" (61 FR 10736)<br>• *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a) | 2036 (61 FR 10736) | Yes | Yes (on site) | Yes (note: the movement of K Basin spent nuclear fuel to the 200 Areas was completed in 2005) | No (ongoing activity) | Yes |
| Complete U Plant regional closure | • *Final Feasibility Study for the Canyon Disposition Initiative (221-U Facility)* (DOE 2004e)<br>• *Proposed Plan for Remediation of the 221-U Facility (Canyon Disposition Initiative)* (DOE 2004b)<br>• *ROD, "221-U Facility (Canyon Disposition Initiative)," Hanford Site* (DOE 2005d)<br>• *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a) | 2014 (DOE 2004e:K-14) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b]: Reasonably Foreseeable? | Evaluation Criteria[b]: Within the Regions of Influence?[c] | Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*? | Evaluation Criteria[b]: Accounted for in Baseline? | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| Final disposition of the canyons, PUREX Plant, PUREX tunnels, and other facilities in the 200 Areas and cleanup to Industrial-Exclusive land use standards | • *Plan for Central Plateau Closure* (Fluor Hanford 2004)<br>• *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a) | 2035 (DOE 2002a:8) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |
| Transport of sodium-bonded spent nuclear fuel to INL for treatment | • *Final EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE 2000b)<br>• "ROD for the *Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*" (65 FR 56565) | 2012 (DOE 2000b:4-21) | Yes | Yes (transportation corridors) | Yes | No | Yes |
| Deactivation of FFTF in the 400 Area | • *EA, Shutdown of the FFTF, Hanford Site* (DOE 1995c)<br>• *"Shutdown of the FFTF, Hanford Site," DOE, FONSI* (DOE 1995d)<br>• *EA, "Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, FFTF Project," Hanford Site* (DOE 2006b)<br>• *FONSI, "EA, Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, FFTF Project, Hanford Site"* (DOE 2006c)<br>• *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a) | 2016 (SAIC 2007a) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b] | | | | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| | | | Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | |
| Construction and operation of a PNNL Physical Sciences Facility | • *EA, Construction and Operation of a Physical Sciences Facility at PNNL* (DOE 2007a)<br>• *FONSI for "Construction and Operation of a Physical Sciences Facility at the PNNL"* (DOE 2007b) | Construction completed in 2010 (PNNL 2007) | Yes | Yes (on site) | Yes | No (relocation of activities from 300 Area) | Yes |
| Excavation and use of geologic materials from existing borrow pits | • *Final Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a)<br>• "*ROD: Hanford Comprehensive Land-Use Plan EIS*" (64 FR 61615)<br>• *EA, Use of Existing Borrow Areas, Hanford Site* (DOE 2001b)<br>• *FONSI, "Use of Existing Borrow Areas, Hanford Site"* (DOE 2001c)<br>• *EA, Reactivation and Use of Three Former Borrow Sites in the 100-F, 100-H, and 100-N Areas* (DOE 2003d)<br>• *FONSI, "Reactivation and Use of Three Former Borrow Sites in the 100-F, 100-H, and 100-N Areas"* (DOE 2003e)<br>• *Supplement Analysis, Hanford Comprehensive Land-Use Plan EIS* (DOE 2008a)<br>• "Amended ROD for the *Hanford Comprehensive Land-Use Plan EIS*" (73 FR 55824) | 2050 (64 FR 61615)<br><br>2011 (DOE 2001c)<br><br>2013 (DOE 2003e) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| | | | Evaluation Criteria[b] | | | | |
|---|---|---|---|---|---|---|---|
| **Activity** | **Source Document** | **Completion Date[a]** | **Reasonably Foreseeable?** | **Within the Regions of Influence?[c]** | **Within the Timeframe of *TC & WM EIS*?** | **Accounted for in Baseline?** | **Considered in *TC & WM EIS* Cumulative Impacts[d]** |
| Construction and operation of the Environmental Restoration Disposal Facility near the 200-West Area | • *Remedial Investigation and Feasibility Study Report for the Environmental Restoration Disposal Facility* (DOE 1994)<br>• *Proposed Plan for an Amendment to the Environmental Restoration Disposal Facility ROD, Hanford Site* (DOE 2001d) | 2024 (DOE 1994:9-23) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |
| Implementation of the programmatic waste management decisions described in the RODs for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* | • *Final Waste Management PEIS for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a)<br>• "ROD for the DOE's Waste Management Program: Treatment and Storage of Transuranic Waste" (63 FR 3629)<br>• "ROD for the DOE's Waste Management Program: Treatment of Non-wastewater Hazardous Waste" (63 FR 41810)<br>• "ROD for the DOE's Waste Management Program: Storage of High-Level Radioactive Waste" (64 FR 46661)<br>• "ROD for the DOE's Waste Management Program: Treatment and Disposal of Low-Level Waste and Mixed Low-Level Waste" (65 FR 10061) | 2017 (DOE 1997a) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b] | | | | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| | | | Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | |
| Implementation of the programmatic waste management decisions described in the RODs for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (continued)* | • "Revision to the ROD for the DOE's Waste Management Program: Treatment and Storage of Transuranic Waste" (65 FR 82985)<br>• "Revision to the ROD for the DOE's Waste Management Program: Treatment and Storage of Transuranic Waste" (66 FR 38646)<br>• "Revision to the ROD for the DOE's Waste Management Program: Treatment and Storage of Transuranic Waste" (67 FR 56989)<br>• "Revision to the ROD for the DOE's Waste Management Program: Treatment and Storage of Transuranic Waste" (69 FR 39446)<br>• "Revision to the ROD for the DOE's Waste Management Program" (70 FR 60508)<br>• "Amendment to the ROD for the DOE's Waste Management Program: Treatment and Storage of Transuranic Waste" (73 FR 12401) | 2017 (DOE 1997a) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b]: Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| Retrieval of suspect TRU waste buried after 1970 | • *EA, Transuranic Waste Retrieval from the 218-W-4B and 218-W-4C Low-Level Burial Grounds, Hanford Site* (DOE 2002b)<br>• *FONSI, "Transuranic Waste Retrieval from the 218-W-4B and 218-W-4C Low-Level Burial Grounds, Hanford Site"* (DOE 2002c)<br>• *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a)<br>• "Retrieval of Retrievably Stored TRU Waste from the Alpha Caissons" (SAIC 2007b) | 2007 (DOE 2002b)<br><br>2010 (DOE 2002a:47)<br><br>2018 (SAIC 2007b) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |
| Construction and operation of facilities for disposal of greater-than-Class C low-level radioactive waste | • "Notice of Intent to Prepare an *EIS for the Disposal of Greater-Than-Class C Low-Level Radioactive Waste*" (72 FR 40135) | Not available | Yes | Yes (if a disposal facility is located at Hanford) | Yes | No | Yes |
| Cleanup and protection of groundwater | • *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a)<br>• *CERCLA Five-Year Review Report for the Hanford Site* (DOE 2006a) | 2018 (DOE 2002a:A-33) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |
| Transport of TRU waste to WIPP near Carlsbad, New Mexico | • *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997b)<br>• "ROD for the DOE's *WIPP Disposal Phase*" (63 FR 3624) | 2033 (63 FR 3624) | Yes | Yes (transportation corridors) | Yes | No (ongoing activity) | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b]: Reasonably Foreseeable? | Evaluation Criteria[b]: Within the Regions of Influence?[c] | Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*? | Evaluation Criteria[b]: Accounted for in Baseline? | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| **Non-DOE Activities on Hanford Site** | | | | | | | |
| Transport of Navy reactor plants from the Columbia River and their disposal in trench 218-E-12B in the 200-East Area | • *Final EIS on the Disposal of Decommissioned, Defueled Cruiser, OHIO Class, and LOS ANGELES Class Naval Reactor Plants* (Navy 1996)<br>• "NEPA ROD for the *Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants*" (61 FR 41596) | 2029 (Navy 1996:S-11) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |
| Continued operation of the Columbia Generating Station (previously Washington Public Power Supply System, Nuclear Project No. 2) | • *Hanford Site Environmental Report for Calendar Year 2006* (Poston et al. 2007)<br>• *2004 Annual Report* (Energy Northwest 2004)<br>• *Columbia Generating Station 2005 Annual Radiological Environmental Operating Report* (Energy Northwest 2006) | 2026 (Energy Northwest 2004) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |
| Operation of the US Ecology commercial low-level radioactive waste disposal site near the 200-East Area | • *Final EIS for the Commercial Low-Level Radioactive Waste Disposal Site, Richland, Washington* (Ecology and WSDOH 2004)<br>• *Hanford Site Environmental Report for Calendar Year 2006* (Poston et al. 2007)<br>• *Annual Environmental Monitoring Report for Calendar Year 2006* (US Ecology 2007) | 2056 (Ecology and WSDOH 2004:i) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b] | | | | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| | | | Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | |
| Management of the Hanford Reach National Monument and Saddle Mountain National Wildlife Refuge | • *Hanford Reach of the Columbia River: Final River Conservation Study and EIS* (NPS 1994)<br>• ROD, *"Hanford Reach of the Columbia River Final EIS for Comprehensive River Conservation Study"* (DOI 1996)<br>• ROD, "Extension of the Saddle Mountain National Wildlife Refuge Acquisition Boundary" (64 FR 66928)<br>• *Hanford Reach Protection and Management Program Interim Action Plan* (CAP 1998)<br>• *"Establishment of the Hanford Reach National Monument"* (65 FR 37253)<br>• *Hanford Reach National Monument Final Comprehensive Conservation Plan and EIS* (USFWS 2008) | 2022 (USFWS 2008:i) | Yes | Yes (on site) | Yes | No (ongoing activity) | Yes |
| Operation of the Laser Interferometer Gravitational-Wave Observatory | • *Hanford Site Environmental Report for Calendar Year 2006* (Poston et al. 2007) | Not available | Yes | Yes (on site) | Yes | Yes (ongoing activity) | No |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b] | | | | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| | | | Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | |
| **Other Activities in the Region** | | | | | | | |
| Changes in land use in the region | • *Adams County Comprehensive Plan* (ACPC 2005)<br>• *Benton County Comprehensive Land Use Plan* (BCPC 2003)<br>• *Benton County Sustainable Development Overall Economic Development Plan* (BCPC 2006)<br>• *City of Richland Comprehensive Land Use Plan* (Richland 2002)<br>• *Preliminary Assessment of Redevelopment Potential for the Hanford 300 Area* (Richland 2005a)<br>• *City of Kennewick Comprehensive Plan 2006* (Kennewick 2006)<br>• *Franklin County Growth Management Comprehensive Plan* (Franklin County 2005)<br>• *Grant County Comprehensive Plan* (GCDCD 1999)<br>• *Kittitas County Comprehensive Plan* (Kittitas County 2001)<br>• *Klickitat County, Washington, Comprehensive Plan* (Dreyer 2007) | 2024 (Richland 2005b:1-1)<br><br>2025 (Kennewick 2006:23)<br><br>2018 (BCPC 2003)<br><br>2015 (Yakima County 1998)<br><br>2018 (GCDCD 1999)<br><br>2021 (Kittitas County 2001)<br><br>2026 (Benton County 2006:1)<br><br>2023 (Franklin County 2005)<br><br>2025 (Walla Walla County 2007:1-14) | Yes | Yes (various) | Yes | No (ongoing activity) | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b]: Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| Changes in land use in the region (*continued)* | • *Plan 2015: A Blueprint for Yakima County Progress* (Yakima County 1998)<br>• *Walla Walla County Integrated Comprehensive Plan and EIS* (Walla Walla County 2007) | | | | | | |
| Operation of the Perma-Fix Northwest (formerly Pacific Ecosolutions) waste treatment facility in Richland, Washington | • *EA, Non-thermal Treatment of Hanford Site Low-Level Mixed Waste* (DOE 1998a)<br>• *FONSI, "Non-thermal Treatment of Hanford Site Low-Level Mixed Waste"* (DOE 1998b)<br>• *Final EIS for Treatment of Low-Level Mixed Waste* (Richland 1998)<br>• *EA, Offsite Thermal Treatment of Low-Level Mixed Waste* (DOE 1999c)<br>• *EA*, *"Offsite Thermal Treatment of Low-Level Mixed Waste," FONSI* (DOE 1999d)<br>• *Hanford Site Environmental Report for Calendar Year 2006* (Poston et al. 2007)<br>• *Annual Environmental Monitoring Report for 2006* (Pacific Ecosolutions 2007) | 2019 (Richland 1998:1, 25) | Yes | Yes (0.8 km south) | Yes | No (ongoing activity) | Yes |
| Operation of the AREVA NP nuclear fuel fabrication facility in Richland, Washington | • *NRC Inspection Report No. 70-1257/2004-001* (NRC 2004) | Not available | Yes | Yes (directly south) | Yes | No (ongoing activity) | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b]: Reasonably Foreseeable? | Evaluation Criteria[b]: Within the Regions of Influence?[c] | Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*? | Evaluation Criteria[b]: Accounted for in Baseline? | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| Operation of the AREVA NP nuclear fuel fabrication facility in Richland, Washington (*continued)* | • *NRC Inspection Report No. 70-1257/2005-002* (NRC 2005)<br>• *Hanford Site Environmental Report for Calendar Year 2006* (Poston et al. 2007)<br>• *Supplement to Applicant's Environmental Report* (AREVA 2006) | Not available | Yes | Yes (directly south) | Yes | No (ongoing activity) | Yes |
| Operation of the Westinghouse Service Center decontamination facility in Richland, Washington | • *Hanford Site Environmental Report for Calendar Year 2006* (Poston et al. 2007) | Not available | Yes | Yes (1.5 km south) | Yes | No (ongoing activity) | Yes |
| Operation of the IsoRay medical facility in Richland, Washington | • "Results of 2006 Air Emissions Monitoring" (Boyce 2007) | Not available | Yes | Yes (1 km south) | Yes | No (ongoing activity) | Yes |
| Operation of the Moravek Biochemicals facility in Richland, Washington | • *Report on Compliance with the Clean Air Act Limits for Radionuclide Emissions* (Moravek 2005) | Not available | Yes | Yes (2 km south) | Yes | No (ongoing activity) | Yes |
| Cleanup of EPA NPL sites and state toxic waste sites | • *National Priorities List Sites in Oregon* (EPA 2006a)<br>• *National Priorities List Sites in Washington* (EPA 2006b)<br>• *Hazardous Sites List* (Ecology 2006a) | Various | Yes | Yes (various) | Yes | No (ongoing activity) | Yes |
| Oil and gas leasing and exploration | • *Leasing Washington State-Owned Lands for Oil and Gas Exploration* (WDNR 2007a) | Not applicable (ongoing) | Yes | Yes (various) | Yes | No (ongoing activity) | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b]: Reasonably Foreseeable? | Evaluation Criteria[b]: Within the Regions of Influence?[c] | Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*? | Evaluation Criteria[b]: Accounted for in Baseline? | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| Oil and gas leasing and exploration (*continued*) | • *Final Supplemental EIS on the Oil and Gas Leasing Program for State Lands* (WDNR 2005) | Not applicable (ongoing) | Yes | Yes (various) | Yes | No (ongoing activity) | Yes |
| Surface mining | • *Surface Mining Reclamation Program* (WDNR 2007b)<br>• *Directory of Washington State Surface Mining Reclamation Sites–2006* (WDNR 2006) | Not applicable (ongoing) | Yes | Yes (various) | Yes | No (ongoing activity) | Yes |
| Operation of the U.S. Army Yakima Training Center | • *Final Programmatic Environmental Impact Statement for Army Growth and Force Structure Realignment* (Army 2007) | Realignment complete in 2013 (Army 2007:iii) | Yes | Yes (10 km northwest) | Yes | No (ongoing activity) | Yes |
| DoD base realignment and closure—Umatilla Army Depot | • *2005 Defense Base Closure and Realignment Commission Report* (BRAC 2005)<br>• *Commission Makes More BRAC Decisions* (AFIS 2005) | 2011 (BRAC 2005:Ind-14) | Yes | Yes (55 km south) | Yes | No | Yes |
| Construction and operation of the Wanapa Energy Center | • *Wanapa Energy Center Final EIS* (BIA 2004)<br>• "Wanapa Energy Center: Notice of Availability of ROD" (70 FR 10612)<br>• *Generation and Interconnection Projects on Hold* (BPA 2008) | 2055 (BIA 2004:ES-14) | No; project on hold (BPA 2008) | Yes (48 km south) | Yes | No | No |
| Construction and operation of the Plymouth generating facility | • *Final EIS, Plymouth Generating Facility* (Benton and BPA 2003)<br>• ROD, *"Plymouth Generating Facility"* (68 FR 60342)<br>• *Generation and Interconnection Projects on Hold* (BPA 2008) | Not available | No; project on hold (BPA 2008) | Yes (40 km south) | Yes | No | No |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b] | | | | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| | | | Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | |
| Big Horn Wind Project | • *Supporting the Development of Wind Resources in the Pacific Northwest* (BPA 2005b)<br>• *Completed Wind Projects* (BPA 2007c)<br>• *ROD for the Electrical Interconnection of the Big Horn Wind Energy Project* (BPA 2005c)<br>• "PPM Announces 200 MW Big Horn Wind Project" (PPM Energy, Inc. 2005)<br>• *Renewable Energy Projects Serving Northwest Load* (RNP 2006) | Not available | Yes | Yes (72 km southwest) | Yes | No (ongoing activity) | Yes |
| Combine Hills II Wind Project | • *Supporting the Development of Wind Resources in the Pacific Northwest* (BPA 2005b)<br>• *Current Wind Projects* (BPA 2007a) | Not available | Yes | Yes (56 km southeast) | Yes | No | Yes |
| Desert Claim Wind Project | • *Desert Claim Wind Power Project, Final EIS* (Kittitas County 2004)<br>• *Desert Claim Wind Power Project - Revised* (EFSEC 2009) | Not available | Yes | Yes (72 km northwest) | Yes | No | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| | | | Evaluation Criteria[b] | | | | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| **Activity** | **Source Document** | **Completion Date[a]** | **Reasonably Foreseeable?** | **Within the Regions of Influence?[c]** | **Within the Timeframe of *TC & WM EIS*?** | **Accounted for in Baseline?** | |
| Wild Horse Wind Project | • *Supporting the Development of Wind Resources in the Pacific Northwest* (BPA 2005b)<br>• *Renewable Energy Projects Serving Northwest Load* (RNP 2006) | Not available | Yes | Yes (56 km northwest) | Yes | No (ongoing activity) | Yes |
| Designation of west-wide energy corridors | • *PEIS, Designation of Energy Corridors on Federal Land in the 11 Western States* (DOE and BLM 2008) | Not applicable | Yes | No | Yes | No | No |
| McNary–John Day transmission line project | • *McNary–John Day Transmission Line Project, Draft EIS* (BPA and DOE 2002a)<br>• *McNary–John Day Transmission Line Project, Abbreviated Final EIS* (BPA and DOE 2002b)<br>• *"McNary–John Day Transmission Line Project" ROD* (BPA and DOE 2002c)<br>• *Generation and Interconnection Projects on Hold* (BPA 2008) | 2003–2007 (BPA and DOE 2002c:1, 2) | No; project on hold (BPA 2008) | Yes (40 km south) | Yes | No | No |
| Columbia River Basin water management | • *Final PEIS for the Columbia River Water Management Program* (Ecology 2007a)<br>• *Upper Columbia Alternative Flood Control and Fish Operations, Columbia River Basin, Final EIS* (USACE 2006)<br>• *Potholes Reservoir Supplemental Feed Route Draft EA* (BOR 2007a)<br>• *Initial Alternative Development and Evaluation: Odessa Subarea Special Study* (BOR 2006a) | Ongoing management activities | Yes | Yes (various) | Yes | No (ongoing activity) | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b] | | | | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| | | | Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | |
| Priest Rapids Hydroelectric Project relicensing | • *Priest Rapids Project License Application, FERC No. 2114, Executive Summary* (Grant County PUD 2003)<br>• *Final EIS, Priest Rapids Hydroelectric Project, Washington* (FERC 2006a)<br>• *Order Issuing New License* (FERC 2008) | 2052 (FERC 2008) | Yes | Yes (6 km northwest) | Yes | No (upgrades not included in baseline) | Yes |
| Yakima River Basin water management (also see the next row on Black Rock Reservoir) | • *Sunnyside Division Board of Control, Water Conservation Program, Yakima Project, Washington: FONSI and Final EA* (BOR 2004a)<br>• *Phase I Assessment Report, Storage Dam Fish Passage Study, Yakima Project, Washington* (BOR 2005)<br>• *Supplemental Draft EIS, Yakima River Basin Water Storage Feasibility Study* (Ecology 2008) | Ongoing management activities | Yes | Yes (various) | Yes | No | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b]: Reasonably Foreseeable? | Evaluation Criteria[b]: Within the Regions of Influence?[c] | Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*? | Evaluation Criteria[b]: Accounted for in Baseline? | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| Construction and operation of the Black Rock Reservoir or Wymer Reservoir | • *Yakima River Storage Enhancement Initiative, Black Rock Reservoir Study* (WIS 2002)<br>• *Summary Report Appraisal Assessment of the Black Rock Alternative,* Executive Summary (BOR 2004b)<br>• *Yakima River Basin Storage Alternatives Appraisal Assessment* (BOR 2006b)<br>• *Recreation Demand and User Preference Analysis: A Component of Yakima River Basin Water Storage Feasibility Study* (BOR 2007b)<br>• *Potential Impacts of Leakage from Black Rock Reservoir on the Hanford Site Unconfined Aquifer* (Freedman 2008)<br>• *Modeling Groundwater Hydrologic Impacts of the Potential Black Rock Reservoir* (BOR 2007c)<br>• *One-Dimensional Hydraulic Modeling of the Yakima Basin* (Hilldale and Mooney 2007)<br>• *Yakima River Basin Storage Study, Wymer Dam and Reservoir Appraisal Report* (BOR 2007d)<br>• *Draft Planning Report/EIS, Yakima River Basin Water Storage Feasibility Study* (DOI and Ecology 2008) | 10-year construction period, 100-year operations period (McCartney 2007) | Yes | Yes<br>Black Rock Reservoir (8 km west); Wymer Reservoir (45 km northwest) | Yes | No | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b] | | | | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| | | | Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | |
| Construction and operation of water pipelines | • *Projects Near You* (FERC 2007a) | Not applicable | Yes | No | Yes | No | No |
| Construction and operation of biofuels facilities | • *Biofuel Development in Washington* (WSU 2007)<br>• *NorthWest Biofuels, Inc., SEPA Checklist* (CCH 2006)<br>• *SEPA Checklist for the Central Washington Biodiesel Ellensburg Plant* (Central Washington Biodiesel, LLC 2006)<br>• *Walla Walla County Mitigated Determination, of Non-significance,* Gen-X Energy Group Biodiesel Production Facility (WWCCDD 2006)<br>• *Determination of Non-significance,* Central Washington Biodiesel Ellensburg Plant (Ecology 2006b)<br>• *SEPA Environmental Checklist, Washington Ethanol Plant, Moses Lake, Washington* (Washington Ethanol, LLC 2006)<br>• "Biofuel or Ethanol Production" (Plummer 2007) | Various | Yes | Yes (various) | Yes | No | Yes |

**Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)***

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b]: Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| Construction and operation of biofuels facilities (*continued*) | • *Mitigated Determination of Non-significance, Moses Lake Ethanol Plant* (GCPD 2007)<br>• *SEPA Checklist for the Moses Lake Ethanol Plant* (Liquafaction Corporation 2007)<br>• *Mitigated Determination of Nonsignificance,* Washington Ethanol LLC Plant (Ecology 2007b)<br>• *SEPA Environmental Checklist for the Columbia Ethanol Plant* (Columbia Ethanol Plant Holdings, LLC 2006)<br>• *Revised SEPA Mitigated Determination of Nonsignificance for the Proposed Columbia Ethanol Facility* (Ecology 2006c)<br>• *Notice of Construction, Final Order of Approval No. 2006-0009,* Columbia Ethanol Plant Holdings, LLC (Benton Clean Air Authority 2007) | | | | | | |
| Construction and operation of natural gas terminals, pipelines, and storage projects | • *Projects Near You* (FERC 2007a)<br>• *Major Storage Projects on the Horizon* (FERC 2006b)<br>• *Major Pipeline Projects on the Horizon* (FERC 2007b)<br>• *Existing and Proposed North American LNG Terminals* (FERC 2007c) | Not applicable | Yes | No | Yes | No | No |

## Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

| Activity | Source Document | Completion Date[a] | Evaluation Criteria[b]: Reasonably Foreseeable? | Within the Regions of Influence?[c] | Within the Timeframe of *TC & WM EIS*? | Accounted for in Baseline? | Considered in *TC & WM EIS* Cumulative Impacts[d] |
|---|---|---|---|---|---|---|---|
| Regional road projects | • *Washington Projects* (WFLHD 2007)<br>• *Oregon Projects* (WFLHD 2006)<br>• *Making Every Dollar Count for Benton County* (WSDOT 2007)<br>• *Agency Projects: Highway, Ferry and Rail Construction and Improvement Projects* (WSDOT 2006, 2009b)<br>• *Agency Projects: Completed Projects* (WSDOT 2009a) | 2009 (WSDOT 2006, 2009a, 2009b) | Yes | Yes (various) | Yes | No | Yes |
| Regional rail projects | • *WSDOT Projects: Highway, Ferry and Rail Construction and Improvement Projects* (WSDOT 2006) | Not applicable | Yes | No | Yes | No | No |

[a] The "completion date" is the date the activity is expected to be completed. This information determines if the activity is within the same time period as the *TC & WM EIS* alternatives.

[b] These evaluation criteria are used to help determine if the activity should be considered in the *TC & WM EIS* cumulative impacts analysis. See Figure R–2 (Phase 2) for a description of how the criteria are used.

[c] Because regions of influence vary by resource, the action may lie outside the region of influence for one resource and within it for another. Distances measured using Google Earth Version 4.2.0198.2451.

[d] This column presents the results of the assessment performed in Phase 2 of Figure R–2 for each activity evaluated.

[e] Appendix A of the *Draft Hanford Remedial Action EIS and Comprehensive Land Use Plan* (DOE 1996a) describes the activities analyzed in that EIS. Page A-3 notes that decommissioning of major canyon facilities in the 200 Areas (i.e., T Plant, B Plant, and the PUREX Plant) are not included.

[f] B Reactor was recently designated a National Historic Landmark (DOE and DOI 2008). Therefore, B Reactor will not be decommissioned and moved to the Hanford Central Plateau for disposal as analyzed in the *Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington* (DOE 1989, 1992) and assumed in this *TC & WM EIS*.

**Note:** B Reactor was recently designated a National Historic Landmark (DOE and DOI 2008). Therefore, B Reactor will not be decommissioned and moved to the Hanford Central Plateau for disposal as analyzed in the *Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington* (DOE 1989, 1992) and assumed in this *TC & WM EIS.* To convert kilometers to miles, multiply by 0.6214.

**Key:** BRAC=Base Realignment and Closure; CERCLA=Comprehensive Environmental Response, Compensation, and Liability Act; DOE=U.S. Department of Energy; DoD=U.S. Department of Defense; DOI=U.S. Department of the Interior; EA=environmental assessment; EIS=environmental impact statement; EPA=U.S. Environmental Protection Agency; FERC=Federal Energy Regulatory Commission; FFTF=Fast Flux Test Facility; FONSI=Finding of No Significant Impact; INL=Idaho National Laboratory; km=kilometers; MW=megawatt; NEPA=National Environmental Policy Act; NPL=National Priorities List; NRC=Nuclear Regulatory Commission; *PEIS=Programmatic Environmental Impact Statement;* PNNL=Pacific Northwest National Laboratory; PPM=Pacific Core Power Marketing, Inc.; PUREX=Plutonium-Uranium Extraction; ROD=Record of Decision; SEPA=State Environmental Policy Act; *TC & WM EIS=Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*; TPA=Tri-Party Agreement; TRU=transuranic; WIPP=Waste Isolation Pilot Plant; WSDOT=Washington State Department of Transportation.

## R.13 REFERENCES

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