Cover Sheet

Lead Federal Agency: U.S. Department of Energy (DOE)

Cooperating Agencies: U.S. Department of the Interior (Bureau of Land Management, Bureau of Reclamation, and U.S. Fish and Wildlife Service); Benton, Franklin, and Grant counties; and the City of Richland, Washington

Consulting Tribal Governments: Nez Perce Tribe Department of Environmental Restoration and Waste Management and the Confederated Tribes of the Umatilla Indian Reservation

***Title**: Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (HCP EIS), Hanford Site, Richland, Washington

Contacts: For further information on this EIS call or contact:

Thomas W. Ferns, HCP EIS Document Manager
U.S. Department of Energy, Richland Operations Office
P.O. Box 550, MSIN HO-12
Richland, Washington 99352
(509) 372-0649 or thomas_w_ferns@rl.gov
Fax: (509) 376-4360

For general information on DOE's *National Environmental Policy Act of 1969* (NEPA) process, call 1-800-472-2756 to leave a message, or contact: Carol Borgstrom, Director, Office of NEPA Policy and Assistance (EH-42), U.S. Department of Energy, 1000 Independence Avenue SW, Washington, D.C. 20585, (202) 586-4600.

Abstract: The DOE prepared this *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (HCP EIS) to evaluate the potential environmental impacts associated with implementing a comprehensive land-use plan for the Hanford Site for at least the next 50 years. With the exception of the required No-Action Alternative, each of the six alternatives presented represents a Tribal, Federal, state, or local agency's Preferred Alternative. Each alternative is presented separately. The DOE's Preferred Alternative anticipates multiple uses of the Hanford Site, including: consolidating Waste Management operations in the Central Plateau, allowing industrial development in the eastern and southern portions of the Site, increasing recreational access to the Columbia River, and expanding the Saddle Mountain National Wildlife Refuge to include all of the Wahluke Slope and ALE (managed by the U.S. Fish and Wildlife Service).

The Hanford Site occupies 1,517 square kilometers (km^2) (586 square miles [mi^2]) in southeastern Washington. Today, the Hanford Site has diverse missions associated with environmental restoration, Waste Management, and Science and Technology. These missions have resulted in the growing need for a comprehensive, long-term approach to planning and development for the Site.

Public Comments: The Final EIS is a revision of the *Revised Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land-Use Plan* (HRA-EIS) published in April 1999 and responds to comments received in writing and at public hearings. The Final EIS is being transmitted to commenting agencies and individuals, made available to the public, and filed with the Environmental Protection Agency (EPA). A DOE decision on proposed actions will not be made earlier than 30 days after EPA issues a public notice of availability for the Final EIS. The DOE will issue a Record of Decision (ROD) published in the *Federal Register*.

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Foreword[1]

Objective of the EIS

This Final HCP EIS was prepared by the Department of Energy (DOE) and its nine cooperating and consulting agencies to develop a comprehensive land-use plan (CLUP) for the Hanford Site. The DOE will use the Final HCP EIS as a basis for a Record of Decision (ROD) on a CLUP for the Hanford Site. While development of the CLUP will be complete with release of the HCP EIS ROD, full implementation of the CLUP is expected to take at least 50 years.

Implementation of the CLUP will begin a more detailed planning process for land-use and facility-use decisions at the Hanford Site. The DOE will use the CLUP to screen proposals. Eventually, management of Hanford Site areas will move toward the CLUP land-use goals. This CLUP process could take more than 50 years to fully achieve the land-use goals.

The final CLUP will consist of the following:

A Final Land-Use Map, depicting the desired future patterns of land use on the Hanford Site. This map will be one of the alternative land-use maps presented in the EIS, or a map that combines features of several of the alternatives maps such as the new Preferred Alternative based on public comment.

Land-Use Definitions, describing the purpose, intent, and principal use(s) of each land-use designation on the final CLUP map.

Land-Use Policies, directing land-use actions. These policies will help to ensure that individual actions of successive managers collectively advance the adopted CLUP map, goals, and objectives over time.

Land-Use Implementing Procedures, including:

- Administrative procedures for reviewing and approving requests for use of Hanford Site lands.

- A Site Planning Advisory Board (SPAB), consisting of representatives from DOE, the cooperating agencies with land-use authority, and the affected Tribes, to evaluate and make recommendations on development proposals and land-use requests. It is anticipated that some requested activities will be permitted under the plan, but that others will need to be modified or required to incorporate mitigation to reduce potential impacts.

- New or revised "area" and "resource" management plans for the Site aligned and coordinated with the new land-use maps, policies and procedures of the adopted CLUP.

[1]Vertical lines in the margins like these to the right indicate where changes have been made since the publication of the Revised Draft HRA-EIS in April, 1999.

Integration of the CLUP

The process described above would be integrated with existing DOE land-use review procedures (e.g., the Draft *Biological Resources Management Plan* and the Draft *Cultural Resources Management Plan*). The final CLUP map, policies, and implementing procedures would be integrated with and addressed at the threshold decision points of all authorizations, operational plans, and actions, including contracts and budget proposals that directly or indirectly affect land use so that they would not create unintentional conflicts with the CLUP, or fail to advance CLUP objectives where the opportunity and ability to do so exists.

The DOE would have the final approval of all land-use decisions taking place on the Hanford Site while under DOE responsibility. The DOE Richland Operations Office would coordinate review of Hanford land development and land-use requests and determine, with input from the SPAB, whether a request represents an *allowable use*, *special use*, or whether the request would require an *amendment* to the CLUP.

Cooperating Agencies and Consulting Tribal Governments

The nine cooperating agencies and consulting Tribal governments that participated in the preparation of this Final HCP EIS are the U.S. Department of the Interior (Bureau of Land Management [BLM], Bureau of Reclamation [BoR], and the U.S. Fish and Wildlife Service [USFWS]); the City of Richland, Washington; Benton, Franklin, and Grant counties; the Nez Perce Tribe, Department of Environmental Restoration and Waste Management; and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR).

The HCP EIS Alternatives

Six land-use alternatives (including the No-Action) were developed by the nine Cooperating Agencies and Consulting Tribal Governments using common land-use designations and definitions. With the exception of the No-Action Alternative, each of the six alternatives presented represents a Tribal, Federal, state, or local agency's Preferred Alternative.

No-Action Alternative. This alternative, developed by DOE in compliance with the *National Environmental Policy Act of 1969* (NEPA), presents the current status of land use at the Hanford Site and represents no change from current land-management processes or intergovernmental relationships with the cooperating agencies. Specific land-use decisions for Hanford would continue to be made under the NEPA process and the Tri-Party Agreement, based on the current *Hanford Strategic Plan* (Mission Plan) and on a project-by-project basis.

DOE's Preferred Alternative. DOE's Preferred Alternative anticipates multiple uses of the Hanford Site, including anticipated future DOE missions, non-DOE Federal missions, and other public and private-sector land uses. The DOE Preferred Alternative would do the following:

- *For the cleanup mission* – Consolidate Waste Management operations on 50.1 km^2 (20 mi^2) in the Central Plateau of the Site.

- *For the economic development mission* – Allow industrial development in the eastern and southern portions of Hanford and increase recreational access to the Columbia River.

- *For the Natural Resource Trustee mission* – Expand the existing Saddle Mountain National Wildlife Refuge to include all of the Wahluke Slope (North Slope) of the Site, consistent with the 1994 Hanford Reach EIS and 1996 Hanford Reach ROD; place the Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE Reserve) under USFWS management by permit so it may be included in the overlay wildlife refuge, add McGee Ranch to the overlay wildlife refuge; and ensure that, where practicable, withdrawn BLM lands are clean enough to support BLM's multiple-use mandate.

Alternative One (Natural Resource Trustee). The USFWS's alternative emphasizes a Federal stewardship role for managing the natural resources at Hanford. This alternative considers these resources in a regional context, and would expand the existing Saddle Mountain National Wildlife Refuge to include all of the Wahluke Slope (North Slope), the Riverlands, McGee Ranch, and the ALE Reserve (e.g., all of the Hanford lands north and east of the Columbia River and west of State Highways 24 and 240). The vision of Alternative One is to conserve the Hanford Site shrub-steppe ecosystem and protect the Hanford Reach of the Columbia River.

Alternative Two (Nez Perce Tribe, Environmental Restoration and Waste Management Department). This Nez Perce alternative calls for preservation of natural and cultural resources and traditional Tribal use at the Site. Future DOE missions would be constrained to the Central Plateau, 300 Area, and 400 Area. Both this alternative and Alternative Four (developed by the CTUIR) reflect Tribal visions and views of Tribal members' treaty rights and traditional Tribal uses of Hanford lands. The Tribes and DOE have "agreed to disagree" on the interpretation of treaty rights on Hanford lands in the interest of moving the EIS process forward. Each party reserves the right to assert its respective interpretation of treaty rights at Hanford.

Alternative Three (Cities and Counties). This local governments' alternative is based on the individual planning efforts of local agencies and organizations including Benton County, Franklin County, Grant County, and the City of Richland. Alternative Three recognizes the potential that land use at the Hanford Site has in relation to economic development. Alternative Three would allow dryland (non-irrigated) agricultural and grazing activities, and irrigated agriculture on the Hanford Site. The land-use designations contained in Alternative Three were developed consistent with local availability of infrastructure, nearness of urban areas, soils capabilities, and current use patterns.

Alternative Four (Confederated Tribes of the Umatilla Indian Reservation, CTUIR). This CTUIR alternative calls for preservation of natural resources and areas of religious importance to the CTUIR as well as traditional Tribal use at the Site. Both this alternative and Alternative Two (developed by the Nez Perce Tribe, Environmental Restoration and Waste Management Department) reflect Tribal visions and views of Tribal members' treaty rights and traditional Tribal uses of Hanford lands. The Tribes and DOE have "agreed to disagree" on the interpretation of treaty rights on Hanford lands in the interest of moving the EIS process forward. Each party reserves the right to assert its respective interpretation of treaty rights at Hanford.

Public Comment

The DOE received more than 400 comment letters, 30 E-mails, and 86 transcript comments from four public hearings on the Revised Draft HRA-EIS. The DOE also accepted a binder with 922 endorsements for the Wild and Scenic River (with the inclusion of a Wahluke Wildlife Refuge) that were collected for the Department of the Interior's Hanford Reach EIS in 1994. More than 200 request forms for farmland on the Wahluke Slope (also generated for the Hanford Reach EIS in 1994) were accepted in the same spirit. Each of these signaturegathering efforts were assigned only one comment number. Based on the public comment received, the following changes have been made to the DOE's Preferred Alternative:

- All Conservation (Mining and Grazing) has been changed to Conservation (Mining).
- The National Wildlife Refuge designation (from Alternative One) has been extended to include the ALE Reserve, the Riverlands, and McGee Ranch; and all river islands not in Benton County. The Preferred Alternative clarifies that the refuge will be an overlay wildlife refuge (without a transfer of title from DOE), and that DOE retains the right to mine the ALE insert for cover materials.
- A railroad right-of-way through the Riverlands portion of the proposed Refuge will be given status as a preexisting condition and included in the proposed USFWS permit to manage the Refuge.
- The White Bluffs town-site (from Alternatives One and Three) has been added to the Preferred Alternative map as Low-Intensity Recreation to serve as the White Bluffs Memorial.
- The Low-Intensity Recreation dots (comfort stations) along the river which could eventually serve as anchor points for a river trail from Richland to Vernita Bridge have been moved to ensure that they have both river and road access.
- A High-Intensity Recreation triangle (from Alternative Three) has been added to the Preferred Alternative map near Horn Rapids Park on the Yakima River

In addition to changes made to the Preferred Alternative, and the identifying of Alternative One as the environmentally preferable alternative, many other changes were made to the document updating items, refining analyses, and correcting errors. Each change in the Final EIS from the Revised Draft EIS is identified by vertical line on the outside margin of the page such as the one that accompanies this paragraph.

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Preamble

In response to public comment, the U.S. Department of Energy (DOE) has changed the name of this environmental impact statement (EIS) from the *Hanford Remedial Action Environmental Impact Statement and Comprehensive Land-Use Plan* (HRA-EIS) to the **Hanford Comprehensive Land-Use Plan EIS (HCP EIS)**. In the Notice of Intent in 1992, establishing future land uses was listed as one of the HRA-EIS objectives. Since that time, various considerations have led to this Final HCP EIS in which future land use is now the EIS's main objective. To reflect this reduction in scope from the 1996 Draft HRA-EIS, DOE solicited comments on the proposed name change (as well as the contents), and in response to comments has changed the name to the HCP EIS.

Originally, this EIS was intended to provide an environmental review under the *National Environmental Policy Act of 1969* (NEPA) for all aspects of the developing Hanford Environmental Restoration Project. The document, however, no longer directly considers remediation issues. Instead, remediation issues are now integrated into specific Tri-Party Agreement remediation decision documents. Remediation decisions are made by the U.S. Environmental Protection Agency and the State of Washington, as lead regulatory agencies, and DOE as lead implementing agency. The DOE does expect that the EIS process will assist Hanford remediation efforts by determining reasonably foreseeable land uses and establishing land-use decision-making processes to ensure the viability of any future institutional control that might be required.

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Acronyms and Initialisms

ac	acres
AEA	*Atomic Energy Act*
AEC	Atomic Energy Commission
ALE	Fitzner/Eberhardt Arid Lands Ecology Reserve
AMP	area management plan
ATG	Allied Technology Group
BLM	Bureau of Land Management
BoR	Bureau of Reclamation
BPA	Bonneville Power Administration
BRMA	B Reactor Museum Association
BRMaP	Biological Resources Management Plan
BRMiS	Biological Resources Mitigation Strategy Plan
CAA	*Clean Air Act of 1970*
CAAA	*Clean Air Act Amendments of 1990*
CBC	Columbia Basin College
CBRP	Columbia Basin Reclamation Project
CCP	Comprehensive Conservation Plan
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CLUP	comprehensive land-use plan
CRADA	Cooperative Research & Development Agreement
CRMP	Cultural Resources Management Plan
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
D&D	decontamination and decommissioning
DCGL	derived concentration guide level
DOE	U.S. Department of Energy
DOH	Department of Health (State of Washington)
DOI	U.S. Department of the Interior
DSTs	double-shell tanks
DWS	drinking water standard
Ecology	Washington State Department of Ecology
EIS	environmental impact statement
EM	Environmental Management
EMSL	Environmental Molecular Sciences Laboratory
Energy Northwest	formerly known as the Washington Public Power Supply System (WPPSS)
EPA	U.S. Environmental Protection Agency
EPZ	emergency planning zone
ERDF	Environmental Restoration Disposal Facility
ERWM	(Nez Perce Tribe) Environmental Restoration and Waste Management (Program)
ESU	Evolutionary Significant Units
EUZ	exclusive-use zone
FFCA	*Federal Facilities Compliance Act of 1992*

1	FFTF	Fast Flux Test Facility
2	FLEFA	*Federal Land Exchange Facilitation Act of 1988*
3	FLPMA	*Federal Land Policy and Management Act of 1976*
4	RI/FS	remedial investigation/feasibility study
5	FONSI	finding of no significant impact
6	Working Group	Future Site Uses Working Group
7	GIS	Geographic Information System
8	GMA	*Growth Management Act*
9	GSA	General Services Administration
10	ha	hectares
11	HAB	Hanford Advisory Board
12	HAMMER	Hazardous Materials Management and Emergency Response
13	HAP	hazardous air pollutants
14	HCP EIS	*Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (formerly named the *Hanford Remedial Action Environmental Impact Statement and Comprehensive Land-Use Plan* [HRA-EIS])
15	HCRL	Hanford Cultural Resources Laboratory
16	HEHF	Hanford Environmental Health Foundation
17	HGIS	Hanford Geographic Information System (database)
18	HMS	Hanford Meteorological Station
19	I&I	irreversible and irretrievable
20	ICBEMP	Interior Columbia Basin Ecosystem Management Project
21	ILCR	incremental lifetime cancer rate
22	INEEL	Idaho National Engineering and Environmental Laboratory
23	km^2	square kilometers
24	LIGO	Laser Interferometer Gravitational-Wave Observatory
25	LLW	low-level waste
26	MCL	maximum contamination level
27	MEI	maximally exposed individual
28	mi^2	square miles
29	MMI	Modified Mercalli Intensity
30	MOA	Memorandum of Agreement
31	MTCA	*Model Toxics Control Act of 1989*
32	MOX	mixed oxide
33	NAAQS	National Ambient Air Quality Standards
34	NARM	naturally occurring and accelerator-produced radioactive materials
35	NCO	NEPA Compliance Officer
36	NCP	National Contingency Plan
37	NEPA	*National Environmental Policy Act of 1969*
38	NERP	National Environmental Research Park
39	NOA	Notice of Availability
40	NOI	Notice of Intent
41	NPA	*Northwest Power Act*
42	NPDES	National Pollutant Discharge Elimination System
43	NPL	National Priorities List
44	NPPC	Northwest Power Planning Council
45	NPS	U.S. National Park Service
46	NWR	National Wildlife Refuge

ORP	Office of River Protection (formerly Tank Waste Remediation System [TWRS])
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PFP	Plutonium Finishing Plant
PNNL	Pacific Northwest National Laboratory
PSD	Prevention of Significant Deterioration
PUD	Public Utility District
PUREX	Plutonium-Uranium Extraction
R&D	research and development
RCRA	*Resource Conservation and Recovery Act of 1976*
RCW	*Revised Code of Washington*
REO	Real Estate Officer
RL	(U.S. Department of Energy) Richland Operations Office
RMP	resource management plan
ROD	Record of Decision
SALDS	state-approved land disposal structure
SARA	*Superfund Amendments and Reauthorization Act of 1986*
SDWA	*Safe Drinking Water Act of 1974*
SEPA	*State Environmental Policy Act of 1971*
SHPO	State Historic Preservation Office
SMB	Site Management Board
SPAB	Site Planning Advisory Board
SRS	Savannah River Site
SSTs	single-shell tanks
TAP	toxic air pollutants
THPO	Tribal Historic Preservation Officer
TPA	Tri-Party Agreement
TRIDEC	Tri-City Industrial Development Council
TSCA	*Toxic Substances Control Act of 1976*
TSD	treatment, storage and disposal
TSP	total suspended particulates
TWRS	Tank Waste Remediation System (now known as the Office of River Protection [ORP])
UBC	Uniform Building Code
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WAC	*Washington Administrative Code*
WCAA	*Washington Clean Air Act of 1991*
WDFW	Washington Department of Fish and Wildlife
WIDS	Waste Information Data System (database)
WNP-2	Washington Nuclear Plant Number 2
WSU-TC	Washington State University - Tri-Cities

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1.0 Introduction[2]

Coordinated land-use planning is one of the many trustee responsibilities the U.S. Department of Energy (DOE) has, as a Federal agency holding Federal assets. This *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (HCP EIS) considers several land uses for the Hanford Site planned for at least the next 50 years. As Hanford cleanup progresses through the next 40 years, cleanup Records of Decision (RODs) issued under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) and decisions made through the *Resource Conservation and Recovery Act of 1976* (RCRA) permitting process will impact some areas within the proposed land uses. Likewise, other DOE missions, such as research and development (R&D), might be collocated at Hanford because of DOE's continued Federal presence as the long-term caretaker of CERCLA/RCRA or low-level waste (LLW) disposal sites. Other DOE missions ,such as economic development or even other Federal mandates such as natural resource protection, could also impact Hanford land uses.

As with all Federal activities, where, when, and how quickly Hanford waste sites are remediated and proposed land uses are achieved depends on Congressional funding. It is DOE's responsibility to include in its annual budget request sufficient funds for applicable environmental requirements. The Tri-Party Agreement, which defines the schedule for clean-up activities at the Hanford Site is one source of such requirements, and is itself dependent on Congressional funding. These cleanup activities are an important factor in determining when, or even if, proposed land uses might be fulfilled.

The DOE has prepared this HCP EIS to evaluate the potential environmental impacts associated with implementing a comprehensive land-use plan (CLUP) for the Hanford Site for at least the next 50 years. The DOE is expected to use this land-use plan in its decision-making process to establish what is the "highest and best use" of the land (41 *Code of Federal Regulations* [CFR] 101-47, "Federal Property Management Regulations"). The final selection of a land-use map, land-use policies, and implementing procedures would create the working CLUP when they are adopted through the ROD for this EIS.

Creating this land-use plan benefits DOE in several ways:

- As a Natural Resource Trustee, DOE is encouraged by the Council on Environmental Quality (CEQ) to further the goals of biodiversity and actively manage the land's intrinsic resources.

- Federal law and Executive Orders require that executive agencies hold only that land necessary to economically and efficiently support agency missions.[3]

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[2] Vertical lines in the margins like these to the right indicate where changes have been made since the publication of the Revised Draft HRA-EIS in April, 1999.

[3] Specifically, Executive Order 12512, *Federal Real Property Management*, requires executive agencies to ensure the effective use of real property in support of mission-related activities. Also, to stimulate the identification and reporting of excess real property and to achieve maximum utilization, the *Federal Property and Administrative Services Act of 1949*, as amended, requires all executive agencies to periodically review their real property holdings. These reviews identify property which is "not needed," "underutilized," or "not being put to optimum use." Property determined to be excess should be promptly reported to the Federal General Services Administration (DOE 1997b).

- DOE is required to develop a future use plan for the Hanford Site by 42 U.S.C. 7274k (Public Law 104-201, Section 3153, *National Defense Authorization Act for Fiscal Year 1997*).

- DOE's *Land- and Facility-Use Policy* is to develop a comprehensive plan to support the Department's critical missions, stimulate the economy, and protect the environment.

- A land-use plan provides a means for coordinating planning and plan implementation with Tribal governments and local jurisdictions, as well as facilitating site and infrastructure transition and privatization activities.

- A land-use plan formed with cooperating agencies and consulting Tribal governments establishes a planning baseline for the Hanford Site in a regional context, from which DOE and stakeholders can deliberate from, and depart on new future directions.

- Completing this HCP EIS and subsequent publication of the ROD finalizes the Hanford Future Site Uses Working Group (Working Group) process begun in 1992 as scoping for this EIS.

- This land-use plan can be used by the regulators to establish goals for the CERCLA/RCRA cleanup (i.e., remediation) processes (see Table 1-3). Remediation will be conducted under CERCLA/RCRA authority. If the remediation process cannot support the proposed land use within the National Contingency Plan's (NCP's) 10^{-4} to 10^{-6} risk range, then this EIS contains a proposed process for changing the "highest and best use" of the land while maintaining institutional controls (see Chapter 6).

In this EIS, DOE is working with Tribal governments and Federal, state, and local agencies to develop several land-use alternatives – specifically, the potential environmental consequences associated with each alternative – for at least the next 50-year time frame. These individual land-use plans, together with a common set of policy statements, represent the distinct alternatives developed by the cooperating agencies and consulting Tribal governments on this document. The cooperating agencies are the U.S. Department of the Interior (DOI), which includes the Bureau of Land Management (BLM), Bureau of Reclamation (BoR), and U.S. Fish and Wildlife Service (USFWS); Benton, Franklin, and Grant counties; and the City of Richland. The consulting Tribal governments are the Nez Perce Tribe Department of Environmental Restoration and Waste Management (Nez Perce Tribe) and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR).

With the exception of the required No-Action Alternative, each alternative presented represents a Tribal, Federal, state, or local agency's Preferred Alternative. Each alternative is presented independently. Effort was taken to present each alternative with equal measure to encourage public comment.

This CLUP's authority is limited to as long as DOE retains legal control of some portion of the real estate. This EIS does not contain any new mechanisms or preferences regarding the transfer of land, but with input from the cooperating agencies and consulting Tribal governments, this EIS would continue to be useful for considering proposals regarding Hanford lands that might be transferred beyond the control of DOE. This EIS is not focused on land transfer, but rather speaks to the integrated use and management of land and resources independent of who owns the land. Land transfer is a complicated and separate process from the CLUP and once property leaves DOE control, DOE has no more authority over the use of that land unless the property was conveyed with deed or other legal restrictions. For more information about the process for transferring property, see Section 1.4.3.

The HCP EIS provides environmental review for the following DOE actions:

- Designation of existing and future land uses, and land-use policies and implementing procedures, through the adoption of a CLUP for the Hanford Site.

- Incorporation of site-specific CERCLA RODs into a regional land-use planning process.

1.1 Historic Background

The Hanford Site is a geographically diverse land area in southeastern Washington State. A large area of pristine shrub-steppe habitat, the Hanford Site is bisected by the last free-flowing stretch of the Northwest's Columbia River. In contrast, the Hanford Site is also included on the CERCLA National Priorities List (NPL) of contaminated sites. About 4 percent of the Site is surface contaminated, and 30 percent of the Site overlays contaminated groundwater from the past production of defense nuclear materials.

The Hanford Site occupies 1,517 square kilometers (km^2) (586 square miles [mi^2]) in the southeastern portion of the State of Washington (see text box, *"How Big is Hanford?"* and Figure 1-1, Location of the Hanford Site). Figure 1-2 shows the names and locations of local landmarks that are referenced throughout this EIS. Within the geographic boundary of the Site, there are 36.42 km^2 (14.1 mi^2) of Columbia River surface water and one section (1 mi^2) of land owned by the State of Washington. Established by the Federal government in 1943, the Hanford Site is owned by the Federal government and is managed by the U.S. Department of Energy, Richland Operations Office (RL).

1.1.1 Early Land Use of the Region

The Hanford Site is located within the Pasco Basin, a unique feature of the Columbia Plateau. The basin is the only area along the mid-Columbia River where the river is not confined within a gorge. Instead, the river is bounded by wide expanses of uplands. During the pre-contact era, these uplands contained abundant natural resources, including native plants, wildlife, and geologic resources. In addition, the Pasco Basin is where the Snake River and the Yakima River join the Columbia River, providing a wealth of riparian areas as well as an excellent means of transportation throughout the semiarid inland northwest. These rivers once contained enormous fisheries of salmon, steelhead, sturgeon, eels, freshwater clams, and other aquatic resources.

How Big is Hanford?

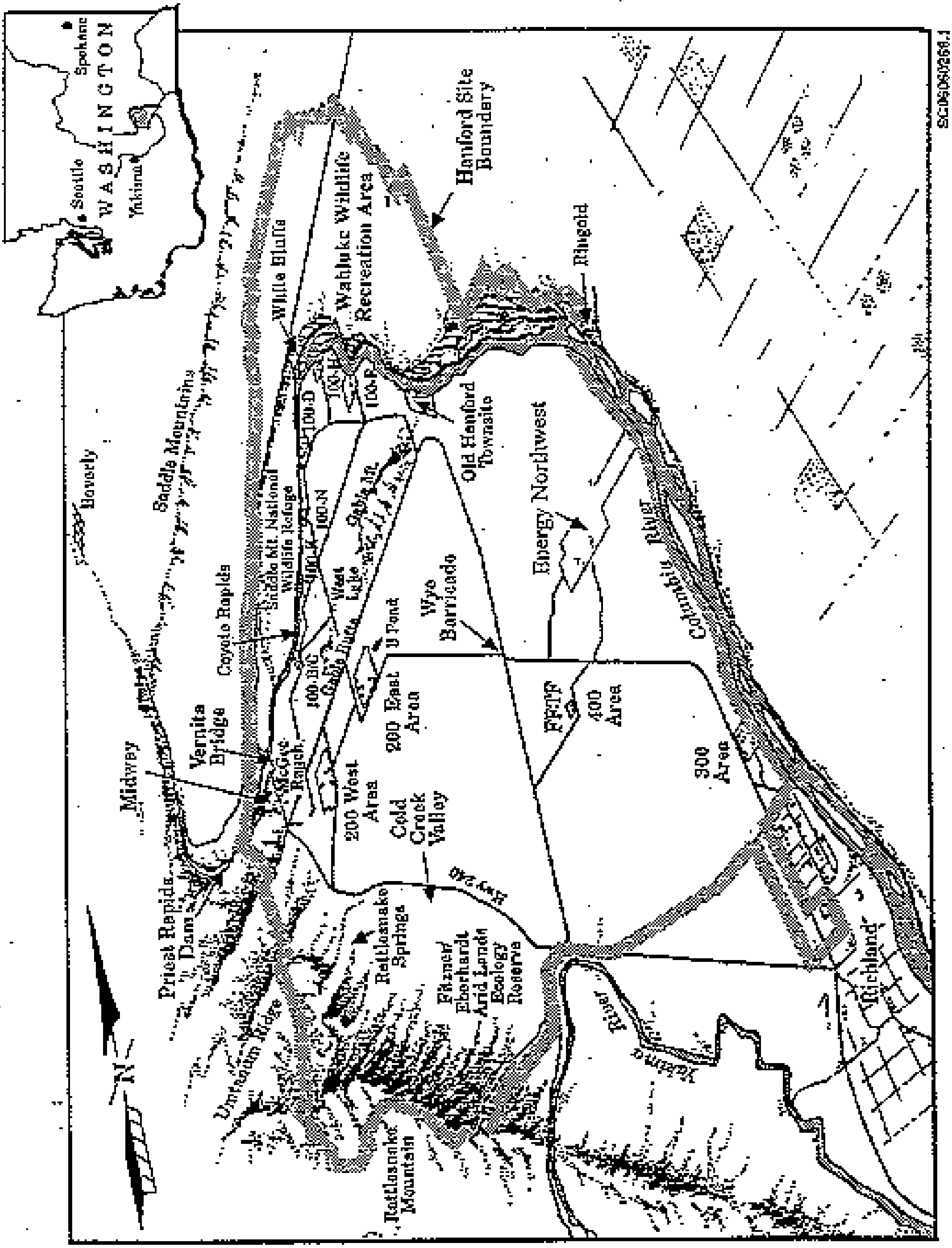
The Hanford Site boundary encloses 1,517 square kilometers (km^2) (586 square miles [mi^2]) based on the newest GIS interpolation of the legal site boundary. Historically the site area of 1,450 km^2 (560 mi^2) was calculated by addition of sections and their subunits based on surveys from the 1800's. Included within the Site is 36.42 km^2 (14.1 mi^2) of Columbia River surface water and one square mile of Washington State land. A square mile is 1,609 meters (5,280 feet) to a side. A square mile is also known as a section, equal to 259.2 hectares (ha) (640 acres [ac]). Typically, in eastern Washington agriculture, four 65-ha (160-ac), center-pivot circle irrigation systems would occupy each section.

In this document, all measurements are in metric units, followed by the British equivalents. The DOE's documents use metric units as required by Executive Order 12770, Metric Usage in Federal Government Programs"; the *Metric Conversion Act of 1975* (Public Law 94-168, as amended by Public Law 100-418); and various Title 15, *Code of Federal Regulations*.

Figure 1-1. Location of the Hanford Site.

BHErpp 01/13/98 draft_2/region1.aml Database: 03-AUG-1998

Figure 1-2. Hanford Site Local Names and Landmarks.



These physical features of the Pasco Basin made the basin highly attractive to American Indian Tribes. Archeologic evidence has demonstrated their presence in the area for more than 10,000 years. Tribal oral histories confirm that Tribes have been in the region for a very great period of time. The near-shore areas of these rivers contain many village sites, fishing and fish processing sites, hunting areas, plant gathering areas, and religious sites, while upland areas were used for hunting, plant gathering, religious practices, and overland transportation.

For at least the past several thousand years, the Pasco Basin was a major economic hub in the larger Columbia River Basin trading region. The Pasco Basin's location along the main travel corridor between Puget Sound and the Great Plains meant American Indian Tribes in the area were extensively involved in inter-regional economic activity. As a result, the Pasco Basin was relatively densely populated and contained a diversity of Tribes and bands (Figure 1-3).

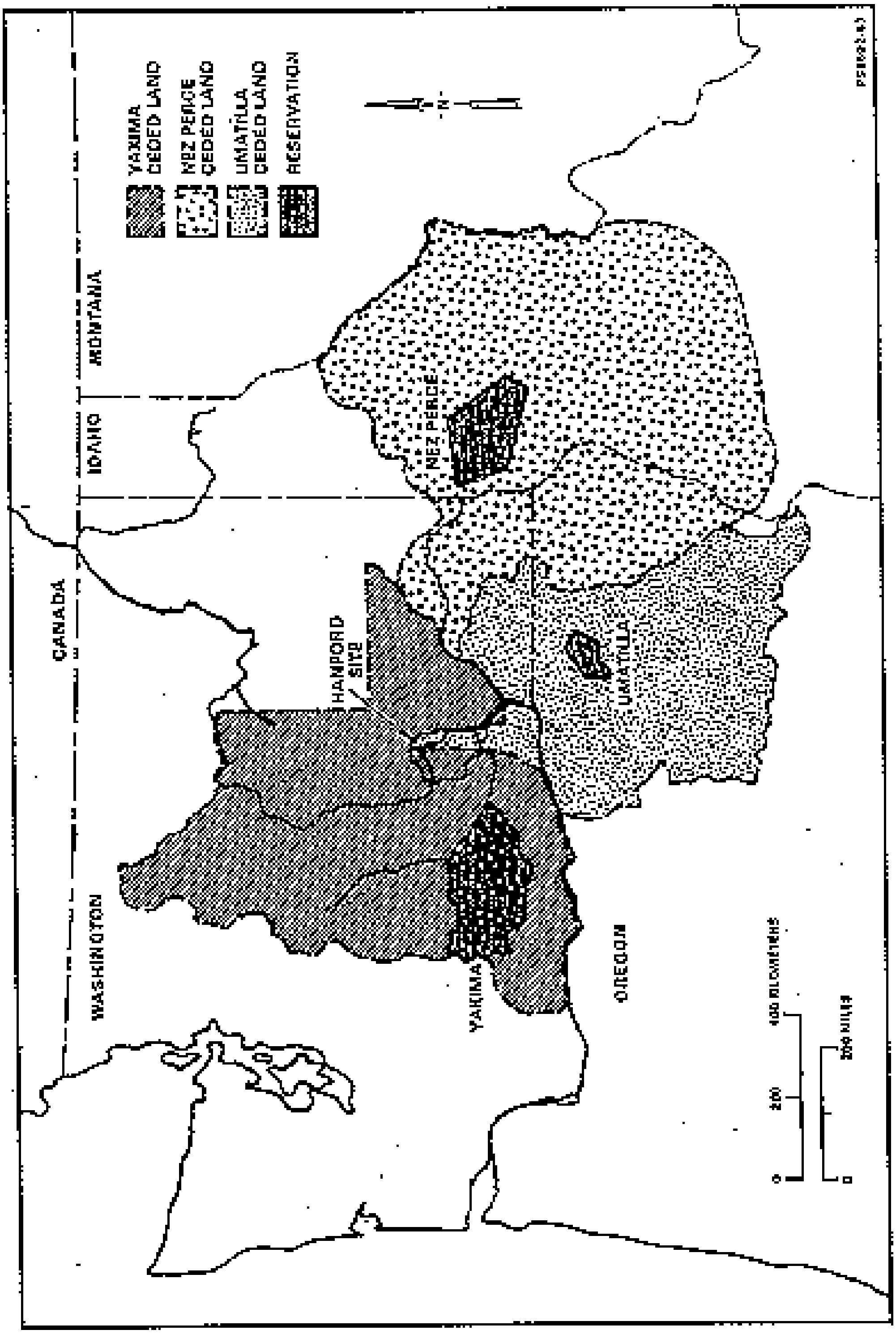
The arrival of the horse in the region around the year 1700 greatly increased the distances that could be traveled by individuals and by Tribes and bands, further increasing the intensity of trade, warfare, and other interaction between groups. The arrival of the horse also initiated a period during which American Indians of the region began keeping large herds of domesticated horses.

The first European-American trappers and traders began arriving in the region around 1800. Their goals were to acquire furs to sell in Asia and Europe. Lewis and Clark arrived in the fall of 1805 to establish the United States' territorial claim to the region. Trapping organizations such as the Hudson's Bay Company and the Northwest Bay Company became increasingly active in the years after the Lewis and Clark expedition. These arrivals were followed by Catholic and Protestant missionaries. Catholic missionaries briefly established a mission at Columbia Point (the confluence of the Yakima and Columbia Rivers). Although the Oregon Trail was established in 1843, and large numbers of non-Indians came to the Northwest via that trail, very few settled in the Pasco Basin, preferring instead to continue on to the Willamette Valley of Oregon.

In 1855, Governor Isaac Stevens, representing the United States government, and Joel Palmer, U.S. Superintendent of Indian Affairs, negotiated treaties with many of the American Indian Tribes in the region (see Appendix A). These treaties called for the relocation of those Tribes to permanent reservations located away from the Pasco Basin. The Tribes retained in their treaties, however, the right of taking fish at all "usual and accustomed" places; erecting buildings for curing; and to hunt, gather plants, and pasture livestock on "open and unclaimed lands" where they traditionally had conducted these activities. To this day, American Indians travel to the Pasco Basin to use its resources.

There were other exceptions to the relocation of American Indians. Peopeomoxmox, a Walla Walla negotiator of the treaty between the United States and the Cayuse, Walla Walla, and Umatilla Tribes, retained in that document the right to operate a trading post where the Columbia River and Yakima River join at Columbia Point. In addition, the Wanapum Band, which did not negotiate a treaty with the United States, remained resident in the Pasco Basin. Nevertheless, over the following 88 years, the Wanapum came under ever-increasing pressure as non-Indian homesteaders seized much of their lands.

Figure 1-3. American Indian Ceded Land and Retained Reservations.



Significant non-Indian settlement of the region began relatively late. In 1888, small irrigation companies and farmer cooperatives began to develop irrigation systems in the Columbia Basin. The agricultural economy of the region saw upswings and downswings, from agricultural price increases during World Wars I and II, drought during the 1920s, and the Great Depression during the 1930s. While, principally, non-Indian farmers lived on the adjacent private lands, members of the Wanapum Band continued to reside on portions of the future Hanford Site that remained in Federal ownership. In 1942, approximately 19,000 people lived in Benton and Franklin counties. Pasco was the largest population center, with approximately 3,900 people (Gerber 1992). The City of Richland had a population of approximately 200 people (Relander 1956).

In the 1940s, almost all of the land that would at some time be considered part of the Hanford Site was being used for crops or grazing. More than 88 percent (about 152,971 ha [378,000 ac]) was sagebrush range land interspersed with volcanic outcroppings, where some 18,000 to 20,000 sheep grazed during winter and spring. Some 11 percent (almost 19,830 ha [49,000 ac]) was farmland, much of it irrigable but not all under cultivation. Less than 1 percent (less than 809 ha [2,000 ac]) consisted of town plots, right of ways, school sites, cemeteries, and similarly used land, most of it in or near the three small communities of Richland, Hanford, and White Bluffs (Jones 1985).

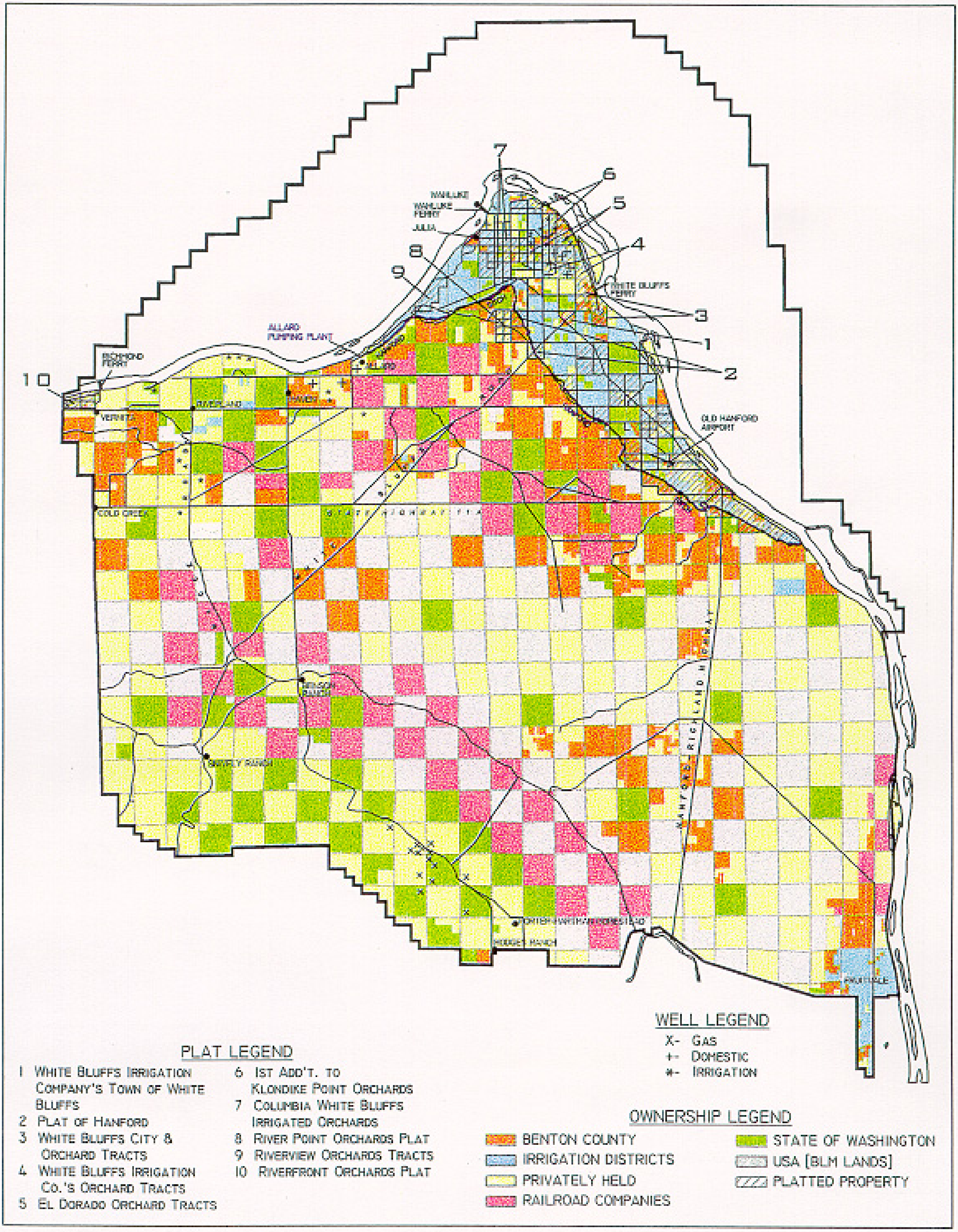
More than one-third of the Hanford area at the time was government-owned. The Federal government owned nearly 28,733 ha (71,000 ac); the State of Washington more than 18,211 ha (45,000 ac); and the five local counties (i.e., Benton, Yakima, Grant, Franklin, and Adams) about 16,592 ha (41,000 ac). More than 91,054 ha (225,000 ac) belonged to private individuals or to corporate organizations, including more than 2,428 ha (6,000 ac) owned by several irrigation districts (Jones 1985). Figure 1-4 provides an example of pre-Hanford Benton County lands in 1943.

1.1.2 Establishment of the Hanford Site

The entry of the U.S. into World War II and the race to develop an atomic bomb led to a search for a suitable place to locate plutonium production and purification facilities. The U.S. Army Corps of Engineers (USACE) selected the site near the towns of White Bluffs and Hanford because of the remote location, good climate, and, most importantly, the abundant supply of hydroelectric power and clean water from the Columbia River. The selection was made in early 1943 and land acquisition proceedings began. The War Department began with condemnation of private lands, followed by appraisals, negotiations, and payments to landowners. Some property owners protested the offered purchase prices and won larger settlements through the courts. Originally, 1,605 km^2 (620 mi^2) were acquired through a combination of withdrawal of lands from the Public Domain and the acquisition of state and privately owned lands. The towns of Hanford and White Bluffs were vacated, the Wanapum were relocated to above the Priest Rapids area, and Richland was transformed into a government town. The U.S. Atomic Energy Commission (AEC) leased an additional 70,000 ha (173,000 ac) as secondary control zones. These secondary zones were released in 1953 and 1958.

For more than 40 years, the primary mission at Hanford was associated with the production of nuclear materials for national defense. Land management and development practices at the Hanford Site were driven by resource needs for nuclear production, chemical processing, Waste Management, and R&D activities. The DOE developed infrastructure and facility complexes to accomplish this work, but large tracts of land used as protective buffer zones for safety and security purposes remained undisturbed. These buffer zones preserved a biological and cultural resource setting unique in the Columbia Basin region.

Figure 1-4. Pre-Hanford Benton County Lands - 1943.



1.1.3 Change in Mission from Defense Production to Environmental Restoration

In the late 1980s, the primary DOE mission changed from defense materials production to environmental restoration. In 1989, DOE entered into the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) with the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology) (Ecology et al. 1989). This agreement is intended to accomplish the following:

- Define EPA's CERCLA cleanup provisions for remediation of hazardous substances.
- Define the RCRA waste treatment, storage, and disposal requirements and corrective actions for hazardous waste management as administered by Ecology.
- Establish the responsibilities for each agency (DOE, EPA, and Ecology).
- Establish milestones for achieving remediation and regulatory compliance.

The DOE expects that CERCLA/RCRA authority will be used to remediate areas of the Hanford Site consistent with applicable requirements to support "highest and best use" land use. If the remediation process cannot support the proposed land use within the NCP's 10^{-4} to 10^{-6} risk range, then this EIS contains a proposed process for changing the "highest and best use" of the land (see Chapter 6).

Today, the Hanford Site has a diverse set of missions associated with environmental restoration, Waste Management, and Science and Technology. These missions have resulted in the growing need for a comprehensive, long-term approach to planning and development for the Site. Additionally, DOE's *Land- and Facility-Use Policy* (DOE 1994b); DOE Order 430.1, *Life-Cycle Asset Management* (DOE 1995c); and the *National Defense Authorization Act for Fiscal Year 1997* each require the development of a CLUP for the Hanford Site.

To comply with these requirements, DOE has developed a process for implementing a Hanford CLUP, and has integrated this process into this Final HCP EIS (see Chapter 6). The NEPA ROD issued for this EIS would create the CLUP by documenting a final land-use map and adopting final Hanford land-use policies and implementing procedures. Together, these pieces would form the CLUP. The CLUP would consider the role of the Hanford Site in a regional context, and would integrate mission requirements and other factors as directed by the Secretary of Energy (see text box, *"Land- and Facility-Use Policy"* [DOE 1994b]).

> ***DOE's Land- and Facility-Use Policy***
>
> On December 21, 1994, the Secretary of Energy issued a *Land- and Facility-Use Policy* for DOE, which contains the following statement:
>
> "It is Department of Energy policy to manage all of its land and facilities as valuable national resources. Our stewardship will be based on the principles of ecosystem management and sustainable development. We will integrate mission, economic, ecological, social, and cultural factors in a comprehensive plan for each site that will guide land and facility use decisions. Each comprehensive plan will consider the site's larger regional context and be developed with stakeholder participation. This policy will result in land and facility uses which support the Department's critical missions, stimulate the economy, and protect the environment."

1.2 The National Environmental Policy Act Process

The *National Environmental Policy Act of 1969* (NEPA) requires consideration of potential environmental impacts associated with Federal agency actions and provides opportunities for public involvement in the decision-making process. In accordance with NEPA requirements, DOE has prepared this Final HCP EIS to help decision makers and the public understand the potential environmental impacts associated with establishing future (for at least the next 50 years) land uses at the Hanford Site through the adoption of a CLUP and its integral land-use maps, policies, and implementing procedures.

1.2.1 Scope of the Hanford Comprehensive Land-Use Plan Environmental Impact Statement and Comprehensive Land-Use Plan

The DOE received more than 2,000 comments from approximately 233 commenters on the August 1996 Draft HRA-EIS. Response was mixed. Many commenters felt land-use planning was poorly integrated into the public scoping process and the Draft HRA-EIS. Ecology's and EPA's comments centered around disagreements with the CERCLA/RCRA assumptions that were used for the waste volume, cost, and risk assessments. Several key stakeholders (i.e.; the DOI, City of Richland, Benton County, and Nez Perce Tribe) felt that with the magnitude of the land-use decision, they needed to be invited into the process as cooperating agencies.

The DOE realized that, without stakeholder support, the regulators (EPA and Ecology) would not be able to use the Draft HRA-EIS land-use plan, as presented, in terms of factoring in potential future land use into the cleanup decision-making process. The DOE then formally invited local land-use planning authorities and Tribes to be cooperating agencies and consulting Tribal governments. From January through March 1997, DOE worked with the cooperating agencies and consulting Tribal governments to clarify and resolve the issues, still with the intent of incorporating comments on the August 1996 Draft HRA-EIS to produce a final EIS. However, through this consultation process, DOE determined that stakeholders wanted an EIS emphasizing land-use maps as alternatives (as opposed to alternatives representing levels of access independent of the land use[s], as presented in the August 1996 Draft HRA-EIS). The DOE then decided to produce a Revised Draft HRA-EIS in cooperation with, and response to EPA, Ecology, Tribal governments, local governments, and other stakeholder comments.

On April 23, 1999, DOE published the Revised Draft HRA-EIS. A public comment period was held from April 23, 1999, to June 7, 1999. Comments on the Revised Draft HRA-EIS have been incorporated into this Final HCP EIS as appropriate. The DOE's responses to comments are presented in the Comment Response Document of this Final EIS.

The Final HCP EIS evaluates the potential environmental impacts from establishing land uses at the Hanford Site for at least the next 50 years, defers the evaluation of impacts associated with remedial actions to Tri-Party Agreement documents, and includes the entire Hanford Site within the scope of the document. In general, the differences between the Final HCP EIS and the August 1996 Draft HRA-EIS can be summarized as follows:

- This Final HCP EIS focuses on land-use impacts and decisions rather than potential remediation impacts.

- Each alternative in the Final HCP EIS features a Site-wide map designating land uses, whereas alternatives in the August 1996 Draft HRA-EIS focused on individual geographic areas.

- In response to public comment, the Final HCP EIS includes a new DOE Preferred Alternative as well as land-use alternatives developed by the cooperating agencies and consulting Tribal governments.

- The Final HCP EIS contains land-use policies and implementing procedures for integration into the Hanford CLUP (see Chapter 6).

Preparation of the Final HCP EIS is consistent with the *National Defense Authorization Act of 1994*, which requires the development of a future-use plan for the Hanford Site; and is responsive to public comments received during scoping and during public comment periods on the 1996 original draft and the 1999 Revised Draft HRA-EIS. The Final HCP EIS also provides a basis for considering potential future proposals regarding transferring ownership and control of some or all of the Hanford Site such as the Wahluke Slope. As the original 1996 Draft EIS provided for consideration of land use, no additional scoping meetings were required.

1.2.1.1 Public Review of the Revised Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land-Use Plan. Once DOE made the decision to reduce the scope of the August 1996 Draft HRA-EIS and issue a Revised Draft, the agency announced it would conduct a 45-day public review and comment period following issuance of the Revised Draft EIS to the public. This public review and comment period, held from April 23, 1999, to June 7, 1999, included four formal public hearings in Portland, Oregon; Richland, Washington; Mattawa, Washington; and Spokane, Washington. The DOE accepted public comments on the Revised Draft HRA-EIS at these hearings and throughout the comment period, and has responded in writing to those comments in this Final HCP EIS.

1.2.2 External Coordination/Involvement in the Preparation of the Revised Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land-Use Plan

During the public comment period on the August 1996 Draft HRA-EIS, several agencies and American Indian Tribes expressed an interest in working with DOE to establish alternative visions for land use. To encourage a variety of viewpoints and strengthen the EIS, DOE involved representatives of other Federal agencies, American Indian Tribes, and state and local governments in ongoing planning efforts. Eventually, these groups received formal invitations from DOE to become cooperating agencies and consulting Tribal governments in the preparation of the Revised Draft HRA-EIS.

Since March 1997, DOE has worked with the cooperating agencies and consulting Tribal governments to establish a framework for the environmental analyses presented in this Final HCP EIS. Substantial agreement was reached among the cooperating agencies and consulting Tribal governments on the development of land-use designations and on the format for determining the potential environmental impacts associated with the land uses carried forward in this Final HCP EIS (see Chapters 3 and 5). The cooperating agencies and consulting Tribal governments also worked together to develop the policies and implementing procedures for the CLUP (see Chapter 6). Alternatives that reflect the land-use values and preferences of different organizations were developed because the cooperating agencies and consulting Tribal governments have different resource usage requirements and goals.

1.2.3 Identification of Public Land-Use Values

Through cooperative activities during the past seven years, diverse stakeholder groups have developed statements of values related to the future of the Hanford Site to provide guidance to Congress, the states of Oregon and Washington, DOE, Ecology, and EPA. It is from this guidance that the proposed policies and implementing procedures for the CLUP have been developed. The first set of values was formulated in 1992 by the Hanford Future Site Uses Working Group (FSUWG 1992) and includes the following statements:

- Protect the Columbia River.

- Deal realistically and forcefully with groundwater contamination.

- Use the Central Plateau wisely for Waste Management.

- Do no harm during cleanup or with new development.

- Cleanup of areas of high future use value is important.

- Clean up to the level necessary to enable the future use option to occur.

- Transport waste safely and be prepared.

- Capture economic development opportunities locally.

- Involve the public in future decisions about the Hanford Site.

After the success of the Hanford Future Site Uses Working Group, other similar stakeholder groups were formed, including the Hanford Tank Waste Task Force and the Hanford Advisory Board (HAB). In 1993, the Hanford Tank Waste Task Force reinforced the first set of values by adding the following statements (Hanford Waste Tank Task Force 1993):

- Protect the environment.

- Protect public/worker health and safety.

- “Get on with the cleanup” to achieve substantive progress in a timely manner.

- Use a systems design approach that keeps endpoints in mind as intermediate decisions are made.

- Establish management practices that ensure accountability, efficiency, and allocation of funds to high priority items.

The first major action taken by the HAB in early 1994 was to endorse and adopt both previously issued sets of values. In September 1994, acting on a recommendation from the Cultural and Socioeconomic Committee, the HAB adopted the following additional values (Takaro 1995):

- Historic and cultural resources have value and should not be degraded or destroyed. Appropriate access to those resources is a part of that value.

- Workforce stability and reasonable stability in the demand for public services are important for the affected communities. In decisions on projects and contractors, consideration should be given to affected workforce and population shifts.

- Cleanup and Waste Management decisions should be coordinated with the efforts of the affected communities, to shift toward more private business activity and away from dependence on Federal projects that have adverse environmental or economic impact.

- The importance of ecological diversity and recreational opportunities should be recognized; those resources should be enhanced as a result of cleanup and Waste Management decisions.

- These concerns should be considered while promoting the most effective and efficient means that will protect environmental quality, and public health and safety, now and for future generations.

- Cleanup activities should protect, to the maximum degree possible, the integrity of all biological resources, with specific attention to rare, threatened, and endangered species and their related habitats.

1.2.4 Development of the August 1996 Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land-Use Plan

The Notice of Intent (NOI) to prepare the HRA-EIS was published in the *Federal Register* (57 FR 37959) on August 21, 1992. The NOI stated that the EIS would evaluate a range of reasonable alternatives to accomplish the scope of the Tri-Party Agreement within the framework of potential future Hanford Site use/cleanup strategies.

Public scoping meetings were held at four locations in the Northwest: Spokane, Washington, on September 29, 1992; Pasco, Washington, on October 1, 1992; Seattle, Washington, on October 5, 1992; and Portland, Oregon, on October 8, 1992. The public scoping period for the HRA-EIS ended on January 15, 1993.

As discussed in Section 1.2.3, in 1992 the EPA, Ecology, and DOE, in cooperation with other interested parties, organized a process to involve stakeholders in the development of a vision for the future of the Hanford Site. A committee consisting of representatives of labor, environmental, governmental, agricultural, economic development, citizen-interest groups, and Tribal governments was established and became known as the Hanford Future Site Uses Working Group (Working Group). The Working Group was charged with three related tasks (see text box, *"Working Group's Objectives"*). The result of the Working Group's efforts, a report entitled, *The Future for Hanford: Uses and Cleanup -- The Final Report of the Hanford Future Site Uses Working Group*, was issued in December 1992 (FSUWG 1992), and was submitted to DOE as a formal scoping comment for the HRA-EIS.

Working Group's Objectives

- Identify a range of potential future uses for the Hanford Site.
- Select cleanup scenarios enabling the future uses in light of potential exposure to contaminants, if any, after cleanup.
- Probe for convergence among the cleanup scenarios to identify priorities or criteria that could prove useful in focusing or conducting the cleanup.

The August 1996 Draft HRA-EIS was developed to assess the potential environmental impacts, primarily from remediation activities, associated with establishing land-use objectives for the Hanford Site. The land-use objectives were developed by DOE using concepts developed by the Working Group. In 1996, DOE decided to expand the land-use planning initiative into a formal CLUP in the August 1996 Draft HRA-EIS to conform to the Secretary of Energy's new *Land- and Facility-Use Policy* (DOE 1994b) and DOE Order 430.1, *Life-Cycle Asset Management.*

1.2.5 Public Review of the August 1996 Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land-Use Plan

The August 1996 Draft HRA-EIS, which addressed impacts associated with remedial actions and land-use planning, was released to the public during the week of August 26, 1996. A public hearing was held in Richland, Washington, on October 17, 1996, and additional public meetings were held throughout the Northwest during the public comment period, which ended December 10, 1996.

1.2.5.1 Major Issues. Numerous public agencies, American Indian Tribes, interest groups, and members of the public provided comments that indicated a diverse range of values and objectives. Several major issues and concerns were identified by commenters during the August 1996 Draft HRA-EIS formal public comment period. The primary issues identified by the commenters included the following:

- Remedial action cost and volume of contaminated material estimates in the August 1996 Draft HRA-EIS were not considered to be consistent with similar estimates made in support of CERCLA documentation.

- Analyses of potential impacts associated with remediation were considered duplicative of the CERCLA process.

- The combination of a land-use plan with remedial action evaluations was confusing. Suggestions were made to reduce or eliminate emphasis on remedial actions and focus instead on those elements of the HRA-EIS pertaining to land-use planning. Widespread support for the development of a comprehensive land-use plan was evident, though not necessarily for the "Hanford Site Comprehensive Land-Use Plan," presented in Volume 4 of the August 1996 Draft HRA-EIS.

- The August 1996 Draft HRA-EIS did not identify DOE's Preferred Alternative for level-of-access controls (i.e., unrestricted, restricted, or exclusive use) for the Hanford Site although there was only one land-use map presented.

- The Comprehensive Land-Use Plan was considered by commenters to be a major Federal action that was not only inadequately integrated in the August 1996 Draft HRA-EIS, but also was out of the scope of the EIS.

- Land-use alternatives, other than the one plan presented in Volume 4 of the August 1996 Draft HRA-EIS, were not evaluated.

- Tribal members' treaty rights and authority were inadequately addressed in the August 1996 Draft HRA-EIS.

- Cumulative impact analyses were considered inadequate.

- The August 1996 Draft HRA-EIS did not adequately address the need of the local community to diversify and strengthen the economy to offset the decline of Hanford Site employment and did not sufficiently emphasize the role that agriculture and related industries play in the region.

- Many commenters requested that the entire Hanford Site be cleaned up to a level that would allow for unrestricted level-of-access use.

- DOE should coordinate with Benton County and the City of Richland to develop an integrated land-use planning process.

- The level-of-access alternatives (unrestricted, restricted, and exclusive) were confusing without an actual land-use designation.

The comments received on the August 1996 Draft HRA-EIS, as well as transcripts from the public hearing are contained in a Revised Draft HRA-EIS Comment and Response Document, which is available for review in the public reading rooms. In addition, a comment summary is provided in Appendix F of the Revised Draft document. A summary of comments received on the Revised Draft HRA-EIS is included as part of this Final HCP EIS.

1.2.6 Public Review of the Revised Draft HRA-EIS and Summary of Major Issues

On April 23, 1999, DOE published the Revised Draft HRA-EIS. A public comment period was held from April 23, 1999 to June 7, 1999. Public hearings on the Revised Draft HRA-EIS were held on May 18, 1999, in Portland, OR; on May 20, 1999, in Richland, WA; on June 2, 1999 in Mattawa, WA; and on June 3, 1999 in Spokane, WA. Comments on the Revised Draft HRA-EIS have been incorporated into this *Final Hanford Comprehensive Land-Use Plan* EIS (HCP EIS), as appropriate. The DOE's responses to comments are presented in the Comment Response Document of this Final EIS.

More than 400 comment documents were received by DOE, including letters, postcards, questionnaires, and surveys as well as electronic mail. In addition, more than 200 pages of transcripts were generated during the four public hearings.

The DOE considered all comments received on the Revised Draft HRA-EIS. Many of the comments supported particular alternatives, or a combination of alternatives. A significant number of the comments addressed environmental issues, such as the plight of wildlife habitat and the continued preservation of habitat for plants and animals, including the diminishing population of salmon, and the Hanford Reach designation as a Wild and Scenic River. The comments and comment responses are given in the Final HCP-EIS Comment Response Document, and summarized comments and responses are found in Appendix F.

Twenty-eight major topics were identified and given general responses from the hundreds of comments received. More than 200 detailed comments were given individual responses in the Comment Response Document. The major topics are summarized below.

***No-Action Alternative*.** A few commenters gave input regarding this alternative, with two supporting it and two opposing the lack of planning in this alternative.

***DOE's Preferred Alternative*.** Most commenters citing this alternative offered support, albeit with many favoring some modification to further protect the environment. Those opposed cited the lack of economic development for Grant County and keeping the Wahluke Slope under Federal control as the basis for their opposition.

***Alternative One*.** Almost all letters received regarding this alternative were in favor of this alternative, citing the emphasis on preservation and the additional protection that it provides for high value or sensitive ecological areas on the Hanford Site, and the prohibition against agriculture, mining, grazing, and intensive recreational uses that would compromise the ecological and wildlife values presented. The opposing letter expressed the need for economic development.

***Alternative Two*.** Almost all commenters citing this alternative were in favor of it. The primary issue expressed in the supporting comments was the additional protection given to the environment, particularly that afforded to the high value ecological areas and natural and sensitive lands on the Hanford Site. Some commenters expressed the desire for even more protection of the environment, citing this alternative as the one closest to total preservation. The two opposing commenters cited lack of economic development.

***Alternative Three*.** A significant majority of the commenters citing this alternative supported it, particularly the economic development provided to Grant County. These commenters wanted the land returned to farming. Opposing commenters cited the lack of adequate protection of the shrub-steppe habitat, and the concern that irrigation would undermine the White Bluffs.

***Alternative Four*.** Commenters expressing an opinion on this alternative generally supported it, citing the large amount of preservation. Those opposed expressed concern that there was no economic development.

***National Wildlife Refuge/DOE's Preferred Alternative*.** More than 300 commenters wrote concerning the DOE's Preferred Alternative, with the modification that a National Wildlife Refuge be created/expanded for additional protection of the environment. Six commenters were against this combination, citing as their reasons the USFWS's lack of adequate resources to properly manage the land, and the lack of consideration of the previous use in farming and future economic development.

***Other Combinations*.** More than 100 comments expressed concern or support for parts of alternatives or an additional alternative. A few submitted their own alternative maps. Some commenters addressed the issue of Federal versus local control. A few supported an extension to the public comment period. The comment was made that additional mapping be done to better represent the wildlife population picture. Others suggested that cleanup, not planning, be the focus of the mission at the Hanford Site.

***Preservation*.** Several commenters expressed their support for preservation of the Hanford Site, varying from preservation of the entire Hanford Site, to the addition of the 200 West Area sagebrush to preservation. Many cited the Hanford Reach, the creation of a National Wildlife Refuge, McGee Ranch, May Junction, the islands, the LIGO land, Gable Mountain, Gable Butte, and the sand dunes. Reasons cited were historical, ecological, cultural, biological, and economic.

***Conservation (Mining)*.** A large majority of the commenters expressing a view on this topic said mining could be allowed but only for the necessary materials to support cleanup of the Hanford Site. Some letters described specific areas that should not be mined (primarily the ALE Reserve), while one commenter cited the need for McGee Ranch silt specifically for the cleanup program.

***Conservation (Mining and Grazing)*.** More than 200 commenters were against allowing any commercial grazing on the Hanford Site. Many commenters cited grazing as being incompatible with wildlife protection. The spreading of noxious weeds was attributed to livestock grazing, because hooves tear up the delicate ground cover habitat. There was a concern raised regarding possible plutonium contamination of the livestock.

***Low-Intensity Recreation*.** Commenters gave a variety of views regarding recreation. Boat launches were generally supported, although a boat launch at White Bluffs drew comments for and against. Two commenters opposed any recreation at the Hanford Site. Several expressed the view that only non-motorized vehicles or recreation be allowed on constructed trails, while others supported access for limited recreation such as campsites for paddlers and access for kayakers and rafters.

***High-Intensity Recreation*.** Most of the commenters who expressed views on High-Intensity Recreation were in support of the B Reactor Museum. Some commenters were opposed to any High-Intensity Recreation on the Hanford Site.

***Research and Development*.** Letters received on this land-use designation cited the need for restricting or prohibiting research and development, using only the 300 Area, LIGO, and FFTF, for example.

***Industrial*.** Some commenters addressing this topic recommended limiting industrial development to the 300 Area and 1100 Area, or areas near the Tri-Cities, which would support the industry with infrastructure. A few commenters were against any industrial development at Hanford, while some expressed that timing was important, with cleanup of the site first, then development.

***Industrial-Exclusive*.** Several commenters stated that the area designated for Industrial-Exclusive land use should be reconfigured to represent what was shown in Alternatives One and Two.

***Agriculture*.** Ninety percent of the more than 200 commenters addressing Agriculture were opposed to any agriculture on the Hanford Site, citing the possible endangering of the health of the Columbia River from irrigation runoff, the potential damage to the White Bluffs from irrigation, the need for preservation of the shrub-steppe habitat for wildlife, and the possibility that agriculture on the Hanford Site would be bad, perceptually, for all Washington State agriculture. The commenters in support cited the need to support world food production, schools, and the rural area in Grant County.

***Policy*.** Several letters were received addressing payment in lieu of taxes (PILT), expressing support for DOE to give Grant County PILT; others would like the PILT based on lost opportunity instead of current land use. Commenters also reiterated the need for continuation of the cleanup mission, the need to consider human health and safety, and the need to better address environmental justice by expanding farming opportunities on the Wahluke Slope.

***Procedure*.** Several letters addressed the membership of the Site Planning Advisory Board, wanting to add regulators and Tribes as sovereign nations, and to limit counties involvement. Several commenters expressed the opinion that the Secretary's announcement in April 1999 of the DOE's Preferred Alternative prejudiced the outcome. Commenters also wanted a document name change, a change in timing, and cultural reviews and natural resources for land-use planning.

Plan. Some commenters addressed the comprehensive land-use plan, citing a variety of items. These included the concern that "management by committee" is too risky, thanking the DOE for keeping an open process, lack of impacts from industrial development, the recommendation that planning should be seven generations out, and concerns regarding the sensitivity of LIGO to noise and vibration.

Public Involvement. Several letters cited the commenter's appreciation for the opportunity to comment, positive feedback on multiple public hearings, and complimented DOE and the Cooperating Agencies on the quality of the document and the work that went into preparing the document.

Salmon and Steelhead. All letters addressing salmon were in support of protection of salmon and salmon habitat and salmon recovery efforts, and this extended to other anadromous fish, such as steelhead, as well.

Hanford Reach. More than 100 letters were received supporting protection of the Hanford Reach, citing the importance of the salmon spawning habitat and the welfare of the eagles and other wildlife that eat the salmon. Concern was expressed for the erosion of the White Bluffs, and the effects of regional agricultural growth on spawning habitat.

***Tribal Rights*.** Several commenters expressed their concern that Tribal rights be honored by the DOE. Many expressed an opinion that no grazing of any type should be allowed on the

Hanford Site. Also supported was the protection of cultural and religious sites, working with the Yakama Indian Nation, and consideration of an option to deed stewardship back to the Tribes.

***Wild and Scenic River*.** Several commenters supported a Wild and Scenic River designation for the Columbia River flowing through the Hanford Reach, citing protection of the river and the riverbanks. A few of those opposed the designation were concerned for future local needs, such as water rights.

***Habitat*.** Many commenters were in favor of setting aside land for conservation and preservation of habitat, noting that the wildlife needs protection. Many of the commenters mentioned the valuable shrub-steppe habitat, which is home to many species, including the sage sparrow, desert butterflies, and species of snakes, other reptiles, and amphibians. A few commenters did not support wildlife habitat, noting that shrub-steppe is only weeds, or that wildlife can coexist with farming.

***Wahluke Slope*.** Many commenters addressed the Wahluke Slope, with more than half against any farming there. Other commenters supported farming, or an impartial study of all the potential uses of the land.

***Split Record of Decision*.** Over 180 commenters supported a split ROD in the interest of moving the designation of a wildlife refuge forward, without waiting for cleanup of the site to be completed.

1.2.7 Summary of Changes Made in Response to Public Comment

Based on the public comment received, the following changes have been made to the DOE's Preferred Alternative:

- All Conservation (Mining and Grazing) has been changed to Conservation (Mining).
- The National Wildlife Refuge designation (from Alternative One) has been extended to include the ALE Reserve, the Riverlands, and McGee Ranch; and all river islands not in Benton County. The Preferred Alternative clarifies that the refuge would be an overlay wildlife refuge (without a transfer of title from DOE), and that DOE retains the right to mine the ALE insert for cover materials.
- A railroad right-of-way through the Riverlands portion of the proposed Refuge would be given status as a preexisting condition and included in the proposed USFWS permit to manage the Refuge.
- The White Bluffs town-site (from Alternatives One and Three) has been added to the Preferred Alternative map as Low-Intensity Recreation to serve as the White Bluffs Memorial.
- The Low-Intensity Recreation dots (comfort stations) along the river which could eventually serve as anchor points for a river trail from Richland to Vernita Bridge have been moved to ensure that they have both river and road access.
- A High-Intensity Recreation triangle (from Alternative Three) has been added to the Preferred Alternative map near Horn Rapids Park on the Yakima River.

In addition to changes made to the Preferred Alternative, and the identifying of Alternative One as the environmentally preferable alternative, many other changes were made to the document updating items, refining analyses, and correcting errors.

1.2.8 Biodiversity in the National Environmental Policy Act Process

In January 1993, the CEQ issued a report titled, *Incorporating Biodiversity Considerations Into Environmental Impact Analysis Under the National Environmental Policy Act* (CEQ 1993). This report was designed with the following objectives:

- Provide an overview of major issues related to biodiversity
- Outline general concepts regarding biodiversity analysis and management
- Describe how biodiversity is addressed in NEPA analyses
- Provide options for agencies undertaking NEPA analyses that consider biodiversity.

The CEQ report indicated that physical alteration, as a result of changing land use, is the most profound cause of biodiversity loss. When natural, undisturbed lands (resembling much of the land at the Hanford Site) are converted to industrial, residential, agricultural, or recreational uses, ecosystems are disrupted and biodiversity is diminished. The CEQ report further states that, "Beyond the direct removal of vegetation and natural landforms in local areas, development of sites for human use fragments larger ecosystems and produces isolated patches of natural areas. Activities such as timber harvesting and grazing also may fragment natural areas, but more important, they result in simplification of ecosystems."

On February 11, 1999, the President issued Executive Order 13112, *Invasive Species*, intended to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts caused by invasive species. The Order, which is applicable to each Federal agency whose actions may affect the status of invasive species, establishes an Invasive Species Council made up of the Secretaries of various Federal agencies, and also calls for the formation of a stakeholders' Invasive Species Advisory Committee to provide information and advice to the Council.

Each disturbance factor on a given tract of land weakens the native plant community, causing potentially catastrophic and accelerated change in landscape components. Therefore, any activity proposed for a site that disturbs the vegetation and soil surfaces of that site should be examined for its effect on invasive weeds and consequences to site biodiversity. If such disturbance activities do occur, it is important to consider how the effects of the disturbance would be managed, before the action takes place. Specific actions can be taken to help prevent the introduction and/or spread of invasive weeds onto the Wildlife Refuge areas of the Hanford Site. For example, equipment being moved onto the Refuge could be steam-cleaned and washed free of vegetation and soil debris at an offsite location before being placed onsite to remove invasive plant seeds and reproductive parts. Additionally, Hanford road activity should be monitored and immediate management action should be taken, when necessary, to prevent invasive species from becoming established along roadsides.

It is the goal of DOE to ensure that the Hanford Site lands are managed in a way that allows biodiversity to be considered prior to finalizing any land-use or land-management decision. To further the biodiversity goal, DOE contacted the Interior Columbia Basin

Ecosystem Management Project (ICBEMP)[1], and provided the Geographic Information System (GIS) database developed for this EIS as a contribution to that project.

1.2.9 Environmental Justice in the National Environmental Policy Act Process

On February 11, 1994, the President of the U.S. issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. This Executive Order mandates each Federal agency to make environmental justice part of the agency mission. To the greatest extent practicable and permitted by law, Federal agencies must identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations.

As stated in the President's February 11, 1994, memorandum to Heads of Agencies that accompanied the Executive Order, "Each Federal agency shall analyze the environmental effects, including human health, economic, and social effects, of Federal actions, including effects on minority communities and low-income communities, when such analysis is required by NEPA. Mitigation measures outlined or analyzed in an environmental assessment, EIS, or ROD, whenever feasible, should address significant and adverse environmental effects of proposed Federal actions on minority communities and low-income communities." The memorandum and Executive Order ensure that minority and low-income communities will have a voice in the development and implementation of any Federal action that might adversely affect those communities.

In addition, the memorandum and Executive Order indicated that all Federal agencies were to be proactive in identifying and, to the extent practicable, mitigating any potential disproportionately high and adverse impacts on minority and low-income communities that could result from proposed Federal actions. In order to implement the provisions of Executive Order 12898, the *U.S. Department of Energy Environmental Justice Strategy* (DOE 1995a), was prepared. Guidance provided in this publication, as well as CEQ's *Environmental Justice Guidance under NEPA* (March 1998) and EPA's *Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses* (April 1998), were used to the extent practicable in the HRA-EIS.

1.3 National Environmental Policy Act and Other Environmental Reviews

Past land-use commitments, based on other NEPA documents, as well as CERCLA RODs addressing remediation, have had a direct impact on the development of the land-use alternatives presented in this Final HCP EIS. Table 1-1 summarizes the Hanford-related EISs

[1] The Interior Columbia Basin Ecosystem Management Project is a Federal land- and ecosystem-management plan commissioned in 1993. The plan affects 100 counties in seven states (including all of eastern Washington and eastern Oregon), and includes more than nearly 22 million ha (54 million ac) of private property. Federal agencies involved are the BLM, National Marine Fisheries Service, Forest Service, and the EPA. Much of the plan deals with water. The plan also proposes aggressive ecosystem restoration practices in order to better control fire, insect outbreaks, and noxious disease spread. Over 75,000 comments (mostly form letters) have been received on the project. In June 1998, the U.S. House Appropriations Subcommittee on the Interior said that ICBEMP should be stopped, its field offices closed, and its studies turned over to the appropriate Federal agencies (TCH 1998a). If the project is stopped, either by Congressional action or lack of funding, the thousands of pages of studies and ideas that have been produced by the project will be given to Federal land management agencies such as the Forest Service.

and RODs and shows the relationships these documents have to land-use planning. Table 1-2 summarizes the regional *State Environmental Policy Act of 1971* (SEPA) EISs. Table 1-3 summarizes CERCLA RODs.

The restrictions posed by approved CERCLA RODs were taken into consideration in the development of the land-use alternatives in this Final HCP EIS. Conversely, the land-use alternative selected for implementation in the ROD for this EIS would be useful for remediation decisions yet to be made in other areas of the Hanford Site. The EPA, Ecology, and DOE consider land-use designations in a given area when determining cleanup levels. If the desired "highest and best use" land use cannot be attained because of remediation-linked technical or economic constraints, or if the remedial action required to achieve that land use would cause unacceptable-unavoidable impacts, then the land use designation of this EIS would be amended using the policies and implementing procedures in Chapter 6 to the next "highest and best use" land use. If required by the CERCLA ROD/RCRA Permit, a deed restriction would be filed with the local land-use jurisdictional agency to conditionally implement the land use.

1.3.1 Interim Actions

During the preparation of this EIS, several outside parties have made proposals to DOE regarding future uses of portions of the Hanford Site. Such proposals undergo NEPA review to determine whether they are major Federal actions, or if they have significant environmental impacts that would require preparation of EISs. This is consistent with the CEQ's regulation in 40 CFR 1506.1(b), "Limitations on Actions During the NEPA Process."

The Hanford 1100 Area and the Hanford railroad southern connection (from Horn Rapids Road to Columbia Center) have been transferred from DOE ownership to Port of Benton ownership in order to support future economic development. Land use of the 1100 Area and the railroad southern connection would remain Industrial, as proposed in all alternatives of this EIS. The DOE prepared an environmental assessment that resulted in a finding of no significant impact (FONSI) on August 27, 1998, transferring the 1100 Area and the Southern rail connection to the Port of Benton (DOE/RL EA-1260). The Port officially took ownership and control of the "1100 Area" (consisting of 318 ha [786 ac], 26 buildings, and 26 km [16 mi] of rail tract) on October 1, 1998, and is currently studying the feasibility of reconnecting the Hanford main rail line to Ellensburg, Washington, as it was in the 1970s, as an alternative route for Yakima Valley rail traffic flowing between the Puget Sound and the Tri-Cities. Although the 1100 Area is no longer under DOE control, it is included in this EIS to support the local governments with their SEPA EIS analyses of the Hanford sub-area of Benton County under the State of Washington's Growth Management Act.

Energy Northwest (formerly known as the Washington Public Power Supply System, or WPPSS) has requested DOE approval of a sublease of a portion of the land they lease from DOE north of the 300 Area. This sublease would be for siting, construction, and operation of an aluminum smelter. Land use of the Energy Northwest-leased land would remain Industrial, as proposed in all alternatives of this EIS. The environmental effects of the proposed sublease and aluminum smelter were being considered in DOE/EA-1259, which was suspended due to lack of response from the proponents.

Table 1-1. NEPA Reviews Affecting the Hanford Site. (5 pages)

NEPA EISs	Purpose	Status	Potential Mission Impacts on Hanford	Relationship to Land-Use Planning
Double-Shell Tanks for Defense High-Level Radioactive Waste Storage, Hanford Site, Richland, Washington (DOE/EIS-0062, April 1980)	To complete construction and operation of 13, 1-million gallon double-shell waste tanks. These tanks would be used to manage defense high-level radioactive wastes resulting from the chemical processing of spent nuclear fuel in the 200 East Area.	The ROD was published in the *Federal Register* on July 9, 1980.	The double-shell tanks were constructed and are currently in operation.	Committed the 200 Areas to continued Waste Management (Industrial-Exclusive use).
Decommissioning of the Shippingport Atomic Power Station, Hanford Site, Richland, Washington (DOE/EIS - 0080, May 1982)	Dismantle and remove all fluids, piping, equipment, components, structures, and waste to a waste disposal facility.	The ROD was published in the *Federal Register* on August 19, 1982.	The Shippingport Atomic Power Station Waste was disposed at the Hanford Site.	Committed the 200 Areas to continued Waste Management (Industrial-Exclusive use).
Operation of PUREX and Uranium Oxide Plant Facilities, Hanford Site, Richland, Washington (DOE/EIS - 0089, February 1983)	This EIS analyzed the environmental effects of DOE's proposal to resume operations of the PUREX and Uranium Trioxide chemical processing plants.	The ROD was published in the *Federal Register* on May 16, 1983.	In 1990, DOE determined that the PUREX Facility would no longer operate. The plant has been shutdown, deactivated, and readied for decontamination and decommissioning (D&D). Operation up until 1990 resulted in discharge of liquid effluents to the ground in the 200 East Area.	Committed the 200 Areas to continued Waste Management (Industrial-Exclusive use).
Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes, Hanford Site, Richland, Washington (DOE/EIS-0113, December 1987)	Examined the potential impacts for final disposal of existing high-level, tranuranic, and tank waste stored at the Hanford Site.	The ROD was published in the *Federal Register* on April 14, 1988.	Committed to dispose of double-shell tank waste, cesium and strontium capsules, retrievably stored and newly generated transuranic waste in the 200 Areas. Also committed to construct and operate facilities associated with high-level waste vitrification; construct and operate the WRAP facility for transuranic soil waste, and a grout facility for LLW.	Committed to Waste Management (Industrial-Exclusive use) in the 200 Area. Many of the tank waste issues were superseded by the *Tank Waste Remediation System EIS* (DOE/EIS-189).
Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington (DOE/EIS-0119, December 1991)	Evaluated decommissioning alternatives for the eight surplus plutonium production reactors at the Hanford Site.	The ROD was published in the *Federal Register* in September 1993.	The DOE determined that the reactor blocks for the eight plutonium reactors will be kept at their present sites for up to 75 years until their radiation level lowers through natural decay. The reactor blocks would then be moved to the 200 Areas for burial.	Commits to restrictive land use of the 100 Areas surrounding the reactors until 2068. Constitutes a future committed land use, Waste Management (Industrial-Exclusive use), for the 200 Areas.

Table 1-1. NEPA Reviews Affecting the Hanford Site. (5 pages)

NEPA EISs	Purpose	Status	Potential Mission Impacts on Hanford	Relationship to Land-Use Planning
Columbia River System Operation Review Environmental Impact Statement (DOE/EIS-0170, November 1995)	To develop Bureau of Reclamation (BoR), U.S. Army Corps of Engineers (USACE), DOE, and Bonneville Power Administration (BPA) management strategy for multiple uses of the Columbia River System.	The ROD was approved on March 10, 1997. This was prepared by the BPA, USACE, and the BoR.	May control Columbia River flows.	May limit land use along the Columbia River (Low-Intensity Recreation use).
Tank Waste Remediation System, Hanford Site, Richland, Washington (DOE/EIS-0189, August 1996)	This EIS addressed management and disposal of the contents of 177 high-level radioactive waste tanks and cesium and strontium capsules.	The ROD was published in the *Federal Register* on February 27, 1997.	The DOE would implement the preferred alternative to retrieve, separate, vitrify, and dispose of the tank waste. The low-level fraction of the separation process would be disposed of onsite in subsurface vaults. The high-level fraction would be disposed of offsite at the potential geologic repository. A decision on the cesium and strontium capsules was deferred.	Commits the 200 Areas to Waste Management (Industrial-Exclusive use) during the retrieval, separation, and vitrification process. It also constitutes a long-term commitment of the 200 Areas for onsite disposal of LLW.
Waste Management Programmatic Environmental Impact Statement (DOE/EIS-0200, May 1997)	This EIS is a nationwide study that examines the management of five types of radioactive and hazardous waste: tranuranic, hazardous waste, high-level waste, and low-level and low-level mixed waste.	*Federal Register* notice announcing change in scope of PEIS (narrowing to Waste Management alternatives) 1/24/95. Eleven regional public hearings held on DEIS (10/17-11/14/95). Public comment period extended through 2/19/96. ROD for treatment and storage of tranuranic waste (63 FR 3629, 1/23/98). ROD for treatment of non-waste water hazardous waste (63 FR 41810, 8/5/98). ROD for storage of High-level Radioactive Waste (64 FR 46661, 8/26/99. Planning additional RODs.	Alternatives considered include centralizing or regionalizing the waste at one or two sites. Those sites that have the largest volumes of a given waste type generally were considered as sites for treatment, storage, or disposal.	A decision to centralize the waste could commit the 200 Areas to Waste Management (Industrial-Exclusive use).

Table 1-1. NEPA Reviews Affecting the Hanford Site. (5 pages)

NEPA EISs	Purpose	Status	Potential Mission Impacts on Hanford	Relationship to Land-Use Planning
Idaho High Level Waste and Facility Disposition Environmental Impact Statement (DOE/EIS-0287)	This EIS is a site specific EIS tiering from the *Waste Management Programmatic Environmental Impact Statement* (DOE/EIS-0200, May 1997 and the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement* (DOE/EIS-203-F).	In preparation.	Calcined wastes would be shipped to Hanford for vitrification under an alternative in the EIS.	Area in the Central Plateau would be required to stage the wastes before and after treatment.
Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs (DOE/EIS-0203, April 1995)	EIS evaluated programmatic alternatives to managing spent nuclear fuel until 2035. This EIS did not evaluate the final disposition of the spent nuclear fuel.	The ROD was published in the *Federal Register* on June 2, 1995. An amended ROD was published in the *Federal Register* on February 28, 1996.	According to this ROD, Hanford production reactor fuel would remain at the Hanford Site pending ultimate disposition. Fast Flux Test Facility (FFTF) fuel will be sent to the Idaho National Engineering and Environmental Laboratory (INEEL). The amended ROD reduced the number of shipments of sodium-bonded fuel from Hanford to the INEEL from 524 to 12.	This decision commits to onsite storage of spent fuel in the 200 Areas until as late as 2035.
Safe Retrieval, Transfer and Interim Storage of Hanford Tank Wastes, Hanford Site, Richland, Washington (DOE/EIS-0212, October 1995)	EIS evaluated alternatives for addressing near-term safety issues in the Hanford Site priority watch list tanks. Accumulation of flammable gas in three tanks had been identified as a safety issue.	The ROD was published in the *Federal Register* on November 21, 1995.	Construction of a replacement Cross-Site Transfer System (pipeline) for moving waste from the 200 West Area to the 200 East Area. Construction of a waste retrieval system in one tank and continuation of mitigation actions to control flammable gas.	This decision creates infrastructure support to tank waste management in the 200 East Area, and commits the new cross-site transfer system pipeline (Industrial-Exclusive use).
Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement (DOE/EIS-0229, November 1996) *Surplus Plutonium Disposition Environmental Impact Statement* (DOE/EIS-0283)	DOE/EIS-0229 evaluated alternatives of facilities for plutonium disposition. Included conversion of bomb components into plutonium oxide, immobilization of surplus plutonium in glass, and mixed oxide fuel fabrication. Site-specific decisions would be made in DOE/EIS-0283.	The ROD for DOE/EIS-0229 was published in the *Federal Register* on January 14, 1997. The Notice of Intent for DOE/EIS-0283 was published in the *Federal Register* on May 18, 1997. The Draft EIS was released in July 1998, and a supplement to the Draft EIS was released in May,1999.	May result in plutonium or highly enriched uranium storage in the 200 West or 400 Areas. Under EIS-0283, the SRS is the site chosen for siting the facility for weapons-useable plutonium disposition.	The 400 Area would remain as Industrial use, with the exception of one to two buildings being used for nuclear materials storage (Industrial use).
Plutonium Finishing Plant Stabilization Environmental Impact Statement (DOE/EIS-0244, May 1996)	To reduce potential health risks and environmental risks associated with 3,800 kg (8,400 lbs) of plutonium within the Plutonium Finishing Plant.	The ROD was published in the *Federal Register* on July 10, 1996.	Stabilized forms of plutonium would be stored within vaults at the Plutonium Finishing Plant pending ultimate disposition.	Commits the 200 West Area to long-tem storage of plutonium and other transuranic materials (Industrial-Exclusive use).

Table 1-1. NEPA Reviews Affecting the Hanford Site. (5 pages)

NEPA EISs	Purpose	Status	Potential Mission Impacts on Hanford	Relationship to Land-Use Planning
Management of Spent Nuclear Fuel from the K Basins Hanford Site, Richland, Washington (DOE/EIS-0245, January 1996)	Evaluated alternatives for spent nuclear fuel stored in the 100-K Area Basins to reduce risk to public health and the environment.	The ROD was published in the *Federal Register* on March 15, 1996.	Irradiated fuel will be removed from 100 K-Basins, treated, and sealed in canisters and stored in the 200 Area. Sludge from the K Basins will be disposed of in existing double-shelled tanks or grouted and packaged for disposal in the 200 Areas.	Commits the 200 Area to the storage of the K Basin fuels and conversion of sludge. Future uses must accommodate restoration after 105-K fuel storage basins are remediated (Industrial-Exclusive use).
Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (DOE/EIS-0250) In preparation.	Would evaluate the suitability of a geologic repository (e.g., Yucca Mountain at the Nevada Test Site) for the disposal of commercial and defense high-level radioactive waste.	The Notice of Intent (NOI) was published in the *Federal Register* in August 1995. The Draft EIS was published in July 1999.	The Yucca Mountain site would accept up to 7000 metric tonnes (7,700 tons) of vitrified defense waste from Hanford and other DOE sites.	Until the Yucca Mountain facility is licensed by the Nuclear Regulatory Commission, high-level radioactive waste and spent nuclear fuel would be stored in the 200 Areas (Industrial-Exclusive use).
Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants Environmental Impact Statement (Adopted by DOE as DOE/EIS-0259, April 1996)	Evaluated alternatives for the disposal of defueled reactor compartments from cruisers and submarines.	The ROD was published in the *Federal Register* on August 9, 1996.	Approximately 100 cruiser and submarine reactor compartments would be disposed of in a 70-ha (173-ac) waste disposal unit in the 200 East Area.	Commits the 200 East Area to Waste Management activities (Industrial-Exclusive use).
Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement (DOE/EIS-0286) In preparation.	To review ongoing and proposed waste management activities, to implement programmatic RODs that result from the *Final Waste Management Programmatic EIS (DOE/EIS-0200*), and to facilitate decisions on the future operation of Hanford waste treatment, storage, and disposal facilities.	The NOI was published in the *Federal Register* on October 27, 1997. The scoping period closed January 30, 1998. In April 1998, DOE accepted the request of the Yakama Nation that they be co-preparers of the EIS. The Draft EIS is expected sometime in late 1999.	May result in unchanged, minimized, or maximized levels of waste storage, treatment, and disposal of low-level, low-level mixed, transuranic, and hazardous waste and contaminated equipment at Hanford.	Is expected to require continued use of the 200 Areas for Waste Management purposes (Industrial-Exclusive use).
Waste Management Operations, Hanford Reservation, Richland, Washington (ERDA-1538, December 1975)	To provide information for use in planning and decision making to ensure that future waste management practices would be conducted to minimize adverse environmental consequences.	Final EIS issued December 1975. Predates final Council on Environmental Quality (CEQ) NEPA regulations; therefore, ROD not required.	Reassessed the environmental impacts associated with continuing the Hanford Site Waste Management Operations Program to provide information for use in planning and decision making. Addressed waste generated by nuclear defense production, research and development, and other programs and activities at the Hanford Site. The high-level waste preferred alternative was to continue solidifying liquid tank waste to a salt cake form and construct additional double-shell tanks.	Committed portions of the 100, 200, and 300 Areas to continued Waste Management (Industrial-Exclusive use).

Table 1-1. NEPA Reviews Affecting the Hanford Site. (5 pages)

NEPA EISs	Purpose	Status	Potential Mission Impacts on Hanford	Relationship to Land-Use Planning
Bonneville Power Administration Transmission System Vegetation Management Program Draft Environmental Impact Statement (DOE/EIS-0285)	This DEIS establishes Planning Steps for managing vegetation across 24,000 km (15,000mi) of power lines and 350 substations in the northwest.	The Draft EIS was issued August, 1999 and public comment is open until October 9,1999.	Establishes BPA's vegetation management preferences across several areas of the Hanford Site. Noxious weeds and weed corridors are associated with access roads.	Would determine the available vegetation control techniques, herbicides used, and acceptable biological impacts.
Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants (Lead Agency - Department of the Navy; DOE was a Cooperating Agency) (May 1984)	Evaluated disposition of defueled reactor compartments from decommissioned nuclear submarines. (See also DOE/EIS-0259.)	The ROD was published in the *Federal Register* in December 1984.	Land disposal of reactor compartments in the 200 East Areas	Committed the 200 East Area to Waste Management (Industrial-Exclusive use).
Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (DOE/EIS-0310)	Would evaluate expansion of FFTF missions.	The Secretary decided on August 18, 1999, that the DOE would conduct a programmatic National Environmental Policy Act (NEPA) review, including an Environmental Impact Statement.	Potential environmental impacts associated with proposed expansion of infrastructure, including the possible role of the FFTF, for civilian nuclear energy research and development activities; production of isotopes for medical, research, and industrial uses; and production of plutonium-238 for use in advanced radioisotope power systems for future NASA space missions.	Proposed FFTF uses are compatible with Industrial or Research and Development land uses.
Hanford Reach of the Columbia River, Comprehensive River Conservation Study and Final Environmental Impact Statement (National Park Service, June 1994)	The Department of the Interior (DOI) and DOE evaluated alternatives for protecting and managing the Hanford Reach and environs of the Columbia River.	The ROD was approved in July 1996. Congressional action is required for the recommended Wild and Scenic River. The proposed National Wildlife Refuge could be established administratively.	Wild and Scenic designation (recreational) would eliminate certain land uses (residential, agricultural, and waste management) within the study area. Establishes wildlife and habitat management access for other areas.	Compatible land uses with the recommendation include: recreation, wildlife, and habitat management for the river corridor and areas north of the river (Low-Intensity Recreation use). Incompatible land uses include: industrial, waste management, agricultural, and grazing.

Table 1-2. SEPA Reviews Affecting the Hanford Site. (2 pages)

SEPA EISs	Purpose	Status	Potential Mission Impact on Hanford	Relationship to Land-Use Planning
Commercial Low-Level Radioactive Waste Disposal Site (U.S. Ecology) on the Hanford Site Environmental Impact Statement - In preparation.	To provide sufficient information to allow state agencies to make the following key decisions: approval of a site closure plan, renewal of the operating license, and an amendment to the regulations limiting the receipt of naturally occurring and accelerator-produced radioactive materials (NARM).	The lead agencies are the Washington Department of Ecology (Ecology) and the Washington Department of Health (DOH). Public scoping - February 1997 through March 27, 1997. A public meeting was held March 5, 1997 at Ecology's office in Kennewick, Washington. Ecology and Health have invited DOE Richland Operations Office (RL) to consult with them on issues, concerns, and potential impacts that should be considered in the EIS. The three agencies met on March 25, 1997, and on April 8, 1997, RL sent a response letter to DOH and Ecology outlining DOE's issues and concerns, and RL's role.	May allow additional amounts of low-level radioactive wastes and NARM to be disposed in the Central Plateau at the privately owned US Ecology site, which was leased by the State from the Federal government.	Expected to continue to require waste management in the 200 Areas (Industrial-Exclusive use).
City of Richland Comprehensive Plan/EIS (August, 1997)	When adopted, the Comprehensive Plan will include the mandated elements on land use, housing, transportation, capital facilities, and utilities, with an optional element on economic development.	The lead agency is the City of Richland. The Final EIS was issued on August 27, 1997.	The City of Richland's Comprehensive Plan is consistent with current and proposed land uses at Hanford and DOE missions.	The City of Richland's Comprehensive Plan addresses land use within the City boundary, and zones land within the City of Richland's urban growth area that extends into the 300 Area of the Hanford Site (Industrial use).
SEPA EIS on Treatment of Low-Level Mixed Wastes (ATG) City of Richland EIS (EA6-97, March 1998)	ATG proposes to build a gasification and vitrification treatment, storage and disposal (TSD) facility in Richland, Washington.	The Final SEPA EIS was issued on March 9, 1998.	Effect of construction and overall operation of the building was evaluated under SEPA. The action would be undertaken as a private action in anticipation of future work for a variety of contracts, including DOE. ATG may proceed with the facility whether or not the Hanford Site low-level mixed waste is included.	A mixed waste TSD facility would be built in an area which is outside of, but in close proximity to the Hanford Site boundary. A TSD facility is a compatible land use under the Heavy Industrial land-use designation in the City of Richland's Comprehensive Plan. The Hanford CLUP does not have a Heavy Industrial land-use designation.

Table 1-2. SEPA Reviews Affecting the Hanford Site. (2 pages)

SEPA EISs	Purpose	Status	Potential Mission Impact on Hanford	Relationship to Land-Use Planning
Draft Benton County Comprehensive Plan (SEPA EIS Addendum) (September 1997)	To revise the Benton County Comprehensive Plan in accordance with the *State Growth Management Act* and SEPA. The Comprehensive Plan is being updated to address land-use planning for all of Benton County, including the portion of the Hanford Site that lies within Benton County. The Comprehensive Plan includes an addendum to the Final SEPA EIS, dated March 1981, prepared for the 1985 Benton County Comprehensive Plan. Detailed planning for the Hanford sub-area was not included in the 1985 plan.	The Final HCP EIS would provide the basis for the Benton County SEPA review for the Hanford sub-area plan of the Benton County Comprehensive Plan. The lead agency is Benton County.	The Benton County Comprehensive Plan will not affect DOE missions at Hanford while DOE retains management of the Site. If, however, land is turned over to state or local governments, such as the Port of Benton, then the stipulations identified in the Benton County Comprehensive Plan would apply. Such transfers might help to fulfill DOE's mission of economic transition and diversification of the local economy.	The Benton County Comprehensive Plan addresses land uses for the County, including the portion of the Hanford Site that lies within Benton County (Industrial, Industrial-Exclusive, Research and Development, High-Intensity Recreation, and Low-Intensity Recreation use). The 1100 Area and 300 Area would remain in an Industrial use designation. The HCP EIS could fulfill the SEPA requirements for the Counties and, as cooperating agencies, they could identify another alternative as their Preferred Alternative.

SEPA = *State Environmental Policy Act of 1971*

1 **Table 1-3. CERCLA Reviews Affecting the Hanford Site.**

	CERCLA RODs	Purpose	Status	Potential Mission Impact on Hanford	Relationship to Land-Use Planning
2	**CERCLA RODs**	**Purpose**	**Status**	**Potential Mission Impact on Hanford**	**Relationship to Land-Use Planning**
3	1100 Area	Remediation of the 1100 Area and scattered other waste sites still within the southern portion of the Hanford Site.	1100-EM-1, 1100-EM-2, 1100-EM-3, and 1100-IU-1 - Final Record of Decision (ROD) issued September 24, 1993. Certified remedial action - July 1996 Delisted from National Priorities List	1100 Area remediated and available for other compatible uses.	Institutional controls required to prevent disturbance of the asbestos landfill barrier and groundwater. A deed restriction for the Horn Rapids asbestos landfill has been filed with the Benton County Auditor's Office. Industrial-Exclusive equivalent land-use designation.
4	300 Area	Remediation of the 300 Area	300-FF-1, 300-FF-5 - Final ROD issued July 17, 1996. Remedial Investigation/Feasibility Study (RI/FS) for NPL Site - to be completed after all operable units are addressed.	Remediation would allow industrial use.	Institutional controls required to prevent disturbance of soil below 15 ft and groundwater. Restricted subsurface and groundwater use. Industrial-Exclusive equivalent land-use designation.
5	100 Area	Remediation of the 100 Areas	100-BC-1, 100-HR-1, and 100-DR-1 - Interim ROD for 37 high-priority waste sites issued September 1995. The ROD was amended May 14, 1997, to include additional waste sites. 100-HR-3/100-KR-4 (Groundwater OUs) - Interim ROD April 1, 1996 100-IU-1, 100-IU-3, 100-IU-4, 100-IU-5 - Interim ROD issued February 12, 1996. RI/FS for NPL Site - to be completed after all operable units are addressed.	100 Areas to be remediated to allow unrestricted residential use: - Unrestricted surface use - Restricted subsurface and groundwater use - Support facilities for groundwater pump-and-treat remediation systems must be maintained.	Institutional controls required to prevent disturbance of soil below 15 feet and groundwater. A deed restriction has been filed for the 183-H Solar Basin RCRA closure with the Benton County Auditor's Office. Industrial-Exclusive equivalent land-use designation. Restricted subsurface and groundwater use.
6	200 Areas	Remediation of the 200 Areas	Environmental Restoration Disposal Facility - Final ROD issued January 1995. 200-ZP-1 (Groundwater OU) - Interim ROD issued June 5, 1995. 200-UP-1 (Groundwater OU) - Interim ROD issued February 24, 1997. RI/FS for NPL Site - to be completed after all operable units are addressed.	200 Areas to be remediated to industrial-exclusive use. Support facilities for groundwater pump-and-treat remediation systems must be maintained.	Institutional controls required to prevent disturbance of barriers and groundwater. Restricted surface, subsurface, and groundwater use. A deed restriction has been filed for an asbestos trench in the Central Waste Landfill with the Benton County Auditor's Office. Industrial-Exclusive equivalent land-use designation.

7

1.4 Hanford Site Planning Efforts

1.4.1 Hanford Site Planning Documents

Several Hanford Site planning documents have been developed to address the various information needs of DOE managers. These planning documents are periodically updated to reflect new information and DOE decision making, such as the decision(s) DOE will make based on this Final HCP EIS. Summarized below these planning documents are:

- Draft *Hanford Cultural Resources Management Plan* (CRMP) (DOE-RL 1999)
- Draft *Hanford Biological Resources Management Plan* (BRMaP) (DOE-RL 1996c)
- *Hanford Strategic Plan* (DOE-RL 1996b)
- *Accelerating Cleanup: Paths to Closure at the Hanford Site* (DOE 1998)
- *Hanford Site Ground-Water Protection Management Plan* (DOE-RL 1995c)
- *Management and Integration of Hanford Site Groundwater and Vadose Zone Activities* (DOE-RL 1998).

The CRMP establishes guidance for the identification, evaluation, recordation, curation, and management of archaeological, historic, and traditional cultural resources. The plan specifies methods of consultation with affected Tribes, government agencies, and interested parties; and includes strategies for the preservation and/or curation of representative properties, archives, and objects. This plan is currently being revised with the active participation of affected Tribes and government agencies.

The BRMaP provides DOE and DOE contractors with a consistent approach for protecting biological resources and for monitoring, assessing, and mitigating impacts to biological resources from site development and environmental restoration activities. Primarily, the BRMaP supports DOE's Hanford missions; provides a mechanism for ensuring compliance with laws protecting biological resources; provides a framework for ensuring that appropriate biological resource goals, objectives, and tools are in place to make DOE an effective steward of the Hanford biological resources; and implements an ecosystem management approach for biological resources on the Site. The BRMaP provides a comprehensive direction that specifies DOE biological resource policies, goals, and objectives.

> ***Hanford Strategic Plan***
>
> The 1996 *Hanford Strategic Plan* identifies six critical success factors to achieve the Hanford vision and missions. It will be periodically updated.
>
> **Protect worker safety and health**
> - reduce accidents and radiological exposure
> - achieve voluntary protection program "star" status
>
> **Protect public health and the environment**
> - reduce or eliminate emissions and effluents
> - regulatory and Tri-Party Agreement compliance
>
> **Manage Hanford to achieve progress**
> - projectize Hanford for clear management accountability, responsibility, and authority
> - establish and control project baselines
> - link key performance measures to results
> - maintain a well-trained and qualified workforce
>
> **Optimize the Hanford Site infrastructure**
> - develop cost-competitive infrastructure commensurate with mission needs
> - involve staff and community in the outsourcing process
>
> **Contribute to economic diversification**
> - blend economic diversification strategies with all Hanford activities and contractors
> - involve local community and leaders in projects
>
> **Build and strengthen partnerships for progress**
> - include American Indian Tribes, regulators, and stakeholders in planning processes
> - champion the public's right to know with prompt, accurate information

The *Hanford Strategic Plan* is a planning document that articulates DOE's current vision and commitments to a long-range strategic direction for the Hanford Site missions (see text box, *"Hanford Strategic Plan"* on previous page). Decisions and actions are made using NEPA, CERCLA, RCRA, and recognized processes as appropriate.

A revision of the *2006 Plan*, the *Accelerating Cleanup: Paths to Closure at the Hanford Site* builds on an already accelerated pace of activities and numerous efficiencies implemented at the Hanford Site during the last few years. It commits to significant cleanup progress on the Site by 2006, while recognizing that much cleanup effort will remain beyond 2006.

The *Hanford Site Ground-Water Protection Management Plan*, and the *Management and Integration of Hanford Site Groundwater and Vadose Zone Activities* documents both provide management and protection guidelines to protect groundwater from radioactive and nonradioactive hazardous substances.

This Final HCP EIS builds on these past planning efforts to address land-use planning at the Hanford Site and presents a range of alternative land uses that represents different visions.

1.4.2 Integrating Planning Efforts by Other Governments and Agencies

This section includes information supplied to DOE by representatives of other governments and agencies about their respective planning efforts. The concept of "agreeing to disagree" on issues such as Tribal members' treaty rights allowed the agencies to set aside differences and work together on the land-use planning process.

1.4.2.1 Tribal Rights. Tribal governments and DOE agree that the Tribal members' treaty-reserved right of taking fish at all "usual and accustomed" places applies to the Hanford Reach of the Columbia River where it passes through Hanford.

Tribal governments and DOE, however, disagree over the applicability of Tribal member's treaty-reserved rights to hunt, gather plants, and pasture livestock on the Hanford Site. The Tribal governments and DOE have decided not to delay completion and implementation of a comprehensive land-use plan for the Hanford Site. Instead, the Tribes and DOE have gone ahead with the land-use planning process while reserving all rights to assert their respective positions regarding treaty rights. Neither the existence of this EIS nor any portion of its contents is intended to have any influence over the resolution of the treaty rights dispute.

1.4.2.2 Other Federal Agencies. In 1943, the USACE began the acquisition of the Hanford Site. Public land managed by the BLM was withdrawn from BLM and placed under DOE control by a land withdrawal order. The BoR land was placed under DOE control by a memorandum of agreement and, finally, land was purchased (sometimes via condemnation) from private owners. Today, DOE continues to manage these acquired lands, which form a checkerboard pattern of underlying ownership over large portions of the Hanford Site (for additional information, see Section 4.1.3).

The BLM and BoR continue to retain an interest in their original property holdings prior to the establishment of the Hanford Site. The DOE must use the land consistent with the purposes for which they were originally acquired from BLM and BoR. Any other use of these lands by DOE requires BLM and BoR involvement. The BLM is responsible for administering Public Domain land. The BoR is responsible for the ultimate development of the irrigable lands within the Wahluke Slope as part of the Columbia Basin Reclamation Project. Both the BLM and BoR have an interest in the Hanford resources and in management of those resources over the long term. When DOE relinquishes its withdrawals on these lands, the BLM and/or BoR would have the right of first refusal to the land. The BLM would examine the lands for current uses and suitability for return to the Public Domain. Depending upon condition, and after public involvement, suitable lands could be retained and designated for a special protective classification, recreational use, multiple use management, exchange, etc. If unsuitable, then DOE or the Federal General Services Administration (GSA) would have the responsibility to dispose of the land.

In addition to BoR's irrigation system maintenance activities, DOE lands on the Wahluke Slope, have been managed in part by the Washington Department of Fish and Wildlife (WDFW) as the Wahluke State Wildlife Recreation Area and, in part, by the USFWS as the Saddle Mountain National Wildlife Refuge. In April 1999, the WDFW and the USFWS notified the DOE of their intent to modify their management responsibilities on the Wahluke Slope under the 1971 agreement. The USFWS informed the DOE that it intends to allow essentially the same uses permitted by the State of Washington under the WDFW's management of the Wahluke Slope. Therefore, transfer of management of the Wahluke Slope from the WDFW to the USFWS involves only a change in the agency managing the property and does not involve any change in the management activities for the Wahluke Slope. Management of the entire Wahluke Slope by the USFWS as an overlay wildlife refuge is consistent with the 1996 DOI Hanford Reach EIS ROD. The ROD recommended the Wahluke Slope be designated a wildlife refuge and the Hanford Reach a Wild and Scenic River, and that the wildlife refuge be managed by the USFWS.

The USFWS is managing the Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE Reserve) under a cooperative agreement with DOE that was signed on August 27, 1997. The USFWS is currently preparing a Comprehensive Conservation Plan (CCP) (equivalent to an area management plan [AMP]; see Chapter 6) for the ALE Reserve.

Aside from BoR, BLM, and the USFWS current management responsibilities, the U.S. National Park Service (NPS) has, with DOE as a co-preparer, completed an EIS for the Hanford Reach of the Columbia River in 1994. The *Hanford Reach of the Columbia River, Comprehensive River Conservation Study and Final Environmental Impact Statement* (Hanford Reach EIS) (NPS 1994) examines alternatives for preservation of the resources and features of the Hanford Reach (including addition of the Hanford Reach to the National Wild and Scenic Rivers System), and evaluates impacts that could result from various uses of the river. The DOI's ROD (NPS 1996) recommends that the Congress designate federally owned and privately owned lands within 0.4 km (0.25 mi) of the Columbia River, on both banks from river mile 396 to 346.5 as a Recreational River under the Wild and Scenic Rivers System; and that the portion of the Hanford Site that lies north of the river be designated as a National Wildlife Refuge managed by the USFWS. Congress is still contemplating actions that are necessary to implement the DOI's ROD.

In addition to the proposed wild and scenic discussions, other discussions have occurred to transfer administrative jurisdiction over certain parcels of land in the State of Washington from the Secretary of Energy to the Secretary of the Interior, affecting ownership of about 19,943 ha (49,280 ac, 197 km^2, 75 mi^2) of the Hanford Site. This swap would consolidate the scattered Benton County portion of Hanford's BLM Public Domain lands, into an area beginning near 100-D, running south and east along the Columbia River shore, to just north of Energy Northwest (formerly known as WPPSS) and then west to Gable Mountain.

As long as these lands are needed by DOE (i.e., still withdrawn from the BLM by DOE), this legislative action would not affect DOE's administration of the areas involved (see Figure 4-3). The DOE's use of withdrawn BLM Public Domain lands is consistent with most land-use designations with the exceptions of Industrial Exclusive, Research and Development, High-Intensity Recreation, or Industrial designations where BLM's multiple-use mandate would be limited by an extensive infrastructure.

1.4.2.3 Local Governments. Portions of the Hanford Site lie within Benton, Franklin, Adams, and Grant counties. The primary contaminated portion of the Site falls within Benton County, and parts of the Wahluke Slope fall within Franklin, Grant, and Adams counties. The City of Richland abuts the southern boundary of the Hanford Site in Benton County. The City of Richland's urban growth area (UGA) extends into the Hanford Site's 300 Area and considerable development within the city limits and adjacent to the Site has already occurred.

Most planning by local governments falls under the *State of Washington Growth Management Act of 1990* (GMA), which established a statewide planning framework and created roles and responsibilities for planning at the local, regional, and state level. The GMA requires the largest and fastest growing counties (counties with more than 50,000 people or population growth of more than 20 percent in the past 10 years), and cities within those counties to develop new comprehensive plans. Counties not required to plan under the GMA may elect to do so. Benton, Franklin, and Grant counties, along with the City of Richland, have elected to plan under the GMA requirements.

Under the GMA, any county or city that implements the GMA is required to: (1) have the county legislative authority adopt a county-wide planning policy under the *Revised Code of Washington* (RCW) 36.70A.210; (2) have the county and each city located within that county adopt development regulations conserving agricultural lands, forest lands, mineral resource lands, and critical areas which must be designated by the local government within one year of the date the county legislative authority adopts its resolution of intention; (3) have the county designate the UGAs in cooperation with each city under RCW 36.70A.110; and (4) have the county and each city located within the county produce a comprehensive plan and development regulations within four years of the county announcing its intention to plan.

1.4.2.3.1 Benton County. The relationship between DOE and Benton County differs from DOE's relationship to other counties with an interest in Hanford because most of the Hanford Site is located within Benton County. As a cooperating agency, Benton County does not agree with the Tribal view that Hanford lands are "open and unclaimed." Benton County is preparing a comprehensive land-use plan that covers the entire county, which includes a portion of the Hanford Site. The DOE is committed to cooperating with the Benton County's planning effort, per a signed agreement by the Secretary of Energy in March 1996 with local governments, titled *Statement of Principles Outlining the Relationship Between the U.S. Department of Energy and Local Governments* (RL No. 98-089, dated June 1998).

As part of its planning effort, Benton County has developed a proposed critical areas map, which depicts lands identified as critical areas under the GMA (see Figure 1-5). The county has completed its SEPA review of the critical areas map and draft implementing ordinance provisions, which would be amended to the county's adopted Critical Resources Protection Ordinance. The Benton County Planning Commission has reviewed and approved the map and ordinance amendments at public hearings, and has forwarded them to the Board of County Commissioners for action, which is pending. Critical areas include wetlands areas with a critical recharging effect on aquifers used for potable water, fish and wildlife habitat conservation areas, frequently flooded areas, and geologically hazardous areas.

The Port of Benton, which must comply with county land-use plans, has already received the 1100 and 3000 Areas, and has expressed interest in the industrial development of portions of the 300 Area and in the area south of Energy Northwest (formerly known as WPPSS) Plant Number 2.

1.4.2.3.2 City of Richland. The City of Richland plans in coordination with Benton County under the GMA. Richland is greatly influenced by activities at the Hanford Site and has gone through several boom-and-bust cycles in response to employment levels at Hanford. Land use at Hanford has the potential to affect the economic development of Richland. The city currently provides services such as water, electricity, and sanitary sewers to the southern portion of the Hanford Site. The City of Richland has identified portions of the southern Hanford Site (Figure 1-6) suitable for industrial development and possible annexation.

1.4.2.3.3 Counties of the Wahluke Slope. Franklin, Grant, and Adams counties also contain portions of the Hanford Site. The planning efforts of these local county governments vary by each planning jurisdiction. For example, land-use planning for Grant County reflects the Wahluke 2000 Plan prepared by farming interests in 1992 and supported by Grant County (Figure 1-7). Land-use planning for Franklin County reflects the results from a land-use analysis conducted by the Franklin County Planning Department.

1.4.3 Federal Land-Transfer Procedures

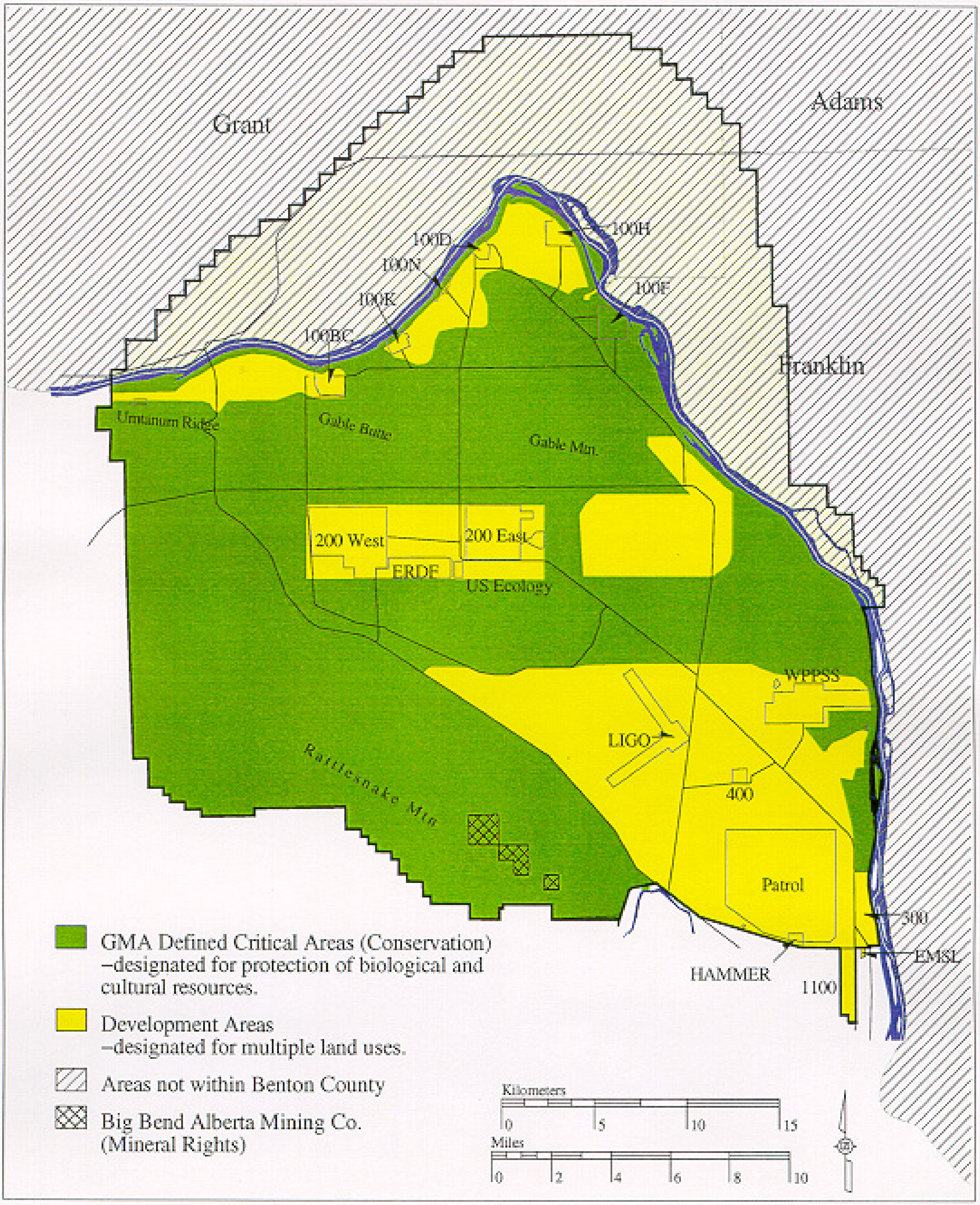
The DOE annually examines its real estate holdings to identify any excess properties. The GSA has developed the following questions for executive agencies such as DOE to consider in identifying valid real property needs (DOE 1997c):

- Is all of the property essential for program requirements?
- Are buffer zones kept to a minimum?
- Can the land be disposed of and program requirements satisfied through reserving rights and interests in the property?
- Is the land being retained merely because it is landlocked?
- Is the land being retained merely because it is considered undesirable due to topographical features or believed to be not disposable?
- Is any portion of the property being retained primarily because the present boundaries are marked by existing fences, roads, and utility systems?

These questions are specifically applicable to purchased land. However, in the absence of other guidance, it is reasonable to apply these same factors when assessing the need for land withdrawn from the Public Domain.

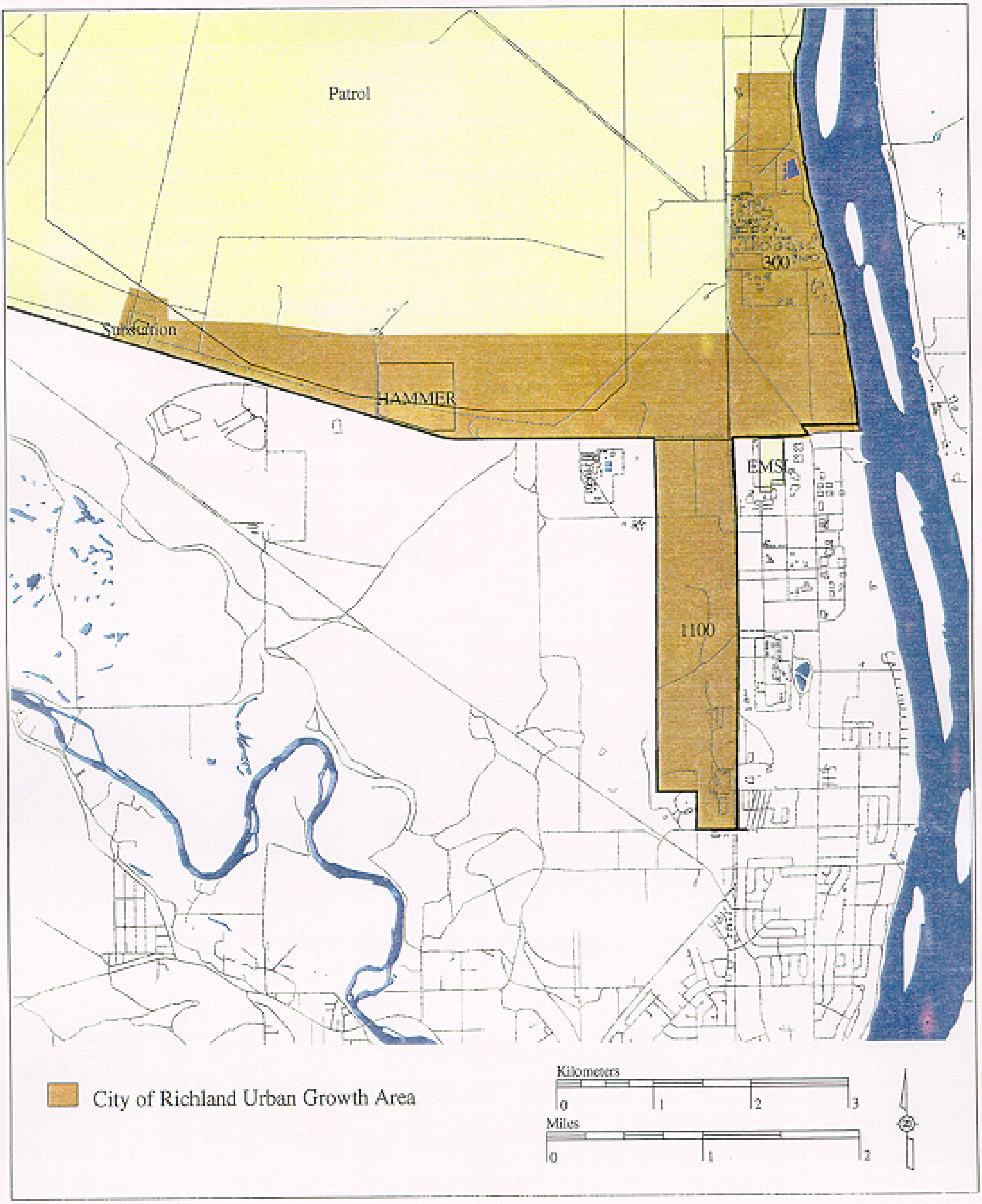
Within the context of Hanford, the CLUP's authority exists only as long as DOE retains legal control of some portion of the real estate. For example, in the Columbia River Corridor, DOE might decide to retain control of the subsurface or groundwater and release only the first 4.6 m (15 ft) of the surface. However, because of the cooperating agencies' involvement in the CLUP process, the CLUP can provide reasonable assurance as to what the land use would be if the land is transferred to the control of one of the cooperating agencies. Further, the creation of a land-use plan through the NEPA process would provide a basis for considering future land transfer proposals. The DOE would conduct appropriate further NEPA review (i.e., EIS, environmental assessment, or categorical exclusion), tiered from this EIS, before making decisions on any specific future land-transfer proposals.

Figure 1-5. Benton County Proposed Critical Areas Map.



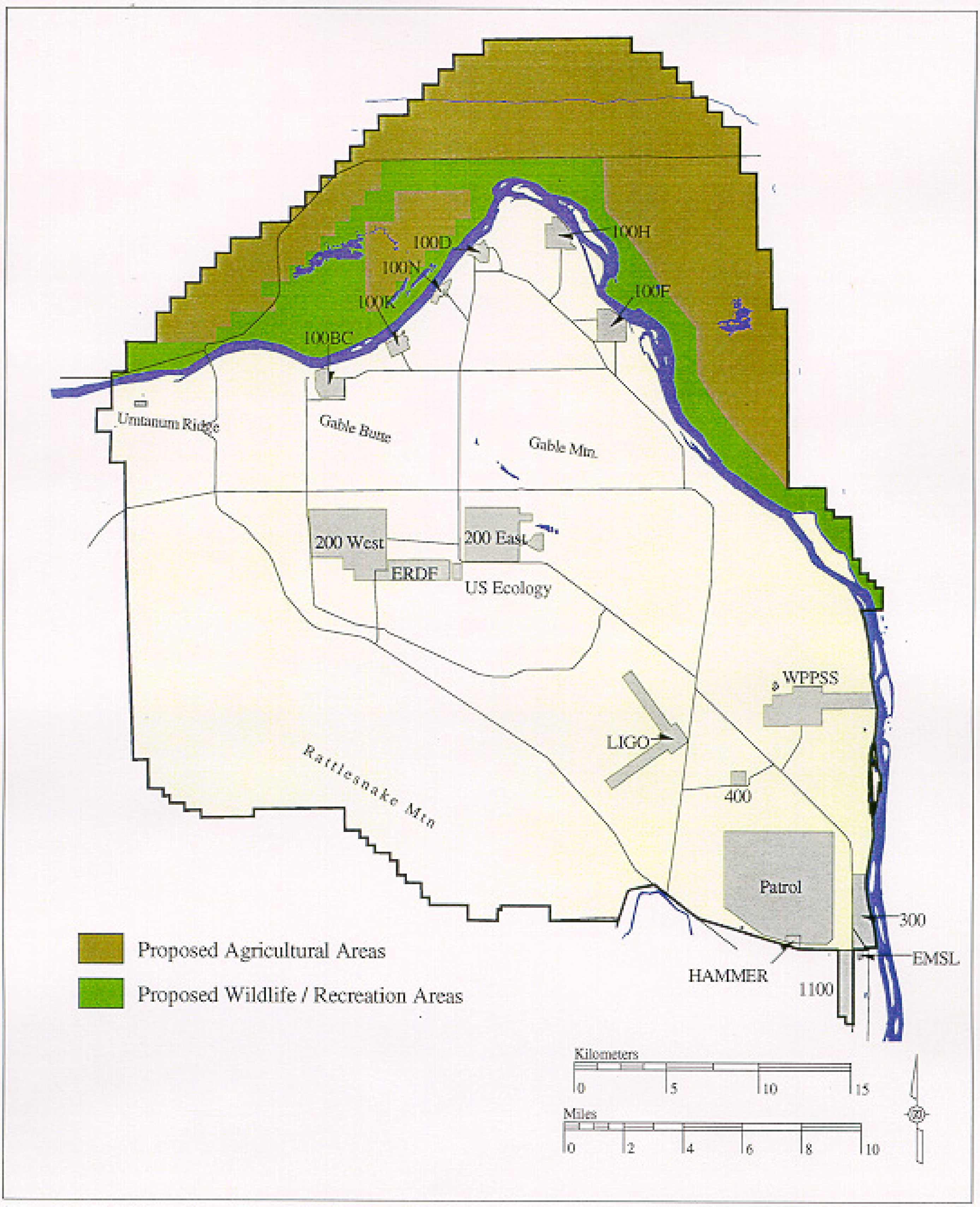
BHI:rpp 04/23/96 clup/bentonco1.aml Database: 03-AUG-1998

Figure 1-6. City of Richland Urban Growth Area.



BHI:rpp 01/13/98 draft_2/urban1.aml Database: 03-AUG-1998

Figure 1-7. Wahluke 2000 Plan Map.



BHI:rpp 01/13/98 draft_2/urban4.aml Database: 03-AUG-1998

In its NEPA regulations (10 CFR 1021), DOE has identified several categorical exclusions of typical classes of action relevant to land transfers that normally do not require an EIS or an environmental assessment. As described in 10 CFR 1021.410, to find that a proposal may be categorically excluded, DOE must determine that the proposal fits within the class of action (see text box, "*DOE's Land Transfer CXs*") that there are no extraordinary circumstances that may affect the significance of the proposal (e.g., "... unresolved conflicts regarding alternate uses of available resources..."), and that the proposal is not connected to other actions with potentially significant impacts. Departmental policy requires field activities to identify long-term mission needs and rationally plan for future site development. More specifically, policy requires that comprehensive land-use plans be developed based on mission needs, site and regional conditions, strategic goals, and other technical information such as the need for buffer zones. Also, disposals are made through the Department's certified realty specialists at field sites in accordance with statutory and regulatory requirements. This CLUP's authority is limited to as long as DOE retains legal control of some portion of the real estate.

DOE's Land Transfer CXs

A.7 Transfer, lease, disposition, or acquisition of interests in personal property (e.g., equipment and materials) or real property (e.g., permanent structures and land), if property use is to remain unchanged; i.e., the type and magnitude of impacts would remain essentially the same.

B1.24 Transfer, lease, disposition or acquisition of interests in uncontaminated permanent or temporary structures, equipment therein, and only land that is necessary for use of the transferred structures and equipment, for residential, commercial, or industrial uses (including, but not limited to, office space, warehouses, equipment storage facilities) where, under reasonably foreseeable uses, there would not be any lessening in quality, or increases in volumes, concentrations, or discharge rates, of wastes, air emissions, or water effluents, and environmental impacts would generally be similar to those before the transfer, lease, disposition, or acquisition of interests. Uncontaminated means that there would be no potential for release of substances at a level, or in a form, that would pose a threat to public health or the environment.

B1.25 Transfer, lease, disposition or acquisition of interests in uncontaminated land for habitat preservation or wildlife management, and only associated buildings that support these purposes. Uncontaminated means that there would be no potential for release of substances at a level, or in a form, that would pose a threat to public health or the environment.

This EIS does not contain any new mechanisms or preferences regarding the transfer of land, but with the input from the cooperating agencies and consulting Tribal governments, this EIS would continue to be useful for considering proposals regarding Hanford lands that might be transferred beyond the control of DOE. This EIS is not focused on land transfer, but instead focuses on the integrated use and management of land and resources independent of who owns the land. Land transfer is a complicated and separate process from the CLUP and, once property leaves DOE control, DOE has no control over the use of that land unless the property was conveyed with deed or other legal restrictions. For more information about regulations pertaining to land transfer or facility leasing, see Table 1-4. For more information about the process for transferring property, refer to the guidebook, *Cross-Cut Guidance on Environmental Requirements for DOE Real Property Transfers* (DOE 1997b), or Ecology's guidebook, *Hanford Land Transfer* (Ecology 1993).

1 **Table 1-4. Regulations Affecting Land Transfer. (3 pages)**

	Year	Law	Name	Mechanism	Term	Approvals	Major Elements
3	1954	PL 83-703, Sec. 161(g)	*Atomic Energy Act* (AEA)	S Lease Real Property S Lease Personal Property S Sell Real Property S Sell Personal Property	Not specified	Sec. of Energy approval delegated to field offices	S General authority to sell, lease, grant, and dispose of real and personal property. (There must be a direct correlation between the purpose of the lease and the mission of DOE derived from the AEA.) S Limited to R&D efforts or efforts to support atomic energy, or efforts to support international agreements
4	1955	PL 221-Chapter 543: 69 STAT 471, as amended 1964 (PL 88-394); (US Code 42 U.S.C. 2349)	*Atomic Energy Community Act*	S Lease Land S Lease Equipment S Sell Equipment	Not specified	Sec. of Energy approval Congressional Review	S Applies to Hanford Site only S Must obtain fair market value S Congress has 45 day review S Must reduce adverse economic impact in local area
5	1977	PL 95-91, 91 STAT 565, as amended, 42 U.S.C. 701 et. seq., August 4, 1977	*Energy Organization Act*	Lease Real Property	5 years	Local DOE field office authority for approval established under DOE Order 4300.1C	S Not currently needed, but not yet excessed S Does not require fair market value, but implementing DOE Order 4300.1C does require fair market value
6	1948	PL 80-537	Authorizing the transfer of certain property for wildlife, or other purposes	Transfer of excess	Not specified	General Services Administration	Upon application to GSA, the Secretary of the Interior is authorized to accept transfer of federally excessed land that has value for migratory birds without compensating the excessing agency.
7	1954	43 U.S.C. Section 931c, Chapter 22	*Public Lands Authorization for Certain Uses*	Lease Land	30 years	Secretary or designee	S DOE must have authority over land S Fair market value must be received S Can only lease to states, counties, cities, towns, townships, municipal corporations, or other public agencies for the purpose of construction and maintaining on such lands, public buildings or other public works

Table 1-4. Regulations Affecting Land Transfer. (3 pages)

Year	Law	Name	Mechanism	Term	Approvals	Major Elements
1980	PL 96-480	*Stephen-Wydler Technology Innovation Act*	S Technology Transfer S Cooperative Research Agreements S Licensing	N/A	Local DOE field office authority	S Established technology transfer as a mission of the Federal government
1949	Chapter 288, 63 STAT 377 40 U.S.C. 471 et. seq.	*Federal Property and Administrative Services Act of 1949*, as amended				
1994	PL 103-251, 15 USCA 3710a	*Cooperative Research & Development Agreements* (CRADA)	S Land Use S Facility Use S Equipment Transfer	5 years	Local DOE field office authority	S Must be joint effort between one or more government laboratories and one or more non-Federal parties S Work scope must be research and development S Special consideration to small businesses S Both parties can provide people, services, facilities, equipment, intellectual property, and other resources, except government cannot provide cash

Table 1-4. Regulations Affecting Land Transfer. (3 pages)

Year	Law	Name	Mechanism	Term	Approvals	Major Elements
1994	PL 103-160, Sec 3154, 3155	*Defense Authorization Act* (Hall Amendment)	Section 3154: S Lease Real Property and related personal property Section 3155: S Transfer Personal Property	Section 3154: 10 years - option for additional term (unspecified)	Section 3154: S Requires Secretary approval or designee plus administrator of EPA for NPL Site or appropriate state official. State official has 60 days to reject request for concurrence Section 3155: S Secretary or designee approval required	Section 3154: S Located at DOE facility to be closed or reconfigured S Not needed by DOE S Under DOE's control S Must be acquired land, not Public Domain land S Can be leased for less than fair market value S Lease revenues can be used at the Site generating the revenues. Section 3155: S Can be used if transfer mitigates adverse economic consequences that might otherwise arise from the closure of the facility S Equipment must be located at the facility to be closed S Must be excess to DOE needs S Must cost more than 110% of new cost to relocate if needed elsewhere in DOE S Consideration received may be less than fair market value S Additional terms may be required that Secretary deems necessary to protect U.S. interests

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2.0 Purpose and Need

The U.S. Department of Energy (DOE) has several missions to fulfill at the Hanford Site that include, but are not limited to, being a natural resource trustee, developing economic diversification, managing energy research, and remediating legacy wastes. These missions have competing natural resource consumption needs and management values. Governments and stakeholders within the region have an interest in Hanford resources and in management of those resources over the long-term. The DOE needs to assess the relative qualities of Hanford's resources, compare the priorities and needs of Hanford's missions, and reach decisions such as the identification and disposal of any excess lands. DOE Order 430.1 and Federal Law 42 U.S.C. 7274k require a land-use plan for the Hanford Site. This Final HCP EIS provides the analysis needed to adopt a land-use plan.

The DOE needs to determine (1) if DOE wants to plan with the cooperating agencies and Tribal governments, and (2) how the land-use planning process should be integrated into the current Hanford Site management systems. The decision to cooperatively plan involves the adoption of a comprehensive land-use plan that contains three parts, as outlined in Chapter 6: a land-use map, planning policies, and implementing procedures. The default would be no comprehensive land-use plan as referenced in the No-Action Alternative.

The role of the Final HCP EIS is to document, in a public forum, the process of determining the best combination of land uses required to meet DOE mission needs for minimally the next 50 years. Through this EIS, DOE is responding to the following needs:

- Meet the mandate set forth in 42 U.S.C. 7274k, requiring the development of a final future-use plan

- Support the U.S. Environmental Protection Agency, Washington State Department of Ecology, and DOE remediation decision-making processes

- Develop a comprehensive land-use plan for the Hanford Site in accordance with DOE Order 430.1 (DOE 1995c).

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3.0 Description of the Proposed Action and Alternatives

This chapter describes the proposed action and the alternative methods by which the proposed action could be accomplished. Also included is a discussion of the No-Action Alternative. A No-Action Alternative is required by the *National Environmental Policy Act of 1969* (NEPA) and provides a baseline against which the impacts of the other alternatives can be compared.

3.1 Proposed Action

The proposed action for the *Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (HCP EIS) is to develop and implement a comprehensive land-use plan (CLUP) for the Hanford Site. As mandated by 42 U.S.C. 7274k, the land-use plan must address at least a 50-year planning period, although some specific DOE activities such as decommissioning of reactors are expected to take longer. The CLUP would include the following sections which are the minimum parts of a "comprehensive" land-use plan.

- A land-use map with land-use designations. The Record of Decision (ROD) for this HCP EIS would select one of the alternative land-use maps presented in Chapter 3 or would select a land-use map such as the revised Preferred Alternative that combines features of several alternatives.
- A set of definitions for each land-use map designation that apply to all of the alternative land-use maps (not applicable to the No-Action Alternative).
- A set of land-use plan policies (see Chapter 6) that apply to all of the alternative land-use maps (not applicable to the No-Action Alternative).
- A set of procedures for plan implementation (see Chapter 6) that would promote DOE's responsibility for coordination of land-use decisions with cooperating agencies and consulting Tribal governments (not applicable to the No-Action Alternative).

Once established, this land-use plan would provide a framework for making Hanford Site land-use and facility-use decisions.

3.2 Development of the Alternatives

Alternative land-use plans for the Hanford Site were developed through a cooperative effort with DOE; the Confederated Tribes of the Umatilla Indian Reservation (CTUIR); the Nez Perce Tribe Department of Environmental Restoration and Waste Management (Nez Perce Tribe); the U.S. Department of the Interior (DOI) via the Bureau of Land Management (BLM), Bureau of Reclamation (BoR), and the U.S. Fish and Wildlife Service (USFWS); the Washington Department of Fish and Wildlife (WDFW); the City of Richland; and Benton, Franklin, and Grant counties. Following development of the alternatives, an analysis of potential environmental impacts resulting from proposed land uses associated with each alternative was conducted. With the exception of DOE's Preferred Alternative and the No-Action Alternative (both of which were written by DOE), the narratives of each alternative do not contain parallel information because each alternative was written by a separate cooperating agency or consulting Tribal government with differing management goals. The results of these impact analyses are presented in Chapter 5.

3.2.1 *Involvement of the Cooperating Agencies*

During the public comment period on the August 1996 Draft HRA-EIS, several entities formally requested cooperating agency status in developing the Final HCP EIS. These agencies included the DOI, the City of Richland, and Benton and Franklin counties (with whom the State of Washington has placed land-use planning authority under the *Washington Growth Management Act of 1990* [GMA]). Each of these agencies has a legal interest in land-use planning at the Hanford Site because each has some responsibility or interest in managing Hanford lands or dependent resources. From a management perspective, it is also important to understand who orchestrates Columbia River activities (see text box, *"The Managed River"*).

> ***The Managed River***
>
> Because ownership is integral to land-use planning, it is important to understand who owns the Columbia River. Within the Hanford Comprehensive Land-Use Plan, DOE, Bureau of Land Management (BLM), Bureau of Reclamation (BoR), U.S. Army Corps of Engineers (USACE), and Washington State Department of Natural Resources all own portions of the Columbia River's islands, riverbed, shoreline, water, or adjoining riverbanks. The Columbia River is central to both commerce and environmental quality for the Northwest.
>
> In addition to ownership, it also helps to know what activities are regulated and who the managers are in the Columbia River Corridor. The Columbia River is a highly managed river. At the top of the Federal responsibilities are Congressional Treaties. There are treaties with Tribal Nations concerning fishing rights, international treaties concerning migratory birds, and specific treaties with Canada that concern river flows, hydropower marketing, and migratory fish stocks. Next is the authority of the Federal agencies. Section 404 of the *Clean Water Act* involves two lead agencies — the U.S. Environmental Protection Agency (EPA), whose regulations implement the Dredged and Fill Material Discharge Permit Program of Section 404, and the USACE, whose regulations also implement the permit program and who control river flows via their dams.
>
> The DOI has several agencies with regulatory authority on the river, including the USFWS for the migratory and listed *Endangered Species Act* plants or animals, the National Park Service while the river is being considered for Wild and Scenic Recreational status, and the BoR which controls river flows via their dams. The U.S. Department of Commerce's National Oceanic and Atmospheric Administration, National Marine Fisheries Service (or "NOAA Fisheries") administers NOAA's programs that support the migratory salmon and steelhead stocks. The DOE regulates the Columbia River flow through its agency, the Bonneville Power Administration, marketing the

Discussions with the interested agencies were initiated in January 1997 to provide a forum to participate in Hanford Site land-use planning and alternatives development. On March 4, 1997, DOE issued letters formally requesting the participation of these agencies, as well as Grant County and affected Tribal governments, in the development of a Revised Draft HRA-EIS. Later, upon request, a letter was also issued to the USFWS (see Appendix B).

For the convenience of DOE, there are two permits with the USFWS for managing land on the Hanford Site. On the Wahluke Slope, the USFWS manages the Saddle Mountain National Wildlife Refuge (NWR) under a permit signed in 1971. Unless this agreement is dissolved, the Saddle Mountain National Wildlife Refuge would continue to be managed as part of the NWR System under all alternatives described in this chapter. On the Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE Reserve), the USFWS and DOE have a 25-year agreement, signed in 1997, that the USFWS will manage the ALE Reserve consistent with the existing ALE Reserve Management Plan until the new plan is developed. This new Comprehensive Conservation Plan (CCP) is being developed by the USFWS under DOE funding. Through the CCP, the USFWS will identify USFWS proposed management actions. The finished CCP will, in turn, give the USFWS the authority to manage the ALE Reserve as a part of the NWR System. The CCP would be the equivalent of an area management plan (AMP) developed under the guidelines in Chapter 6. Unless the DOE permit is revoked, the USFWS would manage the ALE Reserve and proceed with CCP preparation to identify refuge management actions to bring the ALE Reserve into the NWR System.

The land-use planning sessions with the participating agencies resulted in development of the nine land-use designations, six alternatives (including the No-Action Alternative), land-use planning policies and implementing procedures, the potential environmental impacts analysis, and the structure of the Revised Draft HRA-EIS. The cooperating agency land-use planning sessions are expected to continue through publication of the HCP EIS ROD and implementation of the CLUP (see Chapter 6).

3.2.2 Development of the Nine Hanford Site Land-Use Designations

The following land-use designations and their definitions were co-written by the cooperating agencies and consulting Tribal governments so alternative land-use plans could be commonly developed and compared. These land-use groupings determined to be suitable for the Hanford Site lands include the following designations:

- Industrial-Exclusive
- Industrial
- Agricultural
- Research and Development
- High-Intensity Recreation
- Low-Intensity Recreation
- Conservation (Mining and Grazing)
- Conservation (Mining)
- Preservation.

These Hanford Site land-use designations and their definitions are presented in Table 3-1. In developing these land-use designation definitions, the cooperating agencies and consulting Tribal governments drew from the Final Report of the Future Site Uses Working Group (Working Group), the August 1996 Draft HRA-EIS, Benton County's GMA planning effort, and the City of Richland's GMA planning effort.

3.2.3 Identification of Land-Use Suitability

Developing alternatives was preceded by a land-use suitability analysis for a given area of the Hanford Site. A roundtable opportunity-and-constraint discussion on existing Site conditions was shared by the cooperating agencies and consulting Tribal governments. During these discussions, the land-use designations in Table 3-1 were developed. While land-use decisions are fundamentally value-driven decisions, they also should be decisions formed by opportunities and constraints (see text box, *"What is an Opportunity or Constraint?")*. Existing Site conditions and resources analyzed in the Final HCP EIS include the following:

- Biological
- Surface water
- Groundwater
- Waste sites including vadose zone
- Geological
- Cultural
- Economic (e.g., infrastructure).

These land-use designations, while based on land-use suitability, also provide insight into a myriad of potential land-use opportunities and reflect the many and varied interests of the cooperating agencies and consulting Tribal governments. Examples of potential land-use activities taking place under each land-use designation are defined in Table 3-1.

Table 3-1. Hanford Site Land-Use Designations.

Land-Use Designation	Definition
Industrial-Exclusive	An area suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, and nonradioactive wastes. Includes related activities consistent with Industrial-Exclusive uses.
Industrial	An area suitable and desirable for activities, such as reactor operations, rail, barge transport facilities, mining, manufacturing, food processing, assembly, warehouse, and distribution operations. Includes related activities consistent with Industrial uses.
Agricultural	An area designated for the tilling of soil, raising of crops and livestock, and horticulture for commercial purposes along with all those activities normally and routinely involved in horticulture and the production of crops and livestock. Includes related activities consistent with Agricultural uses.
Research and Development	An area designated for conducting basic or applied research that requires the use of a large-scale or isolated facility, or smaller scale time-limited research conducted in the field or within facilities that consume limited resources. Includes scientific, engineering, technology development, technology transfer, and technology deployment activities to meet regional and national needs. Includes related activities consistent with Research and Development.
High-Intensity Recreation	An area allocated for high-intensity, visitor-serving activities and facilities (commercial and governmental), such as golf courses, recreational vehicle parks, boat launching facilities, Tribal fishing facilities, destination resorts, cultural centers, and museums. Includes related activities consistent with High-Intensity Recreation.
Low-Intensity Recreation	An area allocated for low-intensity, visitor-serving activities and facilities, such as improved recreational trails, primitive boat launching facilities, and permitted campgrounds. Includes related activities consistent with Low-Intensity Recreation.
Conservation (Mining and Grazing)	An area reserved for the management and protection of archeological, cultural, ecological, and natural resources. Limited and managed mining (e.g., quarrying for sand, gravel, basalt, and topsoil for governmental purposes) and grazing could occur as a special use (i.e., a permit would be required) within appropriate areas. Limited public access would be consistent with resource conservation. Includes activities related to Conservation (Mining and Grazing), consistent with the protection of archeological, cultural, ecological, and natural resources.
Conservation (Mining)	An area reserved for the management and protection of archeological, cultural, ecological, and natural resources. Limited and managed mining (e.g., quarrying for sand, gravel, basalt, and topsoil for governmental purposes) could occur as a special use (i.e., a permit would be required) within appropriate areas. Limited public access would be consistent with resource conservation. Includes activities related to Conservation (Mining), consistent with the protection of archeological, cultural, ecological, and natural resources.
Preservation	An area managed for the preservation of archeological, cultural, ecological, and natural resources. No new consumptive uses (i.e., mining or extraction of non-renewable resources) would be allowed within this area. Limited public access would be consistent with resource preservation. Includes activities related to Preservation uses.

Industrial-Exclusive – Would use existing waste management areas, such as the 200 Area. This land-use designation would preserve DOE control of the continuing remediation activities and use the existing compatible infrastructure required to support activities such as dangerous waste, radioactive waste, and mixed waste treatment, storage, and disposal facilities. The DOE and its contractors, and the Department of Defense and its contractors, could continue their federal waste disposal missions; and the Northwest Low-Level Radioactive Waste Compact could continue using the U.S. Ecology site for commercial radioactive waste. Research supporting the dangerous waste, radioactive waste, and mixed waste treatment, storage, and disposal facilities would be also encouraged within this land-use designation. New uses of radioactive materials such as food irradiation could be developed and packaged for commercial distribution here under this land-use designation. This land-use designation supports the Environmental Protection Agency (EPA) Brownfields Initiative for contaminated areas (EPA 1997).

What is an Opportunity or Constraint?

In land-use planning, existing conditions offer a mix of "opportunities and constraints." Not all opportunities are equally viable at a specific point in time. And, few constraints are insurmountable given today's engineering and construction capabilities.

For example, shorelines of navigable water bodies typically have *constraints* to development because of potential flooding, geologic instability, bank erosion, wildlife habitat, and cultural resources. However, shorelines also offer excellent *opportunities* for enhancing recreation, cultural resources, fishery habitat, and water quality. These shorelines also are unique in that siting of needed water "dependent" and water "related" developments that cannot be an opportunity (physically located) in upland landscapes.

Landscapes with few or no constraints present the greatest challenges because they represent boundless opportunities with no hint as to their inherent suitability for one land use or another. Consequently, unless a site's suitability for a particular land use is narrowly prescribed by law (e.g., wetlands are protected for biological and water quality needs), the land-use decision is fundamentally value driven. Therefore, when the opportunities and constraints of a particular landscape are analyzed together, the "suitability" for different land uses can be compared and contrasted for an informed and value-driven decision.

Industrial – Would allow the opportunity for expanded economic growth as a result of an increased and diversified regional marketplace. This land-use designation would use existing compatible infrastructure, including transportation corridors, utilities and availability of energy, and suitable buildings or building space to encourage redevelopment and current DOE missions of research into energy resources development and other research opportunities. Redevelopment could include leasing or selling of idle industrial equipment currently held by DOE such as has been done for the aluminum extrusion presses in the 300 Area or the locomotive machine shop in the 1100 Area, to laboratory facilities and other infrastructure. Leases for industrial facilities such as the Energy Northwest's (formerly the Washington Public Power Supply System, or WPPSS) reactor or a proposed metal smelter cluster would be encouraged. This land-use designation supports the EPA Brownfields Initiative for contaminated areas (EPA 1997).

Agricultural – Would use the economic potential of the Columbia River Basin in eastern Washington (see text box, "*Hanford's Agricultural Opportunity Cost,"* Section 3.3.5.3.1). Under the Agricultural land-use designation, the land would be grazed, irrigated, plowed, planted with monocultures (e.g., wheat, grapes, apples, cherries, alfalfa, potatoes, etc.), fallowed, chemically managed (e.g., fertilizers, and pesticides would be applied), burned to control weeds and disease, and otherwise utilized consistent with common regional agricultural practices.

Research and Development – Would allow economic growth potential from research activities associated with the Hanford Science and Technology Mission, the Hanford Site remediation mission, and non-DOE-related research activities including large-scale, multi-decade research and development (R&D) facilities such as the Environmental Molecular Sciences Laboratory (EMSL) and the Laser Interferometer Gravitational Wave Observatory (LIGO), as well as smaller scale and/or time-limited research conducted in the field or within facilities that consume limited resources. Examples include environmental characterization or monitoring studies, site-specific testing of waste management or cleanup technologies, or environmental research in unique areas such as the Columbia River or the ALE Reserve. This land-use designation would take advantage of existing compatible infrastructure, including transportation corridors, utilities, and availability of energy, suitable buildings or building space, security (i.e., controlled access), and the isolation of the Hanford Site from large population centers.

High-Intensity Recreation – Would use the economic potential of planned multi-activity recreational uses, including destination resorts, golf courses, and recreational vehicle service areas. High-Intensity Recreation is also used to accommodate recreational activities that would require a permanent commitment for infrastructure such as a septic drain field for flush toilets or waste water from fish cleaning stations associated with Tribal-reserved use sites or other public use sites.

Low-Intensity Recreation – Would allow use of the Hanford Site's natural features and the opportunity for human recreational activities (e.g., birding, fishing, hunting, rafting, kayaking, hiking, and biking), which would result in minimal disturbance and require minimal development. Low-Intensity Recreation would require active management practices to enhance or maintain the existing resources, and to minimize or eliminate undesirable or non-native species.

Conservation (Mining and Grazing) – Would enable the extraction of valuable near-surface geologic resources at some locations on the Hanford Site after obtaining NEPA, RCRA, CERCLA, or, where applicable, *State Environmental Policy Act* (SEPA) approval to protect NEPA-sensitive (e.g., biologic, geologic, historic, or cultural) resources. This land-use designation would allow permitted (i.e., conditional) livestock grazing and mining (quarrying) activities for governmental purposes in specific, limited areas. The Hanford Site has no proven reserve of any metallic ore bodies; therefore, heap/leach or open-pit mining methods would not be applicable. Should DOE determine that some or all of the Public Domain lands are surplus to DOE's needs and release the Public Domain lands back to the DOI, the DOI could then determine if the Tribal treaty language "the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land" is applicable. Conservation (Mining and Grazing) would afford protection of natural resources; however, other compatible uses, such as recreation, or non-intrusive environmental research activities would also be allowed provided those activities are consistent with the purposes of the Conservation land-use designation. Conservation would require active management practices to enhance or maintain the existing resources, and to minimize or eliminate undesirable or non-native species.

Conservation (Mining) – Would allow the same permitted uses as Conservation (Mining and Grazing), except grazing would be prohibited. This land-use designation reflects the anticipated need for onsite geologic resources to construct surface barriers as required by Hanford Site remediation activities. Conservation would require active management practices to enhance or maintain the existing resources, and to minimize or eliminate undesirable or non-native species.

Preservation – Would protect the unique Hanford Site natural resources and would enhance the benefits resulting from the protection of these resources. Preservation would require active management practices which could include grazing for fire and weed control to preserve the existing resources, and to minimize or eliminate undesirable or non-native species. Commercial grazing of domesticated livestock would not be allowed. An approved wildfire management plan that manages biological resources and protects cultural resources in addition to infrastructure also would be required. Preservation would not preclude all access, but would allow only uses such as nonintrusive environmental research or game-management activities, provided that those activities are consistent with the purposes of the preservation of natural resources.

A discussion of the affected environment and the existing constraints due to legacy waste contamination and other features is presented in Chapter 4. Chapter 4 also contains Hanford Site maps that illustrate the relevant Site characteristics of the natural environment and individual constraints.

3.2.4 Developing the Environmental Impact Statement Alternatives

Following identification of the opportunities and constraints on the Hanford Site (see Chapter 4), and development of the nine land-use designations, individual alternatives were developed. Based on visions, goals, and objectives of the cooperating agencies and consulting Tribal governments, the land-use designations were applied to specific tracts of land on the Hanford Site. This process resulted in the development of the five (six, including the No-Action) alternatives that are presented and analyzed in this Final HCP EIS.

3.2.5 Incorporation of the Future Site Uses Working Group's Geographic Study Areas into the Alternatives

On December 22, 1992, the Hanford Future Site Uses Working Group (Working Group) which submitted its report into the official scoping record for the HRA-EIS, provided one of the first coordinated outside looks into the future of the Hanford Site. One of the important contributions of the Working Group was the establishment of six geographic study areas for the Hanford Site for planning purposes (see Figure 3-1). These geographic areas were North of the River, the Columbia River, Reactors on the River, the Central Plateau, All Other Areas, and the ALE Reserve. These original geographic areas are used in this EIS with the following slight modifications:

- The North of the River geographic area has adopted the local name, the Wahluke Slope.

- Two geographic areas – the Reactors on the River and the Columbia River – have been combined into a single geographic area, the Columbia River Corridor, consistent with Hanford Advisory Board (HAB) advice.

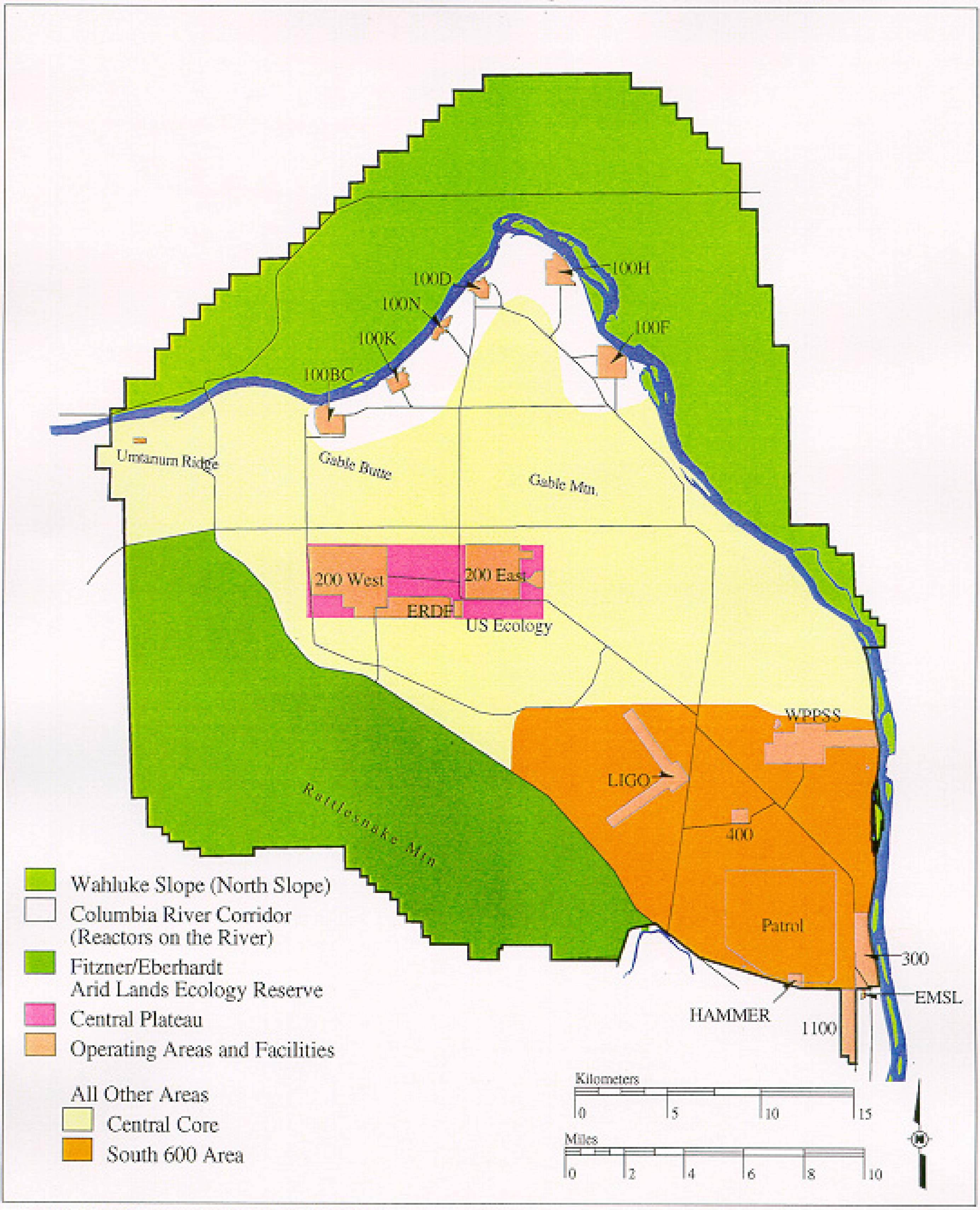
- The buffer area associated with the Central Plateau geographic area is not shown; instead, the Central Plateau geographic area represents only the central waste management area and defers the point of compliance for groundwater to the Tri-Party Agreement's processes.

- The All Other Areas geographic area was divided into the South 600 Area to reflect the clusters of infrastructure located there, and the Central Core that surrounds the Central Plateau but contains less developed infrastructure.

3.2.6 Screening for Reasonable Alternatives

As discussed in the "Memorandum to Agencies: Forty Most Asked Questions Concerning the Council on Environmental Quality's (CEQ) *National Environmental Policy Act* Regulations" (40 FR 18026), reasonable alternatives include the alternatives that are feasible from a common sense, technical, and economic standpoint. Further, the CEQ guidance states that the number of reasonable alternatives considered in detail should represent the full spectrum of alternatives for meeting the purpose and need of the agency, but should not discuss every unique alternative when an unmanageably large number of alternatives would be involved.

Figure 3-1. Geographic Study Areas on the Hanford Site.



BHI:rpp 04/23/96 clup/geogareac1.aml Database: 03-DEC-1998

An infinite number of land-use alternatives could be developed for the Hanford Site. Consequently, DOE and the cooperating agencies and consulting Tribal governments developed a process for generating a series of alternatives representative of the many stakeholder desires for the future of the Hanford Site lands. This involved considering the relevant factors that influence land use at the Hanford Site. These factors include the following:

- Consider public values from scoping and comments on the August 1996 Draft HRA-EIS
- Consider land commitments that have been previously made by major Federal actions (NEPA and CERCLA RODs)
- Consider current DOE missions, including economic diversification
- Consider site characteristics
- Consider regional development and ecosystem characteristics
- Consider the Working Group's possible future-use options and HAB advice
- Consider existing land uses, permits, easements, and current ownerships (i.e., the BLM, BoR, DOE, State of Washington, and Big Bend Alberta Mining Company) in developing proposed land uses
- Consider projected changes to the natural and built environment for at least the next 50 years
- Consider projected land uses for at least 50 years (in the year 2046)
- Evaluate projected land uses against the values, goals, and objectives of the expressed public interests and the cooperating agencies and consulting Tribal governments
- Consider contamination institutional controls
- Honor treaties.

3.3 Description of the Alternatives

The individual alternative land-use plans developed for this Final HCP EIS, as well as the No-Action Alternative, are discussed in the following sections. The No-Action and DOE's Preferred Alternatives were written by DOE, Alternative One was written by DOE with input from the USFWS, Alternative Two was written by a representative of the Nez Perce Tribe Department for Environmental Restoration and Waste Management, Alternative Three was written by local government land-use planners (Benton, Franklin and Grant counties, and the City of Richland), and Alternative Four was written by a representative from the Confederated Tribes of the Umatilla Indian Reservation. Differences between alternatives are the result of each respective agency having unique values, goals, and objectives (vision) that the agency applies to the common set of resources and, from which, each agency develops a vision for the Hanford Site. Each alternative discussion begins with the values used to develop that alternative. Agency goals were used to develop the nine land-use designations listed in Table 3-1. These land-use designations and the agencies' values were, in turn, used to generate the six alternatives.

3.3.1 No-Action Alternative

As required by CEQ regulations for implementing NEPA (40 CFR 1502.14[d]), the No-Action Alternative have been included. Question 3 of CEQ's *NEPA's Forty Most Asked Questions* guidance, "Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the *National Environmental Policy Act*" (40 CFR 1500-1508), 46 FR 18026-18038, explains how DOE is to develop the No-Action Alternative:

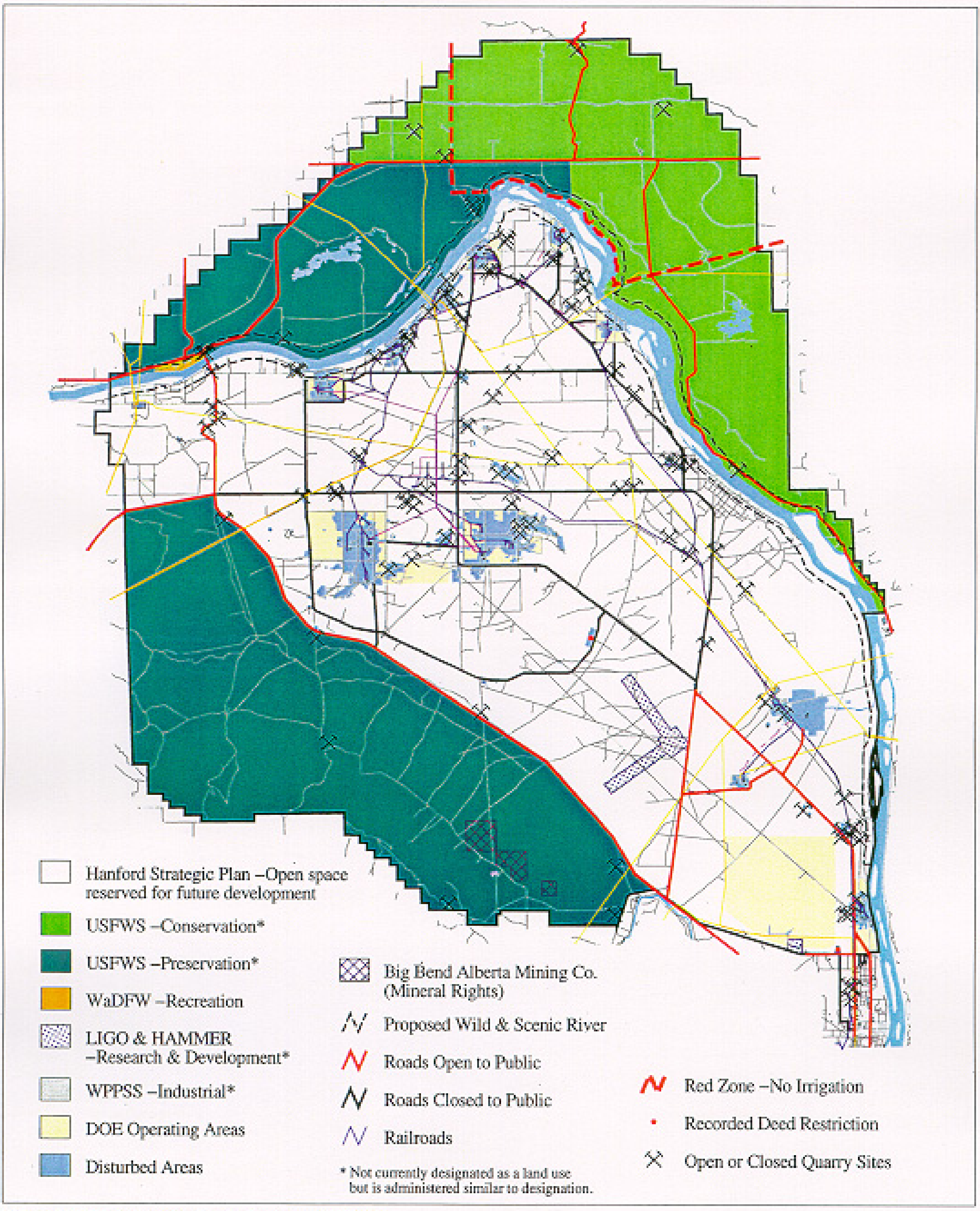
> *There are two distinct interpretations of "no action" that must be considered, depending on the nature of the proposal being evaluated. The first situation might involve an action such as updating a land management plan where ongoing programs initiated under existing legislation and regulations will continue, even as new plans are developed. In these cases "no action" is "no change" from current management direction or level of management intensity. To construct an alternative that is based on no management at all would be a useless academic exercise. Therefore, the "no action" alternative may be thought of in terms of continuing with the present course of action until the action is changed. Consequently, projected impacts of alternative management schemes would be compared in the EIS to those impacts projected for the existing plan. In this case, alternatives would include management plans of both greater and lesser intensity, especially greater and lesser levels of resource development.*

Therefore, in keeping with CEQ guidance, the No-Action Alternative is presented as "no change" from current management direction or level of management intensity. Specifically "no change" means that DOE would not employ the land uses shown in Table 3-1, any of the alternative maps (or combination of alternative maps), and the CLUP policies and implementing procedures in Chapter 6 for managing Hanford Site lands into the future. The No-Action Alternative is DOE's mission-related operation provisions and managerial values of the 1996 *Hanford Strategic Plan* (DOE-RL 1996b) without a framework and implementation procedures to assure the planned use and sustainability of the Site's land and resources. If an alternative is adopted in the ROD, it would simply add more structure to the implementation of the current *Hanford Strategic Plan*.

The No-Action Alternative serves two purposes. First, it serves as a true baseline common to all of the alternatives that presents the current status of land use and land management on the Hanford Site. For this purpose, a baseline no-action map was developed that contains available information defining existing buildings and infrastructure at the Hanford Site. Second, the No-Action Alternative provides a basis for comparing the alternatives against a "no change" in land-use management policy baseline.

To analyze the impacts associated with implementing the no change in land-use management policy/No-Action Alternative, assumptions regarding land-management options were applied. In the No-Action Alternative, specific land-use decisions and designations would be made through the NEPA process on a project-by-project basis as needed. Still there would not be a true land-use designation, land-use policies, or implementing procedures. There would only be areas of the Hanford Site that are currently used or managed for specific purposes guided by administrative agreements (e.g., the ALE Reserve and the Wahluke Slope) and areas of the Hanford Site that are committed to a general land-use because of historical uses and existing NEPA or CERCLA/RCRA ROD commitments but are subject to change by future projects or missions that are unknown at this time. Consequently, potential uses for the Hanford Site lands under the No-Action Alternative are mapped using the policies presented in *Hanford Strategic Plan* (DOE-RL 1996b) (Figure 3-2). Impacts associated with these potential future uses are analyzed and presented in Chapter 5.

Figure 3-2. No-Action Alternative.



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3.3.1.1 Planning Goals, Objectives, and Values (Vision). No publicly reviewed land-management plan has been developed for the Hanford Site since 1975 (ERDA 1975) (see text box, *"Permanent Commitments"*). In the incorporated by reference *Waste Management Operations, Hanford Reservation, Richland, Washington: Final Environmental Statement* (ERDA 1975), the Section IX.2.3, "Land Use," states:

> *Continuation of the Hanford Waste Management Operations Program will result in (1) occupancy of land by structures containing radionuclides, and (2) restricted use of land containing radionuclides. The quantity of land committed will remain essentially constant for about 300 years because of the presence of ^{137}Cs, ^{90}Sr, and transuranium materials in the burial grounds and crib sites unless major recovery and cleanup programs are initiated. After 300 years, the quantity of land required for such purposes will decrease to the lands which contain plutonium or other long-lived transuranics. Recovery of plutonium from stored waste would eliminate the need for long-term control and surveillance.*
>
> *A summary description of the committed lands is presented in Table IX-2. The areas in that table include appropriate buffer zones for surveillance and prevention of disturbance of the radionuclides by nearby activities such as irrigation agriculture.*
>
> *Commitment of some of the Hanford lands to waste management makes that land unavailable for other uses. Because there are tens of thousands of acres of similar desert land available throughout the western United States, the dedicated land cannot be considered to have rare characteristics that result in a premium value, such as for residential or industrial use. Ample similar land is available nearby for any such uses foreseen.*

Permanent Commitments

The resources that are considered to be committed in an irretrievable and irreversible manner by the Hanford Waste Management Operations are (1) land and materials containing or used for storing radionuclides with a half-life longer than 10 years; (2) labor expended by construction and operating personnel; and (3) materials, such as fuels and chemicals, that are burned, diluted, or consumed during use.

Most land containing fission product radionuclides with long half-lives can be considered unusable for agricultural purposes for centuries. Although most of these radionuclides probably could be separated from the land, reduction of the concentration to a level which would permit unrestricted use undoubtedly would cost more than the value associated with normally expected uses. This land will require a commitment of both people and surveillance equipment until the radioactivity is essentially removed by processing or decay.

Land containing transuranic materials, particularly plutonium, can be considered unusable for any purpose for hundreds of thousands of years. Until any recovery program for the transuranic materials would be completed, this land will require a commitment of both people and surveillance equipment.

About half a million tons of fossil fuels and 50,000 tons of chemicals are expected to be irreversibly consumed by the Hanford Waste Management Operations. Some components of the concrete structures and equipment, as well as about 2,428 ha (6,000 ac) of desert land, are essentially irretrievable due to the practical aspects of reclamation and/or radioactive decontamination. Present operating practices will not require additional land usage for cribs (ERDA 1975).

Table IX-2. Dedicated Waste Management Lands.

General Location	*Content*[a]	*Approximate Area (Acres)*
100 Areas	*Burial Grounds*	*70*
200 Areas	*Burial Grounds, Process Buildings, Tank Farms, Cribs, and Ponds*	*5,100*
300 Area	*Burial Grounds and Process Ponds*	*50*
600 Area	*Burial Grounds*	*10*
Total		*5,230*[b]

*Table is a quote from the **Waste Management Operations, Hanford Reservation, Richland, Washington: Final Environmental Statement** (ERDA 1538, 1975). Other EIS's and CERCLA RODs have committed even more areas such as ERDF, the 200 West expansion and the 200 East trenches to DOE waste disposal activities.*
[a] *Excludes standby facilities.*
[b] *This is 1.4% of the total Hanford Reservation land area.*

In place of any formalized plan, land management at the Hanford Site would be administered using the visions outlined in the *Hanford Strategic Plan* (DOE-RL 1996b), which is not a land-use plan but is instead a DOE mission plan that is periodically updated. The 1996 *Hanford Strategic Plan* details the management direction for the Site. As outlined in the Strategic Plan, Hanford's environmental management, or cleanup mission is to protect the health and safety of the public, workers, and the environment; control hazardous materials; and utilize the assets (i.e., people, infrastructure, site) for other missions. Hanford's Science and Technology mission is to develop and deploy Science and Technology in the service of the nation, including stewardship of the Hanford Site.

Hanford Site managerial values, which are further explained in the 1996 Strategic Plan, are identified below:

- **Safety** -- The safety and health of our workers and the public will not be compromised. We place a high priority on managing and reducing the risks in our workplace, as well as risks to the public and the environment.

- **Results** -- We are committed to environmental and scientific excellence. We will meet or exceed the needs and expectations of our customers. Our employees are encouraged to seek creative and innovative solutions and to continuously find ways to improve what we do.

- **Teamwork** -- We work as a team to accomplish our missions. We regard all concerned parties as essential members of the team and value and plan for their participation. "Win-win" solutions are essential elements of the way we do business. We value the diversity of our employees and all other members of the team.

- **Integrity** -- We conduct ourselves with the highest standards of professionalism and ethical behavior. We honor our commitments and comply with applicable laws and regulations. We are proper stewards of the taxpayers' interest.

The 1996 *Hanford Strategic Plan* divided the Hanford Site into five distinct geographic study areas, including the Columbia River, Reactors on the River (100 Areas), Central Core, Central Plateau (200 Areas), and the South 600 Area (DOE-RL 1996b). These areas were modified to be consistent with the geographic areas used in this Final HCP EIS. Specifically, the Columbia River and Reactors on the River geographic areas were combined to create the Columbia River Corridor geographic area. The Wahluke Slope and ALE Reserve were not included in the 1996 *Hanford Strategic Plan* but have been included in this alternative, since these areas would remain under DOE authority.

3.3.1.2 Assumptions Regarding Future Use. Specific land-use decisions under the No-Action Alternative would continue to be made through the NEPA or the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989) process on a project-by-project, as-needed basis and without consideration of conformance to a CLUP.

3.3.1.3 Application of the Land-Use Designations.

3.3.1.3.1 The Wahluke Slope. The entire Wahluke Slope is managed for DOE by other agencies by permit. The western portion of the Wahluke Slope is managed by the USFWS as the Saddle Mountain NWR. Current permit conditions require this area to be closed to the public as part of a security zone for the N Reactor (now shut down), and the area would continue to be managed similar to the Preservation designation. This permit also provides protection for the K Basin spent nuclear fuel (SNF) removal project. The USFWS permit provides additional protection to sensitive areas and species of concern. The remainder of this geographic area has been managed by the WDFW and is now designated the Wahluke Wildlife Recreation Area.

In April 1999, the WDFW and the USFWS notified the DOE of their intent to modify their management responsibilities on the Wahluke Slope under the 1971 agreement leaving only a small portion (about 324 ha (800 ac)) northwest of the Vernita bridge under WDFW permit. The USFWS informed the DOE that it intends to allow essentially the same uses permitted by the State of Washington under the WDFW's management of the Wahluke Slope. Therefore, transfer of management of the Wahluke Slope from the WDFW to the USFWS involves only a change in the agency managing the property and does not involve any change in the management activities for the Wahluke Slope. Management of the entire Wahluke Slope by the USFWS as an overlay wildlife refuge is consistent with the 1996 DOI Hanford Reach EIS ROD. The ROD recommended the Wahluke Slope be designated a wildlife refuge and the Hanford Reach a Wild and Scenic River, and that the wildlife refuge be managed by the USFWS.

Consistent with the permit, this land is managed similar to the Conservation (Mining and Grazing) designation. These designations are also consistent with the BoR's Red Zone, in which irrigation is prohibited to minimize slumping of the bluffs into the Columbia River. Under this alternative, limited public access for hunting, fishing, or recreation; permitted mining and grazing activities; and agricultural leases would continue. Existing permits with the USFWS can be revoked by DOE at any time.

3.3.1.3.2 The Columbia River Corridor. The surface water in this geographic area would continue to be managed to allow limited public access and use as a Low-Intensity Recreation area. Access to the Columbia River's islands would remain restricted to provide protection for cultural, aesthetic, biological, and geologic resources. Restrictions that are intended to preserve the unique character of the Hanford Reach portion of the Columbia River (Public Law 100-605) would also remain in effect. Public access to the Reactors on the River area (i.e., the 100 Areas) would remain restricted, which is consistent with current management.

Hazardous and/or dangerous waste has been disposed of at the 183-H Solar Evaporation Basins under the terms of EPA and Ecology regulations. Future use restrictions associated with this parcel of land are to be consistent with the terms of 40 CFR 264.117(c) and *Washington Administrative Code* (WAC) 173-303-610(7)(d). The WAC 173-303-610(7)(d) and 40 CFR 264.117(c) are identical in intent and similar in text and state the following:

> *Post-closure use of property on or in which [hazardous and/or] dangerous wastes remain after partial or final closure must never be allowed to disturb the integrity of the final cover, liner(s), or any other components of any containment system, or the function of the facility's monitoring system, unless the department finds that the disturbance: (i) Is necessary to the proposed use of the property, and will not increase the potential hazard to human health or the environment; or (ii) Is necessary to reduce a threat to human health or the environment.*

A deed restriction has been filed with Benton County for the 183-H Solar Basin RCRA corrective action (BHI 1997) because of residual contamination. Other deed restrictions or covenants for activities that potentially may extend beyond 4.6 m (15 ft) below ground surface are expected for the CERCLA remediation areas (see Figure 4-34).

3.3.1.3.3 The Central Plateau. Lands within the Central Plateau geographic area would continue to be used for the management of radioactive and hazardous waste materials. These management activities would include collection and disposal of radioactive and/or hazardous waste materials that remain onsite, contaminated groundwater management, current offsite commitments, and other related and compatible uses. After incorporating by reference the previous 1975 ERDA 1538 irreversible and irretrievable (I&I) commitments and other documented commitments into this EIS (see Section 1.3), future individual project land-use requirements would be I&I committed through the appropriate NEPA and CERCLA/RCRA/NEPA integrated processes. Deed restrictions or covenants also would be applied to this area through the CERCLA and RCRA processes.

3.3.1.3.4 The All Other Areas. These areas would be available for other Federal programs or leased for non-Federal uses, provided that such uses are consistent with the safety requirements and address the cultural and biological resource issues through DOE's NEPA process. After incorporating by reference the previous 1975 ERDA 1538 irreversible and irretrievable (I&I) commitments and other documented commitments into this EIS (see Section 1.3), future individual project land-use requirements would be I&I committed through the appropriate NEPA and CERCLA/RCRA/NEPA integrated processes. The All Other Areas geographic area would remain under Federal ownership to protect the public from routine or accidental releases of radiological contaminants and/or hazardous materials. The use of protective buffer zones surrounding the waste remediation, processing, and disposal areas is required by DOE Order 151.1, *Comprehensive Emergency Management System* (DOE 1996f), and Occupational Safety and Health Administration (OSHA) regulations 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (Site Safety and Control Plan), and OSHA 29 CFR 1910.119, "Process Safety Management (PSM) Rule." These buffer zones limit public exposure to radiological and hazardous chemicals from routine operations and accidents.

A portion of this geographic area (just north of the City of Richland) would be used for industrial purposes. An Industrial use would allow R&D facilities similar to the EMSL. The lands in and adjacent to the 300 and 400 Areas would remain under Federal ownership, but DOE would be able to lease lands for private and public uses (including withdrawn public lands with the owning agency's permission) to support regional industrial and economic development (e.g., Energy Northwest [formerly known as WPPSS]). Other Federal uses would be allowed by permit (e.g., LIGO). This area includes a section south of the 200 Areas that was sold to the State of

Washington for a dangerous waste, non-nuclear disposal site but remains undeveloped. If the state were to develop that property per its Quit Claim Deed (State of Washington 1980), the state would have to obtain appropriate county, state, and Federal permits.

The Horn Rapids Landfill (HRL), operated by the U.S. Department of Energy Richland Operations Office (RL), encompasses approximately 20 ha (50 ac) of the 600 Area. Originally, the landfill was a quarry for sand and gravel. Subsequently, the HRL was used as a landfill for office and construction waste, asbestos, sewage sludge, fly ash, and reportedly numerous drums of unidentified organic liquids. Consistent with EPA recommendations for operators of landfills that handle asbestos, fencing and warning signs have been erected around the perimeter of the HRL to control public access. The HRL has been remediated under the terms of the 1100 Area CERCLA ROD. Future-use restrictions associated with this parcel of land as an asbestos-containing landfill are to be consistent with the terms of 40 CFR 61.151. In general, for the purposes of restrictions on land uses, 40 CFR 61.151 indicates that a notation must be made on the deed or covenant notifying a potential purchaser that the land has been used for asbestos-containing waste material. A deed restriction for asbestos has been filed with Benton County for the HRL. Other deed restrictions or covenants would likely be applied to this area through the CERCLA and RCRA processes.

The DOE's transfer of the 1100 Area to the Port of Benton for economic development was approved through an interim action environmental assessment. The DOE prepared an environmental assessment that resulted in a finding of no significant impact (FONSI) on August 27, 1998, transferring the 1100 Area and the Southern rail connection to the Port of Benton (DOE/RL EA-1260). Although the 1100 Area is no longer under DOE control, it is included in this EIS to support the local governments with their SEPA EIS analyses of the Hanford sub-area of Benton County under the State of Washington's Growth Management Act.

The Port of Benton officially took ownership and control of the "1100 Area" (consisting of 318 ha [786 ac], 26 buildings, and 26 km [16 mi] of rail tract) on October 1, 1998. Together with the Washington State Department of Transportation and Legislature Transportation Committee, the Port of Benton is funding a major study ($600,000) to determine the feasibility of reconnecting the Hanford main rail line to Ellensburg, Washington, as it was in the 1970s, as an alternative route for Yakima Valley rail traffic flowing between the Puget Sound and the Tri-Cities. The current Yakima Valley route passes directly through all the cities in the Valley, including the cities of Yakima and Kennewick, which have plans to develop their downtown areas to be more people friendly.

Specifically, the Port of Benton has expressed a desire to use the Hanford rail system and extend the current system upriver where there is currently only an abandoned railroad grade. Provisions for the reconnection would be made in DOE's permit to the USFWS for management of the Riverlands. The DOE Preferred Alternative would not hinder the rail option because it would be considered a pre-existing, nonconforming use (see Chapter 6). At this time, DOE has no plans to maintain the northern portions of the existing rail line.

3.3.1.3.5 The Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE Reserve). The ALE Reserve geographic area would continue to be managed similar to the Preservation designation in accordance with the Rattlesnake Hills Research Natural Area designation and the USFWS permit. Big Bend Alberta Mining Company holds mineral rights on about 5 km^2 (2 mi^2) under the southern portion of the ALE Reserve (see Section 4.2.3.1). The USFWS and DOE have a 25-year agreement signed in 1997 that the USFWS will manage the ALE Reserve consistent with the existing ALE Management Plan until the new plan is developed. This new Comprehensive Conservation Plan (CCP) is being developed by the USFWS under DOE funding. Through the CCP, the USFWS will identify USFWS proposed management actions.

The CCP will give the USFWS the authority to manage the ALE Reserve as a part of the NWR System. The CCP would be the equivalent of an area management plan (AMP) developed under the guidelines in Chapter 6. Unless the DOE permit is revoked, the USFWS would manage the ALE Reserve and proceed with CCP preparation to identify refuge management actions that could bring the ALE Reserve into the NWR System.

Currently, persons wishing to visit the ALE Reserve must first contact an appropriate staff member of either DOE or the USFWS.

3.3.2 The Agency's (DOE's) Preferred Alternative

The CEQ requires an agency to ". . . identify the agency's Preferred Alternative if one or more exists, in the draft statement, and identify such alternative in the final statement . . . (40 CFR 1502.14[e])." In the development of the Preferred Alternative, DOE took into account its role as the long-term caretaker for the Site for at least the next 50 years. The DOE used information from the Hanford Geographic Information System (HGIS) and Waste Information Data System (WIDS) databases. Information considered by DOE includes:

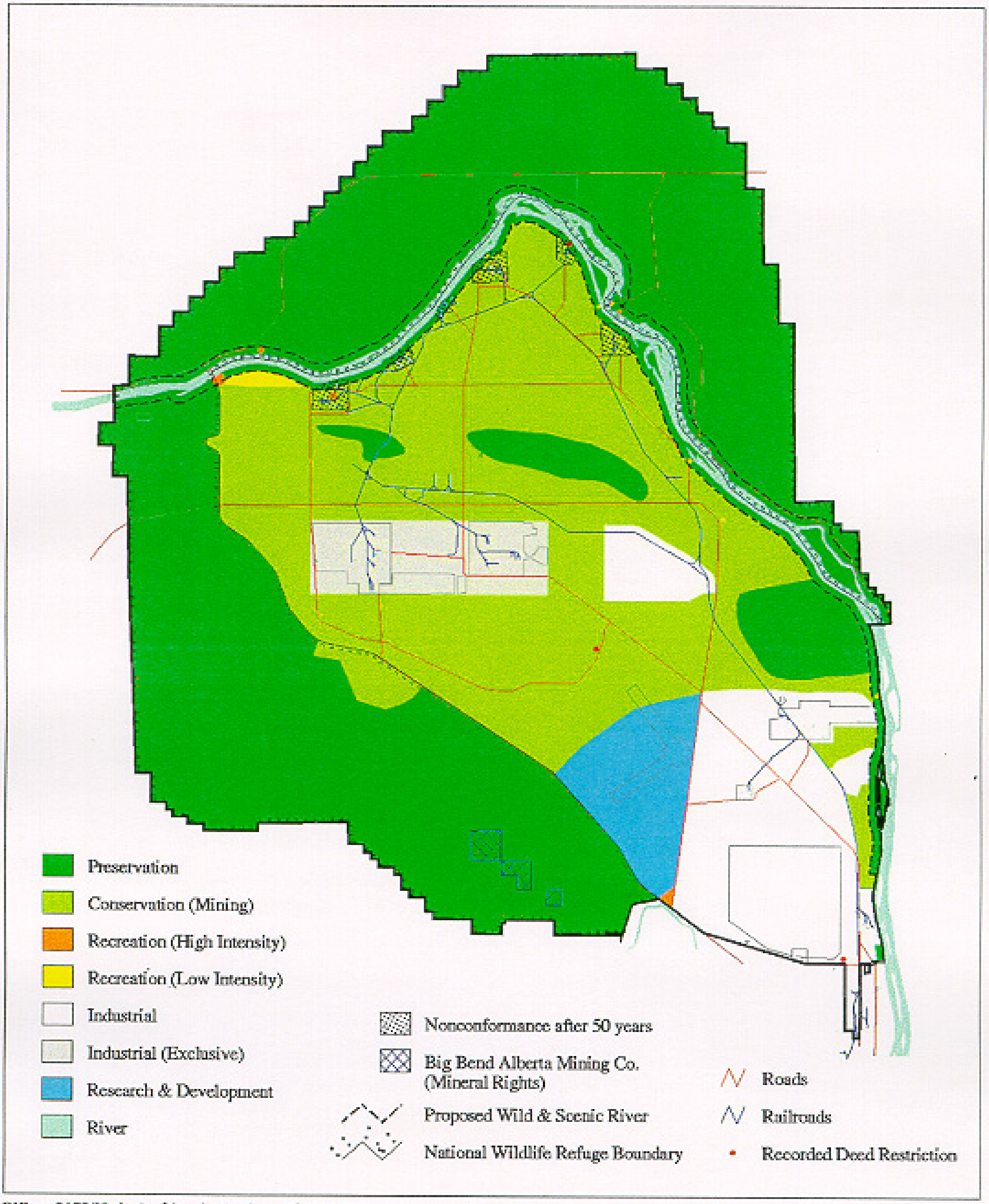
- All surface waste sites, including those remediated (Figure 4-34)
- Groundwater contaminants and flow direction (Figures 4-15, 4-35, and 4-36)
- Cultural and biological resources (Figure 4-27)
- Exclusive-use zones (EUZs) and emergency planning zones (EPZs) associated with DOE and other Hanford activities (e.g., Energy Northwest's nuclear power reactor, U.S. Ecology's low-level waste [LLW] disposal site, LIGO, etc.) (Figure 4-37).

The DOE believes that the Preferred Alternative would fulfill the statutory mission and responsibilities of the agency and give adequate consideration to economic, environmental, technical, and other factors.

3.3.2.1 Planning Goals, Objectives, and Values (Vision). Much like the No-Action Alternative, DOE's Preferred Alternative was developed based on policies that are consistent with the 1996 *Hanford Strategic Plan* (DOE-RL 1996b). However, unlike the No-Action Alternative, DOE's Preferred Alternative would establish policies and implementing procedures that would place Hanford's land-use planning decisions in a regional context.

The DOE has identified the map alternative presented in Figure 3-3 and the land-use policies and implementing procedures of Chapter 6 as the Agency's (DOE's) Preferred Alternative. The DOE's Preferred Alternative represents land-management values, goals, and objectives of DOE for at least the next 50 years. It also represents a multiple-use theme of Industrial-Exclusive, Industrial, Research and Development, High-Intensity Recreation, Low-Intensity Recreation, Conservation (Mining), and Preservation land uses that have been identified by the public, cooperating agencies, and consulting Tribal governments as being important to the region.

Figure 3-3. DOE's Preferred Alternative.



BHI:mp 04/23/98 clup/prefalt.aml Database: 25-AUG-1999

3.3.2.2 Assumptions Regarding Future Use. The assumptions used to develop DOE's Preferred Alternative are as follows:

- DOE, as a Federal agency, has a Trust responsibility to protect Tribal interests.

- DOE has a responsibility to consult with and recognize the interests of the cooperating agencies. The DOE continues to support DOI's proposal to expand the Saddle Mountain NWR to include all of the Wahluke Slope, consistent with the 1994 Hanford Reach EIS and 1996 Hanford Reach ROD.
- DOE will support economic transition and potential industrial development by the City of Richland or the Port of Benton by encouraging the use of existing utility infrastructure on the Hanford Site.

- Other entities will ask for Hanford's resources and lands.

- The public will continue to support protection of cultural and natural resources on the Site, especially on the Wahluke Slope, the Columbia River Corridor, the McGee Ranch, and the ALE Reserve.

- Mining of onsite geologic materials will be needed to construct surface barriers as required by Hanford Site remediation activities.

- Remediation of the Site will continue and, where necessary, the institutional controls currently in place will continue to be required at some level for at least the next 50 years. Institutional controls are transferrable and can be shared with other governmental agencies.

- Plutonium production reactor blocks will remain in the 100 Areas throughout the planning period and will be considered a pre-existing, nonconforming use.

- Vadose zone contamination will persist in the All Other Areas, Central Plateau, and 100 Area. Contaminated groundwater will remain unremediated in the All Other Areas, Central Plateau, and 100 Area.

- The public will support preservation of the Manhattan Project's historical legacy and development of a High-Intensity Recreation area, consistent with the B Reactor Museum proposal.

- The public will support access to the Columbia River for recreational activities and public restrictions consistent with the protection of cultural and biological resources.

- Areas will be set aside specifically for R&D projects.

- Sufficient area will be retained to support current and expected DOE facility safety authorization basis.

Planning for Possible Future Missions

The Preferred Alternative identifies lands required to support DOE's current Environmental Management and Science and Technology missions at the Hanford Site, as well as lands for future industrial development by the City of Richland and the Port of Benton. The DOE is proposing that additional lands be maintained under the Industrial land-use designation in areas where existing infrastructure is available and other compatible uses exist. The DOE believes it is prudent to retain land under the Industrial land-use designation to support possible future missions, rather than convert the land to the Conservation or Preservation land-use designation at this time. This would avoid possible conflicts with future missions. The DOE anticipates that the need for land under the Industrial land-use designation would continue to be evaluated during future planning efforts, which may result in conversion of some lands to the Conservation, Preservation, or other land-use designations.

- An adequate land base and utility infrastructure will be maintained to support possible industrial development associated with future DOE missions.

3.3.2.3 Application of the Land-Use Designations. Land-use designations identified for DOE's Preferred Alternative are Industrial-Exclusive, Industrial, Research and Development, High-Intensity Recreation, Low-Intensity Recreation, Conservation (Mining), and Preservation (see text box, "*Planning for Possible Future Missions,*" and Figure 3-3).

3.3.2.3.1 The Wahluke Slope. Recently the Wahluke Slope was administered for wildlife and recreation as the Saddle Mountain NWR and the Wahluke Wildlife State Recreation Area under permits granted by DOE to the USFWS and WDFW, respectively. In April 1999, the WDFW and the USFWS notified the DOE of their intent to modify their management responsibilities on the Wahluke Slope under the 1971 agreement leaving only a small portion (about 324 ha (800 ac)) northwest of the Vernita bridge under WDFW permit. The USFWS informed the DOE that it intends to allow essentially the same uses permitted by the State of Washington under the WDFW's management of the Wahluke Slope. Therefore, transfer of management of the Wahluke Slope from the WDFW to the USFWS involves only a change in the agency managing the property and does not involve any change in the management activities for the Wahluke Slope. Management of the entire Wahluke Slope by the USFWS as an overlay wildlife refuge is consistent with the 1996 DOI Hanford Reach EIS ROD. The ROD recommended the Wahluke Slope be designated a wildlife refuge and the Hanford Reach a Wild and Scenic River, and that the wildlife refuge be managed by the USFWS.

The DOE's Preferred Alternative would expand the existing Saddle Mountain National Wildlife as an overlay wildlife refuge to include all of the Wahluke Slope consolidating management of the Wahluke Slope under the USFWS, consistent with the Hanford Reach EIS's ROD (DOI 1996). An overlay refuge is one where the land belongs to one or more Federal agency, but it is managed by the USFWS.

The entire Wahluke Slope would be designated Preservation, with the exceptions near the Columbia River as discussed in the Columbia River Corridor section below. The major reason for designating this area as Preservation would be to provide protection for sensitive areas or species of concern (e.g., wetlands, sand dunes, steep slopes, or the White Bluffs) from impacts associated with intensive land-disturbing activities.

A CCP (see Area Management Plans, Chapter 6) for the Wahluke Slope would be developed by USFWS in accordance with the *National Wildlife Refuge System Improvement Act of 1997*. This Act provides significant guidance for management and public use of refuges allowing for wildlife-dependent recreation uses such as hunting, fishing, wildlife observation and photography, and environmental education and interpretation. The USFWS would consult with DOE during the development of this plan to ensure necessary and appropriate buffer zones for ongoing and potential future missions at the Hanford Site.

3.3.2.3.2 The Columbia River Corridor. The Columbia River Corridor has historically contained reactors and associated buildings to support Hanford's former defense production and energy research missions. Nevertheless, remediation planning documents, public statements of advisory groups, and such planning documents as the *Environmental Impact Statement: The Decommissioning of Eight Surplus Reactors* (DOE 1992a) have determined that remediation and restoration of the Columbia River Corridor would return the corridor to a nondeveloped, natural condition. Restrictions on certain activities may continue to be necessary to prevent the mobilization of contaminants, the most likely example of such restrictions being on activities that discharge water to the soil or excavate below 4.6 m (15 ft). Although the Surplus Reactor NEPA

ROD calls for the reactor buildings to be demolished and the reactor blocks to be moved to the Central Plateau, this action might not take place until 2068 or until a new Tri-Party Agreement milestone is negotiated. As a result, the reactor buildings could remain in the Columbia River Corridor throughout the 50-year-plus planning period addressed by the HCP EIS and would be considered a pre-existing nonconformance into the future.

The Columbia River Corridor would include High-Intensity Recreation, Low-Intensity Recreation, Conservation (Mining), and Preservation land-use designations. The river islands and a quarter-mile buffer zone would be designated as Preservation to protect cultural and ecological resources. Those islands not in Benton County would be included in the Refuge.

- Four sites, away from existing contamination, would be designated High-Intensity Recreation to support visitor-serving activities and facilities development. The B Reactor would be converted into a museum and the surrounding area would be available for museum-support facilities (see text box, "*B Reactor Museum Proposal*"). The High-Intensity Recreation area near Vernita Bridge (where the current Washington State rest stop is located) would be expanded across State Highway 240 and to the south to include a boat ramp and other visitor-serving facilities. Two areas on the Wahluke Slope would be designated as High-Intensity Recreation for potential exclusive Tribal fishing villages.

- Six areas would be designated for Low-Intensity Recreation. The area west of the B Reactor would be used as a corridor between the High-Intensity Recreation areas associated with the B Reactor and the Vernita Bridge rest stop and boat ramp. A second area near the D/DR Reactors site would be used for visitor services along a proposed recreational trail as conceptualized on Alternative Three's map. The third and fourth areas, the White Bluffs boat launch, and its counterpart on the Wahluke Slope, are located between the H and F Reactors and would be used for primitive boat launch facilities. A fifth area, near the old Hanford High School, would accommodate visitor facilities and access to the former town site and provide visitor services for hiking and biking trails that could be developed

B Reactor Museum Proposal

Preserving the history of the Hanford Site, and the public's knowledge and understanding of the events that occurred during World War II and the years which followed are the basis for the existence of the B Reactor Museum Association (BRMA). The primary mission of the organization is the long-term preservation of the retired B Reactor at the Hanford Site, and the upgrading of the structure to allow public access and unrestricted tours.

The B Reactor produced the plutonium for the first manmade nuclear explosion – the Trinity test – in New Mexico on July 16, 1945. The second bomb used in World War II contained plutonium produced by B Reactor. That bomb was dropped on Nagasaki on August 9, 1945, and was credited with bringing about the final surrender of Japan and the ending of the war. Plutonium production operation of the B Reactor was permanently stopped in 1968, and the reactor is currently functioning as a controlled-access museum in the 100-B/C Area of the Hanford Site.

As envisioned by the BRMA, the museum would be within the 105-B Reactor building itself, near the east end of a proposed State park. The new park would include the south shore of the Columbia River extending from the Vernita Bridge rest area on State Highway 240, eastward to the 100-B Area (a distance of about 6 km [4 mi]). The park area, the road providing access from Highway 240, and the museum area would be fenced off from the adjacent Hanford area. Ideally, access would be by private automobile, by train across the Hanford Site from Richland, and by boat from the Columbia River.

The B Reactor was entered into the National Register of Historic Places on April 3, 1992, by the National Park Service. Because of this placement, DOE must comply with the *National Historic Preservation Act* (16 U.S.C. 470) prior to taking any action on the historic site. A report, entitled *105-B Reactor Facility Museum Phase I Feasibility Study Report* (BHI 1995a), concluded that the use of the facility as a museum is feasible.

along the Hanford Reach. A sixth site, just north of Energy Northwest (formerly known as WPPSS), would also provide visitor services for recreational trails (e.g., hiking and biking) along the Hanford Reach. On the Wahluke Slope side of the Columbia River, the White Bluffs boat launch would remain managed as is, with a Low-Intensity Recreation designation. A Low-Intensity Recreation designation for the water surface of the Columbia River would be consistent with current management practices and the wishes of many stakeholders in the region.

- The remainder of land within the Columbia River Corridor outside the quarter-mile buffer zone would be designated for Conservation (Mining). This designation would allow for DOE-permitted mining activities and support BLM's mission of multiple use. Mining would be permitted only in support of governmental missions or to further the biological function of wetlands (i.e., conversion of a gravel pit to a wetland by excavating to groundwater). Should DOE determine that some or all of the withdrawn lands are surplus to DOE's needs and releases the Public Domain lands back to the DOI, then the DOI could determine if the Tribal treaty language – "the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land" – is applicable. A Conservation (Mining) designation would allow DOE to provide protection to sensitive cultural and biological resource areas, while allowing access to geologic resources.

- A Preservation land-use designation for the Columbia River islands would be consistent with the Hanford Reach EIS ROD (DOI 1996) and would provide additional protection to sensitive cultural areas, wetlands, floodplains, Upper Columbia Run steelhead, and bald eagles from impacts associated with intensive land-disturbing activities. Remediation activities would continue in the 100 Areas (i.e., 100-B/C, 100-KE, 100-KW, 100-N, 100-D, 100-DR, 100-H, and 100-F), and would be considered a pre-existing, nonconforming use in the Preservation land-use designation.

3.3.2.3.3 The Central Plateau. The Central Plateau (200 Areas) geographic area would be designated for Industrial-Exclusive use. An Industrial-Exclusive land-use designation would allow for continued Waste Management operations within the Central Plateau geographic area. This designation would also allow expansion of existing facilities or development of new compatible facilities. Designating the Central Plateau as Industrial-Exclusive would be consistent with the Working Group's recommendations, current DOE management practice, other governments' recommendations, and many public stakeholder values throughout the region.

To keep the 1975 I&I commitments (see text box in Section 3.3.1.1) and to help maintain the current Waste Management mission, there have been several Notices of Deed Restriction placed with the Benton County Assessor's Office and the Benton County Planning Office. The No-Action Alternative (Figure 3-2) shows where these Notice of Deed Restrictions have been placed across the Hanford Site. They are currently being used mainly for asbestos left in landfills (e.g., the HRL and the Central Waste Complex Landfill) and concrete structures that were surface contaminated (e.g., the 183-H Solar Basins) (BHI 1997). As remediation continues, DOE expects to file more restrictions that would institutionalize the 5-m (15-ft) depth restriction for excavation in the 100 Areas CERCLA RODs, the Industrial land-use restriction CERCLA ROD in the 300 Area, the expected Industrial land-use RODs for the Central Plateau, and point-of-compliance boundaries for groundwater remediation or LLW disposal facility performance assessment purposes. After incorporating by reference the previous 1975 ERDA 1538 irreversible and irretrievable (I&I) commitments and other documented commitments into this EIS (see Section 1.3), future individual project land-use requirements would be I&I committed through the appropriate NEPA and CERCLA/RCRA/NEPA integrated processes.

3.3.2.3.4 The All Other Areas. Within the All Other Areas geographic area, the Preferred Alternative would include Industrial, Research and Development, High-Intensity Recreation, Low-Intensity Recreation, Conservation, and Preservation land-use designations. The majority of the All Other Areas would be designated Conservation (Mining) to support a possible BLM's mission of multiple uses.

Several areas that would be designated as Conservation (Mining) would be unable to fulfill the designated land use:

- A Notice of Deed Restriction would be placed in those areas where vadose zone contamination remained in-place, according to the CERCLA ROD or RCRA Closure Permit (e.g., the HRL, Central Waste Complex, 183-H Solar Basins, etc.), foreclosing the mining option.

- The section of Washington State land that is deed restricted to waste management activities would be designated as Conservation (Mining) consistent with Benton County's Alternative Three (GMA authority) and, therefore, could not fulfill any waste management purpose.

Other land-use designations would introduce new land management priorities into the All Other Areas. These designations and the areas affected are as follows:

- Two distinct areas, one located east of the 200 Areas (i.e., May Junction) and the other located north of Richland, would be designated for Industrial use to support new DOE missions or economic development. This designation would provide additional industrial development and/or expansion area for current facilities.

- An area west of State Highway 10 and east of State Highway 240 would be designated for Research and Development to support economic diversification and DOE's Energy Research mission. This area would allow for the development of R&D facilities, such as LIGO, which could require substantial buffer zones for operation. In addition, R&D facilities not requiring large areas for operation would also be located within this area.

- A small area at the junction of State Highway 10 and State Highway 240 would be designated High Intensity Recreation to allow for visitor serving facilities at the gateway to the Hanford Reach, ALE, Horn Rapids Park and other recreational activities.

- Gable Mountain, Gable Butte, the area west of State Highway 240 from the Columbia River across Umtanum Ridge to the ALE Reserve, and the active sand dunes areas would be designated for Preservation, which would provide additional protection of these sensitive areas. The extant railroad grade across the Riverlands area would be considered an active permitted infrastructure.

After incorporating by reference the previous 1975 ERDA 1538 irreversible and irretrievable (I&I) commitments and other documented commitments into this EIS (see Section 1.3), future individual project land-use requirements would be I&I committed through the appropriate NEPA and CERCLA/RCRA/NEPA integrated processes.

3.3.2.3.5 The Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE Reserve). Nearly all of the ALE Reserve geographic area would be designated as Preservation. This designation would be consistent with current management practices of the Rattlesnake Hills Research Natural Area and the USFWS permit. A portion of the ALE Reserve would be managed as Conservation (Mining) during the remediation of the Hanford Site as a trade-off developed during the cooperating agencies discussions for preservation of a wildlife corridor through the McGee Ranch and after public comment, the inclusion of the McGee Ranch within the Refuge designation. The wildlife corridor through the McGee Ranch/Umtanum Ridge area had been identified by DOE as the preferred quarry site for basalt rock and silty soil materials that could be required for large waste-management area covers (RCRA caps or the Hanford Barrier) in the Central Plateau. In addition to the wildlife corridor function, the mature shrub-steppe vegetation structure in the McGee Ranch area has greater wildlife value (i.e., BRMaP Levels III and IV) than the cheat grass (BRMaP Level I) in the ALE Reserve quarry site (see Section 5.1.2). The BRMaP (DOE-RL 1996c) levels of concern run from Level I through Level IV, increasing in biological importance as the numbers increase, with Level I being the level of least importance.

3.3.3 Alternative One

3.3.3.1 Planning Goals, Objectives, and Values (Vision). Alternative One represents a Federal stewardship role for managing national resources on the Hanford Site with the acknowledged consumptive treaty-reserved "right of taking fish at all usual and accustomed places in common with citizens of the Territory; and of erecting temporary (suitable instead of temporary for the CTUIR) buildings for curing." This does not include the tribal vision of consumptive non-fishing activities by tribal member's exercising their reserved treaty rights, implicit in Alternatives Two and Four. Specifically these rights are, "the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle (stock instead of horses and cattle for the CTUIR) upon open and unclaimed land" (just unclaimed and not open and unclaimed for the CTUIR). The DOE regards Alternative One as the Environmentally Preferable Alternative.

> ***Environmentally Preferable Alternative***
>
> Section 1505.2(b) of CEQ's NEPA regulations requires that in cases where an EIS has been prepared, the Record of Decision (ROD) must identify all alternatives that were considered, ". . .specifying the alternative or alternatives which were considered to be environmentally preferable." The environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101. Ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources.

The land-use designations included in Alternative One are presented in Figure 3-4. This alternative considers Hanford resources (i.e., ecological, historic, cultural, and economic resources) in a regional context. Enlarging the existing Federal Saddle Mountain NWR, to include all of the undisturbed natural area north and east of the Columbia River and west of State Highways 24 and 240, is seen as the best way to preserve these resources. The vision of Alternative One is to preserve the Hanford Site shrub-steppe ecosystem by protecting the high-quality habitat that runs contiguously along the west of the Site from the Wahluke Slope to the ALE Reserve, and at the same time, protect the Hanford Reach of the Columbia River.

Alternative One was developed using the seven land-use planning goals listed below:

- Integrate mission, economic, ecological, social, and cultural factors as stated in the Secretary of Energy's *Land- and Facility-Use Policy* (DOE 1994b), which includes sustaining the valuable biological resources of the Hanford Site and supporting sustainable economic development.

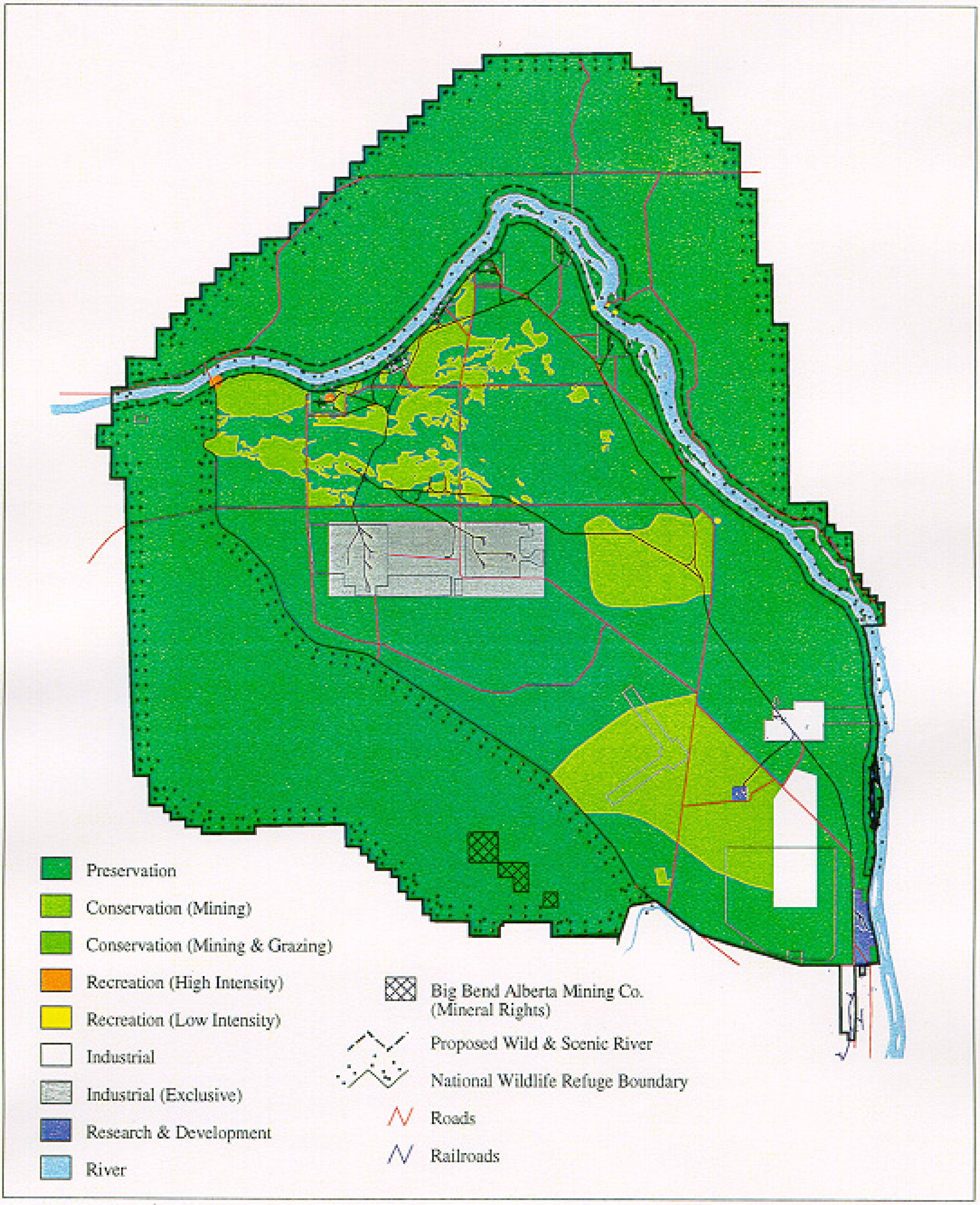
- Support the Rattlesnake Hills Research Natural Area, established in 1971.

- Reduce the inappropriate conversion of undeveloped land into sprawling, low-density development by encouraging siting of high-density development areas.

- Achieve ecosystem planning based on a regional perspective.

> ***Commonly Identified Goals of Alternative One***
>
> - Encourage economic development and diversification.
> - Protect the Columbia River.
> - Use the Central Plateau wisely for Waste Management.
> - Do no harm during cleanup.
> - Recognize the importance of ecological diversity and recreational opportunities and that the quality of those resources should be maintained or improved as a result of cleanup and Waste Management decisions.
> - Protect the integrity of all biological resources, with specific attention given to rare, threatened, and endangered species and their habitats.

Figure 3-4. Alternative One.



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- Preserve the lands, sites, and structures of historical, cultural, or archaeological significance on the Hanford Site.

- Consider the resource needs of the Hanford cleanup program.

- Encourage the retention of open space.

The land-use designations in Alternative One incorporate the commonly identified goals of the Working Group, Hanford Tank Waste Task Force, and HAB as well as DOE's adoption of these stakeholder values (see text box, "*Commonly Identified Goals of Alternative One*").

The objectives of Alternative One are to promote, through the enlargement of an existing Federal wildlife refuge, the protection and recovery of state and federally listed species, a wide range of fish and wildlife recreational opportunities (see text box, "*Wildlife Viewing in Washington*"), aquatic and terrestrial habitats and associated fish and wildlife populations, and the utilization of the existing infrastructure (especially in the southeast portion of the Site and the Central Plateau) for development. The vision of Alternative One is to conserve the Hanford Site shrub-steppe ecosystem, which provides a sanctuary for River and riparian areas to maintain the high quality of the salmon and steelhead spawning areas, and to maintain a habitat link between the Hanford Site and the Yakima Training Center, which is Washington State's second largest shrub-steppe ecosystem. This would ensure conservation of the region's shrub-steppe heritage for future generations to enjoy.

Wildlife Viewing in Washington

More than a third of the population in Washington state participates in wildlife viewing and those wildlife watchers spent nearly $1.7 billion on the pursuit in 1996, according to a 1998 WDFW report.

The "Economic Benefits of Wildlife-Watching Activities in Washington" report found that wildlife watchers spent $1.1 billion on equipment purchases, $509 million on trip-related expenses including food and lodging, $106 million for land-use fees and rentals, and $59 million for items such as magazines, books, membership dues, and other items.

The popularity of wildlife-viewing activities in Washington translates to:

- Nearly 8,000 jobs supported by watchable wildlife activities.
- Destination tourism drawing about 270,000 out-of-state visitors who spent nearly 6 million visitor-days here in 1996.
- State sales tax proceeds amounting to $56.9 million.

The growing interest in wildlife viewing prompted WDFW to establish a Watchable Wildlife program in 1997, aimed at providing recreational opportunities to the public, promoting understanding of wildlife habitat needs and linking wildlife conservation and management to economic opportunities in local communities.

3.3.3.2 Assumptions Regarding Future Use. The assumptions used to develop Alternative One are as follows:

- Existing hazardous waste and ongoing remedial actions will require DOE to maintain control of portions of the Site for the proposed planning period.

- DOE control of the Site will be required to provide a safety buffer for the public from unforeseeable accidents that pose health risks to workers and the public (e.g., the Plutonium Reclamation Facility explosion) during the cleanup mission.

- Plutonium production reactor blocks will remain in the 100 Areas throughout the planning period and will be considered a pre-existing, nonconforming use.

- DOE will continue to practice "as low as reasonably achievable" (ALARA) management designed to keep human exposure to a minimum by only approving staff and projects on the Hanford Site necessary for management of radioactive and hazardous wastes. The intent of the ALARA program is to avoid unnecessary exposure and potential risks from radioactive, hazardous, or biological materials to workers, public, and/or the environment. These risks could include unexpected air releases.

- DOE will find new missions for buildings in the 300 and 400 Areas for exploring new technologies related to the treatment and handling of hazardous waste, developing energy technologies, and other DOE missions. These new missions may be conducted by Federal and non-Federal entities.

- Expansion for future development during the planning period will not exceed historical acreage used by DOE and its predecessors. This projected future development expansion will occur as high-density development to conserve the other natural resources present on the Site.

- Stewardship will be based on the principles of ecosystem management and sustainable development.

- Existing permits and Memoranda of Agreement made by DOE with other entities for land-management purposes will continue, with the exception of the Wahluke State Wildlife Recreation Area, which be terminated to allow management of the expanded Saddle Mountain NWR by the USFWS.

- USFWS will manage the ALE Reserve, McGee Ranch site, Riverlands, and Wahluke State Wildlife Recreation Area.

- The R&D necessary for cleanup will occur in a manner that creates additional private-sector economic development opportunities.

- Quarry sites will support DOE's remediation construction and infrastructure maintenance needs. No commercial use of the quarries will occur during this planning period.

3.3.3.3 Application of the Land-Use Designations. Alternative One land-use designations include Industrial-Exclusive, Industrial, Research and Development, High-Intensity Recreation, Low-Intensity Recreation, Conservation (Mining), and Preservation. The location, shape, and size of the land-use designations were based on analysis of the existing natural and man-made resources (e.g., infrastructure, topography, and biology, etc.) found in Chapter 4 and land-use projects for economic development, which are also found in Chapter 4.

3.3.3.3.1 The Wahluke Slope. The land-use designation for the Wahluke Slope under Alternative One would be Preservation. The Wahluke Slope is currently administered for wildlife and recreation as the Saddle Mountain NWR and the Wahluke Wildlife Recreation Area under permits granted by DOE to the USFWS and WDFW. Management of the Wahluke Slope would be consolidated under the USFWS as a portion of the Saddle Mountain NWR.

The Saddle Mountain NWR would be designated Preservation, which is consistent with the current administered land use. Preservation would provide a protective safety buffer zone for DOE remedial activities in the 100 Areas. These DOE activities are expected to continue for the planning period, and would continue to provide a sanctuary for shrub-steppe dependent species that inhabit the area. Preservation would also prevent activities within the BoR's Red Zone (an area where irrigation is restricted because it accelerates mud slides along the Columbia River) that could jeopardize stability of the White Bluffs. Preservation would not interfere with the BoR's management of the Columbia Basin Project's irrigation wasteways because they would be considered a pre-existing, nonconforming use. An agreement would be established by the DOI between its four agencies (i.e., USFWS, BoR, NPS, and BLM) to enable all to fulfill their Congressionally mandated missions on the Wahluke Slope.

Agriculture (cropland) is a feature of some refuges, and was considered for portions of the Wahluke Slope consistent with currently administered wildlife sharecropping programs (see text box, "*Cropland Management on National Wildlife Refuges*"). Currently, there is a significant amount of privately held agricultural lands in the region that the U.S. Department of Agriculture is protecting (i.e., the lands are not being used for agriculture) for either environmental or cultural reasons under the Conservation Reserve Enhancement Program (CREP) (see Table 3-2). In addition, the markets for apples, potatoes, and wheat are currently soft with the apple industry examining the need to take trees out of production (TCH 1998a).

In consideration of the natural resource trustee's Congressional mandate to preserve and protect endangered ecosystems such as the shrub-steppe, expanding the agricultural base in the region -- while possible under a NWR scenario -- is not considered to be an appropriate use of the Wahluke Slope lands and their dependent fisheries resources.

3.3.3.3.2 The Columbia River Corridor. Land-use designations for the Columbia River Corridor under Alternative One wo'uld include High-Intensity Recreation, Low-Intensity Recreation, Conservation (Mining), and Preservation.

Cropland Management on National Wildlife Refuges

In 1992, estimated cropland in the NWR System was approximately 82,556 ha [204,000 ac] (1.4% of refuge system lands outside of Alaska), down from 8,903 ha (222,000 ac) (1.9% of refuge system lands outside of Alaska) in 1974. Former croplands have been allowed to undergo natural succession, have been planted with desired grasses, trees, or shrubs; or have been converted in some cases to managed moist soil wetland units, according to a USFSW report.

Of the 181 refuges with farming programs in 1989, 129 refuges (and 61,917 ha [153,000 ac]) were farmed by permittees who retained a share of the crop in return for costs incurred to farm the land. On the remaining refuges, USFWS personnel conduct farming operations with government equipment.

Soil preparation, manipulation and treatment practices on refuge croplands are based on sound land-use soil conservation practices. Techniques used include contour farming, cover cropping, windrow planting, sodding waterways, eliminating fall and spring plowing, stubble mulching, and using shallow water retention structures.

On many refuges, crops are systematically rotated and legumes are incorporated with grain crops to improve soil tilth and nutrient content and to reduce weed problems. Biological farming is the preferred farming method on refuges.

Table 3-2. 1997 Regional Conservation Reserve Enhancement Program (CREP) (USDA 1998).

County	Acres	Rental Payment per Acre in 1997	CREP Cost in 1997
Adams County	91,794.00	$45.45	$4,172,037.00
Benton County	29,703.00	$40.63	$1,206,833.00
Franklin County	32,524.00	$48.95	$1,592,050.00
Grant County	25,891.00	$44.64	$1,155,774.00
Hanford Region	179,912.00	$44.92	$8,126,694.00

The Columbia River islands within the Hanford Site boundary would be designated for Preservation and included in the Saddle Mountain NWR to maintain important areas for wildlife. Wildlife species using these islands include mule deer, American white pelicans, sandhill cranes, waterfowl, and ring-necked pheasant. A significant area of the Upper Columbia River summer/fall-run chinook salmon spawning habitat is located near these islands, as well as potential juvenile rearing habitat for the federally listed Upper Columbia River spring-run chinook salmon (Endangered listed -3/99), Middle Columbia River steelhead (Threatened listed-3/99), and Upper Columbia River steelhead (Endangered listed-8/97).

The Columbia River Corridor itself includes Low-Intensity Recreation, High-Intensity Recreation, Conservation (Mining), and Preservation land-use designations. The Low-Intensity Recreation areas would include an existing unimproved boat ramp on the Benton County side of the corridor at the White Bluffs. Use of the boat ramp would be restricted to emergency responses to protect suitable bald eagle nesting habitat. Restrictions would be consistent with the *Hanford Site Bald Eagle Management Plan* (DOE-RL 1994b). The High-Intensity Recreation area currently includes an existing highway rest area on the west side of State Highway 240 at Vernita Bridge. The rest area is leased from DOE by the Washington Department of Transportation. A boat ramp facility has been proposed east of the highway across from the rest area on the Benton County side. The Preservation designation would provide protection for ecologically and culturally sensitive areas being considered for protection under the Wild and Scenic Recreational River designation (DOI 1996) and would be consistent with the current management of the Saddle Mountain NWR.

The 100 Areas would include High-Intensity Recreation, Conservation (Mining), and Preservation land-use designations. The B Reactor would be designated High-Intensity Recreation to allow tourism of the federally registered landmark and would be consistent with the B Reactor Museum proposal. Radioactive contamination would remain below 4.6 m (15 ft) in the 100 Areas vadose zone. During the planning period for this document (at least the next 50 years), the spent fuel will be removed from the K Basins. Associated environmental risks were evaluated in the K Basin EIS (DOE 1996b).

3.3.3.3.3 The Central Plateau. The Central Plateau would include Industrial-Exclusive and Preservation land-use designations. The Central Plateau includes undeveloped and uncontaminated land, the majority of which has been designated priority shrub-steppe habitat by the WDFW. Potential future Hanford Site projects include a full-scale, low-level vitrification plant and a burial ground for eight reactor cores (DOE 1992a). The remaining undeveloped areas would be considered sufficient for the preferred regional alternative of DOE's Programmatic Waste Management EIS (DOE 1997a). Under the Programmatic EIS preferred regional alternative, the Central Plateau would be committed to waste management from other DOE sites. Although this land-use designation does not include Research and Development, R&D projects specific to DOE waste management activities would be allowed. Mitigations for impacts from all the previously mentioned, and any unforeseeable projects, would be consistent with the Draft *Hanford Site Biological Resources Management Plan* (BRMaP) (DOE-RL 1996c).

Land west of the currently developed 200 West Area within the Central Plateau geographic area would be designated Preservation. This area contains high-quality mature sagebrush, which provides essential habitat for shrub-steppe dependent species. This designation would prevent additional sprawl to the west and encourage siting of new projects between the 200 East and 200 West Areas.

3.3.3.3.4 The All Other Areas. The All Other Areas geographic area under Alternative One would include Industrial, Research and Development, Low-Intensity Recreation, Conservation (Mining), and Preservation land-use designations. All development (i.e., Industrial, and Research and Development) would occur south of Energy Northwest (formerly known as WPPSS), inclusive. This development would include transition of existing facilities in the 1100, 300, and 400 Areas and the Energy Northwest area to potential uses such as high technology incubators, manufacturing, and medical isotope production. The majority of non-Federal uses would occur offsite or within a portion of the area identified by the City of Richland's urban growth area (UGA) boundary in the southeast portion of the Site. This reduced UGA would include Industrial and Research and Development. The DOE's industrial needs could also be met within the approximately 5.2 km^2 (4 mi^2) of land identified for industrial use between Energy Northwest and the UGA boundary. This 5.2 km^2 (4 mi^2) area contains low-quality habitat. Just west of the Industrial designation is an extensive tract of seral shrub-steppe habitat which has been designated Conservation (Mining). As the canopy cover increases, this seral shrub-steppe habitat will become more important for shrub-steppe dependent species as additional shrub-steppe habitat is destroyed offsite.

Wildlife corridors designated as Preservation would be located around this industrial development to allow wildlife movements between the ALE Reserve, the Columbia River, and the Saddle Mountain NWR. Between the western boundary and State Highway 240, a wildlife corridor would run north from the ALE Reserve to the Columbia River. This northwestern wildlife corridor would include the areas known as McGee Ranch and the river lands. Within the southeastern wildlife corridor north of the Yakima River, a small area would be designated Conservation (Mining) to allow potential extraction of geologic materials for use in the 200 Areas remedial efforts. Considering this as a quarry site for basalt and soil provides DOE with the option to designate Gable Mountain, Gable Butte, and West Haven as Preservation because of their significant cultural value; and also to designate, as Preservation, the McGee Ranch site (which is DOE land north and west of Highway 24 and south of the Columbia River). This Preservation designation, including the McGee Ranch site as part of the expansion of the Saddle Mountain NWR, would help preserve and protect an important habitat link between the Hanford Site and the Yakima Training Center.

3.3.3.3.5 The Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE Reserve). The ALE Reserve geographic area would be designated Preservation consistent with the management of the expanded Saddle Mountain NWR. Preservation and management of the ALE Reserve as an expansion of the Saddle Mountain NWR would protect the rare and high-quality shrub-steppe plant communities and unique and rare fauna that reside on this portion of the Site. Many of these plant communities and fauna are found nowhere else in the state of Washington or in the Columbia Basin eco-region. Providing an expanded Saddle Mountain NWR for a biological sanctuary of shrub-steppe dependent species would assist agricultural and industrial development in other areas of the Columbia Basin's shrub-steppe community by partially fulfilling the mandate to preserve species under the *Endangered Species Act of 1973.*

3.3.4 Alternative Two

3.3.4.1 Planning Goals, Objectives, and Values (Vision). Alternative Two presents the vision of the Nez Perce Tribe, Department for Environmental Restoration and Waste Management and incorporates their vision of Federal trust responsibility to the Indian Tribes (Figure 3-5). This vision calls for preservation of the natural and cultural resources at the Hanford Site. Traditional Tribal use is consistent with the Preservation land-use designation. Protection of cultural resources at the Hanford Site is the top priority of Alternative Two. Sharing the Nez Perce Tribe's knowledge and point of view about sacred sites and nature with everyone is vitally important. Cultural resources remain important to the Nez Perce Tribe's way of life and are part of the Tribe's tradition.

The Hanford Site, including the Columbia River, has a history of serving as a gathering place for Indian Nations to hunt, fish, trade, and feast. The Nez Perce have shared and participated in these known ancient and traditional activities with other Tribes when and where there were no fences, boundary lines, or treaties. The Hanford Site is one of the largest areas of land in the Pacific Northwest region that has not been developed, with agriculture being the principal development on surrounding lands. The Hanford Site contains the last nontidal, unimpounded section of the Columbia River in the United States, and the Hanford Reach is the only remaining area on the Columbia River where Chinook salmon still spawn naturally. The ALE Reserve geographic area contains one of the few resident elk herds in the world that inhabit a semi-arid area, and the ALE Reserve is one of the largest remnants of relatively undisturbed shrub-steppe ecosystem in the State of Washington. Approximately 50 species of animals that are classified as "sensitive species" currently reside at the Hanford Site. The largest population of sage sparrows in Washington State can also be found at Hanford.

The Nez Perce have always considered that the land and its creatures are essential to everyday life. Humans are considered to be only one small part of a much larger circle of life on the earth. Nez Perce stories exemplify this intimate relationship between humans and the earth, and traditional Nez Perce culture weaves an intimate relationship between humanity and nature. In all phases of their daily lives, the Nez Perce recognize the spirits of the forces and objects around them as supernatural guardian forms, which they call in a personal way their *Wyakin*. The Nez Perce identify themselves with all the natural features of the earth. In the Nez Perce's belief, the earth is the ever-nourishing mother, as any mother provides for a child. We must continue to be caretakers of the earth, or life will surely soon end. These values are used in developing Alternative Two.

3.3.4.2 Assumptions Regarding Future Use. The assumptions used to develop Alternative Two are as follows:

- Potential industrial and recreational development of the City of Richland and Benton County will primarily occur outside of the Hanford Site's boundary and close to Benton County's population centers.
- Remediation of the Hanford Site will continue, and the security measures currently in place will continue to be required.
- Plutonium production reactor blocks will remain in the 100 Areas throughout the planning period and will be considered a pre-existing, nonconforming use.
- The last nontidal, unimpounded section of the Columbia River, and the salmon habitat found therein, as well as cultural resources of the indigenous people who pre-date the Federal government will be protected.

1
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Figure 3-5. Alternative Two.

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- The retained rights to the area, as recognized and affirmed by the Federal government in treaties with the affected Native American Tribes, will be protected.

- International treaties concerned with protecting salmon and other wildlife will be honored.

- With DOE's mission change from defense production to environmental restoration, the land needs of future DOE missions could be contained in the Central Plateau, 400 Area, and 300 Area.

- Major portions of the Site could not be conveyed to private ownership due to soil contamination left at depth after remediation.

- Existing contaminated groundwater conditions would not preclude development in any given location but would be considered a constraint to groundwater use and prevent transfer to private ownership, as the private sector would be unable and unwilling to accept the environmental liabilities.

3.3.4.3 Application of the Land-Use Designations. Alternative Two's land-use designations include Industrial-Exclusive, Industrial, Research and Development, High-Intensity Recreation, and Preservation. The location, shape, and size of the land-use designations were influenced by a thorough analysis of the existing cultural resources, the hazards and resources created by humans, and the geology.

3.3.4.3.1 The Wahluke Slope. Alternative Two would designate the entire Wahluke Slope as Preservation. Preservation would prohibit irrigation of the Wahluke Slope because irrigation is accelerating sloughing of the White Bluffs along the Hanford Reach of the Columbia River. Sloughing of the bluffs, or other activities that change the course of the Columbia River such as dredging or mining, could release chemical and radioactive contaminants that have been entombed within the fine sediments of the Hanford Reach.

Preservation would protect the last nontidal, unimpounded section of Columbia River and the salmon habitat found within, as well as the cultural resources of the indigenous people who pre-date the Federal government. Preservation would honor retained Tribal rights as recognized and affirmed by the United States of America in the *Treaties of 1855* with the affected Tribes (Appendix A), as well as complying with international fishing treaties. Preservation would prevent an additional appropriation of water from the Columbia River in order to support development of lands on the Wahluke Slope. The Wahluke Slope is not in acreage that has been appropriated water from the (57 U.S.C. 14). Finally, a Preservation designation would be appropriate because a large portion of the Wahluke Slope is too steep to develop (see Section 4.2).

3.3.4.3.2 The Columbia River Corridor. The Columbia River Corridor would include High-Intensity Recreation, Low-Intensity Recreation, Research and Development, and Preservation land-use designations. The Columbia River (surface water only) would be designated for Low-Intensity Recreation. The Nez Perce Tribe supports a Preservation designation for the islands in the Columbia River and the designation of the Hanford Reach as a "wild and scenic" river under Federal control. The B Reactor and surrounding area, which are located within the Columbia River Corridor, would be designated for High-Intensity Recreation and would allow conversion of the reactor into a museum with museum-related facilities. The B Reactor was the first full-scale nuclear reactor in the world and was critical in the development of the first nuclear weapons. The K Reactor area would be designated for Research and Development. The K Reactor area could be used by the Tribes and others for fish farming or for aquaculture and aquatic research.

The remainder of land within the 100 Areas would be designated Preservation. Preservation would protect retained rights of American Indian Tribes to the area and would protect sensitive cultural and biological resource areas. Prohibiting further irrigation and other land uses that increase infiltration on both sides of the Hanford Reach would aid in the stabilization of the Columbia River shoreline. Prohibiting irrigation would protect public health and the environment by preventing remobilization of contaminants entombed within the river's sediment and the shoreline's soil column, and would prevent siltation and destruction of salmon spawning beds. Preservation prohibiting irrigation near the reactor areas would mitigate mobilizing contaminants left behind at depth long after cleanup efforts have ceased (see Section 4.11). Because the cleanup efforts in the 100 Area's soil column are limited to a depth of about 6.1 m (20 ft) below ground surface, the contaminants remaining in the soil column below 6.1 m (20 ft) will not be remediated.

3.3.4.3.3 The Central Plateau. The majority of land within the Central Plateau geographic area would be designated Industrial-Exclusive, allowing for continued management of radioactive and hazardous waste. These management activities include collection and disposal of radioactive and hazardous waste materials that remain onsite, contaminated soil and groundwater containment and cleanup, and other related and compatible uses. Deed restrictions or covenants could be applied to this area through the CERCLA and RCRA processes. This designation would allow for expansion of existing facilities or the development of new facilities for Waste Management or other DOE missions.

Land west of the currently developed 200 West Area within the Central Plateau geographic area would be Preservation. This area contains high-quality mature sagebrush, which provides this essential habitat for shrub-steppe dependent species. This designation would prevent additional sprawl to the west and encourage siting of new projects between the 200 East and 200 West Areas.

3.3.4.3.4 The All Other Areas. The All Other Areas geographic area would include Industrial, Research and Development, and Preservation. Alternative Two designates, as Industrial, the City of Richland UGA, the 400 Area (including the Fast Flux Test Facility), and Energy Northwest (formerly known as WPPSS) to allow for future economic development. An Industrial designation would accommodate economic development of the area identified by the City of Richland's UGA boundary at the southeast portion of the Site for at least the next 50 years. An Industrial designation would also reserve the 400 Area for DOE missions and the Energy Northwest (formerly known as WPPSS) area for use by Energy Northwest. The area around LIGO within the All Other Areas geographic area would be designated Research and Development, consistent with current management practices.

The remainder of the All Other Areas geographic area would be designated Preservation. Major constraints identified in the *Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land-Use Plan* (DOE 1996) demonstrated that the majority of the Hanford Site is unsuitable for economic development, and that the best future land use would be Preservation. Designating the majority of the All Other Areas as Preservation is appropriate because, while portions of the All Others Areas geographic area have a well-developed transportation network, these areas are remote from population centers thus limiting their economic potential. A sand dune complex and vegetation-stabilized sand dunes, which extend from the Columbia River westward across the Site to State Highway 240 (see Section 4.5), should not be developed because vegetation-disturbing activity might reactivate stabilized dune fields. Soil and groundwater contamination remaining at depth after remediation prevents these lands from being exploited for economic reasons due to the difficulties involved in transferring public lands with environmental liabilities to private ownership. For example, the widespread environmental contamination from the 200-BC cribs is approximately 32.1 km^2 (12 mi^2).

A Preservation designation also precludes extensive economic development of the All Other Areas geographic area because of the large exclusive-use zones (safety buffers) around the Hanford Site's existing nuclear facilities (see Section 4.11). Additionally, the nature of the research conducted at LIGO requires a substantial seismic buffer zone for operation.

The promontories of Gable Mountain, Gable Butte, Umtanum Ridge, and a large portion of their viewsheds would be designated Preservation, consistent with traditional Tribal use. The *Old Indians* went to high mountains seeking vision sites and to fast for a few days to seek a vision or a *Wyakin* (which is the Nez Perce word for your personal vision spirit that will protect you for the rest of your life). The *Wyakin* could be a bird, four-legged animal, plant, or root, and it will be your personal medicine. During a vision quest, one looks at the big picture or the view as far as the eye can see. This view encompasses the big river, creeks, springs, the various grasses, shrubs, animals, birds, and even insects such as ants. These things and objects all have their place and souls on the mother earth; one prays to the Creator to bless you and ask him to take care of all these things.

To preserve these cultural resources (including wildlife), the large contiguous tract of shrub-steppe habitat in the All Other Areas surrounding the Central Plateau is designated Preservation. The resident elk herd, one of the largest remnants of relatively undisturbed shrub-steppe ecosystem, and viewsheds for American Indian vision sites (e.g., Gable Butte and Gable Mountain) would all be protected by a Preservation land-use designation. The Preservation land-use designation would also ensure that wildlife corridors are maintained.

3.3.4.4 The Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE Reserve). The ALE Reserve geographic area would be designated Preservation in accordance with its management as the Rattlesnake Hills Research Natural Area. Currently, the USFWS manages the ALE Reserve for DOE. Privately owned mineral rights exist on the ALE Reserve that were not conveyed to the Federal government when the Hanford Site was formed. The ALE Reserve contains one of the few resident elk herds in the world that inhabit a semiarid area, and the ALE Reserve is one of the largest remnants of relatively undisturbed shrub-steppe ecosystem in Washington State.

3.3.5 Alternative Three

3.3.5.1 Planning Goals, Objectives, and Values (Vision). Benton, Franklin, Grant, and Adams counties and the City of Richland contain portions of the Hanford Site. Alternative Three represents the individual planning efforts of these local governments. The procedures used by these governments to develop Alternative Three vary by each planning jurisdiction. The designations in Grant County reflect the Wahluke 2000 Plan prepared by farming interests in 1992 and supported by Grant County (NPS 1996). The designations in Franklin County result from a land-use analysis conducted by the Franklin County Planning Department; and designations within Benton County were developed per the procedure outlined below:

- Existing Hanford Site resources were inventoried, mapped, and characterized.

- Biological resources were identified per the WDFW priority habitat and species data base.

- Natural and biological resources were then translated into five "critical resources," consistent with the GMA, including wetlands, fish and wildlife conservation areas, frequently flooded areas, geologically hazardous areas, and critical aquifer recharge areas.

- An opportunities and constraints analysis was performed using the assembled Hanford Site information.

- Critical resources were placed in a single contiguous designation (i.e., the Conservation land-use designation).

- Areas remaining outside of the Conservation designation were identified as suitable for development and analyzed to determine the appropriate "intensity" of use within the designated area.

- After appropriate intensities were identified for each area suitable for development, land uses were designated consistent with "opportunities and constraints" (e.g., availability of infrastructure, nearness of urban areas, soils capabilities, and current use patterns/future options).

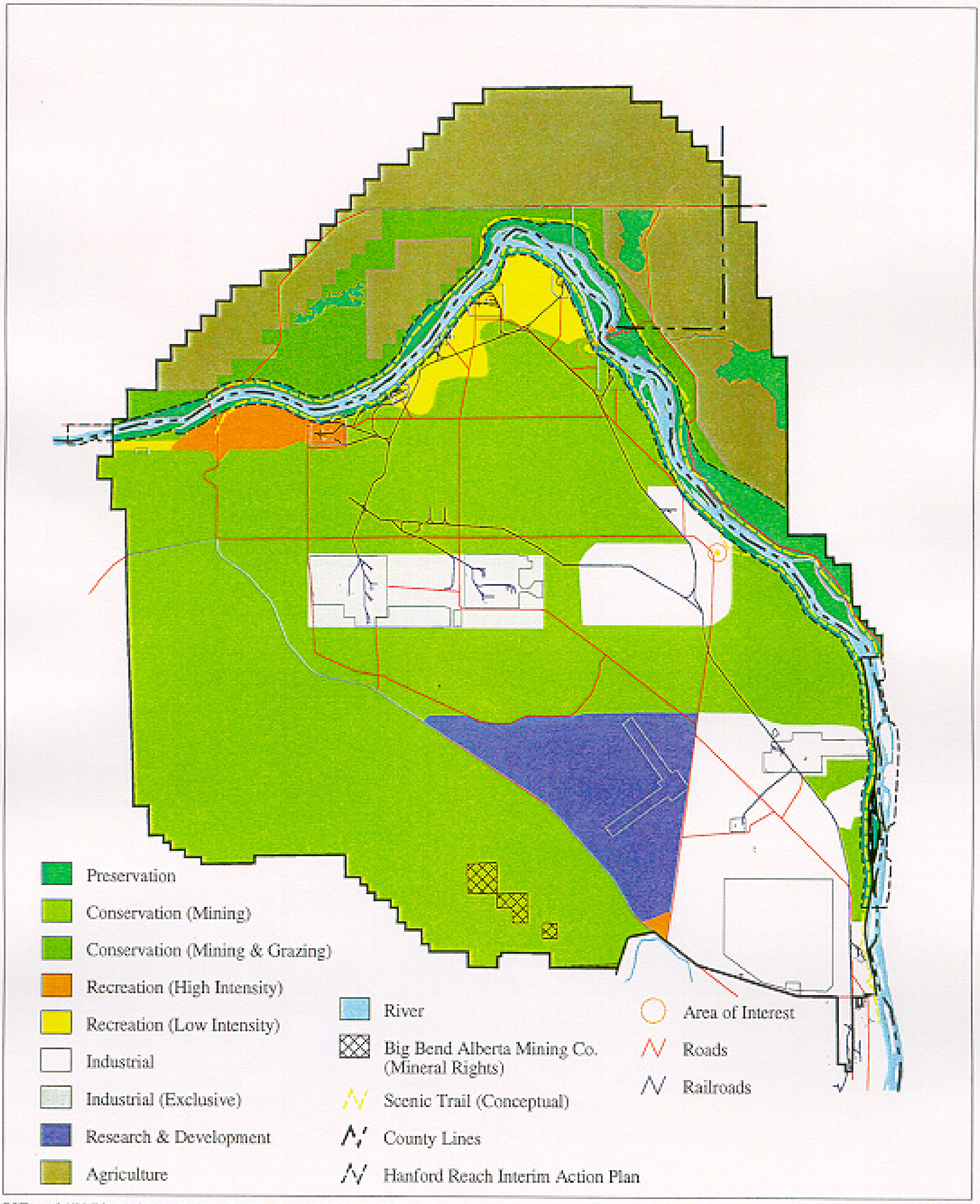
The land-use designations included in Alternative Three are presented in Figure 3-6. The county and city governments believe that the land-use designations for the Hanford Site address identified goals and values of DOE, the City of Richland, Benton County, and the HAB. The goals and values include economic diversification, increased public use for recreation and private enterprise, private-sector utilization of infrastructure, and the protection of biological and cultural resources (see text box, "*Goals and Objectives*").

3.3.5.2 Assumptions Regarding Future Uses. The assumptions used to develop Alternative Three are as follows:

- The Hanford Site will eventually be remediated as recommended by the Working Group.

- Major portions of the Site will be used for multiple private and Federal uses after remediation.

Figure 3-6. Alternative Three.



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- Existing contaminated groundwater conditions will not preclude development in any given location, but will be considered a constraint to groundwater use.

- Plutonium production reactor blocks will remain in the 100 Areas throughout the planning period and will be considered a pre-existing, nonconforming use.

3.3.5.3 Application of the Land-Use Designations. Alternative Three land-use designations include Industrial-Exclusive, Industrial, Agriculture, Research and Development, High-Intensity Recreation, Low-Intensity Recreation, Conservation (Mining), Conservation (Mining and Grazing), and Preservation.

For Site lands within Benton County, the location, shape, and size of the land-use designations were determined by analyzing the existing natural and man-made resources (e.g., infrastructure, topography, and biology) described in Chapter 4 (see text box, "*Allowable and Permitted Uses within the Land-Use Designations of Alternative Three*"). For lands within the Grant County portion of the Site, land-use designations were influenced by the input and analysis resulting from the Benton, Franklin, and Grant County Hanford Reach Citizens Advisory Panel, the Wahluke 2000 Plan, and the Wahluke Slope Element of the Grant County Comprehensive Plan. The lands within the Franklin County portion of the Site went through an analysis similar to that described above. The designations of Preservation, Conservation, Low-Intensity Recreation, and Agriculture on this portion of the Site were developed from onsite analysis and with input from the Benton, Franklin, and Grant County Hanford Reach Citizen's Advisory Panel and the Wahluke 2000 Plan. In addition, the WDFW, the BoR, and the South Columbia Basin Irrigation District provided information.

Goals and Objectives

County and City Objectives (GMA Mandates*)

- Designate city urban growth areas in cooperation with cities.*
- Designate and conserve, by regulation, natural resource lands (i.e., agricultural lands and mineral resources).*
- Designate and conserve, by regulation, critical resources.*
- Protect the environmental, cultural, historical, and economic resources.*
- Maintain functional infrastructure and utilities currently on the Site.
- Provide for Low-Intensity Recreation.

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- Historic and cultural resources have value. They should not be degraded or destroyed. Appropriate access to those resources is a part of their value.
- The importance of ecological diversity and recreational opportunities should be recognized; these resources should be enhanced as a result of cleanup and Waste Management decisions.
- Cleanup and Waste Management decisions should be coordinated with the efforts of the affected communities to shift toward more private business activity and away from dependence on Federal projects that have adverse environmental or economic impact.
- Cleanup activities should protect to the maximum degree possible the integrity of all biological resources, with specific attention to rare, threatened, and endangered species and their habitats.
- Use the Central Plateau wisely for Waste Management.

Hanford Future Site Uses Working Group (1992)

- Deal realistically and forcefully with groundwater contamination.
- Use the Central Plateau wisely for Waste Management.
- Do no harm with cleanup or new development.

Commonly Identified Goals

- Economic development and diversification
- Protect the Columbia River
- Clean up areas for future use.

Alternative Three would accommodate both future Federal missions and private activities, such as business-related industry and R&D enterprises, in the southeastern portion of the Site (north of the City of Richland). This area would be adjacent to essential services and large-capacity infrastructure. Accommodations for the expansion of public and commercial recreational activities would be focused on the northern portion of the Site (i.e., primarily in the vicinity of the Vernita Bridge). The largest land-use designation would be Conservation (Mining), which would represent a single continuous area that would extend over all geographic areas except the southern portion of the Site. Generally, the shape and extent of this designation would include sensitive biological, physical, and cultural features on the landscape (e.g., rare, threatened, or endangered flora/fauna and their habitats; unique geologic hazards and features; and wetland and riverine environments), and would be intended to protect these resources over the long term.

In the southern portion of the Site, located north and northwest of Richland, is a large area designated for Industrial, and Research and Development land uses. Within these land-use designations, a large area of seral-stage, shrub-steppe habitat exists. Given the existence of other planning considerations identified in the All Other Areas geographic area, this area was not included with the Conservation (Mining) land-use designation, and would be considered suitable for future development. However, the importance of this habitat would be recognized and impacts to shrub-steppe habitat would require mitigation.

Allowable and Permitted Uses within the Land-Use Designations of Alternative Three

Allowable and permitted uses within any land-use designation would correspond to those listed in Table 3-1, except that within the Industrial, Research and Development, and High-Intensity Recreation land-use designations, dryland agricultural and commercial grazing would be considered an allowable use (typically interim). Irrigated agriculture would be considered an interim conditionally permitted use, which would be subject to existing deed restrictions or covenants standards that prohibit activities that impact contaminated soil and groundwater. Basalt outcrops and other culturally significant landscape features would not be available for mining.

3.3.5.3.1 The Wahluke Slope. The soil, climate, and topography of the Wahluke Slope make it potentially one of the most productive agricultural areas in the Pacific Northwest. Prior to its inclusion in the Hanford control zone, the BoR had purchased over 10,927 ha (27,000 ac) of the Wahluke Slope for agricultural development. Development of land within the Site that is appropriate for agriculture would result in the completion of the vision for agricultural economy benefitting the citizens of the area. The land-use proposal for the Wahluke Slope seeks to provide balanced and compatible economic development, conservation of critical resource lands, and the protection of the Columbia River Corridor. The Wahluke Slope contains expansive critical resource lands not suitable for farming, but these lands are ideally suitable for wildlife habitat and Low-Intensity Recreation. Such areas constitute an ideal buffer providing protection between agricultural land and the Columbia River Corridor.

Hanford's Agricultural Opportunity Cost

In a May 18, 1995, letter response to the Benton County Assessor, the Washington State University Area Extension Horticulturist, John W. Watson, estimated the present value of crops that could be grown on the Benton County portion of the Hanford Site. Watson's report estimated the farm gate income from arable Hanford acreage (79,737 ha [197,035 ac], or 73 percent of the area) under three assumption scenarios:

- **Assumption 1**. Benton County has 26 major crops currently being grown on irrigated land. Growing those crops on the Hanford Site, Hanford agricultural income would equal $121,491,340.

- **Assumption 2**. If the crops that are expanding the fastest in the county are the only crops used to estimate potential income, the lost farm gate income in 1994 would be as follows:

  -- 50% apples would be 98,517 acres at $5,000/acre for $492,800,000
  -- 25% cherries would be 49,258 acres at $7,000/acre for $344,806,000
  -- 25% grapes would be 49,258 acres at $4,000/acre for $197,032,000

  (resulting in a total of $1,034,638,000).

- **Assumption 3**. If the total acreage was planted to high-income-producing apple varieties (e.g., Gala, Fuji, and Braeburn), then Hanford lands could produce an income of $2,955,525,000 (assuming 197,035 ac at $15,000/ac).

The largest land-use designation would be approximately 23,951 ha (59,184 ac), designated as Agriculture. Development of land for agriculture would be based upon an opportunities and constraints analysis. Land designated as Agriculture within the "Red Zone" consists of approximately 10,813 ha (26,720 ac) that would be conserved under a "no-action" scenario pending initiation and completion of geotechnical studies analyzing the impacts of irrigation to the White Bluffs and the Columbia River. Approximately 6,476 ha (16,003 ac) are designated Conservation (Mining and Grazing), including land providing for wildlife refuge and Low-Intensity Recreational activities. Approximately 9,002 ha (22,244 ac) would be designated as Preservation. Generally, the shape and extent of this designation would include sensitive biological, physical, and cultural features on the landscape (e.g., rare, threatened or endangered flora/fauna and their habitats, unique geologic hazards and features, and wetland and riverine environments), and would be intended to protect these resources over the long term. Agriculture designated within the Franklin County portion of the Site is just outside of the BoR's Red Zone.

3.3.5.3.2 The Columbia River Corridor. Land-use designations included in the Columbia River Corridor under Alternative Three would support conservation of the Columbia River, and would maintain and support high-quality aquatic and riparian habitats. These land-use designations within the Columbia River Corridor geographic area are described below.

The Preservation land-use designation follows the boundaries of the locally proposed Hanford Reach Interim Protection Plan, which is an initial phase of the *Hanford Reach Protection And Management Plan* proposed by Benton, Franklin, and Grant counties to protect and manage the Hanford Reach jointly with Federal, state, and local authorities. The second phase of this proposal, which has legislation pending before Congress, is to appoint a Commission consisting of appointees from Federal and state agencies, and local jurisdictions, which would devise and implement the *Hanford Reach Protection and Management Plan*. The Preservation designation would extend upland 400 m (0.25 mi.) from the average high-water line of the river, except in Franklin and Grant counties, where the boundary would extend further inland to include specific sensitive features, such as the White Bluffs and several upland wetlands. Permitted uses would be similar to those within the Conservation land-use designation, except mining would be prohibited by the permitting process. Although Preservation is not a land-use term used under county-wide planning ordinances, Conservation is a recognized land-use term. The Conservation (Mining) land-use designation would include those areas that extend upland of the Preservation land-use designation. Within the Conservation (Mining) land-use designation, Mining would be allowed as a conditionally permitted use. Agriculture uses would be prohibited. The primary purpose would be to protect and manage fish and wildlife.

Areas surrounding the K, N, D, and H Reactor sites would be designated as Low-Intensity Recreation. This area has minimal biological sensitivity and contains unique natural features potentially suitable for public enjoyment. The Low-Intensity Recreation designation would begin 400 m (0.25 mi.) upland from the average high-water line of the river except in small isolated areas such as the former White Bluffs town site, and the existing recreational access corridors to the Columbia River. Environmental restoration activities would continue in the 100 Areas (i.e., 100-BC, 100-KE, 100-KW, 100-N, 100-D, 100-DR, 100-H, and 100-F). These uses would be considered a pre-existing, nonconforming use in the Low-Intensity Recreation land-use designation.

A hiking and biking recreational trail along the entire river corridor would be proposed from North Richland to the Vernita Bridge, which would allow public access along the river corridor and connect important historic and natural resources, such as the former Hanford and White Bluffs townsites, the Bruggerman Warehouse, and the B Reactor Museum, and would connect the rest stop and boat launch area located at the Vernita Bridge. This trail would be sited to avoid impact to, or contact with sensitive biological, cultural, hazardous, and/or natural resource-sensitive areas. This trail would connect to the river shore trails in Richland at the southern boundary.

3.3.5.3.3 The Central Plateau. The DOE would be expected to continue all Waste Management and disposal activities in the Central Plateau. As a result, the Central Plateau geographic area would be designated for Industrial-Exclusive Use.

3.3.5.3.4 The All Other Areas. The majority of the All Other Areas geographic area would be designated Conservation (Mining). Within the Conservation land-use designation, mining would be allowed as a conditionally permitted use. Agricultural uses would be prohibited. A small area along the southern boundary of the Site near the Yakima River would be designated High-Intensity Recreation. This area, adjacent to the Benton County Horn Rapids Park, is currently "master planned" as a regional park. A High-Intensity Recreation land-use designation would provide commercial use support for the expected increase in recreational and visitor use in the park area (a central feature of the Tapteal Greenway), which would extend along the lower Yakima River from Benton City to Columbia Point. The area adjacent to the Vernita rest stop, east of State Highway 240 (which includes the B Reactor site), would also be designated as High-Intensity Recreation. The Vernita rest stop, the proposed B Reactor Museum, and the proposed boat launch are all expected to increase demand for recreational and visitor use of the Vernita area. The strip designated for the west 135 ha (333 ac) of the Vernita Terrace would be designated Low-Intensity Recreation, primarily for limited activities such as biking, hiking, fishing, hunting, boat launching facilities, primitive day camping, and nature viewing, while maintaining the natural resource values upon which those uses are based.

Areas north of the City of Richland would be designated as Industrial, and Research and Development. This area would be accessible using the State Highway 240 corridor, State Highway 10, and existing railroad infrastructure. Existing municipal water and sewer infrastructure is located nearby within the City of Richland's UGA boundary. Industrial use also would be proposed for the area east of the 200 Area (i.e., May Junction), which contains low-quality biological resources and existing rail and road infrastructure.

3.3.5.3.5 The Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE Reserve). This area would be designated as Conservation (Mining) due to the existing unique and sensitive biological, ecological, and cultural resources.

3.3.6 Alternative Four

3.3.6.1 Planning Goals, Objectives, and Values (Vision). Alternative Four represents the vision of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) for the management of the Hanford Site for the next 50 years (Figure 3-7). The alternative is based on a detailed knowledge of Site resources and upon experience gained from many years participating in a host of Hanford Site planning forums.

In the view of the CTUIR, the greatest value provided to the region and the nation by the Hanford Site is its role as a natural and cultural resource reserve. The CTUIR recognizes, nevertheless, that there are other services provided by the Hanford Site that are not compatible with this primary value, and that a rational land-use plan for Hanford must take into account these other services. In the CTUIR's review of the Hanford Site's resources, and of the current and potential services provided or potentially provided by the Site, we have striven to find the most rationally justifiable balance between these interests.

The result is a land-use plan that protects a significantly greater amount of Hanford resources than is protected under DOE's Preferred Alternative. Nevertheless, Alternative Four provides opportunities for waste management, commercial industry, and recreation that by the CTUIR's estimates would meet or exceed actual demand. In the view of the CTUIR (and consistent with the *Final Report of the Hanford Future Site Uses Working Group* [FSUWG 1992]), all permanent waste disposal sites at Hanford should be located in the Central Plateau waste management area. While Alternative Four provides opportunity for R&D activities, the CTUIR has intentionally provided an area for these activities that may not accommodate all proposals received over the next 50 years. The CTUIR has limited the size of this area because, in its view, the value provided by these activities does not justify the consumption of a large amount of Hanford Site resources. The CTUIR wants to ensure that Hanford lands would only be available to support the most valuable R&D activities, and that any future R&D activities on the Site would make efficient use of Hanford Site resources. Finally, Alternative Four provides no opportunity for agriculture on the Hanford Site. In the view of the CTUIR, agricultural development at Hanford is not justified. Any value that would be added to the region by allowing agricultural development at Hanford is grossly outweighed by the value presently provided by the natural and cultural services of the Site.

3.3.6.2 Assumptions Regarding Future Use

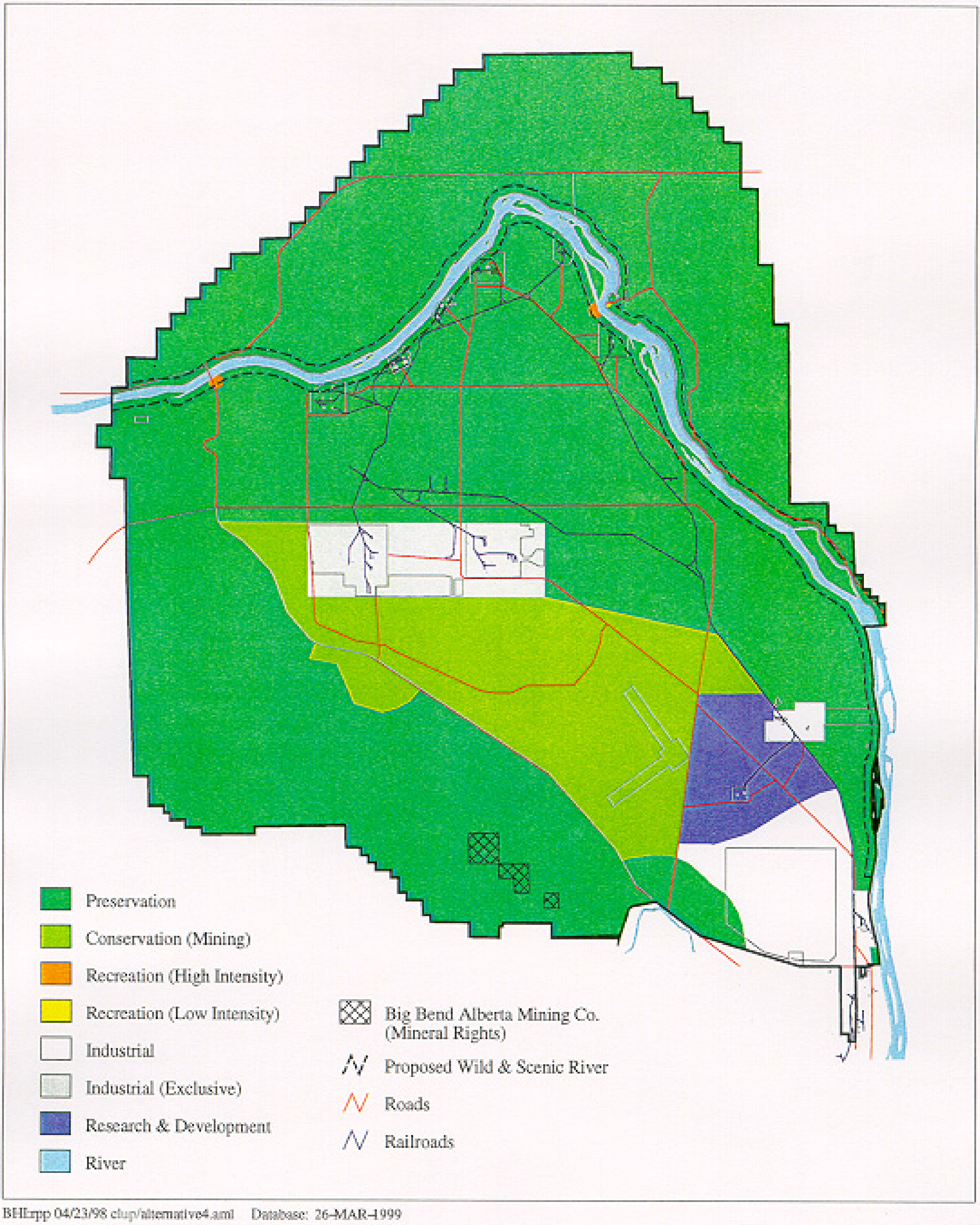
<u>Remediation and Waste Management</u>:

1. Remediation activities on the Hanford Site will continue as planned.

2. The remediation process will generally impose no long-term restrictions on future land use, with the exception of (a) activities that disturb capped permanent waste sites, (b) activities that disturb contaminants which remain in place 4.6 m (15 ft) or more below the ground surface in some areas, and (c) activities that would affect groundwater contaminant plumes.

3. Plutonium production reactor blocks will remain in the 100 Areas throughout the planning period and will be considered a pre-existing, nonconforming use.

Figure 3-7. Alternative Four.



4. All permanent waste disposal activities (e.g., all capped permanent waste sites) will be located in the Central Plateau.

5. Geologic material will need to be mined onsite for the construction of caps over disposal sites.

Local Economic Transition:

1. The Tri-Cities area will need to develop a stable economic base that is independent of DOE activities and budgets. Economic considerations will cause most of that new development to take place within the City of Richland's UGA. Available projections indicate that, at the most, only 809 ha (2,000 ac) to 1,619 ha (4,000 ac) of the Hanford Site will be needed for private commercial development over the next 50 years.

2. Much development in the Tri-Cities area has made inefficient use of available lands, resulting in sprawl. Future land-use regulation should ensure more efficient use of available lands.

Research and Development Activities:

For practical reasons, DOE will locate the R&D activities needed to assist in Hanford remediation, restoration, and Waste Management in the following manner by one of these actions:

1. In sophisticated laboratory facilities within the City of Richland (e.g., EMSL)

2. In the 300 Area

3. Within the Central Plateau Waste Management area, or

4. As field studies with little environmental impact.

From time to time proposals are advanced for R&D activities at Hanford that are unrelated to remediation, Waste Management, or the restoration of the Site. Some of these proposals are rejected as making poor use of Hanford Site resources, but others are developed on the Site. This trend is likely to continue. The land-use planning process should ensure that only proposals that provide a clear value and make efficient use of available Hanford resources are accepted.

Natural and Cultural Resource Values, Management, and Use:

1. The Hanford Site and the U.S. Department of the Army's Yakima Training Center constitute the only large, relatively undisturbed areas of natural shrub-steppe habitat remaining in Central Washington.

2. The Hanford Reach will be designated as a Recreational River under the *Wild and Scenic Rivers Act* or other analogous legislation. Demand for (and the need to manage) recreational activity on the Reach and associated Hanford lands will steadily increase.

3. A public desire for low-impact recreation (including hunting) on the uplands of the

Hanford Site already exists and will increase over time.

4. The gathering, processing, distribution, and use of natural resources, and the cultural and religious laws governing these activities, are at the core of the traditional culture of the CTUIR and other Hanford-affected Tribes. The survival of the CTUIR's culture depends upon the availability of, access to, and traditional use of native natural resources. As a result, protection of native ecosystems and of Tribal member access to such resources is a priority for the CTUIR and other Tribal governments. As areas of the Hanford Site are determined to be clean, and as administrative mechanisms are put in place, members of the CTUIR and other Hanford-affected Tribes will make increasing use of the Hanford Site for the gathering of natural resources. Such activities will include subsistence plant gathering and hunting, as well as subsistence and commercial fishing.

5. The Hanford Site contains numerous places of religious importance to members of the CTUIR who practice traditional Indian religions. These places include the major basalt outcrops, the active dunes area, and other sites. These sites have been used by members of the CTUIR and other Hanford-affected Tribes from time immemorial for a wide variety of religious activities. In addition, the Prophet Smohalla, a founder of the Washat, or Seven Drums, religion, received his principal visions and teachings at places now located within the boundaries of the Hanford Site. Many members of the CTUIR are members of the Washat religion. Protection of these sites, and of Tribal members' access to these sites, is of great importance to the CTUIR and its members (as well as to other Hanford-affected Tribes) and will continue to be an issue of great importance.

6. The area currently occupied by the Hanford Site has been used by American Indian Tribes for at least the past 13,000 years, and likely much longer than that. Cultural resources such as cemeteries, village sites, and archaeologic resources are abundant on the Hanford Site because of the area's abundance of natural resources, its central location on transportation routes, and its climate. The locations of many of these sites are presently unknown. Federal law mandates the protection of these resources. Moreover, the protection of these resources is very important to members of the CTUIR and other Hanford-affected Tribes. Respect for and non-disturbance of these resources is a fundamental religious value of members of the CTUIR who practice traditional religion. These management principles will continue to be defended by the CTUIR and other Hanford-affected Tribes.

3.3.6.3 Application of the Land-Use Designations. Alternative Four land-use designations include Industrial-Exclusive, Industrial, Research and Development, High-Intensity Recreation, Low-Intensity Recreation, Conservation (Mining), and Preservation. Low-Intensity Recreation, while generally not appearing as a separate land use in Alternative Four, would occur in all land-use designations, as long as protected resources are not placed at risk, and so long as incompatible development has not already occurred. Specific planning for support of Low-Intensity Recreation would take place as part of the implementation of the CLUP (see Chapter 6).

3.3.6.3.1 The Wahluke Slope. Alternative Four would manage the entire Wahluke Slope area as Preservation due to the outstanding value of its natural and cultural resources, which would be destroyed by more consumptive land uses. These resources include wetlands, uplands, and the White Bluffs. The White Bluffs are a unique geologic, paleologic, and cultural feature. The Bluffs, in particular, are highly susceptible to collapse due to activities that increase groundwater flow. Such collapses have occurred in recent years and their impacts continue.

Aside from causing the loss of this irreplaceable resource, such collapses bury salmon habitat under tons of silt and alter the course of the Columbia River. The alteration of the river's course causes new erosion which, in turn, destroys cultural resources on the islands and shore of the Columbia River, and potentially mobilizes contaminants that are currently stabilized. Managed, Low-Intensity Recreation (including hunting) and other activities would take place on Preservation lands.

Preservation is the land-use designation which bears the strongest resemblance to the land-use alternative chosen by the *Hanford Reach of the Columbia River, Comprehensive River Conservation Study and Environmental Impact Statement, Record of Decision* (NPS 1996). That Department of the Interior NEPA ROD determined that the best use of the Wahluke Slope is as a NWR. The DOE concurred that the Wahluke Slope should be a NWR. The CTUIR supported that decision, as did other Tribes, governments, and stakeholder groups.

Moreover, as the No-Action Alternative indicates, the Saddle Mountain NWR, which is managed by the USFWS, is currently managed in a manner that is most analogous to Preservation. Likewise, the Wahluke Wildlife Recreation Area is managed in the same manner. In both of these areas, as well as under the Hanford Reach ROD (DOI 1996), grazing is only allowed as a tool to improve wildlife habitat. Grazing solely for commercial production is not allowed anywhere on the Site.

In practice, none of the Saddle Mountain NWR has been grazed for many years. Likewise, the portion of the Wahluke Wildlife Recreation Area south of State Highway 24 is not grazed. Only the portion of the Wahluke State Wildlife Recreation Area north of State Highway 24 has been grazed in order to control cheatgrass. The WDFW lease allowing grazing on the Wahluke State Wildlife Recreation Area was allowed to expire on December 31, 1998 but, under SEPA regulations for up to 10 years after the expiration of the lease, the WDFW can reinstate the grazing lease without public review. Under this Preservation designation, grazing would be barred entirely. This would result in no changes to the current management of 26,000 ha (64,247 ac) or 73 percent of the Wahluke Slope. In the area north of State Highway 24, alternative methods for controlling cheatgrass would be adopted.

3.3.6.3.2 The Columbia River Corridor. Alternative Four would designate almost the entire Columbia River Corridor as Preservation due to its outstanding natural and cultural resources. The Columbia River Corridor contains a wealth of aquatic and terrestrial natural resources, including salmon, sturgeon, mule deer, bald eagles, and many others. The Columbia River Corridor is also an area where cultural resources such as cemeteries and archaeologic resources are highly concentrated.

The Corridor has historically contained reactors and associated buildings to support Hanford's former defense production and energy research missions. Nevertheless, remediation planning documents, public statements of advisory groups, and planning documents such as the "Record of Decision: Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington, Environmental Impact Statement" (58 FR 48509, dated September 16, 1993), have determined that remediation and restoration of the Columbia River Corridor would return the corridor to a non-developed, natural condition. Restrictions on certain activities may continue to be necessary to prevent the mobilization of contaminants, the most likely example of such restrictions being on activities that discharge water to the soil. Although the Surplus Reactor NEPA ROD calls for the reactor buildings to be demolished and the reactor blocks to be moved to the Central Plateau, this action might not take place until 2068 or a new Tri-Party Agreement milestone is negotiated. As a result, the reactor buildings will remain in the Columbia River Corridor throughout the 50-year planning period addressed by the Final HCP EIS.

The Preservation designation would allow managed recreation within the Corridor. This activity would include the continued operation of the White Bluffs boat launch, managed as Low-Intensity Recreation, on the east side of the river. Other infrastructure to support Low-Intensity Recreation would be identified during implementation of the CLUP.

Alternative Four provides for a High-Intensity Recreation public boat launch located near the Vernita Bridge on the south side of the river. Alternative Four provides another High-Intensity Recreation boat launch, located at the White Bluffs boat launch on the west side of the river. The White Bluffs boat launch would support Tribal treaty-reserved fishing activity throughout the Reach, and would contain appropriate support facilities for that purpose.

Alternative Four does not provide for the creation of a High-Intensity Recreation tourist facility at the B Reactor. The CTUIR prefers to remove all vestiges of nuclear weapons production from the Hanford Reach.

3.3.6.3.3 The Central Plateau. Consistent with the findings of the *Final Report of the Future Site Uses Working Group* (FSUWG 1992), subsequent planning documents, and the general consensus of governments and stakeholders, the Central Plateau would be used for waste management activities, designated in this EIS as Industrial-Exclusive. All permanent waste disposal at the Hanford Site would take place within the Central Plateau. Likewise, R&D activities associated with waste management would take place within this geographic area. Land use within this area would have to be carefully planned during implementation of the CLUP to ensure that DOE would not run short of area for waste management activities. Since the Central Plateau currently contains natural resources of high value, developments that impact these resources would be mitigated using the BRMaP.

3.3.6.3.4 The All Other Areas. The All Other Areas geographic area contains a variety of natural and cultural environments, including large stands of mature sagebrush-steppe, basalt outcrops, an active dune complex, stabilized dunes, a wide variety of archaeologic resources, American Indian cemeteries, former agricultural lands, the remains of former DOE facilities, and the remains of two former small towns. Because of the diversity of the All Other Areas, Alternative Four applies a variety of land-use designations to this area. While Low-Intensity Recreation generally does not appear as a separate land use in this geographic area, it is anticipated that during the implementation of the CLUP (Chapter 6), opportunities for compatible Low-Intensity Recreation would be established throughout much of the All Other Areas geographic region.

Alternative Four recognizes that the area within 3.2 km (2 mi) of the Columbia River (an area much larger than the 400 m [0.25 mi.] area protected by proposed legislation for the Hanford Reach, or considered to be part of the Columbia River Corridor) contains a disproportionately high share of the archaeologic resources and cemeteries on the Hanford Site. This area also has high natural resource value as a wildlife corridor. In recognition of these facts and the importance of protecting these resources, Alternative Four designates this expanded corridor area as Preservation.

Alternative Four also recognizes that the area north of Gable Butte and Gable Mountain (but outside of the expanded corridor area), contains large blocks of mature, relatively undisturbed sagebrush-steppe habitat. Alternative Four places these areas under the Preservation designation because of the increasing rarity of such resources in Central Washington, the need to avoid fragmentation, and the value of these areas as wildlife corridors. Alternative Four differs from Alternative One by including areas of lower quality habitat within this Preservation area. Alternative Four does this in the interest of avoiding fragmentation. Under Alternative Four, these lower quality areas would be prime sites for the location of restoration projects initiated under BRMaP as mitigation for development in other parts of the Hanford Site. Likewise, such areas would be appropriate for natural resource restoration initiated under the natural resource damage restoration provisions of CERCLA. The area north of the ALE Reserve and south of Umtanum Ridge (also known as McGee Ranch) would be designated Preservation because of its value as a wildlife corridor and in the interest of avoiding fragmentation. This area would also be a suitable location for habitat impact mitigation activities.

Alternative Four recognizes that the basalt outcrops beginning with Gable Mountain in the east and moving west through Gable Butte and Umtanum Ridge have been of great religious and cultural importance to members of the CTUIR, members of other Hanford-affected Tribes, and their ancestors for many millennia. These sites continue to be of great religious importance to many members of the CTUIR and other Hanford-affected Tribes. In addition to religious importance, these sites are of great cultural and archaeologic value to members of the CTUIR in general. These outcrops also have distinct habitat value, such as providing raptor perching area and talus slope habitat. In recognition of the irreplaceable cultural value of these resources and their biological importance, Alternative Four designates these areas as Preservation.

An important part of cultural and religious use of a basalt outcrop such as Gable Mountain is the view such areas provide of the surrounding landscape. When this landscape is damaged by development -- especially when that development occurs relatively near the viewpoint -- the cultural use of the Site is seriously injured. The CTUIR members' use of Gable Mountain and Gable Butte has already been significantly injured by the development of the Central Plateau. To prevent further injuries to the central basalt outcrops' viewshed, Alternative Four designates the area north of the Central Plateau and south of the outcrops, as well as the area east of the Central Plateau (also known as May Junction), as Preservation. Designation of the May Junction area as Preservation is especially critical, due to its close proximity to Gable Mountain (see Chapter 4, Figure 4-33). The designation as Preservation of other portions of the All Other Areas geographic region, mentioned above, also supports the protection of the central basalt outcrops' viewsheds.

Existing structures on Gable Mountain itself also injure CTUIR members' cultural and religious use of the mountain. Under Alternative Four, structures not currently in use would be removed. During implementation (Chapter 6), further steps would be taken to facilitate the relocation of pre-existing, nonconforming structures to more appropriate locations.

Alternative Four recognizes that the area of active dunes, located north of Energy Northwest (formerly known as WPPSS), is similar to the basalt outcrops in being an area of great religious and cultural significance as well as being an area of distinct habitat value. Alternative Four would treat these dunes in a similar manner to the basalt outcrops, designating the dune area as Preservation.

This alternative anticipates that work in the Central Plateau Industrial-Exclusive waste management area may require the consumption of large quantities of sand, gravel, and basalt for capping material. Economic considerations would likely require that these materials come from areas near the Central Plateau. While making it clear that the basalt outcrops and the active dunes area are fundamentally inappropriate for such consumptive uses, Alternative Four does anticipate the need to make such materials available. As a result, Alternative Four designates a large area near the Central Plateau and between the Plateau and the southeastern border of the Hanford Site as Conservation (Mining). This area contains a variety of soil and rock types allowing DOE several options for locating quarries which would meet anticipated waste management specifications and quantities.

While the Conservation (Mining) designation provides DOE with the means to satisfy its need for geologic materials, the designation also reflects the high quality of the habitat in this area. Portions of this area contain some of the largest and highest quality mature sagebrush communities on the Hanford Site. Were it not for the need to supply DOE with geologic material, much of this area would most appropriately be designated Preservation. As a result, DOE would need to make prudent choices regarding the removal of needed material, so as to minimize impacts to this generally high-quality habitat. Such decisions would be made during implementation of the CLUP (Chapter 6). Likewise, the provisions of BRMaP would provide incentive for DOE to minimize these impacts, while also providing the assurance that such impacts would be appropriately mitigated. If these geologic materials are not needed to support the Waste Management and cleanup mission, the land-use designation for this area should revert to Preservation.

The southern portion of the area, which Alternative Four designates Conservation (Mining), contains the existing LIGO facility. Alternative Four treats LIGO as a pre-existing, nonconforming use. The LIGO facility would continue to operate throughout its life span, but its use could not be altered to increase its nonconformity, and similar R&D facilities could not be located in this area. This area also contains the square mile of land owned by the State of Washington, but not currently developed. The State of Washington's reason for purchasing this land was to build a hazardous waste treatment, storage and disposal facility on this site (State of Washington 1980). In the view of the CTUIR, such a facility would be a poorly reasoned use of the land. Because this square mile of land is not owned by DOE, this EIS apparently cannot determine the land use on this land. It appears that such a determination can only be made by Benton County. The CTUIR urges Benton County and the State of Washington to agree to a land-use designation for this square mile which is consistent with the designation for the surrounding land adopted in the ROD for this Final HCP EIS.

Alternative Four designates the portion of the All Other Areas geographic area that is south and east of the Wye Barricade (between State Highway 10 and the Hanford Site rail line) as Research and Development and Industrial in roughly equal amounts. Alternative Four provides 4,388 ha (10,843 ac) for Research and Development. The primary purpose of this land would be to meet any future DOE need for additional research facilities to support the remediation, Waste Management, and restoration mission. Nevertheless, Alternative Four recognizes that from time to time, proposals will be made for the development of R&D facilities on the Hanford Site that are unrelated to the cleanup mission. Alternative Four provides adequate land for the development of facilities that make efficient use of available resources, while screening out facilities that are highly consumptive of Hanford resources. Such facilities could also be located on available land within the Industrial designation.

While current studies (e.g., the *City of Richland's Comprehensive Plan* [CoR 1997] and the Draft *Benton County Comprehensive Plan* [BCPD 1997]) indicate there will be little or no demand for industrial sites in this area in the next 20 years, Alternative Four recognizes that when private commercial industrial development begins onsite, it would most likely occur in the area immediately north of the City of Richland. Length of commute, distance required for the extension of utilities, and similar factors would encourage private commercial development to take place in this area. While the demand for such land is at this point highly speculative, Alternative Four recognizes that the CLUP adopts a 50-year planning horizon, and that such development may occur within that time frame. As a result, Alternative Four provides 6,882 ha (17,006 ac) for Industrial development. Planning concerning the provision of infrastructure to support industrial development in this area, planning determining the sequence of development in this area, and planning aimed at discouraging sprawl would all occur during implementation of the CLUP (see Chapter 6).

Finally, Alternative Four designates a 3.2 km (2 mi) corridor along the Yakima River as Preservation for the same reasons a similar corridor along the Columbia River was designated Preservation (i.e., the density of archaeologic sites combined with the area's value as a wildlife corridor).

3.3.6.3.5 The Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE Reserve). The same cultural and religious values that pertain to the central basalt outcrops apply with equal force to Rattlesnake Ridge, the dominant feature of the ALE Reserve. The ALE Reserve is currently managed by the USFWS. In recognition of the ALE Reserve's outstanding natural and cultural resource value, the ALE Reserve geographic area has been managed for the past 30 years in a manner that is consistent with the Preservation designation. Alternative Four would continue that mode of management, designating this area Preservation. The sole exception is an area of the ALE Reserve bordering State Highway 240 near the 200 West Area that would be designated Conservation (Mining). This area contains large near-surface basalt and soil sources which would provide an adequate and economic source for Central Plateau waste management needs. Since no siting decision has been made, it is not certain that this area would be used as a quarry site. If the site is not used as a source for waste site capping material, the land-use designation should revert to Preservation. This analysis would occur during implementation of the CLUP (see Chapter 6).

The ALE Reserve geographic area contains buildings and structures that are currently not in use. Structures that are nonconforming and which are not in use at the time the CLUP is finalized cannot be used in a nonconforming manner after the adoption of the CLUP in the ROD for this EIS (see Chapter 6). Under Alternative Four, structures not currently in use would be removed. During implementation, further steps would be taken to facilitate the relocation of pre-existing, nonconforming structures to more appropriate locations.

3.4 Summary of Potential Environmental Impacts

The CEQ NEPA implementing procedures (40 CFR 1500-1508) require a comparative summary of potential environmental impacts and mitigation measures be presented in the alternatives chapter. Table 3-3 contains a summary of land-use designation areas by alternative. For ease in understanding, the table is repeated in hectares, acres, square miles, and percentages. Table 3-4 contains a summary of potential cumulative impacts from the land-use alternatives by impacted resource. Detailed analyses of potential environmental impacts for each of the land-use alternatives are given in Chapter 5 of this document.

3.4.1 Comparison of Affected Areas by Alternative

Table 3-3 is a comparative summary of the amount of acreage under each alternative that would be potentially subject to impacts from development. In addition to the 148,080 ha (572 mi^2) of land surface areas, this EIS affects 3,642.3 ha (14.1 mi^2) of surface water, almost all of which is the Columbia River (i.e., a navigable river) where access cannot be controlled. Because access cannot be controlled on the Columbia River, it has no land-use designation. For this EIS, the 1,517 km^2 (586 mi^2) area within the boundary of the Hanford Site includes both the land area and the river area.

3.4.2 Comparison of Affected Environmental Resources and Other NEPA Values

The effects of choosing a land-use alternative are discussed for the following subject areas: (1) geologic resources, (2) water resources, (3) biological resources, (4) cultural resources, (5) aesthetic resources, (6) socioeconomic resources, (7) environmental justice, and (8) human health. Many of the potentially significant adverse impacts would occur as a result of disturbances of relatively pristine natural areas on the Hanford Site.

Natural plant and wildlife communities have flourished, sensitive species have been preserved, and archaeological and cultural resources have been protected because historically large areas of the Hanford Site have been used solely for security buffers. Each alternative uses an unique balance of impact avoidance (i.e., committing the land to preservation or conservation) versus impact mitigation. This balance is based on the planning goals, objectives, and values (i.e., vision) of each alternative. For example, Alternative Two relies almost exclusively on avoidance by designating 95 percent of the Hanford Site as Preservation. Therefore, among the alternatives, Alternative Two provides the highest level of resource protection. But this resource protection is at the sacrifice of multiple-use goals where the Hanford Site's natural and infrastructure resources could be used for economic development. Mitigation of disturbance effects through the use of policies and implementing procedures as an augmentation to the alternative map, is an alternate means of resource protection exemplified best by Alternative Three. Mitigation is the form of resource protection employed by more development-oriented or multiple-use oriented alternatives. Successful mitigation depends on the adopted CLUP map working in concert with the CLUP policies and implementing procedures to protect unique, cultural, or sensitive resources through avoidance of impacts after site-specific considerations or mitigation of the impacts by prescribed mitigation procedures. The Implementing Procedures (e.g., project review, resource management plans (RMPs), AMPs, and NEPA or SEPA reviews) provide mitigation guidelines where avoidance is less desirable than project implementation with mitigation.

The alternatives vary in their reliance on avoidance or mitigation as the principal means of protection. Because it has no land-use designations, policies, or implementing procedures based on a CLUP, the No-Action Alternative relies almost exclusively on mitigation through NEPA. All the other alternatives fall between Alternative Two and the No-Action Alternative with respect to the balance used between impact avoidance and mitigation.

The DOE intends to prepare a Mitigation Action Plan after the ROD for this EIS is issued which would address mitigation commitments made in the ROD. In general, these mitigation commitments can be expected to include updating the existing resource management plans such as the CRMP, BRMaP, and *Hanford Bald Eagle Management Plan*; and committing to a schedule to develop additional resource management plans (e.g., Minerals Resources Management Plan) under the procedures outlined in Chapter 6. The resource impact analyses in Chapter 5 of this Final HCP EIS include ranges of potential mitigation measures for each land-use alternative.

Table 3-3. Comparisons of Affected Areas by Alternative. (4 pages)

	No-Action[a]	Preferred Alt.	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Areas in Hectares						
Agriculture	0	0 (0)[b]	0	0	23,951	0
Conservation (Mining and Grazing)	0	0 (43,857)[b]	0	0	6,476	0
Conservation (Mining)	0	44,183 (1,005)[b]	15,921	0	72,685	19,341
Industrial	22,534	15,335 (15,378)[b]	2,542	1,830	17,860	6,882
Industrial-Exclusive	5,064	5,064	4,593	4,593	5,064	5,064
Preservation	46,366	78,127 (77,449)[b]	124,517	140,767	9,002	112,321
High-Intensity Recreation	0	125 (82)[b]	64	191	1,768	77
Low-Intensity Recreation	1	334	29	0	3,097	7
Research and Development	0	4,912	414	699	8,177	4,388
Open Space Reserved	74,115	0	0	0	0	0
TOTAL[c]	**148,080**	**148,080**	**148,080**	**148,080**	**148,080**	**148,080**

[a] The No-Action Alternative does not have land-use designations. It has areas administered similar to land-use designations (see Figure 3-2).

[b] Areas in Revised Draft EIS.

[C] In addition to the 148,080 ha (572 mi^2) of land surface areas, this EIS affects 3,642.3 ha (14.1 mi^2) of surface water, almost all of which is the Columbia River.

Table 3-3. Comparisons of Affected Areas by Alternative. (4 pages)

	No-Action[a]	Preferred Alt.	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Areas in Acres						
Agriculture	0	0 (0)[b]	0	0	59,184	0
Conservation (Mining and Grazing)	0	0 (108,371)[b]	0	0	16,003	0
Conservation (Mining)	0	109,179 (2,483)[b]	39,342	0	179,609	47,793
Industrial	55,684	37,894 (38,000)[b]	6,281	4,522	44,133	17,006
Industrial-Exclusive	12,513	12,323	11,350	11,350	12,513	12,513
Preservation	114,573	193,056 (191,381)[b]	307,688	347,843	22,244	277,551
High-Intensity Recreation	0	309 (203)[b]	158	472	4,369	190
Low-Intensity Recreation	2	825	72	0	7,653	17
Research and Development	0	12,138	1,023	1,727	20,206	10,843
Open Space Reserved	183,142	0	0	0	0	0
TOTAL[c]	**365,914**	**365,914**	**365,914**	**365,914**	**365,914**	**365,914**

[a] The No-Action Alternative does not have land-use designations. It has areas administered similar to land-use designations (see Figure 3-2).

[b] Areas in Revised Draft EIS.

[c] In addition to the 148,080 ha (572 mi^2) of land surface areas, this EIS affects 3642.3 ha (14.1 mi^2) of surface water, almost all of which is the Columbia River.

Table 3-3. Comparisons of Affected Areas by Alternative. (4 pages)

	No-Action[a]	Preferred Alt.	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Areas in Square Miles						
Agriculture	0	0 (0)[b]	0	0	92	0
Conservation (Mining and Grazing)	0	0 (169)[b]	0	0	25	0
Conservation (Mining)	0	171 (4)[b]	61	0	281	75
Industrial	87	59 (59)[b]	10	7	69	27
Industrial-Exclusive	20	20	18	18	20	20
Preservation	179	302 (299)[b]	481	544	35	434
High-Intensity Recreation	0	0	0	1	7	0
Low-Intensity Recreation	0	1	0	0	12	0
Research and Development	0	19	2	3	32	17
Open Space Reserved	286	0	0	0	0	0
TOTAL[c]	**572**	**572**	**572**	**572**	**572**	**572**

[a] The No-Action Alternative does not have land-use designations. It has areas administered similar to land-use designations (see Figure 3-2).
[b] Areas in Revised Draft EIS.
[c] In addition to the 148,080 ha (572 mi^2) of land surface areas, this EIS affects 3642.3 ha (14.1 mi^2) of surface water, almost all of which is the Columbia River.

Table 3-3. Comparisons of Affected Areas by Alternative. (4 pages)

	No-Action[a]	Preferred Alt.	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Percentage of Area						
Agriculture	0.00%	0.00% (0.00%)[b]	0.00%	0.00%	16.17%	0.00%
Conservation (Mining and Grazing)	0.00%	0.00% (29.62%)[b]	0.00%	0.00%	4.37%	0.00%
Conservation (Mining)	0.00%	29.84% (0.68%)[b]	10.75%	0.00%	49.08%	13.06%
Industrial	15.22%	10.36% (10.38%)[b]	1.72%	1.41%	12.06%	4.65%
Industrial-Exclusive	3.42%	3.42%	3.10%	3.10%	3.42%	3.42%
Preservation	31.31%	52.76% (52.30%)[b]	84.09%	94.89%	6.08%	75.85%
High-Intensity Recreation	0.00%	0.08% (0.06%)[b]	0.04%	0.13%	1.19%	0.05%
Low-Intensity Recreation	0.00%	0.23%	0.02%	0.00%	2.09%	0.00%
Research and Development	0.00%	3.32%	0.28%	0.47%	5.52%	2.96%
Open Space Reserved	50.05%	0.00%	0.00%	0.00%	0.00%	0.00%
TOTAL	**100.00%**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

[a] The No-Action Alternative does not have land-use designations. It has areas administered similar to land-use designations (see Figure 3-2).

[b] Areas in Revised Draft EIS.

[c] In addition to the 148,080 ha (572 mi^2) of land surface areas, this EIS affects 3642.3 ha (14.1 mi^2) of surface water, almost all of which is the Columbia River.

Table 3-4. Summary of Potential Impacts to Hanford Site Resources. (8 pages)

Resource	Preferred Alternative	Alternative One	Alternative Two	Alternative Three	Alternative Four	No-Action Alternative
GEOLOGIC RESOURCES						
Features	Unique geologic features such as Gable Mountain, Gable Butte, the White Bluffs; and active sand dunes would be protected.	Same as the Preferred Alternative.	Same as the Preferred Alternative. Stabilized sand dunes would also be protected.	Unique geologic features could be developed to obtain materials for remediation and economic development.	Same as the Preferred Alternative except stabilized sand dunes would also be protected.	Unique geologic features could be developed.
Missoula Flood Deposits	Missoula Flood features would be protected by Plan Policies and Procedures.	Missoula Flood features would be protected by Plan Policies and Procedures.	Missoula Flood features would be protected by Plan Policies and Procedures.	Missoula Flood features would be protected by Plan Policies and Procedures.	Missoula Flood features would be protected.	Same as Preferred Alternative because of their cultural significance.
Geologic Materials	Viable sources of geologic materials for governmental purposes could be developed.	Geologic materials could be developed only from existing quarries and to support remediation.	Geologic resources to support remediation would need to be obtained from offsite sources.	Same types of impacts as the Preferred Alternative, but applied to 66% more surface area.	Geologic materials could be developed only to support remediation.	Commercial development of geologic resources would not be restricted.
Natural Gas	Existing natural gas claims on the ALE Reserve could be developed, but the Preservation designation surrounding those claims would preclude construction of an access road.	Same as Preferred Alternative.	Same as Preferred Alternative.	Existing natural gas claims could be developed and an access road could be constructed under the Conservation (Mining) designation.	Same as Preferred Alternative.	Existing natural gas claims could be developed and an access road could be constructed.
Soils	Soil compaction and erosion could occur around quarry sites.	Soil compaction and erosion could occur around quarry sites.	The potential for soil erosion and compaction would be minimized by maintaining existing vegetative cover and precluding development.	Soil compaction and erosion could occur around quarry sites. Cultivated agriculture would increase soil erosion through removal of existing cover and tillage.	The potential for soil erosion and compaction would be minimized. Some soil erosion and compaction could occur as a result of mining in support of remediation.	Mining, grazing, and cultivated agriculture could increase soil compaction or erosion.

Table 3-4. Summary of Potential Impacts to Hanford Site Resources. (8 pages)

Resource	Preferred Alternative	Alternative One	Alternative Two	Alternative Three	Alternative Four	No-Action Alternative
WATER RESOURCES						
Surface Water	Runoff from mining operations located close to the Columbia River could lead to water quality degradation.	Mining restricted to upland areas would have little impact on water quality.	Mining, grazing, and agriculture would not be allowed; therefore, there would be no impacts to surface water.	Mining prohibited within 1/4 mile of the Columbia River, would have little impact on water quality.	Same as Alternative One.	Same as the Preferred Alternative.
	Grazing would not be allowed, so no impacts would result from this activity.	Grazing would not be allowed, so no impacts would result from this activity.	Experimental aquaculture could increase the nutrient load in the Columbia River.	Grazing permitted in irrigation flow returns on the Wahluke Slope, potentially leading to increased siltation.	Grazing would not be allowed, so no impacts would result from this activity.	Same as the Preferred Alternative.
	Increased recreational access to the Columbia River could increase shoreline erosion from boating wake and could generate additional pollution, such as oil, gas, and engine exhaust.	Similar to the Preferred Alternative, but fewer access points would be provided and use of the river might not increase as much.	Recreational access to the Columbia River would not be increased.	Same types of impacts as the Preferred Alternative, but applied to 66% more surface area.	Similar to the Preferred Alternative.	Same as Alternative Two.
Groundwater	Mining operations could require groundwater withdrawal for material washing and dust control. Surface water could also collect in quarry sites increasing groundwater recharge locally.	Similar to the Preferred Alternative.	Mining operations would not be allowed.	Same types of impacts as the Preferred Alternative, but applied to 66% more surface area.	Same as the Preferred Alternative.	Same as the Preferred Alternative.
	Groundwater withdrawal for industrial uses could alter flow patterns. Discharges to the soil column could mobilize contaminants in the vadose zone and accidental releases could contaminate groundwater.	New impacts to groundwater from industrial development would be minimal.	New impacts to groundwater from industrial development would be minimal.	Same as the Preferred Alternative. Agricultural chemicals could impact Wahluke groundwater and recharge from Wahluke irrigation could alter flow patterns and lead to slumping in the White Bluffs.	Same as the Preferred Alternative.	Same potential impacts as the Preferred Alternative, but new impacts could be distributed across the Hanford Site. Potential impacts from Agriculture similar to Alternative Three.

Table 3-4. Summary of Potential Impacts to Hanford Site Resources. (8 pages)

Resource	Preferred Alternative	Alternative One	Alternative Two	Alternative Three	Alternative Four	No-Action Alternative
BIOLOGICAL RESOURCES						
Federal Endangered Species	Increased protection of the river from development would ensure salmon and steelhead spawning areas are protected. Increased recreational access to the Columbia River could adversely affect salmonid spawning areas and the proposed Tribal Village and White Bluffs boat launch could impact the Bald Eagle nesting attempts.	Protects all species from development and restricts access to the Columbia River. Does not assume consumptive use of species through treaty-reserved rights. Is the Environmentally Preferable Alternative.	Protects all species from development and restricts access to the Columbia River. Allows consumptive use of species through treaty-reserved rights.	Increased threat to habitat from Wahluke Slope development. Increased protection of the river from development would help protect salmon and steelhead spawning areas. Increased recreational access to the Columbia River could adversely affect salmonid spawning areas. Proposed High Intensity Recreation Area and White Bluffs boat launch could impact the Bald Eagle nesting attempts.	Protects all species from development and restricts access to the Columbia River. Allows consumptive use of species through treaty-reserved rights.	Between Preferred Alternative and Alternative One.
Vegetation	Surface clearing would eliminate vegetation and wildlife habitat in areas designated for development.	Much lower than the Preferred Alternative.	Much lower than the Preferred Alternative.	Greater impacts than the Preferred Alternative. Clearing of vegetation for cultivated agriculture.	Less than the Preferred Alternative.	Greater than the Preferred Alternative.
Habitat	Utility corridors and access roads could fragment habitat within areas designated for industrial development. Generally protected by Plan's Policies that designate development in habitat that is of lower biological value.	Lower than under the Preferred Alternative.	Potential impacts restricted to urban growth area.	Same as the Preferred Alternative, but larger areas designated for development, so potential greater need for new infrastructure.	Less than the Preferred Alternative.	Greater than Preferred Alternative.
Grazing	Grazing would not be allowed under this alternative.	Commercial grazing is not allowed under this alternative.	Commercial grazing would not be allowed under this alternative.	Grazing is a permitted interim use for other than Preservation or Conservation uses under this alternative's Policies.	Grazing is not allowed under this alternative.	Grazing impacts restricted to the Wahluke Slope north of State Highway 24.

Table 3-4. Summary of Potential Impacts to Hanford Site Resources. (8 pages)

Resource	Preferred Alternative	Alternative One	Alternative Two	Alternative Three	Alternative Four	No-Action Alternative
Aquatic Resources	Increased recreational access to the Columbia River could adversely affect salmonid spawning areas, aquatic plant communities, and other resources associated with the river.	Lower than the Preferred Alternative.	No increase in recreational access under this alternative, so no new impacts.	Same impact as the Preferred Alternative.	Similar, but potentially lower, impacts than the Preferred Alternative.	Less than the Preferred Alternative because no new boat ramps.
Wildlife Migration Corridor	The integrity of the wildlife migration corridor associated with McGee Ranch would be maintained.	Same as the Preferred Alternative.	Same as the Preferred Alternative.	McGee Ranch available for development.	Same as the Preferred Alternative.	McGee Ranch available for development.
Preservation of BRMaP Level III and Level IV Resources	Preservation designation would protect 66% of BRMaP Level III, and 85% of BRMaP Level IV resources.	Preservation designation would protect 92% of BRMaP Level III and 85% of BRMaP Level IV resources.	Preservation designation would protect 96% of BRMaP Level III and 85% of BRMaP Level IV resources.	Preservation designation would protect 5% of BRMaP Level III and 13% of BRMaP Level IV resources.	Preservation designation would protect 85% of BRMaP Level III and 85% of BRMaP Level IV resources.	The No-Action Alternative does not specifically designate land for Preservation.
CULTURAL RESOURCES						
Religious Sites	Cultural resources and religious sites associated with basalt outcrops such as Gable Butte and Gable Mountain would be protected.	Same as the Preferred Alternative.	Same as the Preferred Alternative.	Cultural resources and religious sites associated with basalt outcrops such as Gable Butte and Gable Mountain would be protected by Plan Policies and Procedures.	Same as the Preferred Alternative.	Cultural resources and religious sites associated with basalt outcrops such as Gable Butte and Gable Mountain would be protected by CRMP Plan Policies and Procedures.
Viewsheds	Mining and industrial development could occur within viewsheds from high promontories.	Area that could be developed within viewsheds is smaller than for the Preferred Alternative.	Viewsheds would be protected. Impacts would be less than for the Preferred Alternative.	Development could occur within viewsheds to a greater extent than for the Preferred Alternative.	Same as Alternative Two. Less than the Preferred Alternative.	Development not precluded at any location. Greater than for the Preferred Alternative.
Natural Resource Gathering Areas	Damage to natural resource gathering areas from development and increased recreational use of the Columbia River.	Less than the Preferred Alternative.	Impacts to natural resource gathering areas would be minimal.	Damage to natural resource gathering areas from development, increased recreational use of the Columbia River, and grazing.	Less than the Preferred Alternative.	Greater than the Preferred Alternative.

Table 3-4. Summary of Potential Impacts to Hanford Site Resources. (8 pages)

Resource	Preferred Alternative	Alternative One	Alternative Two	Alternative Three	Alternative Four	No-Action Alternative
Cultural Sites	Damage to cultural sites from development. Increased access to the Columbia River could result in damage from artifact collection, vandalism, and erosion.	Less than the Preferred Alternative.	Commercial grazing would not be allowed and impacts to cultural sites from development would be minimal. Access to the Columbia River would not be increased.	Impacts to the Wahluke Slope and White Bluffs only. Damage to cultural sites on the Wahluke Slope from agriculture (including grazing), and could lead to loss of the White Bluffs.	Less than the Preferred Alternative. No grazing would be allowed.	Greater than the Preferred Alternative.
Salmonid Spawning Sites	No impact to salmonid spawning sites.	No impact to salmonid spawning sites.	No impact to salmonid spawning sites.	Increased sediment loading from White Bluffs irrigation sloughing, and grazing could damage salmonid spawning sites.	Same as Alternative Two.	Between Alternative Three and Preferred Alternative.
AESTHETIC RESOURCES						
Viewsheds	Viewing locations associated with Gable Butte and Gable Mountain would be protected. Locations associated with the Columbia River would be disrupted. Viewsheds could be disrupted.	Same as the Preferred Alternative.	Minimal impacts; less than the Preferred Alternative.	Viewing locations associated with basalt outcrops could be adversely impacted, but locations along the river would be protected. Viewsheds could be disrupted.	Viewing locations would be protected. Minimal impacts to viewsheds. Less than the Preferred Alternative.	Viewing locations and viewsheds could be adversely impacted. Greater than the Preferred Alternative.
Ambient Visibility	Visibility could be impacted by releases of fugitive dust from construction sites and pollutants from new industrial sources.	Similar to, but less than, the Preferred Alternative.	Minimal impacts; less than the Preferred Alternative.	Greater than the Preferred Alternative.	Less than the Preferred Alternative.	Greater than the Preferred Alternative.
Ambient Noise	Blasting, industrial sites, and increased use of motorized water craft could increase noise levels, disrupt wildlife, and detract from recreational experiences.	Less than the Preferred Alternative.	Minimal impacts; less than the Preferred Alternative.	Greater than the Preferred Alternative.	Less than the Preferred Alternative.	Same as the Preferred Alternative.

Table 3-4. Summary of Potential Impacts to Hanford Site Resources. (8 pages)

Resource	Preferred Alternative	Alternative One	Alternative Two	Alternative Three	Alternative Four	No-Action Alternative
SOCIOECONOMICS AND INDUSTRIAL DEVELOPMENT	15,335 ha available for industrial development, which would meet the need forecasted by the Benton County Planning Department and provide ample area to support possible future DOE missions. This amount of land would support employment of 1,000 or more.	2,542 ha available for industrial development, which would meet the forecasted need and provide 1,615 ha for possible future DOE missions. This land could support employment of 100 to 1,000.	1,830 ha available for industrial development, but much of the land is already developed. Would not provide sufficient vacant land to meet Benton County's estimated future needs or provide for possible future DOE missions. Employment limited to less than 100.	17,860 ha available for industrial development, which would meet the need forecasted by the Benton County Planning Department and provide ample area to support possible future DOE missions. This amount of land would support employment of 1,000 or more.	6,882 ha available for industrial development, meeting the estimated future need and providing land for future DOE missions. This land could support employment of 100 to 1,000.	Facility planning and siting conducted on a project-by-project basis as guided by the 1996 *Hanford Strategic Plan*. At least 22,534 ha available to support future Industrial or Research and Development DOE missions
RESEARCH AND DEVELOPMENT	4,912 ha designated for Research and Development could support up to 300 employees.	414 ha designated for Research and Development, but limited to previously developed areas.	Research and Development limited to 699 ha of existing uses at LIGO and the K Reactor water supply used for fish rearing.	Greater than the Preferred Alternative 8,177 ha designated for Research and Development could support up to 600 employees	4,388 ha designated for Research and Development could support up to 300 employees	Facility siting conducted on a project-by-project basis. Ample land available. At least 22,534 ha available to support future Industrial or Research and Development DOE missions
GRAZING AND AGRICULTURE	No lands designated for grazing or cultivated agriculture.	No lands designated for commercial grazing or cultivated agriculture.	No lands designated for commercial grazing. Cultivated agriculture would not be allowed.	1,059 AUM with a value of $12,700. Cultivated agriculture could generate from $16 to $88 million in additional revenue depending on the scenario.	No lands designated for grazing or cultivated agriculture.	Lack of a plan may discourage multiple use of Hanford lands and grazing and agriculture would be considered under individual proposals. Lands permitted for grazing could support 1,655 AUM with a value of $19,900. Cultivated agriculture would be allowed.
MINERAL RESOURCES (Privately Held)	Existing natural gas claims could be developed, but the Preservation designation in the surrounding area would preclude construction of an access road.	Same as the Preferred Alternative.	Same as the Preferred Alternative.	Existing claims could be developed and access roads could be constructed. Additional development of natural gas could be encouraged.	Same as the Preferred Alternative.	Existing natural gas claims could be developed and access roads could be constructed.

Table 3-4. Summary of Potential Impacts to Hanford Site Resources. (8 pages)

Resource	Preferred Alternative	Alternative One	Alternative Two	Alternative Three	Alternative Four	No-Action Alternative
RECREATION	Increased recreation could increase revenues generated by tourism.	Less than the Preferred Alternative.	Less than the Preferred Alternative.	A destination resort/conference center at Vernita Terrace could generate up to $2 million to $4 million in payroll.	Less than the Preferred Alternative.	New revenue generating recreational opportunities would be unlikely.
ENVIRONMENTAL JUSTICE	Increased access to the Columbia River would potentially increase exposure and health risk. Minority or low-income populations may be more prone to adopt a subsistence lifestyle, but a particular population would not necessarily be affected.	Because the purpose of a Federal Wildlife Refuge is to conserve native ecological systems, consumption of those systems would be limited and therefore provide better protection from contamination than the Preferred Alternative.	Access to the Columbia River would be limited. No disproportionately high and adverse impacts would occur.	Same as the Preferred Alternative.	Same as the Preferred Alternative.	Same as the Preferred Alternative.
	Areas of cultural value to American Indians would be protected, but development would be allowed within the viewscape of some of those areas.	Same as the Preferred Alternative.	Same as the Preferred Alternative, but viewscapes would also be protected.	Areas of cultural value to American Indian Tribes could be developed and development could occur within culturally significant viewscapes.	Same as Alternative Two.	Same as Alternative Three.
	Economic development of Hanford Site lands would be neutral in low-income and minority communities within the assessment area.	Limitation on development could adversely impact low-income populations. However, local low-income populations are not greatly influenced by Hanford Site spending.	Same as Alternative One.	Same as Preferred Alternative.	Same as Preferred Alternative.	Same as Preferred Alternative.
	Prohibiting agriculture on the Wahluke Slope would not change the current condition.	Same as the Preferred Alternative.	Same as the Preferred Alternative.	Agriculture would be allowed on the Wahluke Slope, potentially benefitting low-income and minority populations..	Same as the Preferred Alternative.	Same as the Preferred Alternative.

Table 3-4. Summary of Potential Impacts to Hanford Site Resources. (8 pages)

Resource	Preferred Alternative	Alternative One	Alternative Two	Alternative Three	Alternative Four	No-Action Alternative
HUMAN HEALTH	Increased access to Hanford Site lands would increase the potential for health risks.	Less than the Preferred Alternative.	Access to Hanford would be limited and the potential for health risks would be minimized.	Greater than the Preferred Alternative because of the intensity of use.	Less than the Preferred Alternative.	Access would be restricted and risks would be less than for the Preferred Alternative.
	New developments on the Hanford Site could lead to an increase in occupational injuries and fatalities associated with mining and industrial activities.	Less than the Preferred Alternative.	Much less than the Preferred Alternative.	Greater than the Preferred Alternative and would have the additional risk of occupational injuries from agriculture.	Less than the Preferred Alternative.	Potentially greater risk than for the Preferred Alternative.
	Increased recreational activities could increase the risk of injury from recreational accidents.	Less than the Preferred Alternative.	No increase in recreational use and the risk of recreational accidents would be minimized.	Greater than the Preferred Alternative.	Less than the Preferred Alternative.	Minimal increase in recreational use. Risk of recreational accidents would not increase.
HUMAN HEALTH	Remediation to an Industrial standard in the 300 and 200 Areas would involve less remediation worker risk from hazardous materials exposure and cumulative equipment operation time than some of the CRCIA scenarios could require for non-industrial uses. Actual remediation scenario will be picked through the CERCLA/RCRA process which could require more or less remediation based on the scenario chosen.	Minimum Industrial development could require more remediation worker risk exposure than Preferred Alternative.	Minimum Industrial development could require the most remediation worker risk exposure.	Maximum Industrial development could require the least remediation worker risk exposure.	Industrial development between Alternative One and the Preferred Alternative.	Minimal increase in changes of land use from open space reserved designation. The validity of an Industrial remediation scenario could be questioned without an integrated GMA Industrial designation. Actual remediation scenario will be picked through the CERCLA/RCRA process which could require more or less remediation based on the scenario chosen.

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4.0 Affected Environment

The Hanford Site lies within the semi-arid Pasco Basin of the Columbia Plateau in south-eastern Washington State. The Hanford Site occupies an area of approximately 1,517 square kilometers (km^2) (586 square miles [mi^2]) north of the confluence of the Yakima River with the Columbia River. Within the geographic boundary of the Site, there are 36.42 km^2 (14.1 mi^2) of Columbia River surface water, and one section (1 mi^2) of land owned by the State of Washington.

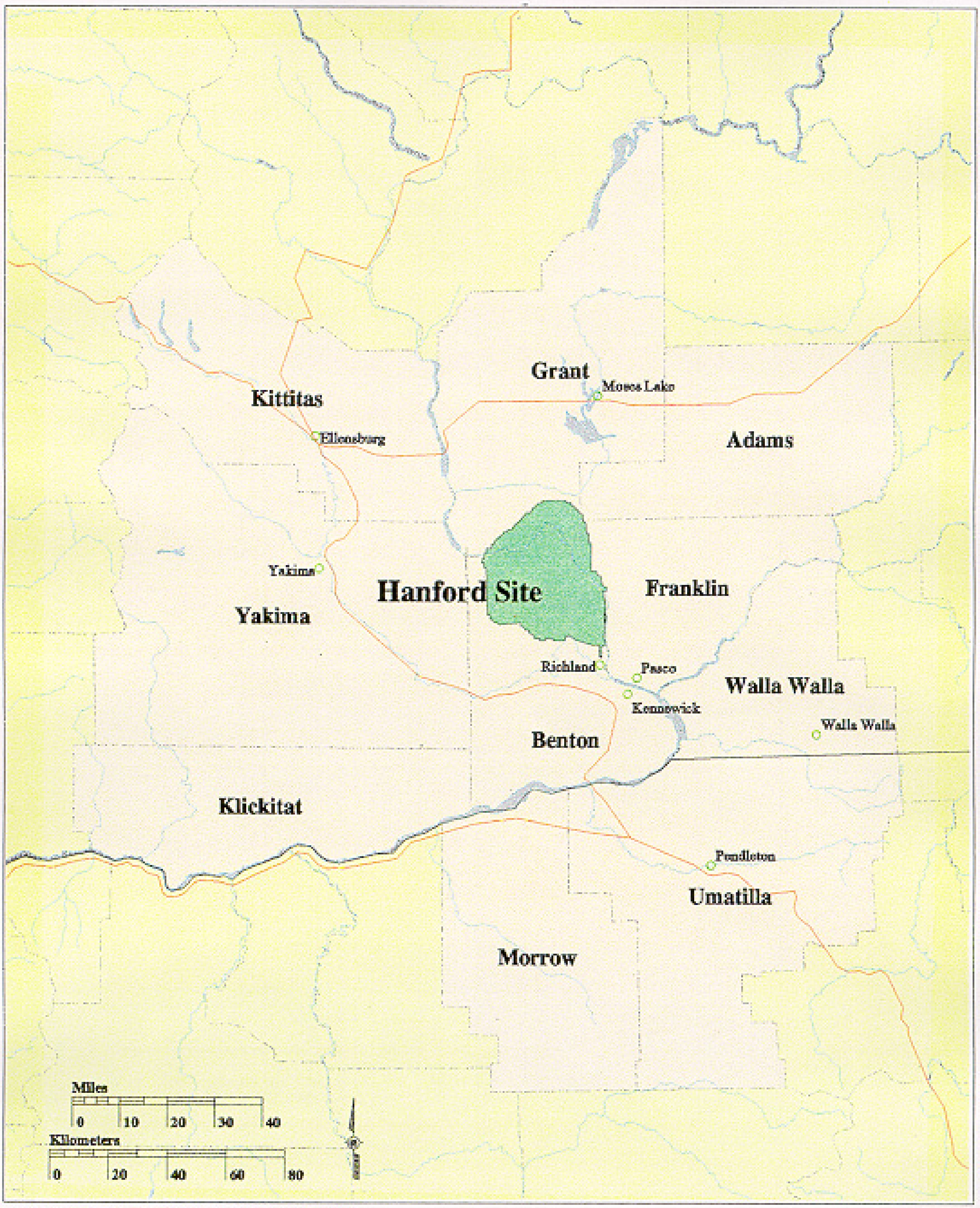
The Hanford Site is about 50 km (30 mi) north to south and 40 km (24 mi) east to west. The Columbia River flows through the northern part of the Hanford Site and, turning south, forms part of the Hanford Site's eastern boundary. The Yakima River runs near the southern boundary and joins the Columbia River below the City of Richland, which bounds the Hanford Site on the southeast. Rattlesnake Mountain, Yakima Ridge, and Umtanum Ridge form the southwestern and western boundaries, and the Saddle Mountains form the Hanford Site's northern boundary. Two small east-west ridges, Gable Butte and Gable Mountain, rise above the plateau of the central part of the Hanford Site. Adjoining lands to the west, north, and east are principally agricultural and range land. The cities of Richland, Kennewick, and Pasco (also referred to as the Tri-Cities) constitute the nearest population center and are located immediately southeast of the Hanford Site. Figure 4-1 depicts the Hanford Site and the surrounding area.

The production of defense nuclear materials at the Hanford Site since the 1940s has necessitated the exclusion of public access and most non-government-related development on the Hanford Site. As a result of its defense-related mission, the Hanford Site has also provided *de facto* protection of the natural environment and cultural resources (NPS 1994); however, the defense nuclear production mission has left the Hanford Site with an extensive waste legacy. Nuclear weapons material production and associated activities at the Hanford Site during the past five decades have generated a variety of radioactive, hazardous, and other wastes that have been disposed of or discharged to the air, soil, and water at the Hanford Site.

4.1 Land Uses

For many years, the area along the Columbia River was used extensively by Tribal members for fishing, hunting, and gathering. Pasturing of livestock became important in pre-contact times. The Cayuse, Umatilla, Walla Walla, and Nez Perce people became very skillful at breeding horses (in the 1700s). When Lewis and Clark first came down the Columbia River, there were great herds of horses grazing the rich hills of southeastern Washington and northeastern Oregon. Although the horse meant greater mobility, these people maintained traditional migratory patterns. The Columbia River supplied an endless cycle of vegetable crops. Most bands gathered at winter sites on or near the Columbia River. Culturally, these sites were used by the same people and their ancestors before them for thousands of years. The routes of migration followed ancient patterns with the band stopping at the same spot it camped the year before. In the early spring, family bands would leave the main encampment on the river and travel to the uplands to dig roots. They timed their returns to utilize the main salmon run in the spring and fall. When they had a sufficient stockpile of dried salmon, they would return to the mountains to gather berries and hunt for game until the snows would push them back to the lowlands near or on islands in the Columbia where they would gather together in the large wintering sites and spend the colder months. Mission, Oregon; Walla Walla, Washington; Pasco, Washington; and Umatilla, Oregon, are just a few of the modern-day names of where some of those old winter camping sites were located.

Figure 4-1. Hanford Site and the Vicinity.



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Land uses at the Hanford Site have changed dramatically over the past 100 years. By the turn of the century, settlers had moved into the area, developing irrigated farmland and practicing extensive grazing (see Figure 1-4). In 1943, the Federal government acquired the Hanford Site for production of nuclear materials to be used in the development of the atomic bomb.

4.1.1 Existing Land Uses in the Vicinity of the Hanford Site

Existing land uses within the vicinity of the Hanford Site include urban and industrial development, wildlife protection areas, recreation, irrigated and dryland farming, and grazing. According to the 1992 Census of Agriculture (USDA-NASS 1992), Benton, Franklin, and Grant counties had a total of 958,626 hectares (ha) (2,396,564 acres [ac]) (9,586 square kilometers [km^2]/3,745 square miles [mi^2]) of land in farms, of which 667,027 ha (1,667,568 ac) (6,670 km^2/ 2,606 mi^2) were in crop land. Approximately 46 percent of crop land was irrigated in 1992, and approximately 40 percent of crop land in 1992 was used as pastureland. According to the 1992 census, the total market value of agricultural products in the three counties was $935 million, including $758 million for crops and $177 million for livestock. In 1994, wheat represented the largest single crop (in terms of area) planted in Benton and Franklin counties. The total area planted in the two counties was 97,490 ha (240,900 ac) (975 km^2/376 mi^2] and 12,020 ha (29,700 ac) (120 km^2/46.4 mi^2) for winter and spring wheat, respectively. Other major crops such as alfalfa, apples, asparagus, cherries, corn, grapes, and potatoes are also produced in Benton and Franklin counties (PNNL 1996a). In 1994, the Conservation Reserve Program of the U.S. Department of Agriculture (USDA)[1] included 10,279.8 ha (25,382.3 ac) [102.8 km^2/ 39.7 mi^2] in Benton County, 9,359.3 ha (23,109.3 ac) [93.6 km^2/ 36.1mi^2] in Franklin County, and 10,116.8 ha (24,979.8 ac) (101.1km^2/39.0 mi^2) in Grant County.[2]

In 1992, the Columbia Basin Project, a major irrigation project to the north of the Tri-Cities, produced gross crop returns of $552 million, representing 12.5 percent of all crops grown in Washington State. Also, in that year, the average gross crop value per irrigated acre was $1,042. The largest percentage of irrigated acres produced alfalfa hay (26.1 percent of irrigated acres), wheat (20.2 percent), and feed-grain corn (5.8 percent). Other significant crops are apples, dry beans, potatoes, and sweet corn (PNNL 1996a).

Other land uses in the vicinity of the Hanford Site include a planned, low-level radioactive waste decontamination, super-compaction, plasma gasification and vitrification unit (operated by Allied Technology Group Corporation); and a commercial nuclear fuel fabrication facility (operated by Siemens Power Corporation).

4.1.2 Existing Hanford Site Land Uses

Land-use categories at the Hanford Site include reactor operations, waste operations, administrative support, operations support, sensitive areas, and undeveloped areas. Remedial activities are currently focused within or near the disturbed areas. Much of the Hanford Site is undeveloped, providing a safety and security buffer for the smaller areas used for operations. Public access to most facility areas is restricted.

4.1.2.1 Wahluke Slope. The area north of the Columbia River encompasses approximately 357 km^2 (138 mi^2) of relatively undisturbed or recovering shrub-steppe habitat. The northwest portion of the area is managed by the U.S. Fish and Wildlife Service (USFWS) under a permit issued by DOE in 1971 as the Saddle Mountain National Wildlife Refuge (NWR). The permit conditions

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[1] Agricultural lands at risk for soil erosion set aside to enhance wildlife.

[2] Personal conference with Rod Hamilton, Conservation Program Specialist with the USDA, Farm Service Agency, in Spokane, Washington, October 1997.

require that the refuge remain closed to the public as a protective perimeter surrounding Hanford operations. The closure has benefitted migratory birds, such as curlews, loggerhead shrikes, and waterfowl.

Until recently, in the northeast portion of the Wahluke Slope, the Washington State Department of Fish and Wildlife (WDFW) operated the Wahluke State Wildlife Recreation Area, which was established in 1971. In April 1999, the WDFW and the USFWS notified the DOE of their intent to modify their management responsibilities on the Wahluke Slope under the 1971 agreement leaving only a small portion (about 324 ha (800 ac)) northwest of the Vernita bridge under WDFW permit. The USFWS informed the DOE that it intends to allow essentially the same uses permitted by the State of Washington under the WDFW's management of the Wahluke Slope. Therefore, transfer of management of the Wahluke Slope from the WDFW to the USFWS involves only a change in the agency managing the property and does not involve any change in the management activities for the Wahluke Slope. Management of the entire Wahluke Slope by the USFWS as an overlay wildlife refuge is consistent with the 1996 DOI Hanford Reach EIS ROD. The ROD recommended the Wahluke Slope be designated a wildlife refuge and the Hanford Reach a Wild and Scenic River, and that the wildlife refuge be managed by the USFWS.

The WDFW had leased a total of approximately 43 ha (107 ac) of the Wahluke State Wildlife Recreation Area for sharecropping. The purpose of these agricultural leases is to produce food and cover for wildlife and manage the land for continued multi-purpose recreation. In addition, the WDFW issued a grazing permit for approximately 3,756 ha (9,280 ac), allowing up to 750 animal-unit-months to graze the parcel (WDFW Grazing Permit #W5-01, and WDFW Agricultural Leases #R-01, #WB-01, and #WB-02). This WDFW grazing lease was allowed to expire on December 31, 1998 but, under SEPA regulations for up to 10 years after the expiration of the lease, the WDFW can reinstate the grazing lease without public review.

The Wahluke Wildlife Recreation Area is open to the public for recreational uses during daylight hours. According to data published in the *Hanford Reach of the Columbia River, Comprehensive River Conservation Study and Environmental Impact Statement Final - June 1994* (NPS 1994), the Wahluke State Wildlife Recreation Area has more than 40,000 visits per year by recreationists. Most recreational visits are related to sport fishing in the Columbia River.

The Wahluke Slope once contained small, nonradioactively contaminated sites (i.e., landfills). These sites were subject to an expedited response action and were remediated by DOE in 1997. Although remediation took place, the landfills could still have hazardous materials that would cause injury to trust resources. The DOE is not planning to alter the current land uses of the Wahluke Slope and is specifically prohibited from causing any adverse impacts on the values for which the area is under consideration for Wild and Scenic River or NWR status (DOI 1996).

4.1.2.2 Columbia River Corridor. The 111.6 km^2 (43.1 mi^2) Columbia River Corridor, which is adjacent to and runs through the Hanford Site, is used by the public and Tribes for boating, water skiing, fishing, and hunting of upland game birds and migratory waterfowl. While public access is allowed on certain islands, access to other islands and adjacent areas is restricted because of unique habitats and the presence of cultural resources.

The 100 Areas occupy approximately 68 km^2 (26 mi^2) along the southern shoreline of the Columbia River Corridor. The area contains all of the facilities in the 100 Areas, including nine retired plutonium production reactors, associated facilities, and structures. The primary land uses are reactor decommissioning and undeveloped areas. Future use restrictions have been placed in the vicinity of the 100-H Area, which is associated with the 183-H Solar Evaporation

Basins. Additional deed restrictions or covenants for activities that potentially extend beyond 4.6 meters (m) (15 feet [ft]) below ground surface are expected for other *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) remediation areas. Additional information is provided in Section 3.3.1.4.2.

The area known as the Hanford Reach includes an average of a 402-m (1,320-ft) strip of public land on either side of the Columbia River. The Hanford Reach is the last unimpounded, nontidal segment of the Columbia River in the United States. In 1988, Congress passed Public Law 100-605, *Comprehensive River Conservation Study*, which required the Secretary of the Interior to prepare an environmental impact study (in consultation with the Secretary of Energy) to evaluate the outstanding features of the Hanford Reach and its immediate environment.

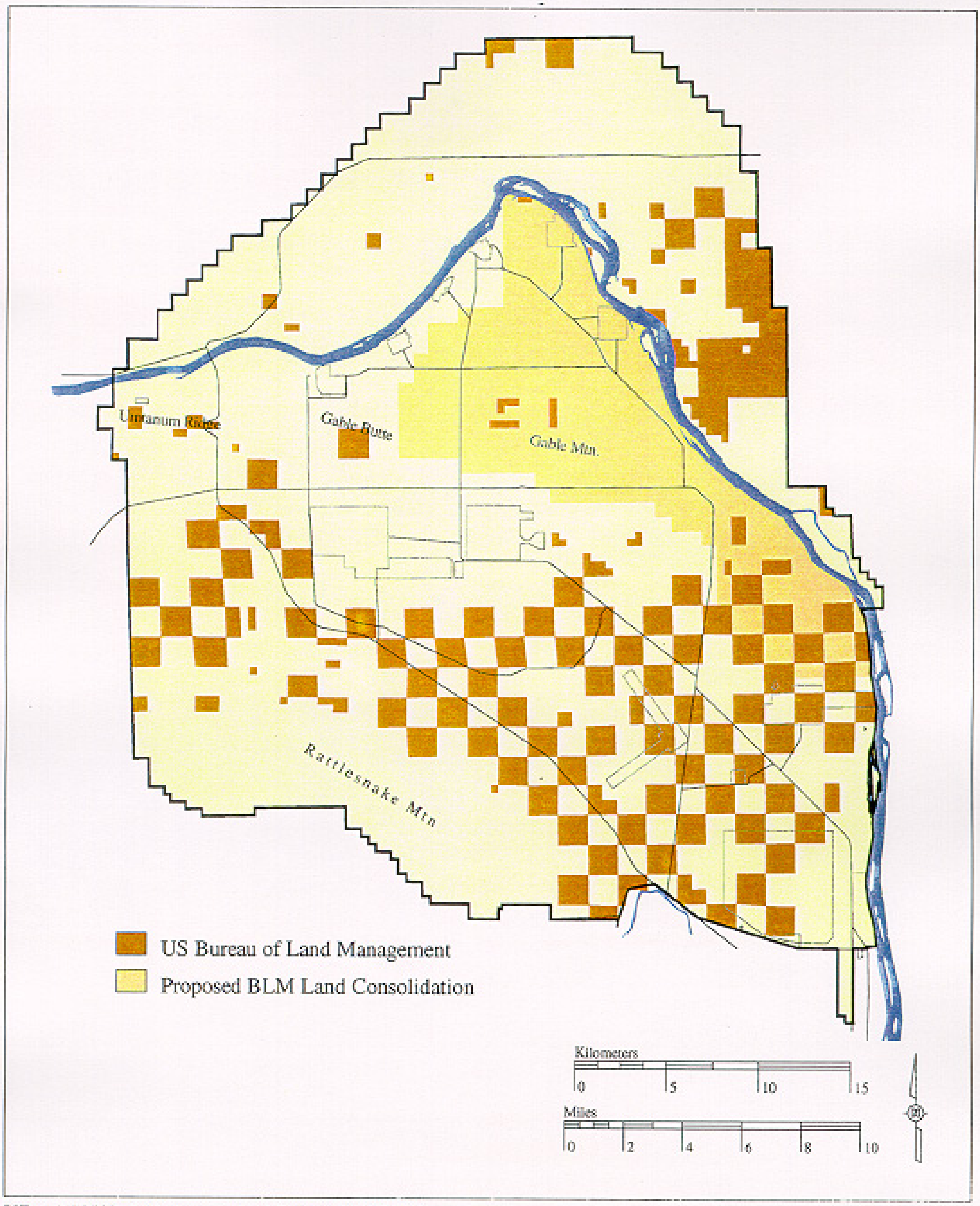
Alternatives for preserving the outstanding features also were examined, including the designation of the Hanford Reach as part of the National Wild and Scenic Rivers system. The results of the study can be found in the *Hanford Reach of the Columbia River, Comprehensive River Conservation Study and Environmental Impact Statement Final - June 1994* (NPS 1994). The Record of Decision (ROD) DOI issued as a result of this EIS in 1996 recommended that the Hanford Reach be designated a "recreational river," as defined by the *National Wild and Scenic Rivers Act of 1968*. The ROD also recommended that the remainder of the Wahluke Slope be established as a National Fish and Wildlife Refuge. Finally, the ROD recommended that the approximately 728 ha (1,800 ac) of private land located in the Hanford Reach Study Area be included in the recreational river boundary, but not the refuge boundary. The final designation will require Congressional legislation.

There are two proposals currently under consideration in Congress. The primary differences between the proposals include the extent of the geographic scope (whether the Wahluke Slope is addressed in addition to the river corridor) and the designation of the land manager (e.g., local vs. Federal control).

In addition to the control and Wahluke Slope issues, the proposed Wild and Scenic legislation contains a provision for transferring administrative jurisdiction over certain parcels of land in the State of Washington from the Secretary of Energy to the Secretary of the Interior, affecting underlying ownership of about 19,943 ha (49,280 ac, 197 km^2, 75 mi^2) of the Hanford Site. This swap would consolidate the scattered Benton County portion of Hanford's Bureau of Land Management (BLM) Public Domain lands, into an area beginning near 100-D, running south and east along the Columbia River shore, to just north of Energy Northwest (formerly known as the Washington Public Power Supply System, or WPPSS) and then west to Gable Mountain (see Figure 4-2). As long as these lands are needed (e.g., still withdrawn from BLM by DOE), this legislative action would not affect DOE's administration of the areas involved. The DOE's use of withdrawn BLM Public Domain lands is consistent with most land-use designations with the exceptions of Industrial Exclusive, Research and Development, or Industrial designations where BLM's multiple-use mandate would be limited by an extensive infrastructure.

4.1.2.3 Central Plateau. The 200 East and 200 West Areas occupy approximately 51 km^2 (19.5 mi^2) in the Central Plateau of the Hanford Site. Facilities located in the Central Plateau were built to process irradiated fuel from the production reactors. The operation of these facilities resulted in the storage, disposal, and unplanned release of radioactive and nonradioactive waste. The primary land uses are waste operations and operations support. Deed restrictions or covenants for activities that potentially may extend beyond 4.6 m (15 ft) below ground surface are expected for CERCLA remediation areas in the Central Plateau geographic study area.

Figure 4-2. Proposed BLM Land Swap.



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In 1964, a 410-ha (1,000-ac) tract was leased to the State of Washington to promote nuclear-related development. A commercial low-level radioactive waste disposal facility, run by U.S. Ecology, Inc., currently operates on 41 ha (100 ac) of the leasehold. The rest of the leasehold was not used by the State, and this portion of the leasehold recently reverted to DOE. The DOE constructed the Environmental Restoration Disposal Facility (ERDF) on this tract.

The ERDF is operated on the Central Plateau to provide disposal capacity for environmental remediation waste (e.g., low-level, mixed low-level, and dangerous wastes) generated during remediation of the 100, 200, and 300 Areas of the Hanford Site. The facility is currently about 65 ha (160 ac) and can be expanded up to 414 ha (1.6 mi^2) as additional waste disposal capacity is required.

4.1.2.4 All Other Areas. The All Other Areas geographic area is 689 km^2 (266 mi^2) and contains the 300, 400 and 1100 Areas, Energy Northwest (formerly known as WPPSS) facilities, and a section of land currently owned by the State of Washington.

The 300 Area is located just north of the City of Richland and covers 1.5 km^2 (0.6 mi^2). The 300 Area is the site of former reactor fuel fabrication facilities and is also the principal location of nuclear research and development (R&D) facilities serving the Hanford Site. Kaiser Aluminum and Chemical Corporation is leasing the 313 Building in the 300 Area to use an extrusion press that was formerly owned by DOE. The Environmental Molecular Sciences Laboratory (EMSL) and associated research programs provide research capability to advance technologies in support of DOE’s mission of environmental remediation and Waste Management.

The 400 Area, located southeast of the 200 East Area, is the site of the Fast Flux Test Facility (FFTF). The FFTF is a 400 megawatt thermal, liquid metal (sodium-cooled) nuclear research test reactor that was constructed in the late 1970s and operated from 1982 to 1992. Although not designed nor operated as a breeder reactor, the FFTF operated during these years as a national research facility for the Liquid Metal Fast Breeder Reactor Program to test advanced nuclear fuels, materials, components, systems, nuclear operating and maintenance procedures, and active and passive safety technologies. The reactor was also used to produce a large number of different isotopes for medical and industrial users, generate tritium for the United States fusion research program, and conduct cooperative, international research.

In December 1993, the FFTF was shutdown due largely at that time from determinations that the facility could not continue to operate economically. In April 1995, defueling was completed and usable fuel is stored on site in fuel storage vessels or in the secure vault at the Plutonium Finishing Plant at the Hanford Site. Unusable spent nuclear fuel (SNF) has been thoroughly washed to remove all sodium residuals, dried, and placed in approved, 50-year Interim Storage Casks on the 400 Area Interim Storage Area pad. In November 1995, the reactor was placed in standby mode with the main cooling system operating at approximately 200°C (400°F) to keep the sodium coolant liquid and circulating to maintain DOE’s option to restart and operate the reactor in the future. Essential systems, staffing, and support services are being maintained in a manner that will support either timely restart or deactivation of the FFTF. In January 1997, the Secretary of Energy officially directed that the FFTF be maintained in a standby condition while an evaluation was conducted of any future role the facility might have in the DOE's national tritium production strategy. In December 1998, the Secretary determined that the FFTF would not play a role in the nation's tritium production strategy.

In May 1999, the Secretary announced that DOE would ask the Pacific Northwest National Laboratory (PNNL) to complete a 90-day study that would resolve outstanding informational needs for the FFTF. Results of this study were completed and documented in a program scoping plan presented by PNNL to DOE in early August 1999. As a result of this study, the

Secretary decided, on August 18, 1999, that DOE would conduct a programmatic *National Environmental Policy Act* (NEPA) review, including an Environmental Impact Statement (EIS), evaluating the potential environmental impacts associated with proposed expansion of infrastructure, including the possible role of the FFTF, for civilian nuclear energy research and development activities; production of isotopes for medical, research, and industrial uses; and production of plutonium-238 for use in advanced radioisotope power systems for future National Aeronautic and Space Administration (NASA) space missions. The Notice of Intent for this programmatic EIS is planned for publication in the *Federal Register* on September 15, 1999. The Final EIS (FEIS) is planned for completion in the Fall of 2000; a Record of Decision utilizing the NEPA review (including the FEIS), is planned by December 2000.

The 1100 Area, located just north of Richland, served as the central warehousing, vehicle maintenance, and transportation operations center for the Hanford Site. A deed restriction has been filed with Benton County for the Horn Rapids Asbestos Landfill, which restricts future land uses in the vicinity of the landfill. Also, DOE transferred the 1100 Area to the Port of Benton. The DOE prepared an environmental assessment that resulted in a finding of no significant impact on August 27, 1998, for the transfer of the 1100 Area and the Southern rail connection to the Port of Benton (DOE/RL EA-1260). The Port officially took ownership and control of the 1100 Area (consisting of 318 ha [786 ac], 26 buildings, and 26 km [16 mi] of rail tract) on October 1, 1998. Although the 1100 Area is no longer under DOE control, it is included in this EIS to support the local governments with their SEPA EIS analyses of the Hanford sub-area of Benton County under the State of Washington's Growth Management Act.

Together with the Washington State Department of Transportation and Legislature Transportation Committee, the Port of Benton is currently funding a major study ($600,000) to determine the feasibility of reconnecting the Hanford main rail line to Ellensburg, Washington (as it was in the 1970s), as an alternative route for Yakima Valley rail traffic flowing between the Puget Sound and the Tri-Cities. The current Yakima Valley route passes directly through all the cities in the Valley, including the cities of Yakima and Kennewick which have plans to develop their downtown areas to be more people friendly. Specifically, the Port has expressed a desire to use the Hanford rail system and extend the current system upriver where there is currently only an abandoned railroad grade.

Additional land uses in the All Other Areas geographic area include the following:

- The Hazardous Materials Management and Emergency Response (HAMMER) Volpentest Training and Education Center, which is used to train hazardous materials response personnel. The HAMMER Volpentest Training and Education Center is located north of the 1100 Area and covers about 32 ha (80 ac).

- Land was leased to Energy Northwest (formerly known as WPPSS) to construct three commercial power reactors in the 1970s. One plant, Washington Nuclear Plant Number 2 (WNP-2), was completed and is currently operating. Activities on the other two plants were terminated and the plants will not be completed. The DOE is considering a proposal from Energy Northwest to allow a sublease for siting, construction, and operation of an aluminum smelter (see Section 1.3).

- In 1980, the Federal government sold a 259 ha (640 ac) section of land south of the 200 East Area, near State Route (SR) 240, to the State of Washington for the purpose of nonradioactive hazardous waste disposal. This parcel is uncontaminated (although the underlying groundwater is contaminated) and undeveloped. The deed requires that if it is used for any purpose other than hazardous waste disposal, ownership would revert to the Federal government.

- The Laser Interferometer Gravitational-Wave Observatory (LIGO), built by the National Science Foundation on the Hanford Site, detects cosmic gravitational waves for scientific research. The facility consists of two underground optical tube arms, each 4 km (2.5 mi) long, arrayed in an "L" shape. The facility is sensitive to vibrations in the vicinity, which can be expected to constrain nearby land uses.

4.1.2.5 The Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE Reserve). The Fitzner/Eberhardt Arid Lands Ecology Reserve (also designated as the Rattlesnake Hills Research Natural Area, or the ALE Reserve), encompasses 308.7 km^2 (119.2 mi^2) in the southwestern portion of the Hanford Site and is managed as a habitat and wildlife reserve and environmental research center. A "research natural area" is a classification used by Federal land management agencies to designate lands on which various natural features are preserved in an undisturbed state solely for research and educational purposes. The ALE Reserve remains the largest research natural area in the State of Washington (PNL 1993a).

The mineral rights to a 518 ha (1,280 ac) area on the ALE Reserve are owned by a private company. The company has been free to enter this area and explore for oil or gas since 1977. Additional information is provided in Section 4.2.3. There are also two ongoing R&D projects under way on the ALE Reserve: gravity experiments in underground Nike bunkers located in the southern portion of the Reserve, and on-line science education, teacher training, and astronomy research in the observatory on the top of Rattlesnake Mountain. Both are long-term projects using existing facilities.

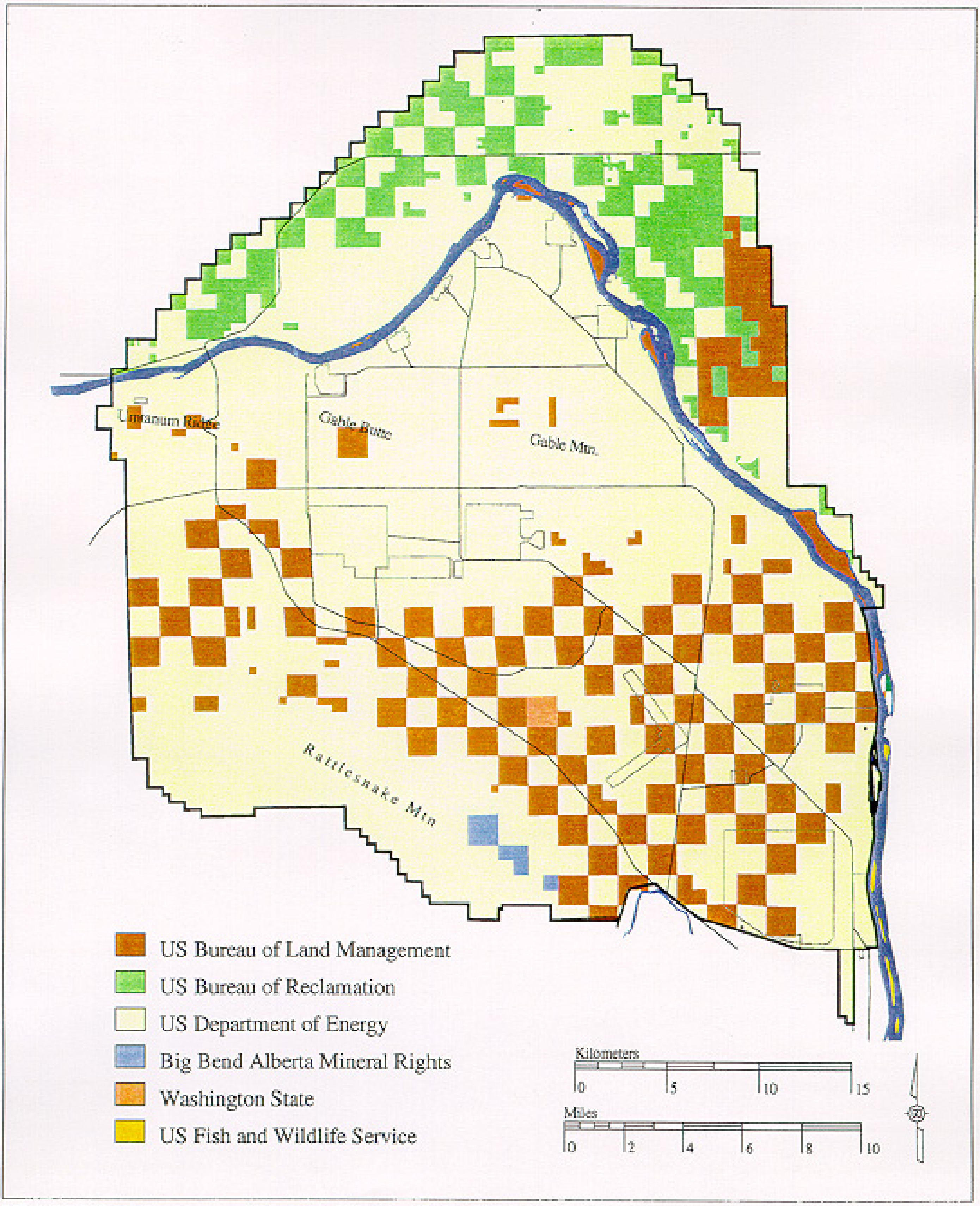
Because public access to the ALE Reserve has been restricted since 1943, the shrub-steppe habitat is virtually undisturbed and is part of a much larger Hanford tract of shrub-steppe vegetation. This geographic area contained a number of small contaminated sites that were remediated in 1994 and 1995 and have been revegetated. There are two landfills on the ALE Reserve, at least one of which was used for disposal of a nonradioactive hazardous waste. Although remediated, one of the landfills may still contain hazardous materials that could cause injury to trust resources.

In 1997, DOE granted a permit and entered into an agreement with USFWS to manage the ALE Reserve consistently with the existing ALE Facility Management Plan. Under this framework, USFWS is preparing a Comprehensive Conservation Plan (CCP) pursuant to the *National Wildlife Refuge Improvement Act of 1997* to identify refuge management actions and to bring the ALE Reserve into the NWR System.

4.1.3 Hanford Site Land Ownership

The Hanford Site land holdings consist of three different real property classifications: (1) lands acquired in fee by DOE or its predecessor agencies, (2) BLM Public Domain lands withdrawn from the Public Domain for use as part of the Hanford Site, and (3) lands the Bureau of Reclamation (BoR) has withdrawn from the Public Domain or acquired in fee as part of the Columbia Basin Project (Figure 4-3). All lands in the Hanford area were ceded to the United States by the Treaties of 1855 (see Appendix A), and these treaties contain

Figure 4-3. Hanford Site Land Ownership.



BHI:rpp 01/13/98 draft_2/landown1.aml Database: 03-AUG-1998 reserved rights for perpetuity. All Federal agencies and projects, including the BoR and BLM, have a Federal trust responsibility to protect the rights of the Indian Tribes.

The BoR agreed in a Memorandum of Agreement (MOA) to transfer custody, possession, and use of certain acquired and withdrawn lands situated within the control zone of the Hanford Works to the U.S. Atomic Energy Commission (AEC) on February 27, 1957. These lands consisted of a checkerboard pattern of alternating square-mile sections on the Wahluke Slope. The BoR retained the right to construct, operate, and maintain the Wahluke Canal and related facilities and any necessary wasteways and drainage ways through the Wahluke Slope in connection with irrigation of lands outside of the control zone. These lands were included in the South Columbia Basin Irrigation District and the East Columbia Irrigation District at the time of district formation. In the MOA, the BoR identified a continued interest in development of irrigable lands on the Wahluke Slope as part of the Columbia Basin Project. The AEC acknowledged the interest of the BoR and reaffirmed a policy of keeping DOE land ownership and restrictions of land use on the Wahluke Slope to a minimum.

The BoR continues to retain an interest in the ultimate development of the irrigable lands within the Wahluke Slope as part of the Columbia Basin Project. The interest of the BoR pertains not only to irrigation development, but also to other project purposes (e.g., fish and wildlife protection) and to resource management and environmental concerns. The BoR maintains that the agreement with the AEC assures return of the lands when the lands are no longer necessary to support DOE's mission for the Hanford Site. Furthermore, the BoR would not concur with any change in the present use of the lands until technical and environmental studies were completed.

> ***Withdrawn Public Domain Lands***
>
> In addition to the lands acquired by DOE through condemnation during and after World War II (WW II), the Hanford Reservation includes: (1) Bureau of Land Management (BLM) administered lands withdrawn from the Public Domain by DOE during and following WW II, (2) BLM lands withdrawn from the Public Domain by the Bureau of Reclamation (BoR) prior to WW II as part of the Columbia Basin Reclamation Project (CBRP), and (3) lands acquired in fee by the BoR prior to WW II as part of the CBRP. The withdrawn lands and non-withdrawn lands form a checkerboard pattern over large portions of the Hanford Site.
>
> The lands in category (2) (as listed above) were subsequently affected by a second overlapping withdrawal by DOE during and following WW II. When DOE relinquishes its withdrawals on lands that were historically Federal, those lands withdrawn only by DOE would revert to the Public Domain and management by BLM. Those lands withdrawn by the overlapping DOE and BoR withdrawals would remain withdrawn and managed by the BoR.
>
> The BoR's use of the withdrawn Public Domain lands (after the relinquishment of DOE's overlapping withdrawal) must be consistent with the purposes for which they were originally withdrawn from BLM by BoR. If they are not, the BoR could be expected to relinquish or renegotiate its withdrawal notice and the lands could be returned to the Public Domain and management by the BLM, or BoR could negotiate a new withdrawal order with the BLM.

The alternating square-mile sections that would eventually revert to the BLM or BoR are an important consideration that complicates land-use planning. Because the lands are owned by another government agency (i.e., BLM), DOE cannot authorize uses of the property beyond the mission needs of the DOE. Typically, after getting the land back, the BLM evaluates current use(s) of the land, compatibility of uses, and suitability of the land for different uses (i.e., mining, grazing, recreation, and preservation) (see text box, "*Withdrawn Public Domain Lands*.")

4.2 Geological Resources

Geologic considerations for the Hanford Site include physiography, stratigraphy, structural geology, seismic and volcanic hazards, and soil characteristics. The *Hanford Site National Environmental Policy Act (NEPA) Characterization* report (Neitzel 1998) provides the basis for the following discussions.

4.2.1 Landscape

The landscape of the Hanford Site is dominated by the low-relief plains of the Central Plains and the anticlinal ridges of the Yakima Folds physiographic regions. The surface topography has been modified within the past several million years by several geomorphic processes: (1) Pleistocene cataclysmic flooding, (2) Holocene eolian activity, and (3) landsliding. Cataclysmic flooding occurred when ice dams in western Montana and northern Idaho were breached and allowed large volumes of water to spill across eastern and central Washington. This flooding formed the channeled scablands and deposited sediments in the Pasco Basin. The last major flood occurred about 13,000 years ago, during the late Pleistocene Epoch. Braiding flood channels, giant current ripples, and giant flood bars are among the landforms created by the floods. Anastomosing flood channels, giant current ripples, bergmounds, and giant flood bars are among the land forms created by the floods. The 200 Area Waste Management facilities are located on one prominent flood bar, the Cold Creek bar (Figure 4-4).

Since the end of the Pleistocene, winds have locally reworked the flood sediments and have deposited dune sands in the lower elevations and loess (windblown silt) around the margins of the Pasco Basin. Many sand dunes have been stabilized by anchoring vegetation, except where they have been reactivated by human activity disturbing the vegetation.

A series of bluffs occurs for a distance of approximately 56 km (35 mi) along the eastern and northern shores of the Columbia River. In the northern portion of the area, these bluffs are known as the White Bluffs.

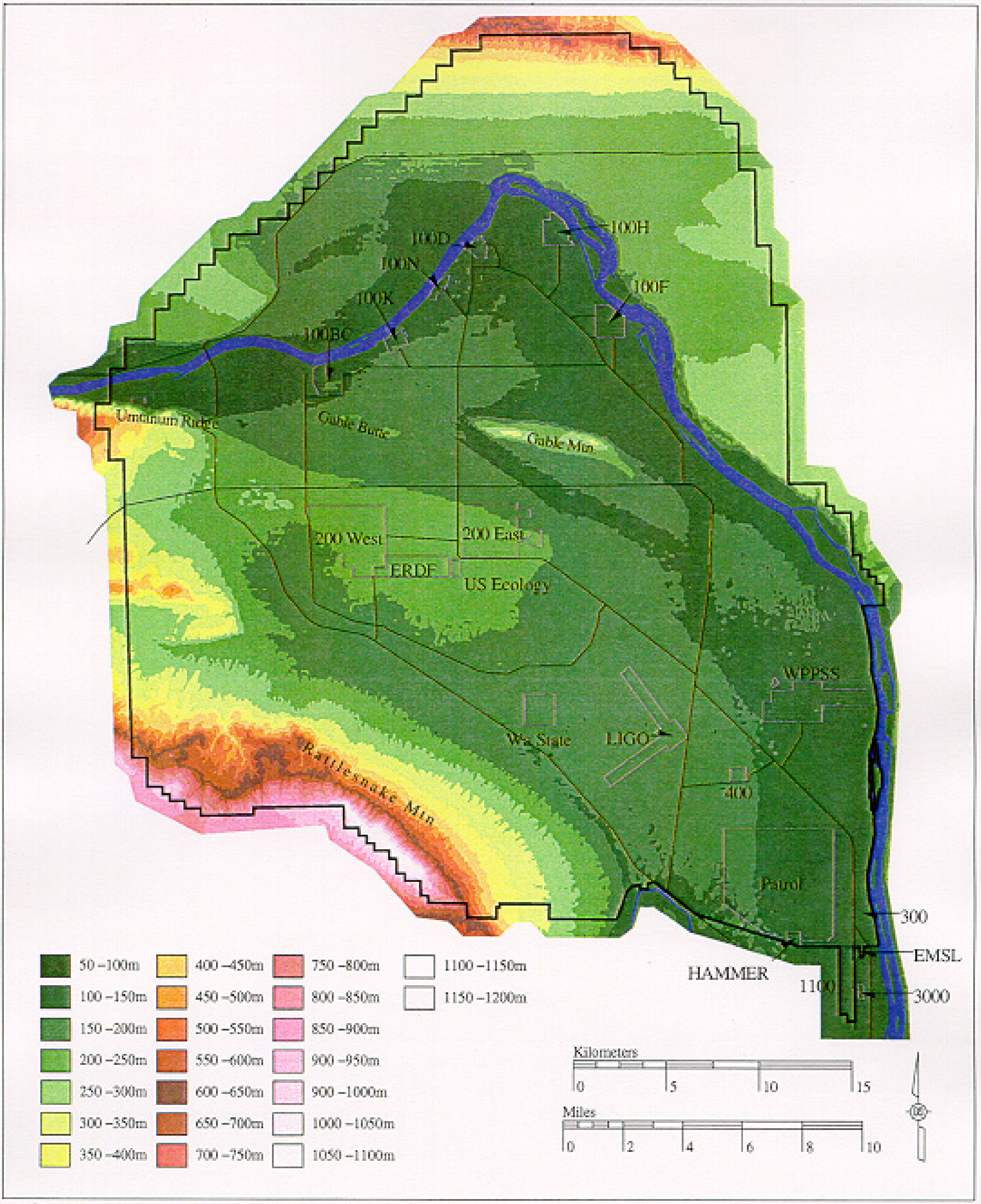
Landslides occur along the north limbs of some Yakima Folds and along steep river embankments such as White Bluffs. Landslides on the Yakima Folds occur along contacts between basalt flows or sedimentary units between the basalt, whereas active landslides at White Bluffs occur in sediments above the basalt flows. A study of the Hanford Reach by U. S. Geological Survey geologists (Shuster and Hays 1987) concluded that nearby irrigation has accelerated the rate of landslides occurring in the area. The active landslides at White Bluffs are the result of irrigation activity east of the Columbia River.

4.2.2 Stratigraphy

The stratigraphy of the Hanford Site consists of Miocene-age and younger rocks. Older Cenozoic sedimentary and volcaniclastic rock underlie the Miocene and younger rocks but are not exposed at the surface. The Hanford Site stratigraphy is described in the following subsections and is summarized in Figures 4-5 and 4-6.

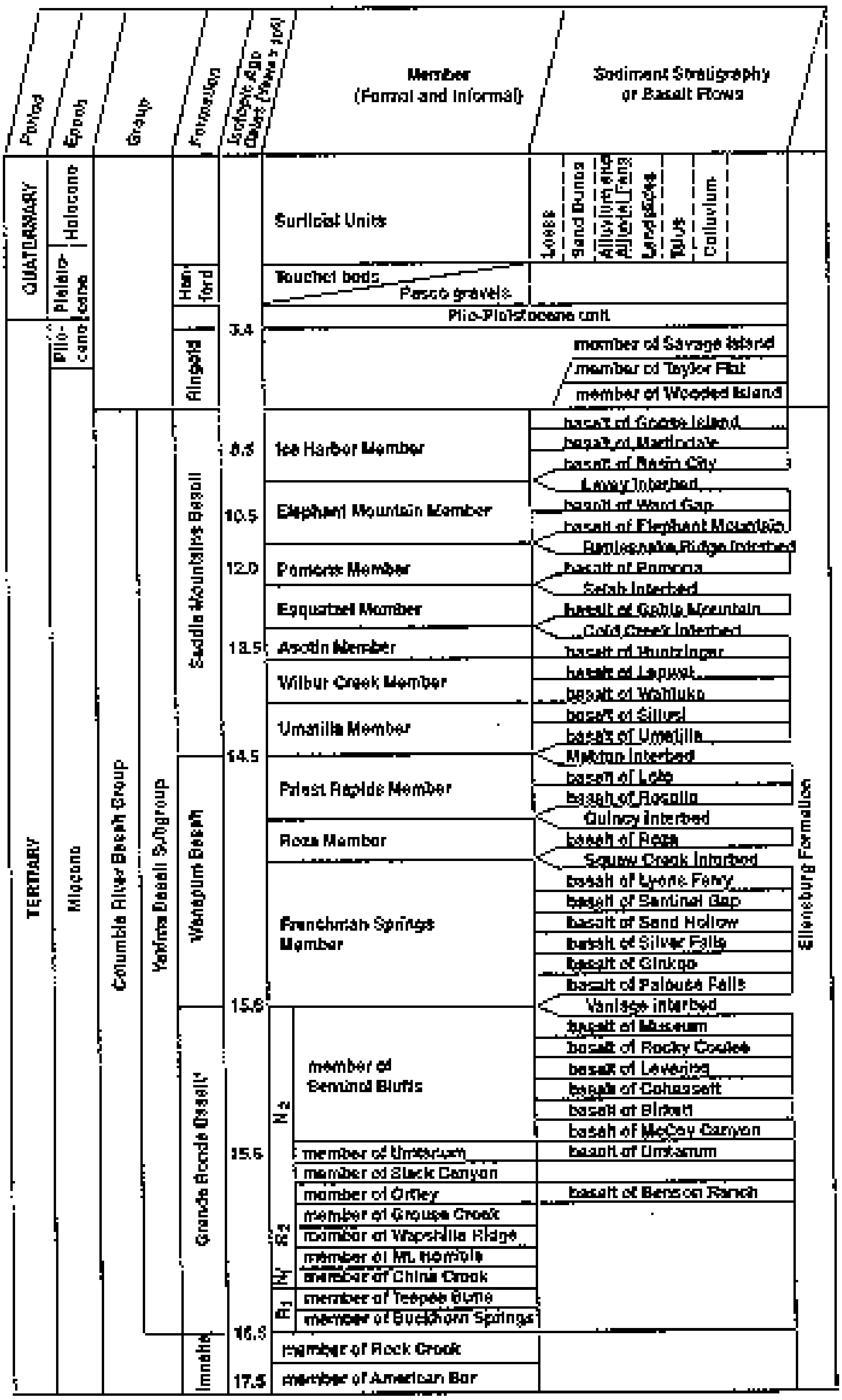
4.2.2.1 Columbia River Basalt Group. The Columbia River Basalt Group consists of an assemblage of continental flood basalts of the Miocene age. These basalts cover an area of more than 163,170 km^2 (63,000 mi^2) in Washington, Oregon, and Idaho, and have an estimated volume of about 174,000 km^3 (67,200 mi^3). Isotopic age determinations suggest flows of the Columbia River Basalt Group were erupted during a period from approximately 17 to 6 million years ago, with more than 98 percent by volume being erupted in a 2.5 million-year period (17 to 14.5 million years ago).

Figure 4-4. Topography of the Hanford Site (WHC 1991a).



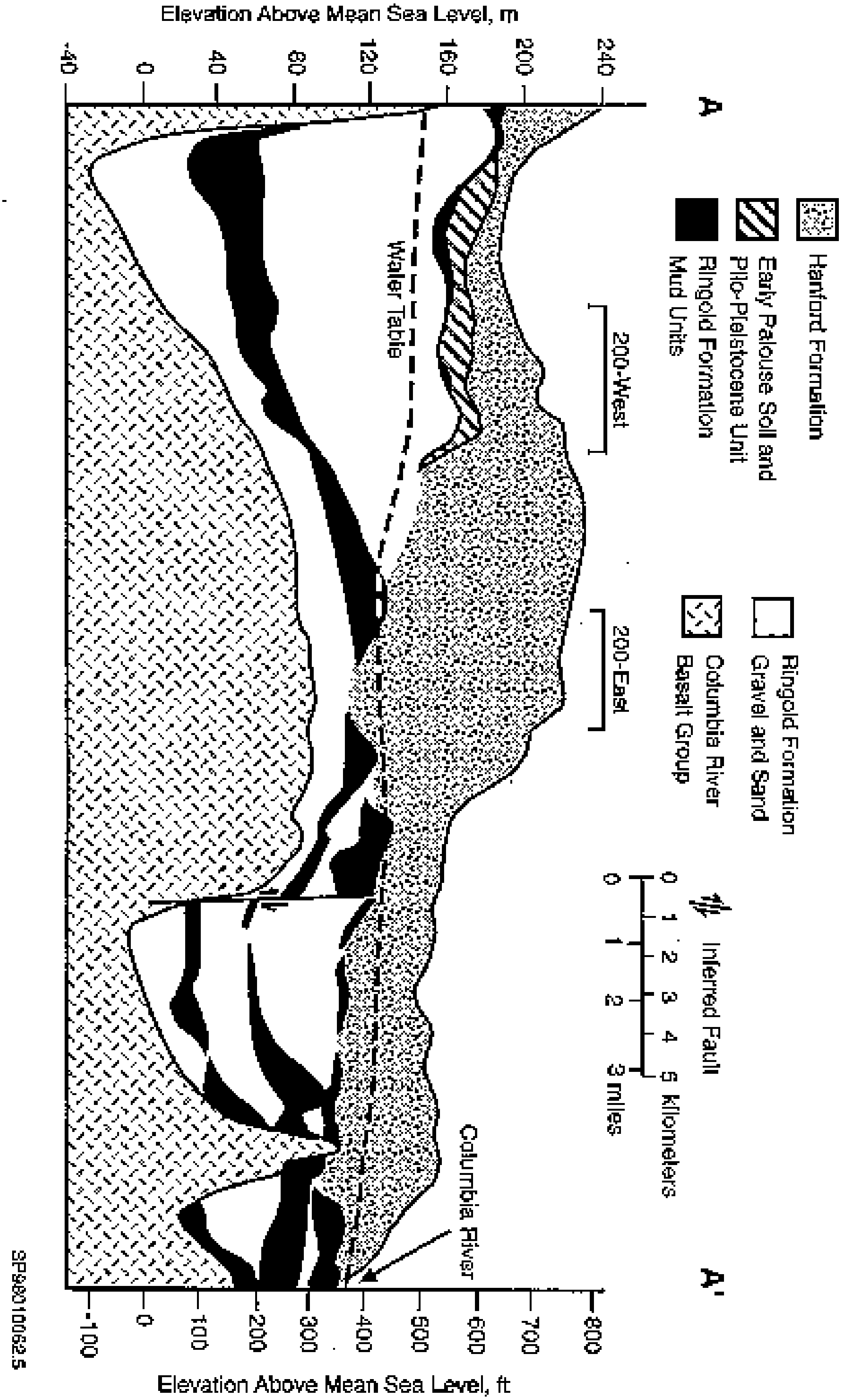
BHI:rpp 04/23/96 clup/topo1.aml Database: 04-FEB-1998

Figure 4-5. A Generalized Stratigraphic Column of the Major Geologic Units of the Hanford Site.



*The Grande Ronde Basalt consists of at least 120 major basalt flows comprising 17 members. N_2, R_2, N_1, and R_1 are magnetostratigraphic units.

Figure 4-6. Geologic Cross-Section of the Hanford Site (PNNL 1996c).



Columbia River basalt flows were erupted from north-northwest-trending fissures (linear vent systems) in north-central and northeastern Oregon, eastern Washington, and western Idaho. The Columbia River Basalt Group is formally divided into five formations (listed in order from the oldest to the youngest): Imnaha Basalt, Picture Gorge Basalt, Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt. Of these, only the Grande Ronde, Wanapum, and Saddle Mountains Basalts are present in the Pasco Basin. The Saddle Mountains Basalt forms the uppermost basalt unit in the Pasco Basin, with the exception that some of the bounding ridges where the Wanapum and Grande Ronde Basalt flows are exposed.

4.2.2.2 Ellensburg Formation. The Ellensburg Formation includes sedimentary rocks interbedded with the Columbia River Basalt Group in the central and western part of the Columbia Plateau. The age of the Ellensburg Formation is principally Miocene, although locally it may be equivalent to early Pliocene. The thickest accumulations of the Ellensburg Formation lie along the western margin of the Columbia Plateau where Cascade Range volcanic materials interbed with the Columbia River Basalt Group. The lateral extent and thickness of interbedded sediments generally increase upward in the section.

4.2.2.3 Suprabasalt Sediments. The suprabasalt (above the basalt) sediments within and adjacent to the Hanford Site are dominated by the Ringold and Hanford formations, with other minor deposits (PNNL 1996a).

4.2.2.3.1 Ringold Formation. Late Miocene to Pliocene deposits, younger than the Columbia River Basalt Group, are represented by the Ringold Formation within the Pasco Basin. The Ringold Formation was deposited in east-west trending valleys by the ancestral Columbia River and its tributaries in response to development of the Yakima Fold Belt. Exposures of the Ringold Formation are limited to the White Bluffs within the central Pasco Basin and to the Smyrna and Taunton Benches located north of the Pasco Basin. Extensive data on the Ringold Formation are available from boreholes on the Hanford Site.

Flood-related deposits of the Ringold Formation can be broken into different associations based on proximity to the ancestral Columbia and/or Snake River channels. Gravel and associated sand and silt represent a migrating channel deposit of the major river systems and generally are confined to the central portion of the Pasco Basin. Overbank sand, silt, and clay reflect occasional deposition and flooding beyond the influence of the main river channels, and generally are found along the margins of the Pasco Basin. Over time, the main river channels moved back and forth across the basin, causing a shift in location of the various facies. Periodically, the river channels were blocked and caused lakes to develop where mud (with minor amounts of sand) was deposited.

4.2.2.3.2 Plio-Pleistocene Unit. A locally derived unit consisting of an alluvium and/or pedogenic calcrete occurs at the unconformity between the Ringold Formation and the Hanford formation. The sidestream alluvial facies are derived from Cold Creek and its tributaries and are characterized by relatively thick zones of unweathered basalt clasts along with wind-blown materials and soil. The calcrete is relatively thick and impermeable in areas of the western Pasco Basin, often forming an aquitard to downward migration of water in the vadose zone where artificial recharge is occurring.

4.2.2.3.3 Early Palouse Soil. Overlying the Plio-Pleistocene unit in the Cold Creek syncline area is a fine-grained sand to silt. It is believed to consist mainly of eolian (derived from wind deposits) origin, derived from either an older reworked Plio-Pleistocene unit or upper Ringold Formation. The early Palouse soil differs from the overlying slackwater flood deposits by a greater calcium-carbonate content, massive structure in core samples, and a high natural gamma response in geophysical logs.

4.2.2.3.4 Quaternary Deposits. Repositioning of sediments resumed during the Quaternary Period, following the period of late-Pliocene to early-Pleistocene erosion. In the Columbia Plateau, the Quaternary record is dominated by cataclysmic flood deposits with lesser amounts of sediments deposited by water and wind lying below, between, and above flood deposits.

Sand and gravel river sediments, referred to informally as the pre-Missoula gravels, were deposited after incision of the Ringold Formation and before deposition of the cataclysmic flood deposits. The pre-Missoula gravels are similar to the Ringold Formation main-channel gravel facies, consisting of dominantly nonbasaltic clasts. These sediments occur in a swath that runs from the old Hanford townsite on the eastern side of the Hanford Site, across the Site toward Horn Rapids on the Yakima River.

Cataclysmic floods inundated the Pasco Basin a number of times during the Pleistocene, beginning as early as one million years ago. The last major flood sequence is dated at about 13,000 years ago by the presence of erupted material from Mount Mazama interbedded with the flood deposits. The number and timing of cataclysmic floods continues to be debated. As many as 10 flood events have been documented during the last ice age. The largest and most frequent floods came from glacial Lake Missoula in northwestern Montana; however, smaller floods may have escaped down valley from glacial Lakes Clark and Columbia along the northern margin of the Columbia Plateau, or down the Snake River from glacial Lake Bonneville. The flood deposits, informally called the Hanford formation, blanket low-lying areas over most of the central Pasco Basin (Neitzel 1997).

Cataclysmic floodwaters entering the Pasco Basin quickly became impounded behind Wallula Gap (located about 32 km [20 mi] downstream from the Hanford Site), which was too restrictive for the volume of water involved. Floodwaters formed temporary lakes with a shoreline up to 381 m (1,250 ft) in elevation, which lasted only a few weeks or less. Two types of flood deposits predominate: (1) a sand-and-gravel main-channel facies, and (2) a mud-and-sand slackwater facies. Within the Pasco Basin, these deposits are referred to as the Pasco Gravels and slackwater deposits of the Hanford formation. Sediments with intermediate grain sizes (e.g., sand-dominated facies) also are present in areas throughout the Pasco Basin, particularly on the south, protected half of Cold Creek Bar.

Landslide deposits in the Pasco Basin are of variable age and genesis. Most of these deposits occur within the basalt outcrops along the ridges (e.g., on the north side of Rattlesnake Mountain) or steep river embankments (e.g., White Bluffs), where the Upper Unit Ringold Formation crops out in the Pasco Basin.

4.2.3 Structure

The Hanford Site is located near the junction of the Yakima Fold Belt and the Palouse structural subprovinces (DOE 1988a). These structural subprovinces are defined on the basis of their structural fabric, unlike the physiographic provinces that are defined on the basis of landforms. The Palouse subprovince is a regional paleoslope that dips gently toward the Columbia Plateau and exhibits only relatively mild structural deformation. The Palouse Slope is underlain by a wedge of Columbia River basalt that thins gradually toward the east and north, and laps onto the adjacent highlands.

The principal characteristics of the Yakima Fold Belt are a series of segmented, narrow, asymmetric anticlines. These anticlinal ridges are separated by broad synclines or basins that, in many cases, contain thick accumulations of Eocene- to Quaternary-age sediments. The deformation of the Yakima Folds occurred under north-south compression. The fold belt was growing during the eruption of the Columbia River Basalt Group and continued to grow into the

Pleistocene and probably into the present. Thrust or high-angle reverse faults with fault planes that strike parallel or subparallel to the axial trends are found principally along the limbs of the anticlines (Figure 4-7) (PNNL 1996a). The amount of vertical stratigraphic offset associated with these faults varies but commonly exceeds hundreds of meters.

4.2.3.1 Mineral Development. Directly after the discovery of gold in British Columbia and Oregon in the 1850s, gold was discovered in eastern Washington. In 1862, the first very successful strike in Washington was made near the mouth of the Methow River. Strikes were also made on the Clearwater River near present-day Orofino, Idaho, in 1860 and in the Boise Basin ("Treasure Valley") in 1862. These discoveries caused prospectors to explore the mid-Columbia region in the 1860s, upstream from the Dalles to the Canadian border. Between Vantage and Alderdale, Washington, at least seven sites along the Columbia River have had past placer mining activity and gold production. The Chinaman's Bar Placer (located on the south side of the river directly upstream of the Vernita Bridge, partially on the Hanford Site) supported a small operation from 1939 to 1941 with an unknown amount of production (NPS 1994).

In addition to gold mining along the Columbia River, natural gas was discovered on Rattlesnake Mountain in 1913. The small, shallow field was developed in 1929 and produced until it was closed in 1941, yielding a total of approximately 0.07 billion m^3 (2.5 billion ft^3) of gas (NPS 1994). Twenty-four wells were drilled, with the main gas field located on the ALE Reserve. Although intensive exploration occurred, deposits proved to be small.

Oil exploration was also conducted in the Rattlesnake Mountain and Rattlesnake Hills area in the 1920s and 1930s, but useful deposits were not found (Gerber 1997). The mineral rights to a 518 ha (1,280 ac) area are still owned by a private company, the Big Bend Alberta Mining Company. The surface title to this acreage was acquired by the AEC by condemnation in 1952. At that time, the final judgment of the court revested in the owners (at that time, the Big Bend Land Company) the gas and oil rights in the land providing, however, that all rights of ingress and egress over the surface of the land for exploration or exploitation of such rights were prohibited for 25 years from the date of the judgment (January 14, 1952). Presently, the Big Bend Alberta Mining Company is free to enter on the lands at will to explore for oil or gas. The company holds all the oil and mineral rights on one section, the oil and mineral rights on three-quarters of a second section, and the soil and mineral rights on one-quarter of a third section.

4.2.4 Geologic Hazards

The White Bluffs represent a geologic hazard resulting from certain types of land uses, such as irrigated farming and other forms of intensive development (Figure 4-8). The White Bluffs are composed of claystones and siltstones that are relatively strong when dry but lose considerable strength when wet. Visual evidence of recent, suspected human-induced landslide activity has developed over the past two decades. Irrigation water applied to croplands immediately east of the White Bluffs has raised the water table significantly, resulting in local saturation, increased pore pressures, reduced shear strength, and instability of slopes above the river. Leaks in local irrigation canals and irrigation waste water are believed to be contributing groundwater to the slide area, but a regional aquifer may also be responsible (NPS 1994).

Based on studies in the early 1970s, the BoR determined that irrigation would increase the potential for landslide activity along the White Bluffs. Also, a detailed drainage investigation completed in 1967 found a large portion of "red zone" area infeasible to drain based on economic criteria. As part of its effort to restrict irrigation in this area, the BoR rescinded the plats for two irrigation blocks (blocks 36 and 55) and acquired private lands on a "willing seller" basis (NPS 1994).

Figure 4-7. Map of the Hanford Site Region Showing Known Faults.

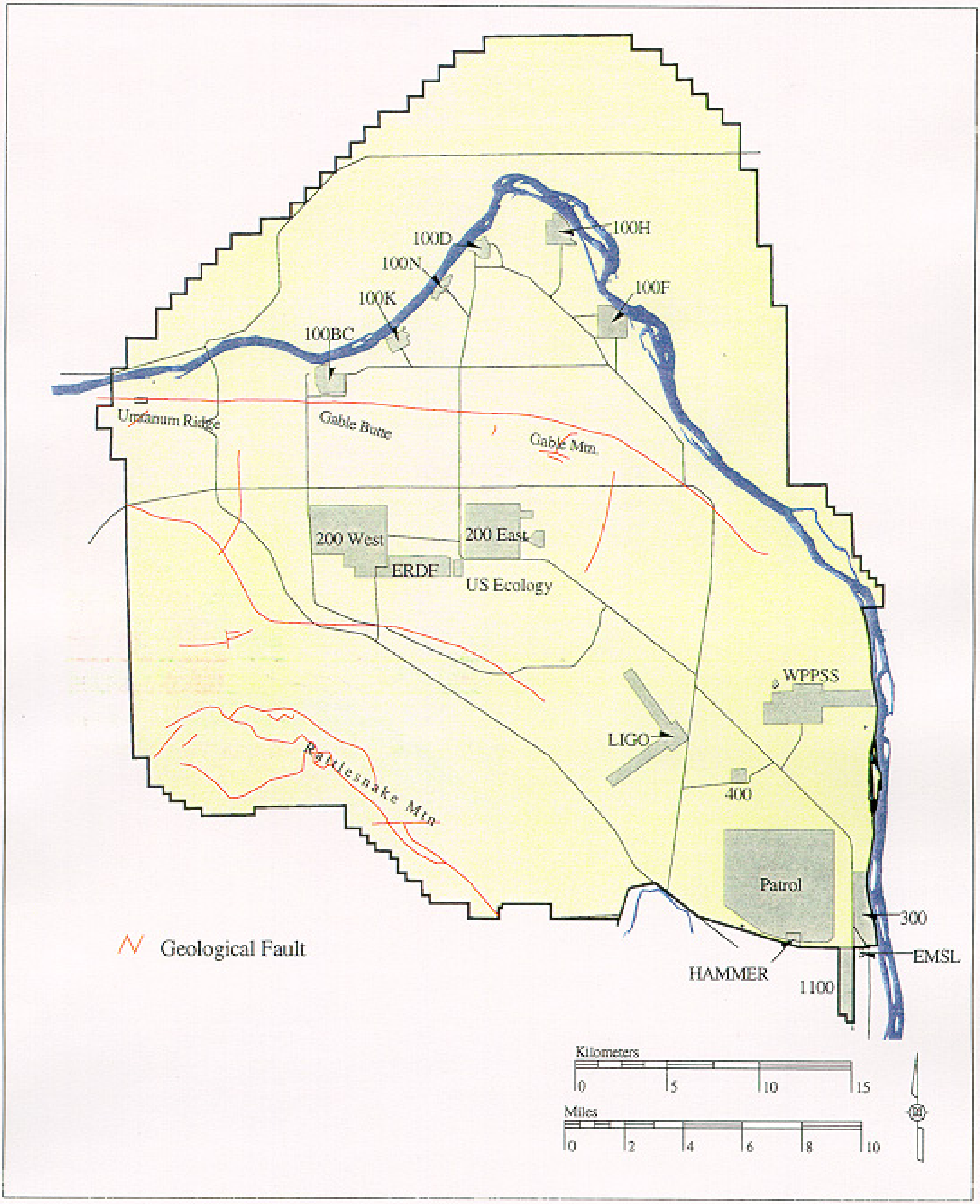


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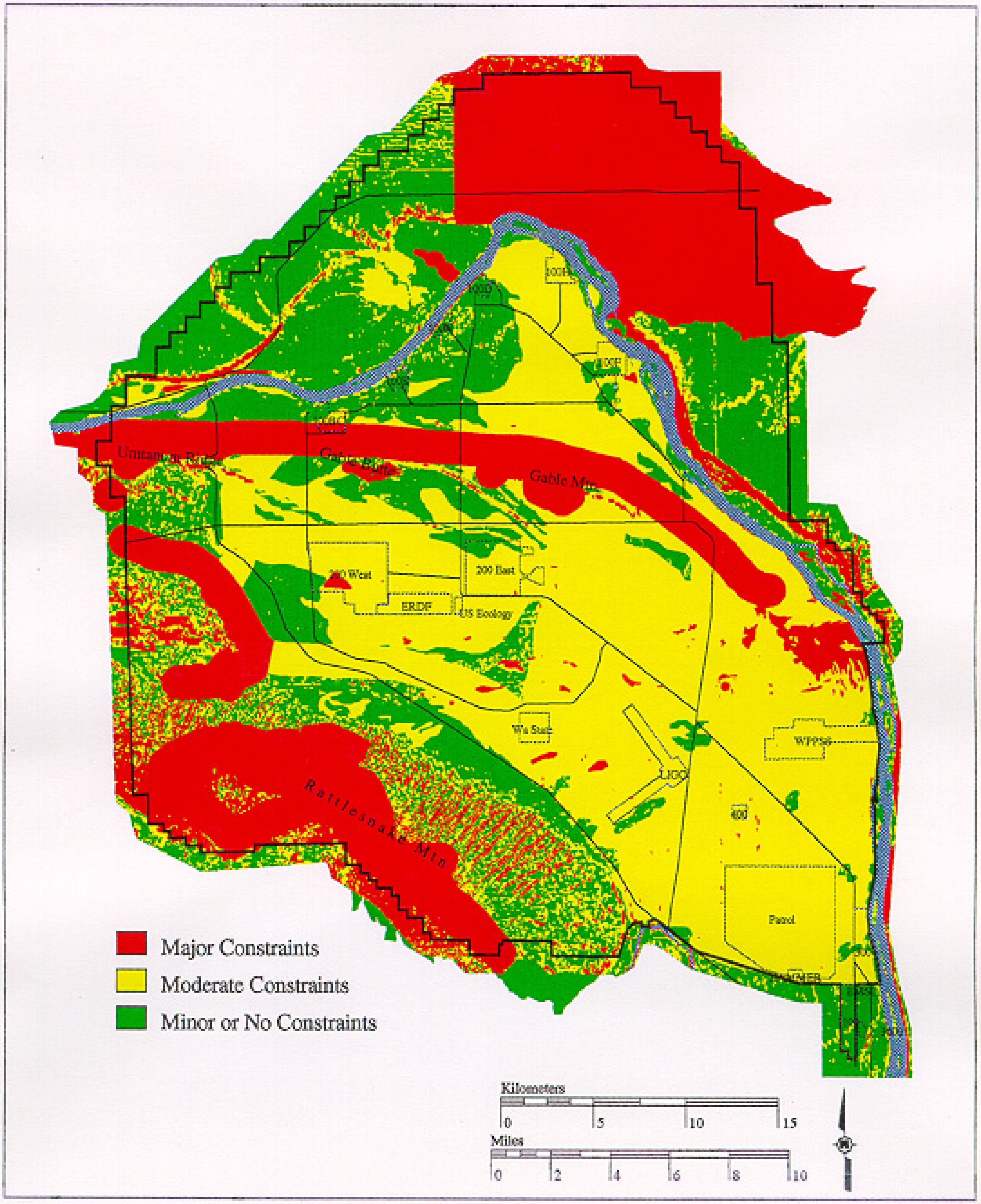
Figure 4-8. Geologic Hazards Related to Economic Land Uses.



Ringold Formation sediments that make up a large portion of the White Bluffs are largely unconsolidated and uncemented (BHI 1995a). These sediments were deposited between 6 and 3.5 million years ago. During and following deposition of Ringold sediment, the floor of the Pasco Basin was subsiding while the surrounding highlands were rising. Consequently, the Ringold sediment layers dip toward the center of the Pasco Basin, which lies in the east-central part of the Hanford Site. The angle of dip of these layers is less than 2 degrees. Ringold sediment layers dip down from the northern and eastern edges of the basin toward the Columbia River. Ringold sediments found in the bluffs consist predominantly of layers of river-deposited sand, ancient soils (paleosols), and sand, silt, and clay deposited in lakes (BHI 1995a).

Throughout the Hanford Site, a series of catastrophic flood deposits, informally known as the Hanford formation, lies atop the Ringold Formation sediments. The Hanford formation consists of fine-grained sediments know as Touchet beds and gravel beds known as the Pasco ravels. The sediments of the Hanford formation are unconsolidated, uncemented, and highly transmissive for the flow of water.

Shuster and Hays (1987) concluded that the entire area of the bluffs along the northern and eastern shores of the Columbia River is susceptible to landslides. Recent landslides have occurred in four areas along the bluffs; these areas are the Locke Island, Savage Island, Homestead Island, and Johnson Island slide areas. The length of the slide areas parallel to the river shoreline ranges from more than a mile at Locke Island to about 0.4 km (0.25 mi) of a mile near Homestead Island.

The Hanford powerline area shows evidence of Late Pleistocene landslides, and the area coincides with lack of irrigation adjacent to the bluffs (Shuster and Hays 1987). The landslides, both active and inactive, total about 11.2 km^2 (4.3 mi^2) in area, and the total landslide susceptible area is about 15.1 km^2 (5.8 mi^2) (Shuster and Hays 1987). These slide areas are characterized by major cracks about two-thirds of the way up the bluff face, surface areas on the slopes below the cracks with an irregular ground surface, and mud flows at the base of the slope. The irregular surface forms as the bluff face slides away and begins to break up. The mud flows occur as a result of a process known as liquefaction, which is water-saturated soil that flows similar to a liquid. Some of the slide areas, such as Savage Island and Locke Island slides, are rimmed by a scarp or cliff. Surface cracks located upland of the bluff face can be found, which indicate the slopes behind the bluffs are very unstable and prone to future landslides.

Examination of slide areas reveals the universal presence of water seeping from the bluffs in springs and marshes. Observation of these springs, saturated cliff faces, and mud flows indicates that water plays a role in producing landslides along the bluffs. The water found in the bluffs reduces the strength, decreases frictional resistance, and adds weight to the unconsolidated Ringold Formation. Because the transmissivity of the Ringold layers varies, water accumulates in certain sediment layers within the bluffs. This wet layer is the plane on which the slide begins. The bluff above a wet layer will slide when the water-laden and lubricated layer fails under the weight of the overburden.

Sources of water on the bluffs are natural precipitation, irrigated farmlands, irrigation and wastewater canals, and irrigation wastewater ponds located up-slope and east of the bluffs and on the Wahluke Slope. Water from these activities percolates through the soil to the Ringold Formation. Some of the layers within the formation resist the downward flow of water, forcing the water to flow laterally. Ringold Formation layers dip toward the Columbia River and the water that collects above less transmissive Ringold Formation layers moves downslope toward the bluffs. Eventually, this water reaches the bluffs and increases the potential for a landslide.

Shuster and Hays (1987) concluded, “In the present climate, most of these bluffs are very stable under natural conditions, but irrigation of the upland surface to the east, which began in the

1950s and has been greatly expanded, led to increased and more widespread seepage in the bluffs and to a spectacular increase in slope failures since 1970. With continuing irrigation, areas of the bluff wetted by seepage will be subject to landslides wherever slopes exceed about 15 degrees and, on lesser slopes, wherever the surficial material is old landslide debris."

The hazards posed by landslides in bluffs range from minor to catastrophic. Economic loss from landslides in the bluffs has not been large because the area is relatively undeveloped. Road closures have occurred. A concrete flume, part of the Ringold wasteway, was destroyed by the Homestead Island slide in the late 1960s (Shuster and Hays 1987). Encroachment up-slope by the Savage Island slide destroyed the riverward margins of irrigated fields along the top of the bluffs (Shuster and Hays 1987).

Perhaps the most unlikely occurrence would be an earthquake-triggered, massive slope failure caused by liquefaction of the White Bluffs, which would temporally block the Columbia River. Hanford facilities on the west side of the river could be endangered, as well as citizens and property located downstream of this temporary dam. Also, contaminants left at depth in the soil column would be further mobilized by the subsequent rise in groundwater levels on the Hanford facilities side of the river.

The Locke Island slide caused the loss of cultural artifacts on the island by changing the channel of the river and causing erosion to occur on Locke Island. Since its beginning in the mid-1970s, the Locke Island slide has extended 150 m (492 ft) into the channel of the Columbia River (Neitzel 1997). Since November 1995, Locke Island has an actively eroding cut bank that is 400 m (1,312 ft) in length, with a horizontal loss of 16 m (53 ft) (Neitzel 1997). These slides can disturb and destroy salmon spawning beds by siltation, and the increase in sediment load in the Hanford Reach could potentially adversely affect the Energy Northwest (formerly known as WPPSS) reactor cooling-water intake systems (Shuster and Hays 1987).

The Hanford Dune Field, located north of the Energy Northwest (formerly known as WPPSS) reactor, also represents a hazard to certain types of land uses. The Hanford Dune Field is one of three great dune fields in the Columbia River Basin. It is an active area of migrating barchan dunes and partially stabilized transverse dunes derived from alluvium, with bare rock-rubbled areas between dunes. In the late 1970s, a study performed by the Heritage Conservation and Recreation Service determined this dune field to be of national significance and proposed a 2,560 ha (6,320 ac) protected area for inclusion in the National Natural Landmark system. For security purposes and other reasons, DOE requested that the site not be designated as such, and the request was honored (NPS 1994).

There is also an extensive dune system that is stabilized with vegetation, located south of the 200 Areas, trending to the northeast toward the Columbia River. This stabilized dune system, which forms hummocky terraces and dune-like ridges, also represents a potential geologic hazard to development. Should the vegetation on the dune system be altered, cleared, or otherwise disturbed, the dunes might remobilize, resulting in dune sand movement and blowing sand during windy weather.

4.2.4.1 Seismic and Volcanic Hazards. The historic record of earthquakes in the Pacific Northwest dates from about 1840. The early part of this record is based on newspaper reports of structural damage and human perception of the shaking and structural damage as classified by the Modified Mercalli Intensity (MMI) scale and is probably incomplete because the region was sparsely populated. Seismograph networks did not start providing earthquake locations and magnitudes in the Pacific Northwest until about 1960. A comprehensive network of seismic stations, which provide accurate locating information for most earthquakes greater than a magnitude of 2.5 on the Richter scale, was installed in eastern Washington in 1969.

Seismicity of the Columbia Plateau, as determined by the rate of earthquakes per area and the historical magnitude of these events, is relatively low when compared to other regions of the Pacific Northwest, the Puget Sound area, and western Montana/eastern Idaho. The largest known earthquake in the Columbia Plateau occurred in 1936 near Milton-Freewater, Oregon. This earthquake had a Richter scale magnitude of 5.75 and a maximum MMI of VII and was followed by a number of aftershocks that, when analyzed, indicated a northeast-trending fault plane. Other earthquakes with Richter scale magnitudes greater than 5.0 and/or MMIs of VI have occurred along the boundaries of the Columbia Plateau in a cluster near Lake Chelan extending into the northern Cascade Range, in northern Idaho and Washington, and along the boundary between the western Columbia Plateau and the Casade Range.. Three MMI VI earthquakes have occurred within the Columbia Plateau, including one in the Milton-Freewater region in 1921; one near Yakima, Washington, in 1892; and one near Umatilla, Oregon, in 1893. In the central portion of the Columbia Plateau, the largest earthquakes near the Hanford Site are two that occurred in 1918 and 1973. These two events were at Richter scale magnitude of 4.4 and MM of V, and were located north of the Hanford Site, near Othello, Washington.

Earthquakes often occur in spatial and temporal clusters in the Columbia Plateau and are termed “earthquake swarms.” The region north and east of the Hanford Site is concentrated with earthquake swarm activity; however, earthquake swarms also have occurred in several locations within the Hanford Site. Earthquakes in a swarm tend to gradually increase and decay in frequency of events, and usually no outstanding large event is present within the sequence. These earthquake swarms occur at shallow depths, with 75 percent of the events located at depths less than 4 km (2.5 mi). Each earthquake swarm typically lasts several weeks to months, may consist of anywhere from several to more than 100 earthquakes, and is clustered in an area 5 to 10 km (3 to 6 mi) in lateral dimension. Often, the longest dimension of the swarm area is elongated in an east-west direction.

Earthquakes in the Columbia Plateau also occur to depths of approximately 30 km (18 mi). These deeper earthquakes are less clustered and occur more often as single, isolated events. Based on epicenter studies and refraction surveys in the region, the shallow earthquake swarms occur in the Columbia River Basalts and the deeper earthquakes occur in crustal layers below the basalts.

Several major volcanoes are located in the Cascade Range west of the Hanford Site. The nearest volcano, Mount Adams, is about 165 km (102 mi) from the Hanford Site. The most active volcano, Mount St. Helens, is located approximately 220 km (136 mi) west-southwest of the Hanford Site.

Because of their close proximity, the volcanic mountains of the Cascades are the principal volcanic hazard at the Hanford Site. The major concern is that ash fall could affect Hanford Site communications equipment and electronic devices, as well as the movement of truck and automobile traffic in and out of the area.

4.2.5 Soils

The *Soil Survey Hanford Project in Benton County Washington*, BNWL-243 (PNL 1966), describes 15 different soil types on the Hanford Site, varying from sand to silty and sandy loam. The soil classifications given in BNWL-243 have not been updated to reflect current reinterpretations of soil classifications (see text box, *“Hanford Site Quick Facts: Soils”*). Until soils on the Hanford Site are

> ***Hanford Site Quick Facts: Soils***
>
> - Fifteen types of soils identified
> - Textures range from sand to silty and sandy loam
> - Most common soil type: Quincy Sand

resurveyed, the descriptions presented in BNWL-243 will continue to be used (see Table 4-1 and Figure 4-9). No soils on the Hanford Site are currently classified as prime farmlands because (1) there are no current soil surveys, and (2) the only prime farmland soils in the region are irrigated (August 1996 Draft HRA-EIS).

The parent material for predominant soil types at the Hanford Site consists of the Hanford formation and Holocene surficial deposits (Cushing 1992). Soils with well-developed profiles occur only where fine and poorly-drained sediments have been deposited and typically are low in organic matter (PNL 1991a).

Wind and water erosion have been key factors in modifying developed soil profiles on the Hanford Site, and have resulted in the loss of soil down to parent material in some areas and the creation of large active sand dunes in other areas. Currently stabilized dune complexes can potentially be reactivated as a result of surface disturbances.

4.3 Water Resources

This section provides an overview of the Hanford Site hydrologic setting, which includes surface water and groundwater resources, and a discussion of existing water rights.

In 1980, Congress enacted the *Northwest Power Act* (NPA) (16 U.S.C. 839-839h), which "marked an important shift in Federal policy." Continually declining fish runs had revealed the failures of previous legislative efforts requiring that "equal consideration" be given to fish and wildlife affected by resource exploitation. The NPA created "a pluralistic intergovernmental and public review process." At the hub of this process, Congress established the Pacific Northwest Electric Power and Conservation Planning Council (Council), directing it to create "a program to protect, mitigate, and enhance" the Columbia River Basin's fish and wildlife "to the extent affected by the development and operation of the Basin's hydropower system." The Council's authority with respect to fish and wildlife measures is contained; the Council "can guide, but not command, Federal river management."

In addition, Canada and the United States signed the Pacific Salmon Treaty in 1985. The Pacific Salmon Treaty has provided for improved conservation and management of the resource. The Treaty covers five species of Pacific salmon and steelhead (two of which -- the Upper Columbia steelhead and the Redfish Lake sockeye salmon -- are now also covered by the *Endangered Species Act of 1973)*, and applies to fisheries in Southeast Alaska, British Columbia, Washington, and Oregon.

There is no single "law of the river" on the Columbia River. Instead, there is a maze of overlapping treaties, laws, and regulations, which together attempt to balance the varied interests on the river. (See text box, "*Columbia River Flow – Who Controls It?*")

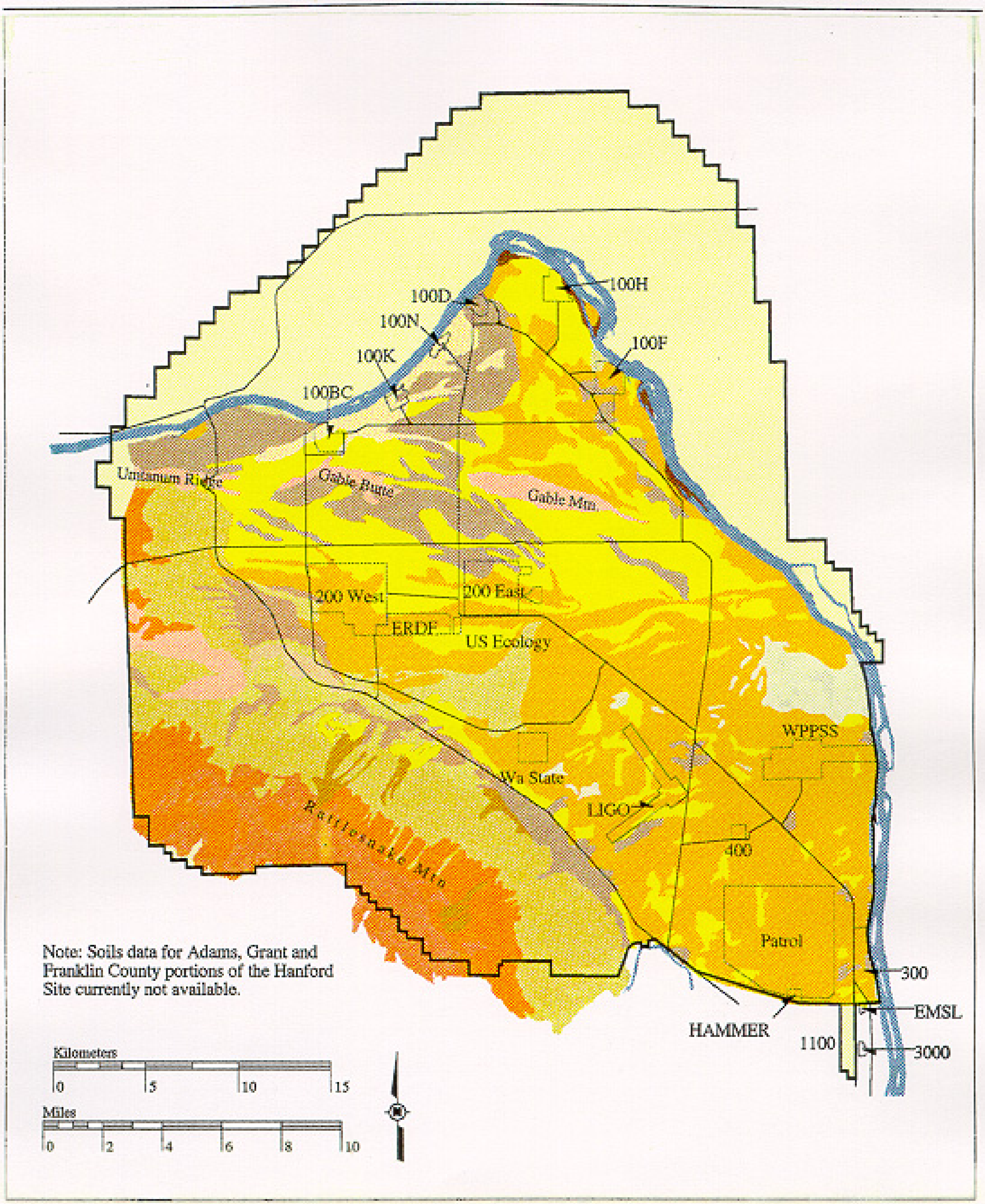
4.3.1 Surface Water

The Pasco Basin occupies about 4,900 km^2 (1,900 mi^2) and is located centrally within the Columbia Basin. Elevations within the Pasco Basin generally are lower than other parts of the Columbia Plateau, and surface drainage enters the Pasco Basin from other basins. Within the Pasco Basin, the Columbia River is joined by three major tributaries: the Yakima River, the Snake River, and the Walla Walla River.

Table 4-1. Soil Types on the Hanford Site (adapted from PNNL 1996a).

Name (Symbol)	Description
Ritzville silt loam (Ri)	Dark-colored silt loam soils midway up the slopes of the Rattlesnake Hills. Developed under bunchgrass from silty wind-laid deposits mixed with small amounts of volcanic ash. Characteristically greater than 150-cm (59-in.) deep; bedrock may occur at less than 150 cm (59 in.) but greater than 75 cm (30 in.).
Quincy (Rupert) sand (Rp)	One of the most extensive soils on the Hanford Site. Brown to grayish-brown coarse sand grading to dark grayish-brown at approximately 90 cm (35 in.). Developed under grass, sagebrush, and hopsage in coarse, sandy, alluvial deposits that were mantled by wind-blown sand. Hummocky terraces and dune-like ridges.
Hezel sand (He)	Similar to Rupert sands; however, a laminated grayish-brown strongly calcareous silt loam subsoil usually is encountered within 100 cm (39 in.) of the surface. Surface soil is very dark brown, and was formed in wind-blown sands that mantled lake-laid sediments.
Koehler sand (Kf)	Similar to other sandy soils on the Hanford Site. Developed in a wind-blown sand mantle. Differs from other sands because the sand mantles a lime-silica-cemented layer "hardpan." Very dark grayish-brown surface layer is somewhat darker than Rupert Sand. Calcareous subsoil usually is dark grayish-brown at approximately 45 cm (18 in.).
Burbank loamy sand (Ba)	Dark, coarse-textured soil underlain by gravel. Surface soil usually is 40-cm (16-in.) thick, but can be 75-cm (30-in.) thick. Gravel content of subsoil ranges from 20 to 80 percent.
Kiona silt loam (Ki)	Located on steep slopes and ridges. Surface soil is very dark grayish-brown and approximately 10-cm (4-in.) thick. Dark brown subsoil contains basalt fragments 30 cm (12 in.) and larger in diameter. Many basalt fragments found in surface layer. Basalt rock outcrops present. A shallow stony soil normally occurring in association with Ritzville and Warden soils.
Warden silt loam (Wa)	Dark grayish-brown soil with a surface layer usually 23-cm (9-in.) thick. Silt loam subsoil becomes strongly calcareous at approximately 50 cm (20 in.) and becomes lighter in color. Granitic boulders are found in many areas. Usually greater than 150-cm (59-in.) deep.
Ephrata sandy loam (El)	Surface is dark colored, and subsoil is dark grayish-brown medium-textured soil underlain by gravelly material, which may continue for many meters (feet). Level topography.
Ephrata stony loam (Eb)	Similar to Ephrata sandy loam. Differs in that many large hummocky ridges presently are made up of debris released from melting glaciers. Areas between hummocks contain many boulders several meters (feet) in diameter.
Scooteney stony silt loam (Sc)	Developed along the north slope of Rattlesnake Hills; usually confined to floors of narrow draws or small fan-shaped areas where draws open onto plains. Severely eroded with numerous basaltic boulders and fragments exposed. Surface soil usually is dark grayish-brown, grading to grayish-brown in the subsoil.
Pasco silt loam (P)	Poorly drained, very dark grayish-brown soil formed in recent alluvial material. Subsoil is variable, consisting of stratified layers. Only small areas found on the Hanford Site, located in low areas adjacent to the Columbia River.
Esquatzel silt loam (Qu)	Deep dark-brown soil formed in recent alluvium derived from loess and lake sediments. Subsoil grades to dark grayish-brown in many areas, but color and texture of the subsoil vary because of the stratified nature of the alluvial deposits.
Riverwash (Rv)	Wet, periodically flooded areas of sand, gravel, and boulder deposits that make up overflowed islands in the Columbia River and adjacent land.
Dune sand (D)	Miscellaneous land type that consists of hills or ridges of sand-sized particles drifted and piled up by wind, and are either actively shifted or so recently fixed or stabilized that no soil horizons have developed.
Lickskillet silt loam (Ls)	Located on ridge slopes of Rattlesnake Hills and slopes greater than 765 m (2,509 ft) in elevation. Similar to Kiona series except surface soils are darker. Shallow over basalt bedrock, with numerous basalt fragments throughout the profile.

Figure 4-9. Soil Map of the Hanford Site (adapted from PNNL 1996a).



The Hanford Site occupies approximately one-third of the land area within the Pasco Basin. Primary surface-water features associated with the Hanford Site are the Columbia and Yakima rivers (see text box, *"Hanford Site Quick Facts: Surface Water"*). Several surface ponds and ditches in the 200 Areas, which were generally associated with fuel- and waste-processing activities, are shown in their historical locations (Figure 4-10). In the 100 Area and 300 Area, historical Hanford irrigation canals are shown. Other active irrigation wasteways (i.e., canals or ditches that carry excess irrigation water back to the Columbia River) that belong to the BoR are shown on the Wahluke Slope. In addition, several small spring-fed streams occur on the ALE Reserve in the southwestern portion of the Hanford Site.

A network of dams and multi-purpose water resource projects is located along the course of the Columbia River. Water storage behind Grand Coulee Dam, combined with storage upstream in Canada, totals 3.1×10^{10} m^3 (1.1×10^{12} ft^3) of usable storage to regulate the Columbia River for power, flood control, and irrigation.

The flow of the Columbia River has been inventoried and described in detail by the U.S. Army Corps of Engineers (USACE) (DOE, DOA, and DOI 1995). Flows through the Hanford Reach fluctuate significantly and are controlled primarily by releases from the Priest Rapids Dam. Recorded flow rates in the Hanford Reach have ranged from 4,500 to 18,000 m^3/s (approximately 158,900 to 635,600 ft^3/s) during the runoff in spring and early summer, and from 1,000 to 4,500 m^3/s (35,300 to 158,900 ft^3/s) during the low-flow period of late summer and winter.

Annual flows near Priest Rapids during the 68 years prior to 1985 averaged nearly 3,360 m^3/s (120,000 ft^3/s) (McGavock et al. 1987). Daily average flows during this period ranged from 1,000 to 7,000 m^3/s (36,000 to 250,000 ft^3/s). During the last 10 years, the average daily flow was also about 3,360 m^3/s (120,000 ft^3/s). However, larger than normal snowpacks resulted in exceptionally high spring runoff during 1996 and 1997. The peak flow rate during 1997 was nearly 11,750 m^3/s (415,000 ft^3/s) (DART 1998). Normal river elevations range from 120 m (394 ft) above mean sea level where the river enters the Hanford Site near Vernita, to 104 m (341 ft) where the river

Columbia River Flow — Who Controls It?

On the Columbia River above the Hanford Site, there are dams such as the Grant County Public Utility District (PUD) Rock Island Dam and Rocky Reach Dam; the Douglas County PUD Wells Dam; the U.S. Army Corps of Engineers Chief Joseph Dam; the BoR Grand Coulee Dam; and the British Columbia Hydro Keenleyside Dam, Revelstoke Dam, and Mica Dam.

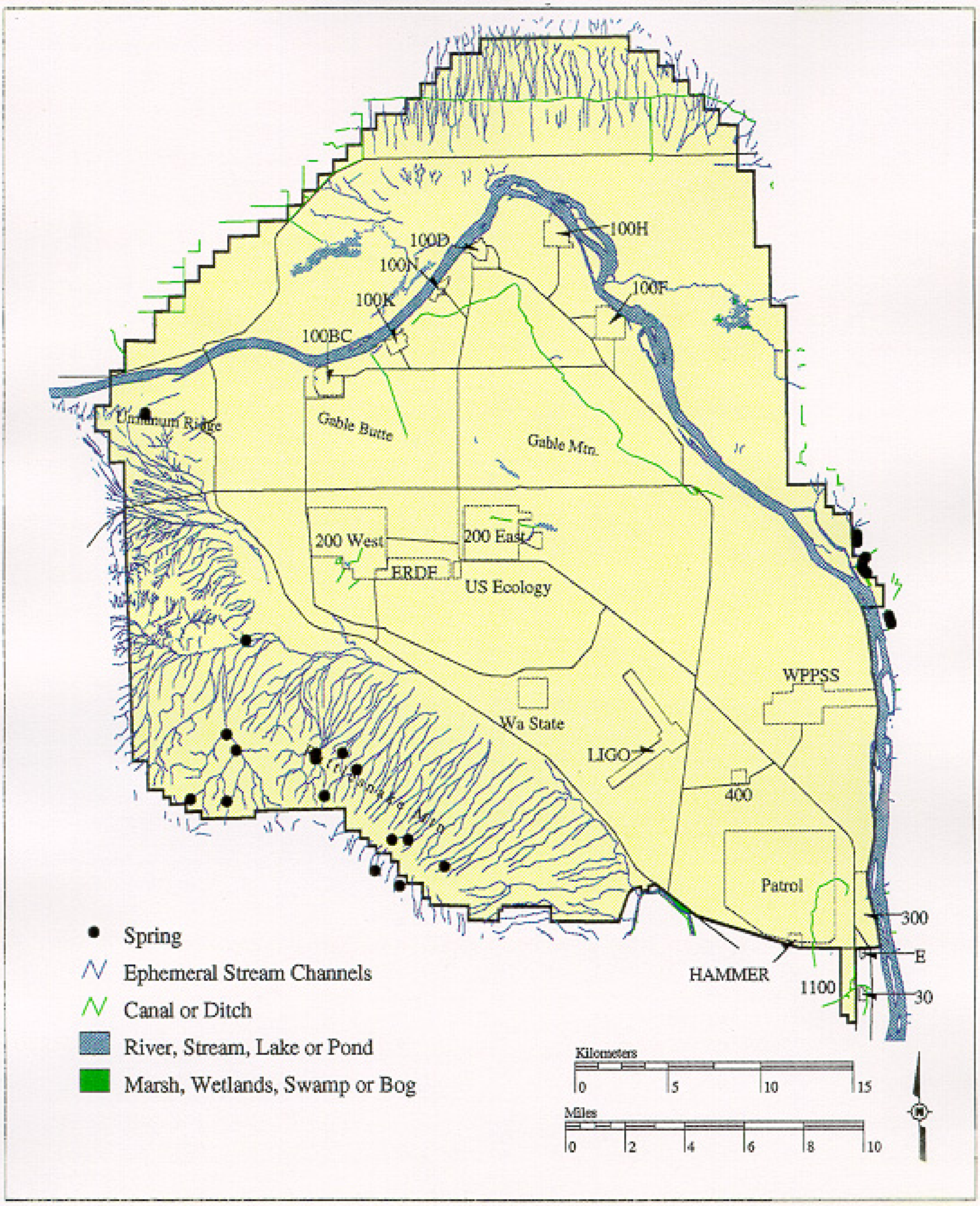
The 1964 Columbia River Treaty between the United States and Canada provided for building four storage reservoirs: three in Canada (Mica, Kennleyside, and Duncan) and one in the United States (Libby). The reservoirs that were built and operated under the Treaty represent almost half the water storage on the Columbia River System. The Treaty required over 15.5 million acre-feet of Canadian storage, but reservoirs actually built contained storage capacity of 20.5 million acre-feet. The excess storage capacity, most of which is behind Mica Dam, is referred to as non-Treaty storage. The Non-Treaty Storage Agreements made by DOE's BPA were necessary to govern the rights to this additional storage capacity. Nothing in the Treaty prevented Canada from using all of the non-Treaty storage unilaterally, although the United States argued it had the right to compensation if use of the non-Treaty storage resulted in reduced Columbia River flows into the United States.

The three dams in British Columbia were developed to provide water storage for power generation in the United States. Mica Dam has the highest "head" at 200 m (656.2 ft) and is the only installation of the three to have a powerhouse. In return for building the three dams (Mica, Keenleyside, and Duncan), B.C. Hydro was entitled to half the additional power generated in the United States that resulted from storage operations in Canada. These "downstream benefits" were sold to a group of American utilities for 30 years. This share, known as the "Canadian Entitlement," is owned by B.C. Hydro. In September 1994, British Columbia and the United States signed a Memorandum of Agreement which outlines new arrangements for the return of the Canadian Entitlement, beginning in 1998.

The Vernita Bar Agreement (signed June 16, 1988, by the U.S. Department of Energy, Federal and state agencies, Tribal governments, and public utility districts in Grant, Chelan, and Douglas counties) was entered into by the dam owners to prevent salmon eggs from being left high and dry when river flows fluctuate to meet peak power demands.

The overall water flow in the Columbia River is precisely controlled with cooperation from all dam owners from the U.S. Army Corps of Engineers Operations Center in Portland, Oregon.

Figure 4-10. Surface Water on the Hanford Site.



leaves the Hanford Site near the 300 Area. Vertical fluctuations of approximately 1.5 m (greater than 5 vertical ft) are not uncommon along the Hanford Reach (Dirkes 1993). The width of the river varies from approximately 300 m (1,000 ft) to 1,000 m (3,300 ft) within the Hanford Site.

Hanford Site Quick Facts: Surface Water

- Columbia River average annual flow: 3,400 m^3 (120,100 ft^3) per second
- Yakima River average annual flow: 104 m^3 (3,673 ft^3) per second

Several drains and intakes are present along the Hanford Reach. These include irrigation outfalls from the Columbia Basin Irrigation Project, Hanford Site intakes for the onsite water export system, and Energy Northwest (formerly known as WPPSS) water intakes.

The primary uses of the Columbia River include the production of hydroelectric power, irrigation of cropland in the Columbia Basin, and transportation of materials by barge. The Hanford Reach is the upstream limit of barge traffic on the main stem of the Columbia River. Barges are used to transport reactor vessels from decommissioned nuclear submarines to Hanford for disposal. Several communities located on the Columbia River rely on the river as their source of drinking water. The Columbia River is also used as a source of both drinking water and industrial water for several Hanford Site facilities (Dirkes 1993). In addition, the Columbia River is used extensively for recreation, which includes fishing, hunting, boating, sailboarding, waterskiing, diving, and swimming.

The Yakima River, bordering the southern portion of the Hanford Site, has a low annual flow compared to the Columbia River. The average flow, based on nearly 60 years of records, is about 104 m^3/s (3,712 ft^3/s), with an average monthly maximum of 490 m^3/s (17,500 ft^3/s) and minimum of 4.6 m^3/s (165 ft^3/s). Exceptionally high flows were observed during 1996 and 1997. The peak average daily flow rate during 1997 was nearly 1,300 m^3/s (45,900 ft^3/s). Approximately one-third of the Hanford Site is drained by the Yakima River system.

An alkaline spring at the east end of Umtanum Ridge was documented by The Nature Conservancy in *Biodiversity Inventory and Analysis of the Hanford Site* (TNC 1998). Several springs are also found on the slopes of the Rattlesnake Hills, along the western edge of the Hanford Site. Cold Creek and its tributary, Dry Creek, are ephemeral streams within the Yakima River drainage system that roughly parallel SR 240 through the Hanford Site. Both streams drain areas to the west of Hanford Site. Surface flow, when it occurs, infiltrates and disappears into the surface sediments in the western portion of the Hanford Site. Rattlesnake Springs, located on the western portion of the Hanford Site, forms a small surface stream that flows for approximately 3 km (1.9 mi) before disappearing into the ground.

There are no currently active ditches on the Hanford Site. The only active pond in Benton County's portion of the Hanford Site is West Lake. West Lake is located north of the 200 East Area and is a natural feature recharged from groundwater (PNNL 1996a). West Lake has not received direct effluent discharges from Hanford Site facilities; rather, its existence is caused by the intersection of the elevated water table with the land surface in the topographically low area south of Gable Mountain (and north of the 200 East Area). The artificially elevated water table occurs under much of the Hanford Site and reflects the artificial recharge from past Hanford Site operations. This elevated water table is dropping and so is the size of West Lake.

The seepage of groundwater into the Columbia River has been known to occur for many years. The riverbank seep discharges were documented along the Hanford Reach long before Hanford Site operations began during World War II (PNNL 1996a). These relatively small seeps flow intermittently, apparently influenced primarily by changes in river level. Hanford-origin contaminants have been documented in these groundwater discharges along the Hanford Reach (PNNL 1996a).

In the 200 West Area, the West Powerhouse Pond, 216-T-1 Ditch, 216-T-4-2 Ditch, and 216-Z-21 Basin are active. In the 200 East Area, only the East Powerhouse Ditch and the 216-B-3C Pond are active. The 216-B-3C Pond originally was excavated in the mid-1950s for disposal of process cooling water and other liquid wastes occasionally containing low levels of Radionuclides. The FFTF pond is located near the 400 Area and was excavated in 1978 for the disposal of cooling and sanitary water from various facilities in the 400 Area (PNNL 1996a). The ponds are not accessible to the public and do not constitute a direct offsite environmental impact (PNNL 1996a). However, the ponds are accessible to migratory waterfowl, creating a potential pathway for the dispersion of contaminants. Periodic sampling provides an independent check on effluent control and monitoring systems (PNNL 1996a).

Among the most interesting discoveries of the 1997 field season were three previously undocumented clusters of approximately 20 vernal pools. Vernal pools are associated more typically with arid areas in California and Oregon. Vernal pools in Washington are little known or studied; therefore, their occurrence on the Hanford Site is significant (TNC 1998). The Hanford Site pools were located on the eastern end of Umtanum Ridge, in the central part of Gable Butte, and at the eastern end of Gable Mountain. Each cluster of pools was situated on top of an impermeable basalt layer that enabled water to pond in shallow depressions during wetter winter seasons. The pools often were characterized by a distinct zonation of species from the bottom of the pool, which might be barren throughout the growing season, to the upper pool edge, which was occupied by various annual plant species. The vernal pools also showed wide variation in their degree of development (i.e., some appeared to be pools that filled intermittently and were invaded by sagebrush during extended dry periods). Most pools apparently filled with water most years.

Vernal pools on the Hanford Site showed wide variation in regard to a number of traits, including pool size, species composition, dominant species, degree of invasion by weedy (mostly non-native) species, and presence of rare plant species. Pools averaged about 60 by 60 ft (18 by 18 m) in size, but ranged from 20 by 20 ft (6 by 6 m) to 150 by 100 ft (46 by 30 m). Dominant species were typically annuals. Some vernal pools had a high cover of moss and lichen species. In addition to their botanical resources, there was ample evidence of avian and other wildlife use of these vernal pools as they often provided water during dry times of the year (TNC 1998).

The cluster of 10 to 11 vernal pools on the eastern end of Umtanum Ridge were of relatively high quality and appeared to be the most undisturbed (pristine) pools on the Site. Large and vigorous subpopulations of *Mimulus suksdorfii* (Suksdorf's Monkey-flower) were found in almost all of these pools. *Myosurus* x *clavicaulis* (Tiny mousetail) was located in one of the vernal pools. The pools were spread out over an area of about 1,000 by 3,000 ft (305 by 915 m). The lower, middle portion of Gable Butte supported a cluster of six or seven vernal pools. These pools supported healthy populations of several thousand *Mimulus suksdorfii* (Suksdorf's Monkey-flower) and *Loeflingia squarrosa* var. *squarrosa* (Sagebrush loeflingia) plants. The area was far from current development; however, an old road did cross through the largest vernal pool. The cluster of three pools on the eastern end of Gable Mountain was the least pristine of the three sets of vernal pools. These weedy, intermittently filled pools supported a population of several hundred *Mimulus suksdorfii* (Suksdorf's Monkey-flower) plants. The aggressive weed *Centaurea solstitialis* (Yellow Starthistle) posed a serious threat to the native plants at these pools (TNC 1998). Because these vernal pools are systems of significant quality, good management practices would include careful monitoring for invasive species. Immediate management action would be needed to stop invasive plants, if detected.

An alkaline spring and marshy area was found in a large shallow basin at the east end of Umtanum Ridge. This previously unknown spring did not appear to have been significantly damaged by past grazing. It is perhaps the only spring of its kind on the Hanford Site. This spring supports a population of *Castilleja exilis* (Foothill Indian Paintbrush) and other alkalitolerant plant species. There also were a number of weedy species present that could threaten the persistence of native plant species at the spring. The alkaline spring, as well as the vernal pool clusters, are considered to be special habitat areas (TNC 1998).

West Lake and its adjacent wetlands also were surveyed during the 1997 field season. A highly alkaline lake, West Lake results from an artificially elevated rise in the water table due to historic waste management practices on Hanford's central plateau (Cushing 1994). There also was evidence of significant groundwater changes in the area, probably due to recent changes in waste management activities that have reduced groundwater discharges on the central plateau. Native plant communities at West Lake appeared to be substantially degraded (TNC 1998). A historic siting of *Castilleja exilis* and many other species for the Hanford Site that had been documented at West Lake in the past (Sackschewsky et al. 1992) were not located during the 1997 survey. Much of the lake basin was invested with weedy species, primarily Bassia hyssopifolia (smotherweed).

Other than rivers and springs, there are no naturally occurring bodies of surface water adjacent to the Hanford Site. However, there are artificial wetlands (caused by irrigation) exist on the east and west sides of the Wahluke Slope portion of the Hanford Site, which lies north of the Columbia River. Hatcheries and canals associated with the Columbia Basin Irrigation Project constitute the only other artificial surface water expressions in the area. The Ringold Hatchery, located just south of the Hanford Site boundary on the east side of the Columbia River (northeast of the 300 Area), is the only local fish hatchery. In addition to the public hatchery, the Yakama Nation raised several species of fish in settling pools in the 100-K Area as part of an experimental program.

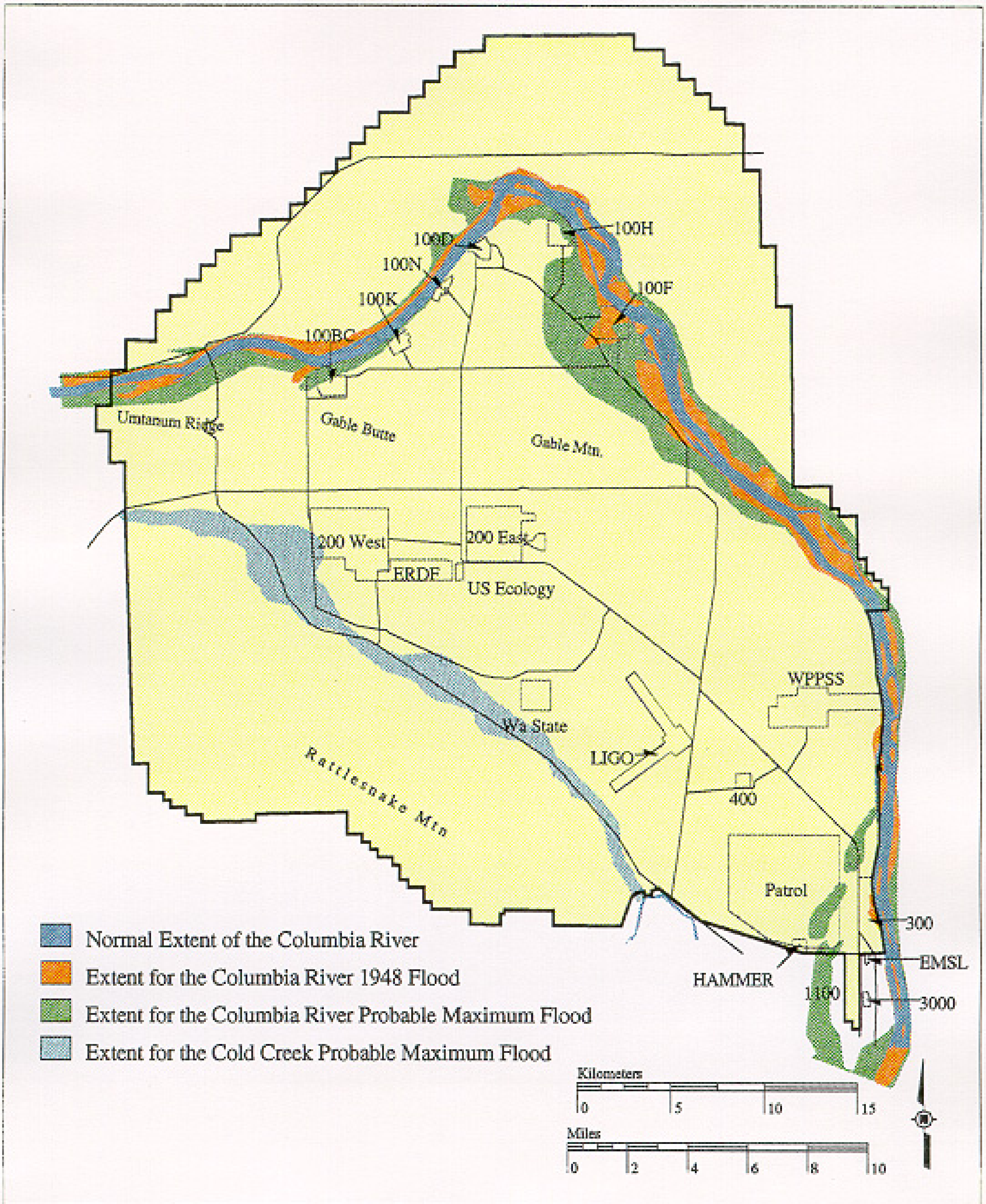
Total estimated precipitation over the Pasco Basin is about 9×10^8 m^3 (3.2×10^{10} ft^3) annually, averaging less than 20 cm/yr (approximately 8 in./yr). Mean annual runoff from the Pasco Basin is estimated at less than 3.1×10^7 m^3/yr (1.1 x 10 ft^3/yr), or approximately 3 percent of the total precipitation. The basin-wide runoff coefficient is zero for all practical purposes. The remaining precipitation is assumed to be lost through evapotranspiration, with less than 1 percent recharging the groundwater system. Precipitation contributes recharge to the groundwater in areas where soils are coarse-textured and bare of vegetation (PNNL 1996a).

4.3.1.1 Flooding. Large Columbia River floods have occurred in the past, but the likelihood of recurrence of large-scale flooding has been reduced by the construction of several flood control and water storage dams upstream of the Hanford Site. Major floods on the Columbia River typically result from rapid melting of the winter snowpack over a wide area, augmented by above-normal precipitation. The maximum historical flood on record occurred June 7, 1894, with a peak discharge at the Hanford Site of 21,000 m^3/s (742,000 ft^3/s). The largest recent flood took place in 1948, with an observed peak discharge of 20,000 m^3/s (706,280 ft^3/s) at the Hanford Site (PNNL 1996a). The exceptionally high runoff during the spring of 1996 resulted in a maximum discharge of nearly 11,750 m^3/s (415,000 ft^3/s) (DART 1998). The floodplain associated with the 1948 flood is shown in Figure 4-11 (see text box, *"Hanford Site Quick Facts: Columbia River Floods"*).

Hanford Site Quick Facts: Columbia River Floods

- Largest flood on record: 1894 at 21,000 m^3/s
- Largest recent flood: 1948 at 20,000 m^3/s
- Probable maximum flood: 40,000 m^3/s

Figure 4-11. Probable Maximum Flood of the Columbia River and Cold Creek, and the Actual 1948 Flood of the Columbia River (adapted from PNNL 1996a).



The Federal Emergency Management Agency has not prepared floodplain maps for the Hanford Reach because they only prepare maps for areas that are being developed (a criterion that specifically excludes the Hanford Reach).

Evaluation of flood potential is conducted, in part, through the concept of the probable maximum flood, which is determined from the upper limit of precipitation falling on a drainage area and other hydrologic factors (e.g., antecedent moisture conditions, snowmelt, and tributary conditions) that could result in maximum runoff. The probable maximum flood for the Columbia River below the Priest Rapids Dam has been calculated at 40,000 m^3/s (1.4 million ft^3/s) (see Figure 4-11) and is greater than the 500-year flood. This flood would inundate some portions of the 100 Area that are located adjacent to the Columbia River; but the central portion of the Hanford Site would remain unaffected (PNNL 1996a). Floodplain issues are further discussed in Appendix C.

The USACE has derived the Standard Project Flood with both dam-regulated and unregulated peak discharges given for the Columbia River below Priest Rapids Dam (PNNL 1996a). The regulated Standard Project Flood for this portion of the river is given as 15,200 m^3/s (540,000 ft^3/s), and the 100-year regulated flood as 12,400 m^3/s (440,000 ft^3/s).

Potential dam failures on the Columbia River have been evaluated (PNNL 1996a). Upstream failures could arise from a number of causes, with the magnitude of the resulting flood depending on the degree of breaching at the dam. The USACE evaluated a number of scenarios for failure of the Grand Coulee Dam, assuming flow conditions of 11,000 m^3/s (400,000 ft^3/s). For purposes of emergency planning, they hypothesized that 25 and 50 percent breaches (the instantaneous disappearance of 25 or 50 percent of the center section of the dam) would result from the detonation of nuclear explosives in sabotage or war. The discharge or floodwave from such an instantaneous 50 percent breach at the outfall of the Grand Coulee Dam was determined to be 600,000 m^3/s (21 million ft^3/s). In addition to the areas inundated by the probable maximum flood, the remainder of the 100 Areas, the 300 Area, and nearly all of Richland, Washington, would be flooded (PNNL 1996).

Determinations were not made for (1) failures of dams upstream, (2) associated failures downstream of Grand Coulee, or (3) breaches greater than 50 percent of Grand Coulee, because the 50 percent scenario was believed to represent the largest realistically conceivable flow that could result from a natural or human-induced breach; that is, it was not considered credible that a structure as large as the Grand Coulee Dam would be 100 percent destroyed instantaneously. The analysis also assumed that the 50 percent breach would occur only as the result of direct explosive detonation, not because of a natural event (i.e., an earthquake), and that even a 50 percent breach under these conditions would indicate an emergency situation in which other overriding major concerns might be present.

The possibility of a landslide resulting in river blockage and flooding along the Columbia River also has been examined for an area bordering the east side of the river upstream from the City of Richland (PNNL 1996a). The possible landslide area considered was the 75-m (250-ft)-high bluff (generally known as White Bluffs). Calculations were made for an 8×10^5 m^3 (1×10^6 yd^3) landslide volume with a concurrent flood flow of 17,000 m^3/s (600,000 ft^3/s) (a 200-year flood) that results in a flood wave crest elevation of 122 m (400 ft) above mean sea level. Areas inundated upstream from such a landslide event would be similar to a 50 percent breach of the Grand Coulee Dam. A flood-risk analysis of Cold Creek was conducted in 1980 as part of the characterization of a geologic repository for high-level radioactive waste. This design work evaluated the probable maximum flood rather than the worst-case and/or 100-year flood scenarios. Therefore, in lieu of 100- and 500-year floodplain studies, a probable maximum flood evaluation was made for a reference repository located directly west of the 200 East Area that encompasses the 200 West Area (PNNL 1996a). Figure 4-11 identifies the extent of this probable maximum flood.

4.3.1.2 Surface Water Quality. The Washington State Department of Ecology (Ecology) classifies the Columbia River, from Grand Coulee to the Washington-Oregon border, which includes the Hanford Reach, as Class A (excellent) (PNNL 1996a). Class A waters are suitable for essentially all uses, including raw drinking water, recreation, and wildlife habitat. Federal and state drinking water standards, as well as DOE Order 5400.5 (DOE 1993a), apply to the Columbia River and are currently being met.

Pacific Northwest National Laboratory (PNNL) conducts routine monitoring (for both radiological and nonradiological water quality parameters) of the Columbia River. A yearly summary of these monitoring results has been published since 1973 (PNNL 1996b). Numerous water quality studies have been conducted on the Columbia River during the past 37 years. Three outfalls, located in the 100-K, 100-N, and 300 Areas of the Hanford Site, are covered by a National Pollutant Discharge Elimination System Permit (Permit No. WA-000374-3). These discharge locations are monitored for various measures of water quality, including nonradioactive and radioactive pollutants. The estimated dose from radionuclide releases is presented in environmental reports such as the *Hanford Site Environmental Report for Calendar Year 1996* (PNNL 1997a). In 1994, monitored liquid discharges resulted in a dose of 0.016 mrem to the downstream maximally exposed individual (PNL 1995).

Radiological monitoring of the Columbia River continues to show low levels of radionuclides. Although radionuclides associated with Hanford Site operations continued to be identified in Columbia River water in 1994, concentrations remained well below applicable standards at all monitored locations (PNL 1995). In 1995, tritium, iodine-129, and uranium concentrations downstream of the Hanford Site were found to be slightly higher than upstream concentrations, but these concentrations were well below guidelines established by DOE through DOE Order 5400.5 (DOE 1993a) and the U.S. Environmental Protection Agency (EPA) drinking water standards (Table 4-2). In 1995, the average annual strontium-90 and technetium-99 concentrations were essentially the same at Priest Rapids Dam (upstream of the Hanford Site) and at the Richland pump house (PNNL 1996b).

Total alpha and beta measurements are useful indicators of the general radiological quality of the river that provide an early indication of changes in radioactive contamination levels because results are obtained quickly. Total alpha and beta measurements for 1996 were similar to the previous year, and were approximately 5 percent or less of the applicable drinking water standards of 15 and 50 pCi/L, respectively. Tritium measured at the Richland pump house was significantly higher than at Vernita Bridge, but continued to be well beyond the state and Federal drinking water standards (Dirkes 1997). The presence of a ^{3}H concentration gradient at the Richland pump house supports previous conclusions made by Backman (1962) and Dirkes (1993) that contaminants in the 200 Area groundwater plume entering the Columbia River at and upstream of the 300 Area are not completely mixed by the time the river reaches the Richland pump house.

Table 4-2. Annual (1995) Average Concentrations of Radionuclides in the Columbia River (adapted from PNNL 1996b).

Radionuclides	Water Concentrations (pCi/L)			Downstream Concentration as Percentage of Drinking Water Standard
	Upstream Concentration (Priest Rapids Dam)	Downstream Concentration (Richland Pump House)	EPA Drinking Water Standard	
H-3	34	79	20,000	0.40
Sr-90	0.08	0.09	8.0	1.1
U	0.40	0.50	20.0 (ug/L)[a]	2.5
Tc-99	ND	0.06	900	--
I-129	3.6×10^{-6}	5.7×10^{-5}	0.48	0.01

[a] Proposed
ND = Not *Detected*.

For nonradiological water quality parameters measured in Columbia River water during 1995, concentrations of metals and anions were similar upstream and downstream and were found to be in compliance with applicable primary drinking water standards. Concentrations of volatile organic compounds (VOCs) also were below regulatory standards (PNNL 1996b).

4.3.2 Groundwater

The following sections describe the groundwater resources at the Hanford Site. Groundwater under the Hanford Site occurs under unconfined and confined conditions. The uppermost aquifer beneath most of the Hanford Site is unconfined and is composed of unconsolidated to semi-consolidated sediments deposited on the basalt bedrock. In some areas, deeper parts of the aquifer are locally confined by layers of silt and clay. Groundwater in the unconfined aquifer systems generally moves from recharge areas along the western boundary of the Hanford Site to the east and north toward the Columbia River, which is the major discharge area. This natural flow pattern was altered by the formation of groundwater mounds created by the discharge of large volumes of wastewater at disposal facilities. These mounds are declining, however, and groundwater flow is gradually returning to earlier patterns.

The confined aquifers consist of sedimentary interbeds and/or interflow zones that occur between dense basalt flows in the Columbia River Basalt group. The main water-bearing portions of the interflow zones occur within a network of interconnecting vesicles and fractures of the basalt flow tops or flow bottoms. Figure 4-6 presents a generalized subsurface cross-section of the Hanford Site.

4.3.2.1 Groundwater Hydrology. The multi-aquifer system within the Pasco Basin has been conceptualized as consisting of four geohydrologic units: (1) Grande Ronde Basalt, (2) Wanapum Basalt, (3) Saddle Mountain Basalt, and (4) Hanford and Ringold formation sediments lying above the basalt units (see Figure 4-5). Geohydrologic units older than the Grande Ronde Basalt probably are of minor importance to the regional hydrologic dynamics and system. Together, the Grande Ronde, Wanapum, Saddle Mountains, and Imnaha Basalts compose the Columbia River Basalt group.

The Grande Ronde Basalt is the most voluminous and widely spread formation within the Columbia River Basalt group and has a thickness of at least 2,745 m (9,000 ft). The Grande Ronde Basalt is composed of the basalt flows and minor intercalated sediments that are equivalent to or part of the Ellensburg Formation (DOE 1988a). More than 50 flows of Grande Ronde Basalt underlie the Pasco Basin, but little is known of the lower 2,200 to 2,500 m (7,216 to 8,200 ft). Groundwater in these basalts is confined to semi-confined and is recharged along the margins of the Columbia Plateau where the basalt is at, or close to, the land surface and by surface-water and groundwater inflow from lands adjoining the plateau. Vertical movement into and out of this system is known to occur. Groundwater within the Grande Ronde Basalt in the eastern Pasco Basin is believed to originate from groundwater inflow from the east and the northeast.

The Wanapum Basalt consists of basalt flows intercalated with minor and discontinuous sedimentary interbeds of the Ellensburg Formation or equivalent sediments. In the Pasco Basin, the Wanapum Basalt consists of three members, each consisting of multiple flows. The Wanapum Basalt underlies the entire Pasco Basin and has a maximum thickness of 370 m (1,215 ft). Groundwater within the Wanapum Basalt is confined to semi-confined.

The Saddle Mountain Basalt is composed of the youngest formation of the Columbia River Basalt group and several thick sedimentary beds of the Ellensburg Formation or equivalent sediments, which comprise up to 25 percent of the unit. Within the Pasco Basin, the Saddle Mountain Basalt contains seven members, each with one or more flows. This Saddle Mountain Basalt underlies most of the Pasco Basin, attaining a thickness of about 290 m (950 ft), but is absent along the northwest part of the basin and along some anticlinal ridges. Groundwater in the Saddle Mountain Basalt is confined to semi-confined, with recharge and discharge believed to be local (PNL 1991a).

The rock materials that overlie the basalts in the structural and topographic basins within the Columbia Plateau generally consist of Miocene-Pliocene sediments, volcanics, Pleistocene sediments (including those from catastrophic flooding), and Holocene sediments consisting mainly of alluvium and eolian deposits. The suprabasalt sediment (referred to as the Hanford/Ringold unit) consists principally of the Miocene-Pliocene Ringold Formation stream, lake, and alluvial materials, and the Pleistocene catastrophic flood deposits informally called the Hanford formation. Groundwater within the suprabasalt sediment is unconfined, with recharge and discharge usually coincident with topographic highs and lows (PNL 1991a). The Hanford/Ringold unit is restricted to the Pasco Basin; principal recharge occurs (along the periphery of the basin) from precipitation and ephemeral streams.

4.3.2.2 Groundwater Recharge. Little, if any, natural recharge occurs within the Hanford Site, but artificial recharge occurs from liquid waste disposal activities (PNNL 1996b) (Figure 4-12). Recharge from irrigation occurs east and north of the Columbia River and in the synclinal valleys west of the Hanford Site. Within the Pasco Basin, recharge occurs along the anticlinal ridges to the north and west and from groundwater inflow from the east and northeast. Sources of natural recharge to the unconfined aquifer are rainfall and runoff from the higher bordering elevations, water infiltrating from small ephemeral streams, and river water along influent reaches of the Yakima and Columbia rivers. To define the movement of water in the unsaturated (vadose) zone, the movement of precipitation through the vadose zone has been studied at several locations on the Hanford Site. Conclusions from these studies vary depending on the location studied.

From the recharge areas to the west, groundwater flows downgradient to the discharge areas, primarily along the Columbia River (Figure 4-13a and 4-13b). This general west-to-east flow pattern is interrupted locally by the groundwater mounds in the 200 East and 200 West Areas. From the 200 East and 200 West Areas, a component of groundwater also flows to the north, between Gable Mountain and Gable Butte. These flow directions represent current conditions; the aquifer is dynamic, and responds to changes in natural and artificial recharge (see Figures 4-14 and 4-15, respectively).

Figure 4-12. Estimated Recharge from Infiltration of Precipitation and Irrigation on the Hanford Site.

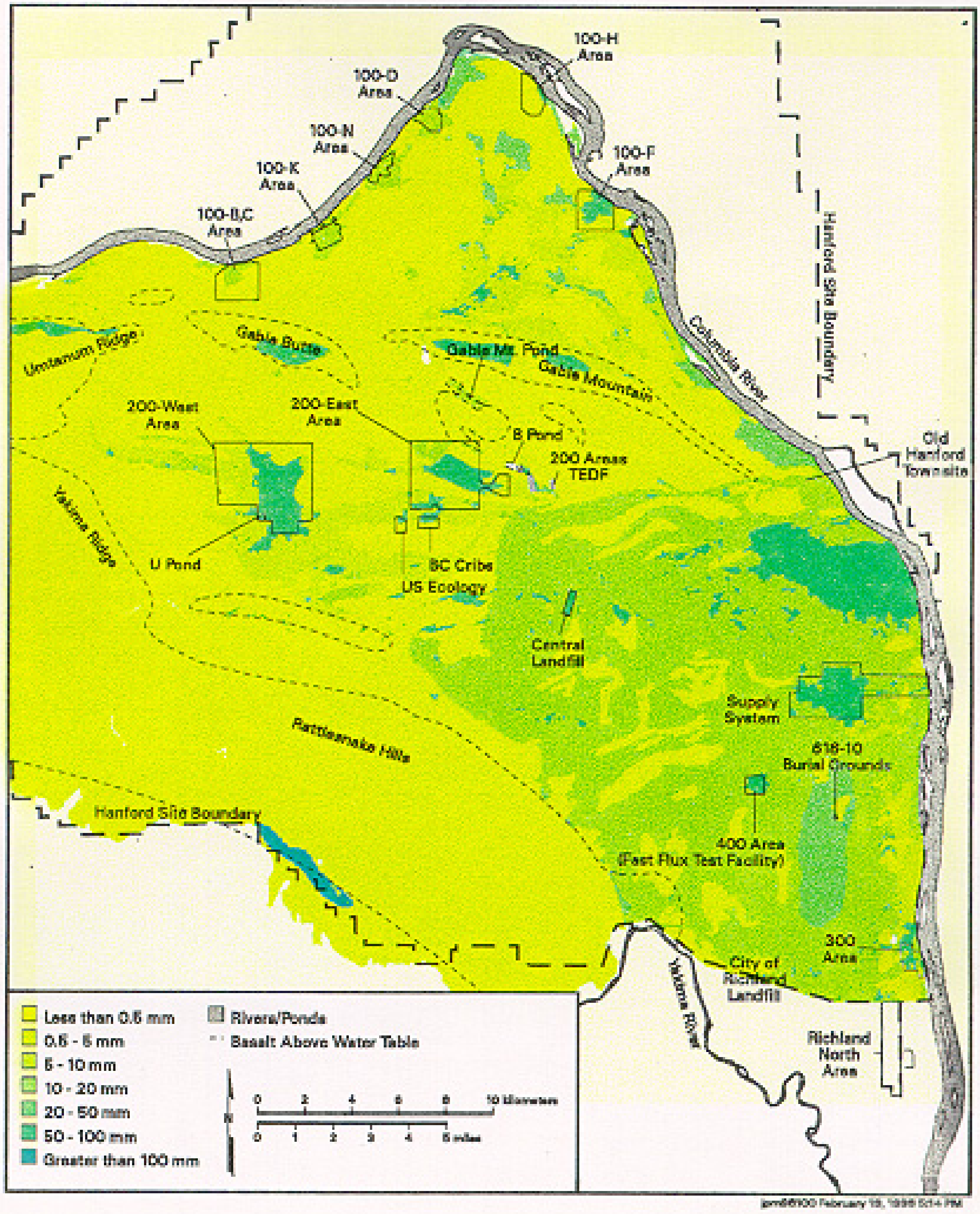


Figure 4-13a. Hanford Site and Outlying Areas Water Table Map -- June 1998 (PNNL 1998).

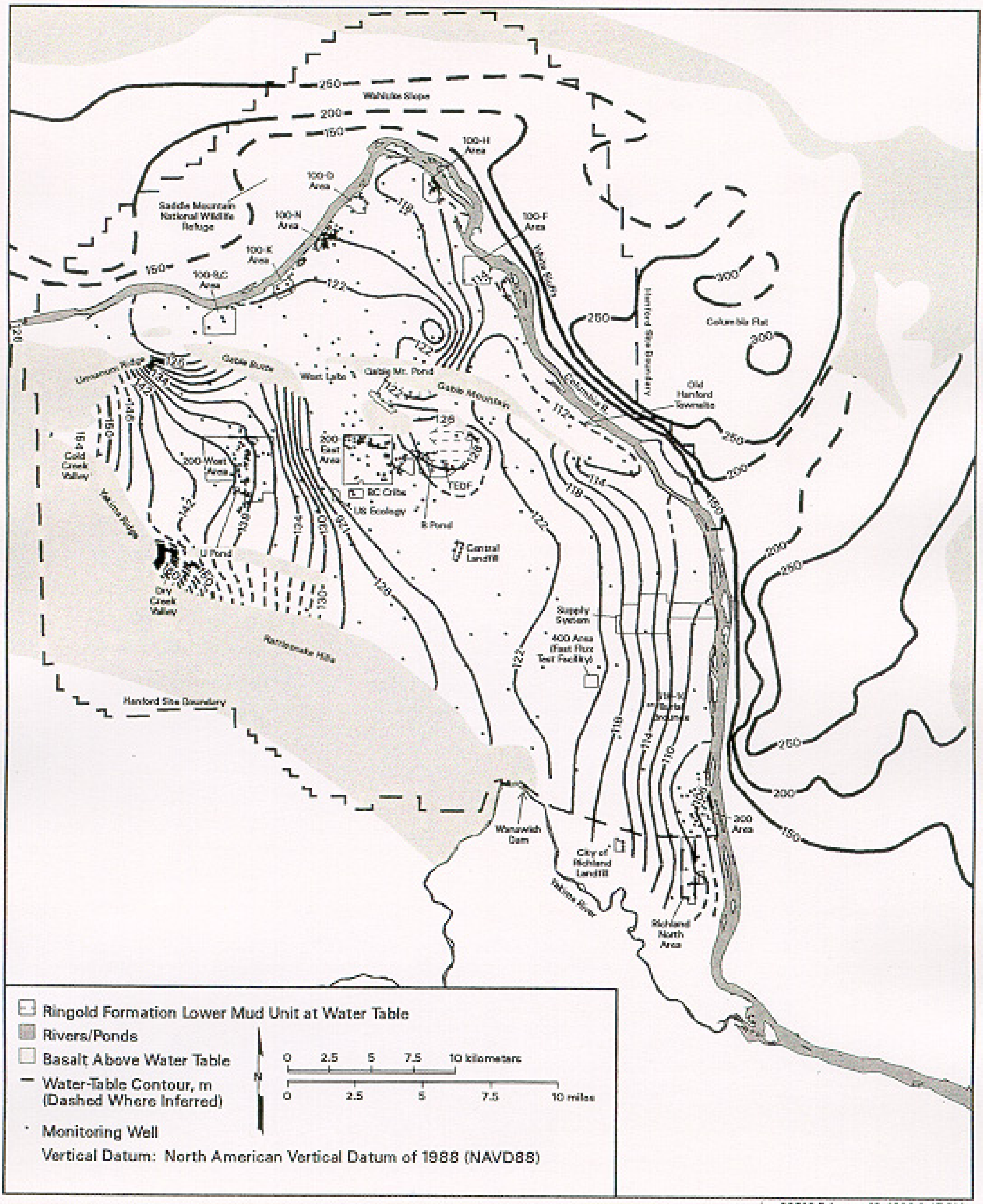


Figure 4-13b. Potentiometric Map of Upper Basalt-Confined Aquifer System -- June 1998 (PNNL 1998).

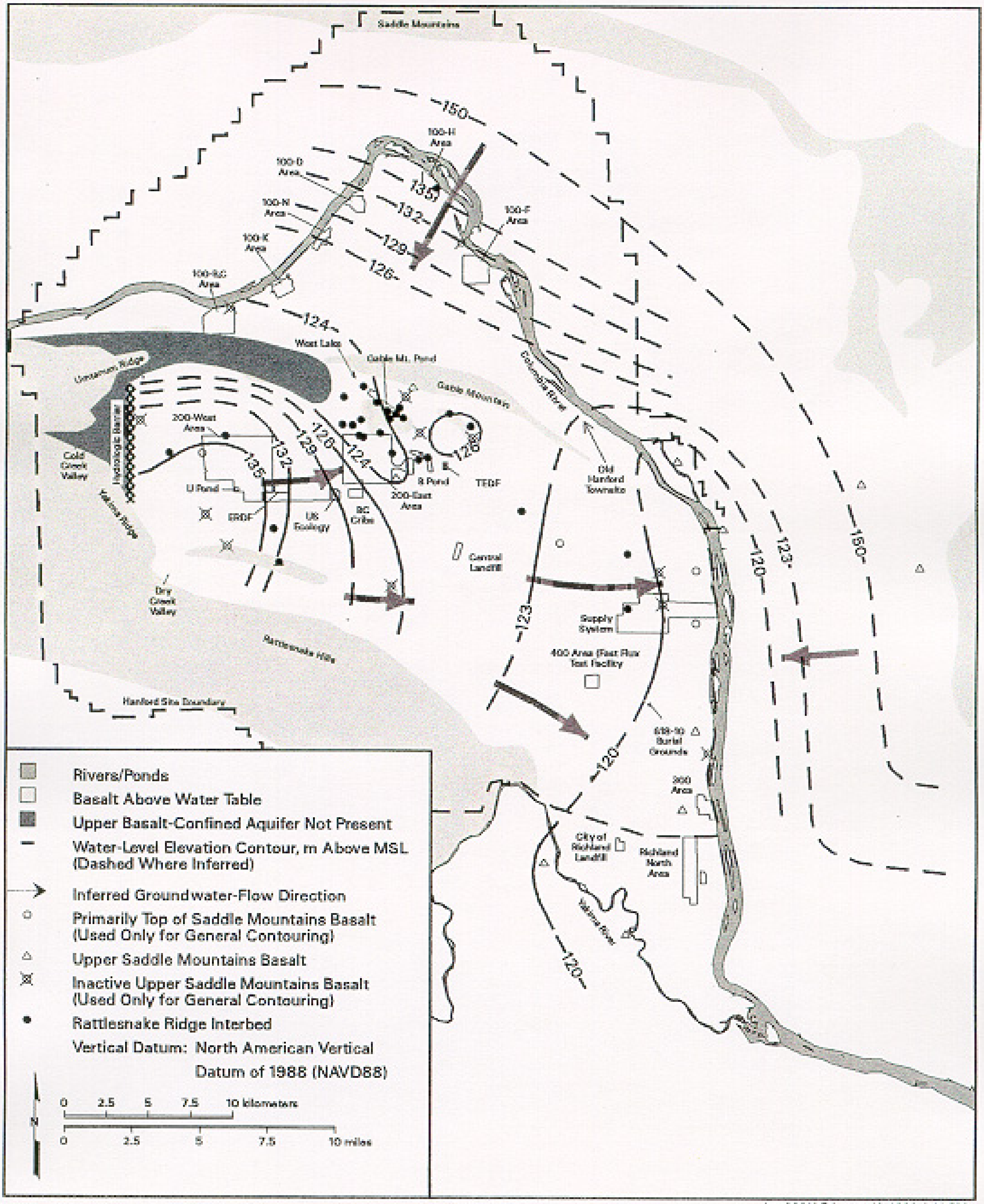


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Figure 4-14. Water Table Change Map for 1944 - 1979.

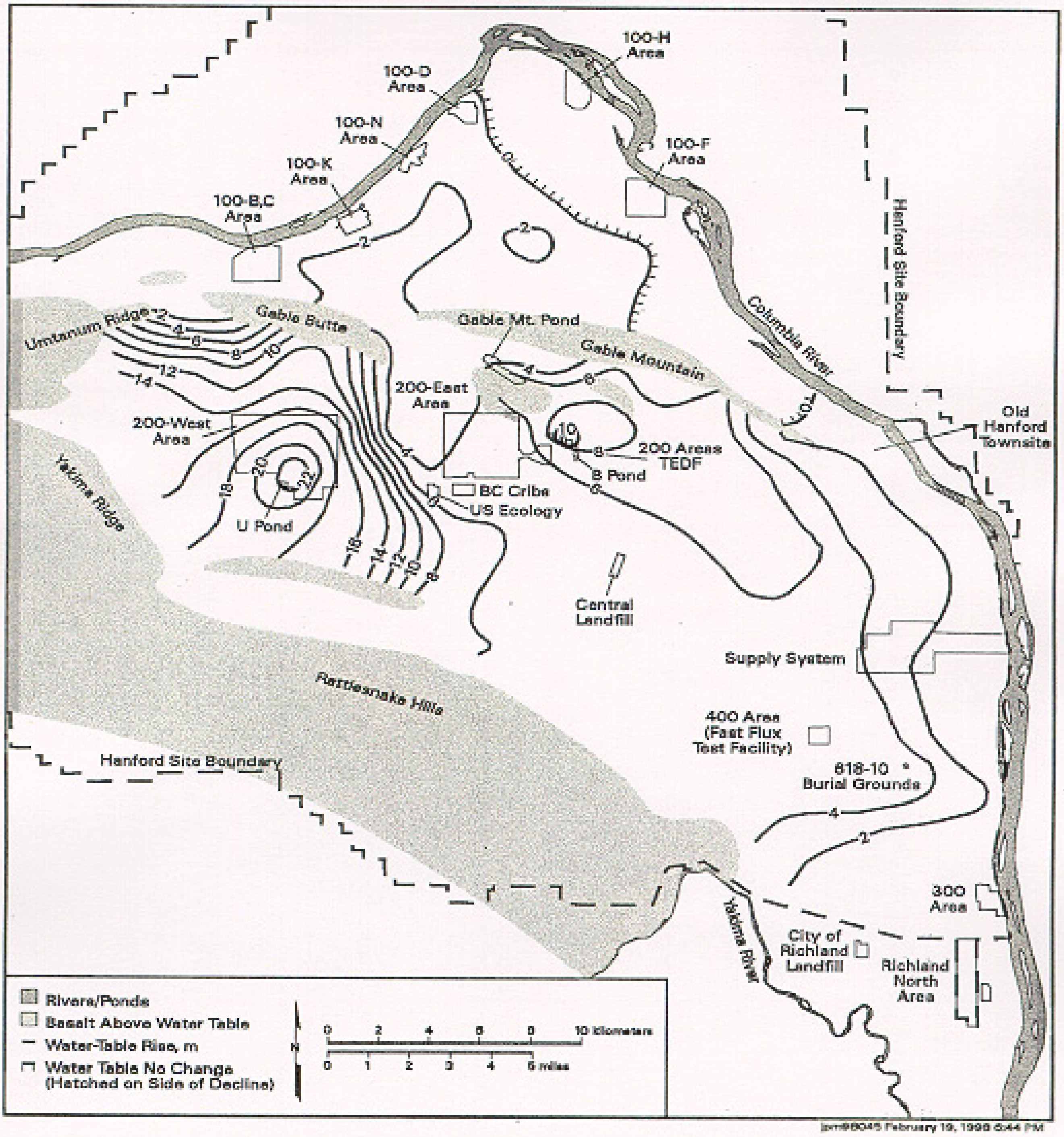
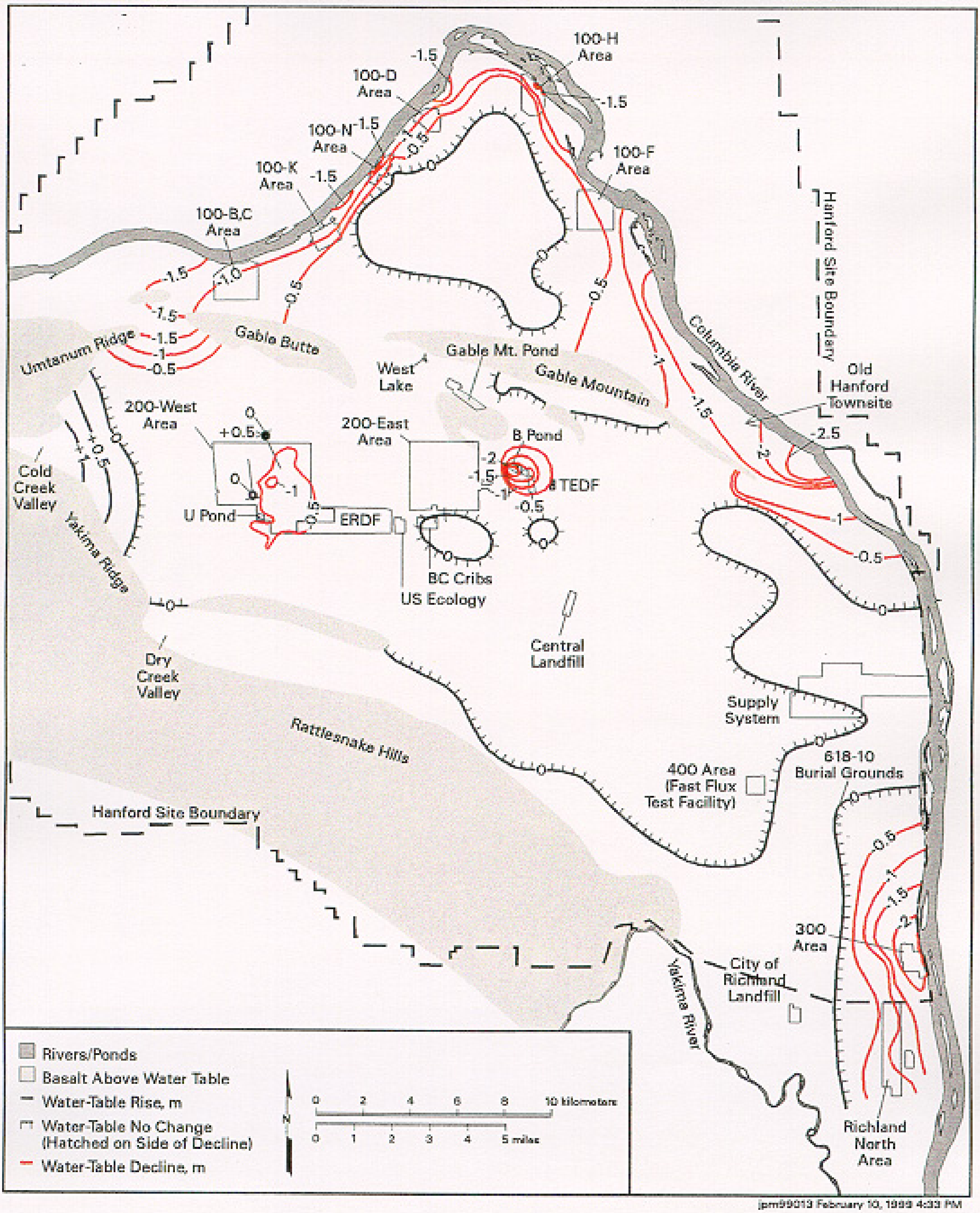


Figure 4-15. Water Table Change Map for 1997 - 1998.



Studies indicate that local recharge to the shallow basalts results from infiltration of precipitation and runoff along the margins of the Pasco Basin. Regional recharge of the deep basalts is thought to result from interbasin groundwater movement that originates northeast and northwest of the Pasco Basin in areas where the Wanapum and Grande Ronde Basalt outcrops are extensive (Neitzel 1997). Groundwater is discharged from the shallow basalt to the overlying unconfined aquifer and the Columbia River. In some cases, well bores may have allowed water movement between the unconfined aquifer and the confined aquifer.

The major recharge sources of the Hanford and Ringold formations are as follows: inflow from Dry Creek, which average 0.035 cm/s; inflow from Cold Creek, which averages 0.028 cm/s; and inflow around Rattlesnake Hills, which averages 0.032 cm/s.

4.3.2.3 Groundwater Quality. The quality of the groundwater at the Hanford Site has been affected by many of the activities related to the production of nuclear materials. Due to the arid climate, natural recharge of the groundwater on the Hanford Site is low. Artificial recharge has occurred in the past from the disposal of liquid waste associated with processing operations in the 100, 200, and 300 Areas, which created mounds of water underlying discharge points. Large areas underlying the Hanford Site have elevated levels of both radiological and nonradiological constituents. The liquid effluents discharged into the ground have carried with them a variety of radionuclides and chemicals that move through the soil column at differing rates, eventually entering the groundwater and forming plumes of contamination (see text box, *"Hanford Site Quick Facts: Principal Groundwater Contaminants"*).

Hanford Site Quick Facts: Principal Groundwater Contaminants

- chromium
- nitrate
- trichloroethylene
- fluoride
- carbon tetrachloride
- cyanide
- tetrachloroethylene
- chloroform
- cis-1, 2-dichloroethylene
- cobalt-60
- strontium-90
- tritium
- uranium
- cesium-137
- carbon-14
- iodine-129
- plutonium
- technetium-99

4.3.2.3.1 Unconfined Aquifer. As part of the continuing environmental monitoring program at the Hanford Site, groundwater monitoring reports are published in the *Hanford Site Environmental Report* (PNNL 1996b), and in the *Hanford Site Groundwater Monitoring Report* (PNNL 1998), which are issued each calendar year. The shallow, unconfined aquifer in the Pasco Basin and on the Hanford Site contains waters of a dilute (less than or approximately 350 mg/L total dissolved solids) calcium bicarbonate chemical type. Other principal constituents include sulfate, silica, magnesium, and nitrate. Variability in chemical composition exists within the unconfined aquifer because of natural variation in the composition of the geologic strata, and irrigation and other agricultural practices north, east, and west of the Hanford Site, and on the Hanford Site, because of liquid waste disposal.

The uppermost aquifer beneath most of the Hanford Site is unconfined and is composed of unconsolidated to semi-consolidated sediments deposited on the basalt bedrock. In some areas, deeper parts of the aquifer are locally confined by layers of silt and clay. Confined aquifers occur within the underlying basalt flows and associated sedimentary interbeds. Groundwater in the unconfined aquifer system generally moves from recharge areas along the western boundary of the Site to the east and north toward the Columbia River, which is the major discharge area. This natural flow pattern was altered by the formation of groundwater mounds created by the discharge of large volumes of wastewater at disposal facilities. These mounds are declining, and groundwater flow is gradually returning to earlier patterns.

Water levels are monitored across the Hanford Site and to the east and north of the Columbia River. The purpose of these measurements is to monitor changes in the water table elevations that affect the direction and velocity of groundwater flow and transport of contaminants, and to assess impacts of the changes on monitoring networks. A Site water table map for June

1998 was constructed and used to infer groundwater-flow directions (see Figure 4-13). Water levels over most of the Site declined during fiscal year 1998, continuing the trend caused by reduction in liquid effluent disposal. Water levels are also measured in wells completed in the upper basalt-confined aquifer. Several areas showed declines in the confined-aquifer potentiometric surface associated with declines in the water table of the overlying unconfined aquifer (PNNL 1998).

Radioactive and nonradioactive liquid effluents were discharged to the environment from facilities in the 100 and 300 Areas, as well as facilities in the Central Plateau (PNNL 1996b). Contamination of the groundwater exceeds drinking water standards in more than 220 km^2 (85 mi^2) of the Hanford Site. The U.S. Department of Energy, Richland Operations Office (RL) has committed to implement the best available technology and all known and reasonable methods of prevention, control, and treatment for several of the effluent streams, and to obtain permits for the waste streams under the "State Waste Water Discharge Permit Program," *Washington Administrative Code* (WAC) 173-216. The goal associated with the use of best available technology is to eliminate, minimize, or treat effluents discharged to the ground.

4.3.2.3.2 Confined Aquifer. The uppermost confined aquifer (Rattlesnake Ridge) was sampled to determine what extent of groundwater contamination occurred from interaction between the confined and unconfined aquifers. Groundwater samples from selected confined aquifer wells were analyzed for a variety of radionuclides and hazardous chemicals. In most cases, no indication of contamination was observed. Detection of radionuclides in well 299-E33-12 (the Central Plateau) was attributed to contamination by high-salt waste that migrated by density flow into the borehole when it was open to both the unconfined and the confined aquifer during drilling (PNNL 1996b). The 1995 samples from well 299-E33-12 contained up to 458 pCi/L of tritium, similar to levels detected since 1982. The 1995 samples from this well also contained cobalt-60 at levels up to 31.4 pCi/L, nitrate at levels up to 11 mg/L, technetium-99 at levels up to 1,560 pCi/L, and cyanide at levels up to 20.7 µg/L. Although all of these constituents are indicators of contamination, only nitrate and technetium-99 were detected at levels greater than drinking water standards.

The upper basalt-confined aquifer system is defined as the groundwater occurring within basalt fractures and joints, interflow contacts, and intercalated sedimentary interbeds within the upper Saddle Mountains Basalt. The thickest and most widespread sedimentary unit is the Rattlesnake Ridge Interbed. Groundwater is confined by the dense, low-permeability, interior portions of basalt flows and by Ringold Formation silt and clay units overlying the basalts.

In 1993, hydraulic head distribution and flow dynamics of the upper basalt-confined aquifer system were evaluated and reported in PNL-8869, which identified the following prominent hydrologic features:

- A broad recharge mound extending northeastward from Yakima Ridge in the 200 West Area

- A small recharge mound (now subsiding) immediately east of the 200 East Area in the vicinity of B Pond

- A subsurface hydrogeologic barrier (i.e., an impediment to groundwater flow), believed to be related to faulting, near the mouth of Cold Creek Valley

- A region of low hydraulic head (potential discharge) in the Umtanum Ridge-Gable Mountain structural area

- A region of high hydraulic head to the north and east of the Columbia River associated with recharge attributed to agricultural activities.

Recharge to the upper basalt-confined aquifer system is believed to result from precipitation and surface water infiltration where the basalt and interbeds are exposed at ground surface. Recharge also may occur through the unconfined aquifer system where a downward hydraulic gradient exists between the unconfined and upper basalt-confined aquifers. Hydraulic communication with overlying and underlying aquifers is believed to cause the region of low hydraulic head found in the Umtanum Ridge-Gable Mountain structural area (these relationships are given in more detail in PNL-8869). Maps of the upper basalt-confined and unconfined aquifer potentiometric surfaces indicate that a downward hydraulic gradient from the unconfined aquifer to the upper basalt-confined aquifer occurs in the western portion of the Hanford Site, in the vicinity of the B Pond recharge mound, as well as in the regions north and east of the Columbia River (see PNL-6313, PNL-8869, PNL-10082, PNNL-11470, PNNL-12067, WHC-EP-0142-3, WHC-EP-0142-4, and WHC-EP-0394-3). In the vicinity of B Pond, however, a recent acceleration in head decline within the unconfined aquifer system may soon lead to a reversal in the vertical hydraulic gradient between the unconfined and upper basalt-confined aquifer systems in this region. In other areas of the Hanford Site, the hydraulic gradient is upward from the upper basalt-confined aquifer to the unconfined aquifer system.

Figure 4-13b, constructed by manual contouring, presents a regional approximation of the potentiometric surface for the upper basalt-confined aquifer system based on water-level measurements taken during June 1998. Measurements in the Rattlesnake Ridge Interbed were primarily used to construct this map, though additional measurements in the upper Saddle Mountains Basalt were used for general contouring. The datum used was NAVD88, which is approximately 1 m higher than the NGVD29 datum used in previous versions of this map (e.g., PNL-8869, PNL-10817, and PNNL-11793).

With some exceptions, the major potentiometric map features shown in Figure 4-13b are nearly the same as those exhibited for 1996, as reported in Section 5.5 of PNNL-11470 and Section 3.10 of PNNL-11793. The potentiometric map indicates that, south of the Umtanum Ridge-Gable Mountain structural area, groundwater flows from west to east across the Site toward the Columbia River, which represents the regional discharge area for groundwater-flow systems. In the region northeast of Gable Mountain, the potentiometric contours suggest that groundwater flows southwest and discharges primarily to underlying confined aquifer systems in the Umtanum Ridge-Gable Mountain structural area (PNL-8869). This increased hydraulic head region is associated with recharge from agricultural activities north and east of the Columbia River and has been observed for deeper, confined aquifer systems. Therefore, the Columbia River does not represent a major discharge area for upper basalt-confined groundwater in the northern portion of the Hanford Site.

Water levels in almost all wells monitoring the upper basalt-confined aquifer system declined from June 1997 to June 1998. The greatest declines occurred near the B Pond (well 699-42-40C) and in the eastern portion of the site (wells 699-26-15C and 699-42-E9B). However, water levels in well 699-42-E9B are known to be affected by stage fluctuations in the Columbia River. The river stage was higher than normal during 1996 and 1997 but returned to normal during 1998, thus accounting for the water-level decline in well 699-42-E9B. For this reason, short-term water-level fluctuations in this well and in other wells near the river (i.e., wells 199-H4-2 and 399-5-2) mask long-term trends in the upper basalt-confined aquifer system. Water levels in confined aquifer wells near the northern boundary of the 200 East Area and immediately east of the 200 East Area near B Pond continue to show a decline, falling in the range of approximately 0.1 to 0.7 m from June 1997 to June 1998. Water levels in confined aquifer wells near the 200 West Area also continue to show a decline of approximately 0.1 to 0.4 m/yr. Water levels in wells located between Gable Mountain and the northern boundary of the

200 East Area fell approximately 0.1 to 0.3 m from June 1997 to June 1998. These declines are a response to curtailed effluent-disposal activities in the 200 Areas and are consistent with water-level declines in the overlying unconfined aquifer system.

4.3.2.4 Vadose Zone. The vadose zone is the area between the land surface and the top of the groundwater table. The vadose zone represents the pathway for contaminants to the groundwater for surface and near-surface releases, leaks, and spills of contaminated liquids. The length of time it takes contaminated material to travel through the vadose zone depends on a number of factors including: (1) the depth to the groundwater, (2) characteristics of vadose zone sediment, and (3) chemical interaction of the contaminated material with the soil and subsoil.

Historically, radioactive contamination was released into the vadose zone sediment (the unsaturated sediment between the ground surface and the top of the unconfined groundwater aquifer) at Hanford from several hundred effluent discharge sites (e.g., cribs and ditches) and from leaks and spills from single-shell radioactive waste tanks. These releases, leaks, and spills represent the largest quantity of radioactive contamination released to the environment from Hanford operations (Dirkes and Hanf 1997).

Soil vapor extraction continued in the 200-ZP-2 Operable Unit as a CERCLA expedited response action to remove the carbon tetrachloride source from the vadose zone. The mix of extraction wells was changed periodically during fiscal year 1998 to improve performance based on a 1997 rebound study. In fiscal year 1998, 777 kg (1,717 lbs.) of carbon tetrachloride were removed, resulting in a total of 75,490 kg (166,455 lbs) since remediation began in 1992 (PNNL1998).

In 1998, results from 1997 spectral gamma logging of boreholes surrounding the B-BX-BY single-shell tank farm in the 200 East Area became available. The logging was to detect changes in the distribution of man-made radionuclides in the sediments associated with liquid waste disposal facilities adjacent to the tank farm. Spectral gamma logging also was performed at boreholes around the Plutonium Finishing Plant liquid disposal facilities to ascertain any changes in subsurface radionuclide distribution since last logging. Also, baseline characterization logging of all drywells in the BX, C, S, and TY tank farms was completed and the results reported in 1998. In addition, 10 new groundwater-monitoring wells were installed and logged by spectral gamma-ray methods. Historical gross gamma logs from boreholes near the SX, BX, BY, and TY tank farms were analyzed to locate mobile radionuclides.

Directional well drilling was tested at two sites. The holes were completed, but boulder gravels at one site presented difficulties in drilling and sampling. Control of drilling fluids also presented an obstacle that must be overcome before using this technique to address vadose zone contamination.

Sediment samples from new vadose-zone or groundwater wells were collected and analyzed for contaminants and physical properties. A vadose-zone borehole near the SX tank farm was extended to groundwater and sediments were analyzed for radionuclides. Cesium-137 contamination decreased with depth and was undetectable at the water table (PNNL 1998).

4.3.2.4.1 Surface Disposal. Radioactive and hazardous waste disposed to the soil column have been the dominant contributor to groundwater contamination at Hanford. Even though disposal of untreated waste water stopped in 1995, movement of contaminant in the soil column beneath historical effluent disposal sites still occurs. Large volumes (1,600 billion L [426 billion gal]) of low-level liquid waste were discharged to surface ponds and ditches. In addition 53 billion L (14 billion gal) of low- and intermediate-level liquid waste were discharged to the subsurface in reverse wells, french drains, cribs, and tile fields (PNNL 1997b).

Early in the Hanford Site's production history, when the bismuth phosphate process was used, the radioactive supernatant from the tanks was discharged directly to soil-column disposal sites. As a result, over 450 million L (120 million gal) of high-level radioactive liquid wastes were discharged to the vadose zone via cribs, trenches, and french drains. Although this disposal practice was terminated over 30 years ago, the residual liquid held in the soil-pore spaces can continue to be a long-term source of groundwater contamination, especially if a source of moisture is available to transport the mobile waste constituents. Some of these sources of moisture include enhanced infiltration from the coarse gravel covering, removal of vegetation, and leaking water lines (Dirkes and Hanf 1998).

4.3.2.4.2 Tank Farms. Contamination was released to the near-surface and subsurface sediment at Hanford Site tank farms as the result of tank leaks, spills, or radioactive effluents on the ground surface, as well as pipe leaks and airborne releases of particulate matter through tank ventilation and access ports. Of the 149 single-shell, and 28 double-shell tanks, 67 single-shell tanks are known or assumed to leak. The estimated volume to date of radioactive waste leakage from single-shell tanks is 2.3 million to 3.5 million L (600,000 to 900,000 gal). A Los Alamos study in 1998 used historical information and new leak models to better define the volume, chemical composition, and radioactive components of leaks from tanks SX-108, SX-109, SX-111, and SX-112. The study estimated that past leaks from the four single-shell tanks likely total between 757,000 and 1,514,00 L (200,000 and 400,000 gal)– about six times more that previous estimates. has recently been reassessed. Airborne releases and surface spills created contaminated plumes in the vadose zone that are generally confined to the near-surface regime, but in some cases surface contamination is known to have migrated deeper into the vadose zone. Pipeline leaks have also occurred either near the ground surface or at a maximum depth of 6 m (20 ft). In some cases, contamination from pipeline leaks has also migrated into the vadose zone; however, tank leaks created the deepest contamination plumes (Dirkes and Hanf 1998).

Spectral gamma log data show that cesium-137 is the most abundant and highly concentrated man-made radionuclide in the vadose zone of several of the tank farms. It was previously believed the cesium-137 was relatively immobile in the sediment and was not expected to migrate more than a few meters from the base of the tanks. In 1996, cesium-137 contamination was detected at relatively high concentrations deeper than expected (as deep as 73 m [240 ft]).

Cobalt-60 has also been detected but at a much lower concentration than cesium-137. Cobalt-60 has been found at depths of between 15 and 50 m (50 to 165 ft) and as trace amounts at depths close to the water table at 69 and 71 m (225 to 234 ft). Cobalt-60 was detected at a depth of 65 m (213 ft), immediately above the water table and within the capillary fringe. Some of the cobalt-60 contamination was detected below the Early Palouse/Plio-Pleistocene interval, which has been considered a barrier to downwardly migrating fluids and groundwater. Additional contaminants detected in the vadose zone as detected in monitoring wells include europium-154, antimony-125, uranium-235, uranium-238, potassium-40, and thorium-232 (Dirkes and Hanf 1998).

4.3.2.4.3 Plutonium Finishing Plant. The spent-process solutions from the Plutonium Finishing Plant contained carbon tetrachloride, nitric acid, and isotopes of plutonium and americium (transuranic waste). Liquid waste discharges to cribs and trenches in the Plutonium Finishing Plant area resulted in the accumulation of an estimated 20,000 Ci of plutonium-239 and americium-241 in the underlying soil column. Based on relative hazard, the Plutonium Finishing Plant’s cribs are some the most significant sources of radioactive contamination in the vadose zone at the Hanford Site.

Transuranic concentration in the soil of >100,000 pCi/g were found immediately beneath the tile fields to a depth of 6 m (20 ft). Transuranics were also found in sediment at depths of 20 to 30 m (66 to 98 ft). Although transuranics are normally expected to be retained in the first few meters of surface sediment, the combination of high acidity and the presence of complexants apparently allowed the transuranics at these sites to penetrate deeper into the soil column.

In addition to transuranics, between 1955 and 1973, the 200 West Area's cribs also received 570,000 to 920,000 kg (1.2 million to 2 million lb) of carbon tetrachloride. Carbon tetrachloride was discovered in the groundwater near the plant in the mid-1980s and was later found to be widespread in the 200 West Area. If left unchecked, the carbon-tetrachloride would significantly increase the extent of groundwater contamination because of vapor-phase transport through soil-pore space or by downward migration through the vadose zone as a dense nonaqueous-phase liquid or dissolved in natural recharge water.

Soil vapor extraction is being used to remove the carbon tetrachloride source from the vadose zone as part of the 200 West Area carbon tetrachloride expedited response action. Approximately 75,000 kg (165,000 lb) of carbon tetrachloride have been removed from the subsurface since extraction operations started in 1992 (Dirkes and Hanf 1998).

4.3.2.4.3 Other Liquid Waste Disposal Sites. Along the Columbia River in the vicinity of the now inactive and closed reactors, once-through cooling waters were routinely disposed into cribs and trenches. The disposed cooling water contained low levels of fission and neutron activation products and very low level of some chemicals and actinides. The biggest concern is the impacts of chromate, nitrate, strontium-90, and tritium to groundwater. Leakage from fuel-storage basins in the 100-K Area also contributes potentially significant inventories of fission products and transuranics to the soil column. Thus both historical waste disposal sites and fuel-storage basin leakage are potential vadose-zone sources (Dirkes and Hanf 1998).

4.3.2.4.4 Vadose Zone Monitoring**.** Two programs currently under way at Hanford characterize and monitor radionuclides in the vadose zone. One program focuses on vadose zone monitoring near single-shell radioactive waste tanks and the other involves monitoring near historical effluent disposal sites, which include cribs, ponds, ditches, injection wells, and french drains. Both programs were designed to characterize and monitor gamma-emitting radionuclides in the vadose zone and focused on establishing existing baseline conditions. Once a baseline is established for a particular tank or effluent discharge site, the facility can be monitored for either long-term or short-term changes. The intent of long-term monitoring is to detect changes over a 5- to 10-year period than can be used for predictive risk assessment. Short-term monitoring is used to identify recent changes in the vadose zone caused by current operations and tank leaks (PNNL 1997b).

In 1994, the tank farms vadose zone baseline characterization project was begun to perform an initial baseline characterization of the vadose zone gamma-emitting contamination at Hanford Site tank farms. Under the baseline characterization program, approximately 800 pre-existing monitoring boreholes surrounding the single-shell tanks are being logged with gamma-ray logging methods. Borehole logging is used to identify the locations and sizes of the contamination plumes. Once the baseline is established for a particular tank, that tank can be monitored over time (PNNL 1997b).

4.3.3 Water Use

Water use in the Pasco Basin is primarily from surface diversion, with groundwater diversions accounting for less than 10 percent of the total use (DOE 1988a). Historically, industrial, agricultural, and municipal usage represented about 32, 50, and 9 percent, respectively. Until recently, the Hanford Site used about 81 percent of the water withdrawn for industrial purposes. However, because of the N Reactor shutdown, and considering other data (PNL 1991a), these percentages now approximate 13 percent for industrial, 75 percent for agricultural, and 12 percent for municipal uses, with the Hanford Site accounting for about 41 percent of the water withdrawn for industrial use (DOE 1995e). The first downstream drinking water intake below the Hanford Site is the City of Richland intake.

The largest categories of wells in the Pasco Basin are those used for domestic purposes (approximately 50 percent). Agricultural wells, used for irrigation and stock supply, constitute the second-largest category of well use (about 24 percent for the Pasco Basin). Industrial users account for only about 3 percent of the wells (DOE 1995e).

Most of the water used by the Hanford Site is withdrawn from the Columbia River. The water distribution systems supplying river water are located at the 100-B, 100-D, 200, and 300 Areas at Energy Northwest (formerly known as WPPSS). In addition, wells supply water to the 400 Area and a variety of low-use facilities at remote locations. The 700 and 1100 Areas are supplied with water by the City of Richland.

Regional effects of water-use activities are apparent in some areas where the local water tables have declined because of withdrawals from wells. In other areas, water levels in the shallow aquifers have risen because of artificial recharge mechanisms, such as excessive application of imported irrigation water or impoundment of streams. Waste water ponds on the Hanford Site have artificially recharged the unconfined aquifer below the 200 East and 200 West Areas. The increase in water table elevations was most rapid from 1950 to 1960 and slowed down substantially between 1970 and 1980, when only small increases in water table elevations occurred. Waste water discharges from the 200 West Area were reduced significantly in 1984, with an accompanying decline in water table elevations.

The Vernita Bar Settlement Agreement, executed June 16, 1988, established a minimum Columbia River flow below Priest Rapids Dam to protect salmon spawning habitat. This Agreement was signed by the Washington Public Utility Districts in Chelan, Grant, and Douglas counties; the Bonneville Power Administration (BPA); National Marine Fisheries Service; WDFW; Oregon Department of Fish and Wildlife; Yakama Nation; the Confederated Tribes of the Umatilla Indian Reservation; and the Colville Confederated Tribes. The Agreement was then approved by the Federal Energy Regulatory Commission as a condition of the license for the Priest Rapids Dam. This minimum flow is in effect from about December 15 to May 31 each year to hold flows down during the fall (which would limit the area of fall chinook salmon spawning to the lower elevations of the Vernita Bar), and then to provide sufficient flows during the winter and spring to assure the survival of the eggs and newly hatched fish. The Vernita Bar Agreement limits river flow in the fall to 1,960 m^3/s (70,000 ft^3/s). The post-spawning flows are determined annually, based on field surveys that identify when, where, and to what extent spawning has occurred (NPS 1994).

4.3.3.1 Water Rights. Water rights in the state of Washington are determined by the Washington State Superior Courts and regulated by Ecology. Water sources relevant to the discussion in this document include the Columbia River and underground aquifers on the Hanford Site.

The DOE's past and present water withdrawals at the Hanford Site are based on the

"Federal Reserved Water Rights" doctrine. This doctrine, developed as case law from U.S. Supreme Court rulings, holds that the Federal government, when it withdraws public domain lands for the purpose of the creation of a Federal reservation, necessarily withdraws unappropriated water rights sufficient to meet the needs for which the reservation was created. The date of priority of these rights is the date of creation of the reservation. In the case of the Hanford Site, this date is 1943. It is the general rule that Federal reserved water rights cease to exist when the Federal reservation ceases to be used for the purposes for which it was created. The limited exception to the rule is reflected in the *U.S. v. Powers*, 305 U.S. 527 (1939), wherein the Court allowed that a purchaser of agricultural land on an Indian reservation may be entitled to a portion of Federal reserved water rights where the use of the property did not change.

The Federal government has not established its own water rights regulation. Instead, it uses the regulatory procedures outlined in the State water rights laws to document the extent of its rights. There has been no general adjudication in the State of Washington of the water rights in the Columbia River and, therefore, the reserved water right of the Hanford Site has not been documented. The quantity of that right, however, would be equal to the maximum amounts used at Hanford during its operation, up to the amount of unappropriated water in the Columbia River as of 1943.

In a report titled, *Hanford Land Transfer* (Ecology 1993), Ecology indicated that if water rights were attached to privately owned parcels of land acquired in fee by the Federal government for the creation of Hanford in 1943, those water rights may continue to be attached to these parcels of land. Ecology has indicated that it has not taken action to extinguish these rights, although under Washington law appropriative water rights are subject to be extinguished if unused for a period of five years.

Further complications exist regarding non-Federal water rights claims at the Hanford Site. The first is the issue of groundwater contamination at Hanford. The second is that the date for filing a water rights claim in the Hanford sub-basin, for both Columbia River water and groundwater, expired in 1992. No claims for water rights under state law appear to have been filed within the required time period (NPS 1994).

4.4 Air Resources

This section addresses the general air resources at the Hanford Site and the surrounding region. Included in this section are discussions on climate and meteorology, ambient air quality, and atmospheric dispersion.

4.4.1 Climate and Meteorology

The Hanford Site climate is classified as mid-latitude semiarid or mid-latitude desert, depending on the climatological classification scheme used. Summers are warm and dry, with abundant sunshine. Large diurnal temperature variations result from intense solar heating during the day and radiational cooling at night. Daytime high temperatures in June, July, and August periodically exceed 38EC (100EF). Winters are cool, with occasional precipitation. Outbreaks of cold air associated with modified arctic air masses can reach the area and cause temperatures to drop below -18EC (0EF). Overcast skies and fog occur periodically (PNNL 1996a).

Topographic features have a significant impact on the climate of the Hanford Site. All air masses that reach the region undergo some modification during their passage over the complex topography of the Pacific Northwest. The climate of the region is strongly influenced by the Pacific Ocean and the Cascade Range to the west. The relatively low annual average rainfall of 16.1 cm (6.3 in.) at the Hanford Meteorological Station (HMS) is caused largely by the rain shadow created by the Cascade Range. These mountains limit much of the maritime influence of the Pacific Ocean, resulting in a more continental-type climate than would exist if the mountains were not present. Maritime influences are experienced in the region during the passage of frontal systems and as a result of movement through gaps in the Cascade Range (e.g., the Columbia River Gorge).

The Rocky Mountains to the east and the north also influence the climate of the region. These mountains play a key role in protecting the region from the more severe winter storms and the extremely low temperatures associated with the modified arctic air masses that move southward through Canada. Local and regional topographical features (e.g., the Yakima Ridge and the Rattlesnake Hills) also impact meteorological conditions across the Hanford Site (PNNL 1996a). In particular, these features have a significant impact on wind directions, wind speeds, and precipitation levels.

Climatological data are available for the HMS, which is located between the 200 East and 200 West Areas. Data collected at this location since 1945 (PNL 1994b) are representative of the general climatic conditions for the region and describe the specific climate of the Central Plateau. Local variations in the topography of the Hanford Site may cause some aspects of the climate to differ significantly from those of the HMS (see text box, *"Hanford Site Quick Facts: Meteorology"*). For example, winds near the Columbia River are different from those at the HMS. Similarly, precipitation along the slopes of the Rattlesnake Hills differs from that at the HMS.

Hanford Site Quick Facts: Meteorology

- Average annual precipitation: 16.1 cm (6.3 in.)
- Prevailing wind direction: Northwest
- Average monthly temperature: January - 0.9EC (30EF); July - 24.6EC (76EF)

4.4.1.1 Wind. Prevailing wind directions on the 200 Area Plateau are from the northwest during all months of the year; southwesterly winds occur less frequently. Summaries of wind direction indicate that winds from the northwest quadrant occur most often during the winter and summer. During the spring and fall, the frequency of southwesterly winds increases with a corresponding decrease in northwest flow. Winds blowing from other directions (e.g., the northeast) display minimal variation from month to month. Monthly average wind speeds are lowest during the winter months, averaging 10 to 11 km/hr (6 to 7 mi/hr), and highest during the summer, averaging 13 to 15 km/h (8 to 9 mi/hr). Wind speeds that are well above average are usually associated with southwesterly winds. However, the summertime drainage winds generally are northwesterly and can frequently gust to 50 km/hr (30 mi/hr). These winds are most prevalent over the northern portion of the Hanford Site (PNNL 1996a).

4.4.1.2 Temperature and Humidity. Nine separate temperature measurements are made at the 125-m (410-ft) tower at the HMS. Temperatures also are measured at the 2-m (6.5-ft) level on the twenty-six 9.1-m (30-ft) towers located on and around the Hanford Site. The three 60-m (200-ft) towers have temperature-measuring instrumentation at the 2-, 10-, and 60-m (6.5-, 33-, and 200-ft) levels. The temperature data from the 9.1- and 61-m (30- and 200-ft) towers are telemetered to the HMS.

Ranges of daily maximum and minimum temperatures vary from normal maxima of 2EC (35EF) in late December to 35EC (95EF) in late July (PNL 1994b). On the average, 52 days during the summer months have maximum temperatures greater than or equal to 32EC (90EF), and 12 days have maxima greater than or equal to 38EC (100EF). From mid-November through early March, minimum temperatures average less than or equal to 0 EC (32EF), with the minima in late December and early January averaging -6EC (21EF). During the winter, on average, three days have minimum temperatures less than or equal to -18EC (0EF); however, only about one winter in two experiences such temperatures. The record maximum temperature is 45EC

(113EF), and the record minimum temperature is -31EC (-23EF). For the period of 1946 through 1998, the average monthly temperatures ranged from a low of -0.9EC (30EF) in January to a high of 24.6EC (76EF) in July. During the winter, the highest monthly average temperature at the HMS was 6.9EC (44EF) in February 1958, and the record average lowest temperature was -11.1EC (12EF) during January 1950. During the summer, the record highest monthly average temperature was 27.9EC (82EF) in July 1985, and the record lowest temperature was 17.2EC (63EF) in June 1953.

Relative humidity and dew-point temperature measurements are made at the HMS and at the three 60-m (200-ft) tower locations. The annual average relative humidity at the HMS is 54 percent. It is highest during the winter months, averaging about 75 percent, and lowest during the summer, averaging about 35 percent. Fog reduces the visibility to 9.6 km (6 mi) during an average of 47 days/yr and to less than 0.4 km (0.25 mi) during an average of 25 days/yr. Other phenomena causing restrictions to visibility (i.e., visibility less than or equal to 9.6 km [6 mi]) include dust, blowing dust, and smoke from field burning. There are few such days; an average of 5 days/yr have dust or blowing dust and less than 1 day/yr has reduced visibility from smoke (Neitzel 1998).

4.4.1.3 Precipitation. The average annual precipitation at the HMS is 16 cm (6.3 in). Winter monthly average snowfall ranges from 0.8 cm (0.32 in) in March to 13.7 cm (5 in) in December. The seasonal record snowfall of 142 cm (56 in.) occurred in the winter of 1992-1993. During the months of December, January, and February, snowfall accounts for about 38 percent of all precipitation (PNNL 1996a). Days with greater than 1.3 cm (0.50 in) precipitation occur on average less than one time each year. Rainfall intensities of 1.3 cm/hr (0.50 in./hr) persisting for 1 hour are expected once every 50 years (Neitzel 1998).

4.4.1.4 Severe Weather. Severe weather on the Hanford Site may include a variety of meteorological events, which include severe winds, blowing dust, hail, fog, ash falls, extreme temperatures, temperature inversions, and blowing and drifting snow. The HMS climatological summary and the National Severe Storms Forecast Center database list only 24 separate tornado occurrences within 161 km (100 mi) of the Hanford Site from 1916 to 1995 (PNNL 1996a). Only one of these tornadoes was observed within the boundaries of the Hanford Site (on the extreme western edge), and no damage resulted. The estimated probability of a tornado striking a point at the Hanford Site is 9.6×10^{-6}/yr (PNNL 1996a). Because tornadoes are infrequent and generally small in the Pacific Northwest (and hurricanes do not reach this area), risk from severe winds normally are associated with thunderstorms or the passage of strong cold fronts. The greatest peak wind gust was 130 km/hr (81 mi/hr), recorded at 15 m (50 ft) above ground level at the HMS. Extrapolations based on 35 years of observations indicate a return period of about 200 years for a peak gust in excess of 145 km/hr (90 mi/hr) at 15 m (50 ft) above ground level.

4.4.1.5 Atmospheric Stability. Atmospheric dispersion is a function of wind speed, duration and direction of wind, atmospheric stability, and mixing depth. Dispersion conditions generally are good if winds are moderate to strong, if the atmosphere is of neutral or unstable stratification, and if there is a deep mixing layer. Good dispersion conditions associated with neutral and unstable stratification exist about 56 percent of the time. Less favorable dispersion conditions might occur when the wind speed is light and the mixing layer is shallow. These conditions are most common during the winter when moderately to extremely stable stratification exists about 66 percent of the time. Less favorable conditions also occur periodically for surface and low-level releases in all seasons from about sunset to about 1 hour after sunrise, as a result of ground-based temperature inversions and shallow mixing layers (PNNL 1996a).

4.4.2 Air Quality

The EPA has set National Ambient Air Quality Standards (NAAQS) that define levels of air quality that are necessary to protect the public health (primary standards) and the public welfare (secondary standards). Regional air quality is generally good, with the occasional exception due to blowing dust.

4.4.2.1 Regional Air Quality. Air quality in the Hanford region is well within the state and Federal standards for criteria pollutants, except that short-term particulate concentrations occasionally exceed the 24-hour "particulate matter nominally 10 microns or less" (PM_{10}) standard. Because the highest concentrations of airborne particulate material are generally a result of natural events, the area has not been designated nonattainment[1] with respect to the PM_{10} standard.

Particulate concentrations can reach relatively high levels in eastern Washington State because of extreme natural events (e.g., dust storms, volcanic eruptions, and large brushfires) that occur in the region. "Rural fugitive dust" from extreme natural events was not considered when estimating the maximum background concentrations of particulates in the area east of the Cascade Mountain crest and when determining Washington State ambient air quality standards. In the past, the EPA has exempted the rural fugitive dust component of background concentrations when considering permit applications and enforcement of air quality standards. However, the EPA is now investigating the prospect of designating parts of Benton, Franklin, and Walla Walla counties as a nonattainment area for PM_{10}. Windblown dust has been identified as a particularly large problem in this area.

Ecology has been working with the EPA and the Benton County Clean Air Authority under a MOA to characterize and document the sources of PM_{10} emissions and develop appropriate control techniques in the absence of formally designating the area nonattainment. At this time, the parties are characterizing the sources of PM_{10} emissions and working through other items in the MOA. A final decision on this issue will be made by the EPA, when the final results of the PM_{10} characterization analysis are received (PNNL 1996a).

Ecology conducted the only offsite monitoring (for PM_{10}) near the Hanford Site in 1996. PM_{10} was monitored at one location in Benton County – at Columbia Center – located approximately 17 km (10.5 mi) south-southwest of the 300 Area, in Kennewick, Washington. During 1996, the 24-hour PM_{10} standard established by the State of Washington, 150 µg/m^3, was not exceeded. The Site did not exceed the annual primary standard, 50 µg/m^3, during 1996. The arithmetic mean for 1996 was 21 µg/m^3 at Columbia Center (Neitzel 1998).

During the past 10 years, carbon monoxide, sulfur dioxide, and nitrogen dioxide have been monitored periodically in communities and commercial areas southeast of the Hanford Site. These urban measurements are used to estimate the maximum background pollutant concentrations for the Hanford Site. Because these measurements were made in the vicinity of local sources of pollution, they might overestimate maximum background concentrations for the Hanford Site or at the Hanford Site boundaries. Concentrations of toxic chemicals, as listed in 40 CFR 60.1, are not measured and, therefore, are not available for the Hanford Site.

4.4.2.2 Hanford Site Nonradiological Air Quality. The *Clean Air Act* (CAA) requires that Federal activities may not cause or contribute to new violations of air quality standards, exacerbate existing violations, or interfere with timely attainment or required interim emission

[1] A nonattainment area is an area where measured concentrations of a pollutant are above the primary or secondary NAAQS.

reductions towards attainment (40 CFR 93.150). A determination of conformity of general Federal actions to state or Federal implementation plans must accompany any major Federal action where air quality might be impacted. Because of the administrative nature of this EIS, and the absence of any on-site nonattainment area, this EIS is exempt from a conformity determination (40 CFR 93.153).

The NAAQS, set by EPA, must be met at the Hanford Site boundary or other publicly accessible locations (i.e., highways on the Hanford Site). The standards define levels of air quality that are necessary, with an adequate margin of safety, to protect the public health and welfare. Standards exist for sulfur oxides (measured as sulfur dioxide), nitrogen dioxide, carbon monoxide, total suspended particulates (TSP), PM_{10}, lead, and ozone. The standards specify the maximum pollutant concentrations and frequencies of occurrence that are allowed for specific averaging periods (e.g., the concentration of carbon monoxide when averaged over 1 hour is allowed to exceed 40 mg/m^3 only once a year). The averaging periods vary from 1 hour to 1 year, depending on the pollutant.

An exception to the rule for using the Hanford Site boundary as the point of compliance for air pollution can occur if a nonattainment area occurs within 100 km (62 mi) of any significant new source that could be built or any revision to an operating source. As a requirement for new sources in attainment or unclassifiable areas, WAC 173-400-113 mandates that "allowable emissions from the proposed new source or modification will not delay the attainment date for an area not in attainment nor cause or contribute to a violation of any ambient air quality standard." The Wallula PM_{10} nonattainment area is within 100 km (62 mi) of all parts of the Hanford Site (62 FR 3800).

Because the Hanford Site is in an attainment area, this type of action is exempt from conformity determinations for Federal actions. Federal conformity rules (40 CFR 93) require agencies to determine that the proposed Federal action is in conformity with the specific requirements pursuant to the agency's affirmative obligation under Section 176(c) of the CAA.

In addition to ambient air quality standards, the EPA has established standards for the Prevention of Significant Deterioration (PSD) of air quality. PSD standards provide maximum allowable increases in concentrations of pollutants for areas already in compliance with NAAQS. The PSD standards are expressed as allowable increments in atmospheric concentrations of specific pollutants (nitrogen dioxide, sulfur dioxide, and PM_{10}) (40 CFR 52). Different PSD standards exist for Class I areas (where degradation of ambient air quality is restricted) and Class II areas (where moderate degradation of air quality is allowed).

The closest Class I areas to the Hanford Site are as follows:

- Mount Rainier National Park, approximately 160 km (100 mi) west of the Hanford Site

- Goat Rocks Wilderness Area, approximately 145 km (90 mi) west of the Hanford Site

- Mount Adams Wilderness Area, approximately 150 km (95 mi) southwest of the Hanford Site

- Alpine Lakes Wilderness Area, approximately 175 km (110 mi) northwest of the Hanford Site.

If the Hanford Reach is given Congressional status as a Wild and Scenic River with the Wahluke Slope added as a wildlife refuge, then it would be eligible for Class 1 air shed status.

The PSD standards are presented in Table 4-3. The Hanford Site, which is located in a

Class II area, operates under a PSD permit (Permit No. PSD-X80-14) issued by the EPA in 1980. This permit provides specific limits for emissions of nitrogen oxide from the Plutonium-Uranium Extraction (PUREX) and the Uranium-Trioxide plants, which are now closed and are being decommissioned.

Table 4-3. Maximum Allowable Increases for Prevention of Significant Deterioration of Air Quality (40 CFR 52).

Pollutant	Averaging Time	Class I	Class II
Particulate matter[a] (PM_{10}) ($\mu g/m^3$)	Annual	4	17
	24 hours	8	30
Sulfur dioxide ($\mu g/m^3$)	Annual	2	20
	24 hours	5	91
	3 hours	25	512
Nitrogen dioxide ($\mu g/m^3$)	Annual	2.5	25

[a] PM_{10} is defined as particulate matter nominally 10 microns or less.

State and local governments have the authority to impose standards for ambient air quality that are more stringent than the national standards. Washington State has established more stringent standards for sulfur dioxide and TSP. In addition, Washington State has established standards for other pollutants, such as fluoride, that are not covered by national standards. The state standards for carbon monoxide, nitrogen dioxide, ozone, PM_{10}, and lead are identical to the national standards. Table 4-4 summarizes the relevant air quality standards (Federal and supplemental state standards).

Emission inventories for permitted pollution sources in Benton County are routinely compiled by the Benton County Clean Air Authority. The annual emission rates for Hanford Site sources are reported to Ecology by DOE (Table 4-5).

Monitoring of nitrogen oxides was discontinued after 1990, mostly because of the end of operations at the PUREX facility. Monitoring of TSP was discontinued in early 1988 when the Basalt Waste Isolation Project ended (for which those measurements were required).

4.5 Biological Resources

As a Federal land manager, DOE is responsible for conserving fish, wildlife, and plant populations and their habitats on the Hanford Site. Information about these natural resources is presented below.

Figures 4-16, 4-17, and 4-18 show priority habitats and priority species within Washington State as identified by the WDFW. Because biological resources are temporal, they may not be found in the same place from year to year or require the same mitigation steps at different times of the year. Also, because many of the siting data used to develop these maps were obtained from incidental sightings (e.g., driving [road] surveys) as opposed to thorough surveying, areas with no record sighting are not necessarily devoid of the species. For these reasons, biological resources are generally inventoried prior to the undertaking of specific projects.

Table 4-4. National and Washington State Ambient Air Quality Standards.

Pollutant[a]	National Primary	National Secondary	Washington State
Total suspended particulates			
Annual geometric mean	NS	NS	60 $\mu g/m^3$
24-hour average	NS	NS	150 $\mu g/m^3$
PM_{10} (fine particulates)			
Annual arithmetic mean	50 $\mu g/m^3$	50 $\mu g/m^3$	50 $\mu g/m^3$
24-hour average	150 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$
$PM_{2.5}$			
Annual arithmetic mean	15 $\mu g/m^3$	--	--
24-hour average	65 $\mu g/m^3$	--	--
Sulfur dioxide			
Annual average	0.03 ppm	NS	0.02 ppm
24-hour average	0.14 ppm	NS	0.10 ppm
3-hour average	NS	0.50 ppm	NS
1-hour average	NS	NS	0.40 ppm[b]
Carbon monoxide			
8-hour average	9 ppm	9 ppm	9 ppm
1-hour average	35 ppm	35 ppm	35 ppm
Ozone			
1-hour average	---	0.12 ppm	0.12 ppm
8-hour average	0.08 ppm[c]	---	---
Nitrogen dioxide			
Annual average	0.05 ppm	0.05 ppm	0.05 ppm
Lead			
Quarterly average	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$
Fluoride			
30-day average			0.84 mg/m^3
7-day average			1.7 mg/m^3
24-hour average			2.9 mg/m^3
12-hour average			3.7 mg/m^3
VOCs			Source-specific standards

[a] Annual standards are never to be exceeded; short-term standards are not to be exceeded more than once per year unless otherwise noted (Ecology 1994).

[b] 0.25 ppm not to be exceeded more than twice in any 7 consecutive days; not to be exceeded more than 1 day per calendar year.

[c] Based on a 3-year average of the annual fourth highest daily maximum 8-hour average.

NS = no standard
ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
VOC = volatile organic compound

Table 4-5. Nonradioactive Constituents Discharged to the Atmosphere, 1995[a] (Dirkes and Hanf 1996).

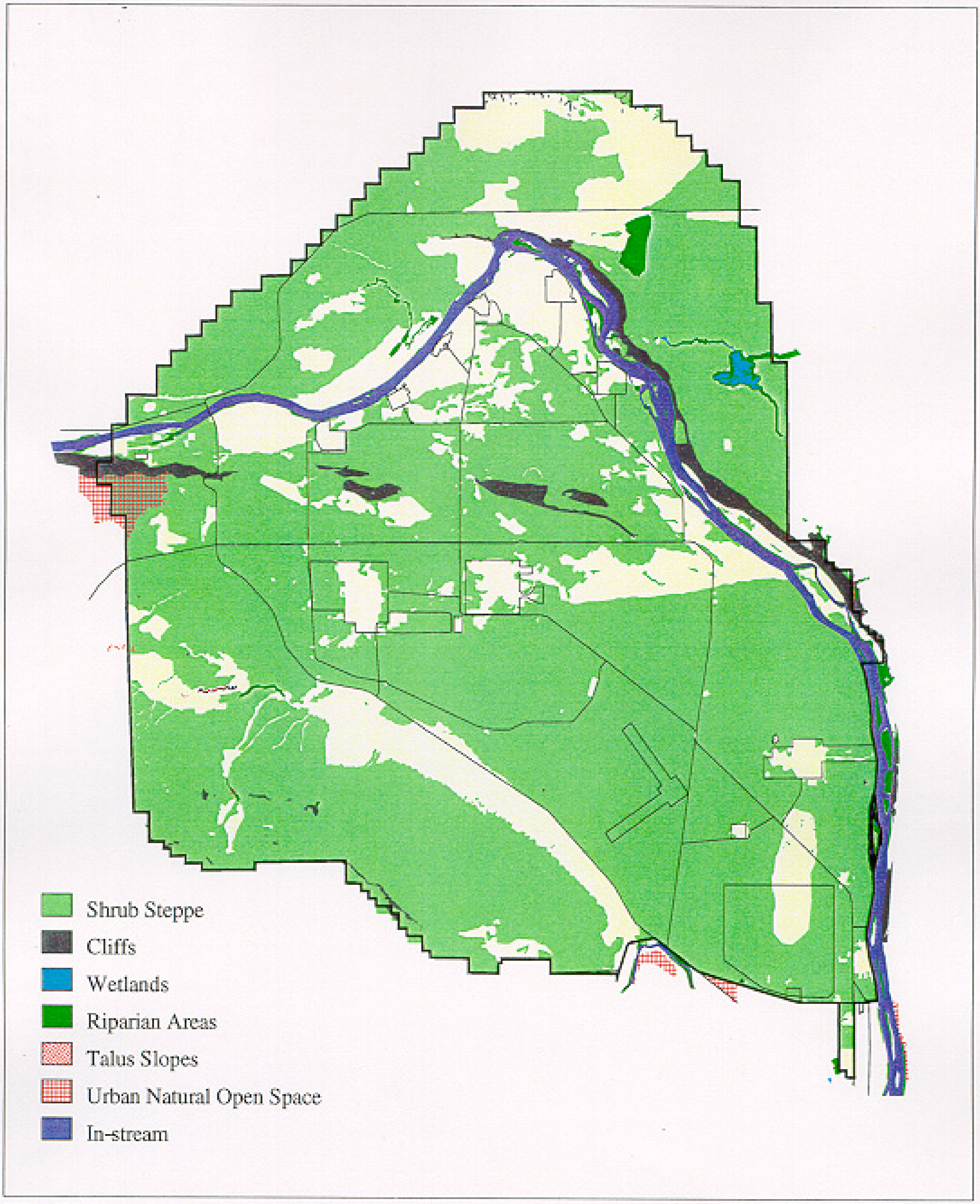
Constituent	Release (kg)		
	200 East Area	200 West Area	300 Area
Particulate matter	3.40×10^{2}	8.02×10^{1}	1.43×10^{4}
Nitrogen oxides	1.77×10^{5}	2.82×10^{4}	4.69×10^{4}
Sulfur oxides	2.25×10^{5}	3.53×10^{4}	2.34×10^{5}
Carbon monoxide	6.43×10^{4}	1.01×10^{4}	4.25×10^{3}
Lead	1.62×10^{2}	2.53×10^{1}	2.52×10^{1}
Volatile organic compounds[b]	6.43×10^{2}	1.00×10^{2}	2.38×10^{2}
Ammonia[c]	6.18×10^{3}	1.53×10^{3}	NM
Arsenic	1.73×10^{2}	2.70×10^{1}	1.48×10^{1}
Beryllium	2.33×10^{1}	3.64×10^{0}	5.46×10^{1}
Cadmium	1.37×10^{1}	2.18×10^{0}	2.74×10^{1}
Carbon tetrachloride[d]	NM	NE	NM
Chromium	5.01×10^{2}	7.83×10^{1}	1.67×10^{1}
Cobalt	NE	NE	1.57×10^{1}
Copper	3.15×10^{2}	5.02×10^{2}	3.62×10^{1}
Formaldehyde	7.05×10^{1}	1.25×10^{1}	5.27×10^{1}
Manganese	6.93×10^{2}	1.08×10^{2}	9.63×10^{0}
Mercury	5.11×10^{0}	8.08×10^{1}	4.16×10^{0}
Nickel	4.12×10^{2}	6.43×10^{1}	3.03×10^{2}
Polycyclic organic matter	NE	6.00×10^{2}	7.14×10^{3}
Selenium	6.26×10^{1}	9.84×10^{0}	4.94×10^{0}
Vanadium	4.31×10^{1}	7.79×10^{0}	3.93×10^{2}

[a] The estimate of volatile organic compound emissions do not include emissions from certain laboratory operations; NM = not measured; NE = no emissions.
[b] Produced from burning fossil fuels for steam generation.
[c] Ammonia releases are from the 200 East Area tank farms, 200 West Area tank farms, and the operation of the 242-A Evaporator.
[d] Does not include carbon tetrachloride Vapor Extraction Project releases from passively ventilated wells.

The block of habitat directly south of the 200 East and West Areas contains high-quality habitat and some of the Hanford Site's best sage sparrow and loggerhead shrike habitat. However, since some of these areas have never been officially surveyed for these species, the species frequently do not show up on maps even though they most likely occur there. Figure 4-17 shows some, but not all, historic bald eagle nesting sites but does not include current or recent bald eagle nest locations which can't be shown because of their sensitivity to disturbance. Similarly, Figure 4-18 shows some, but not all, great blue heron occurrences.

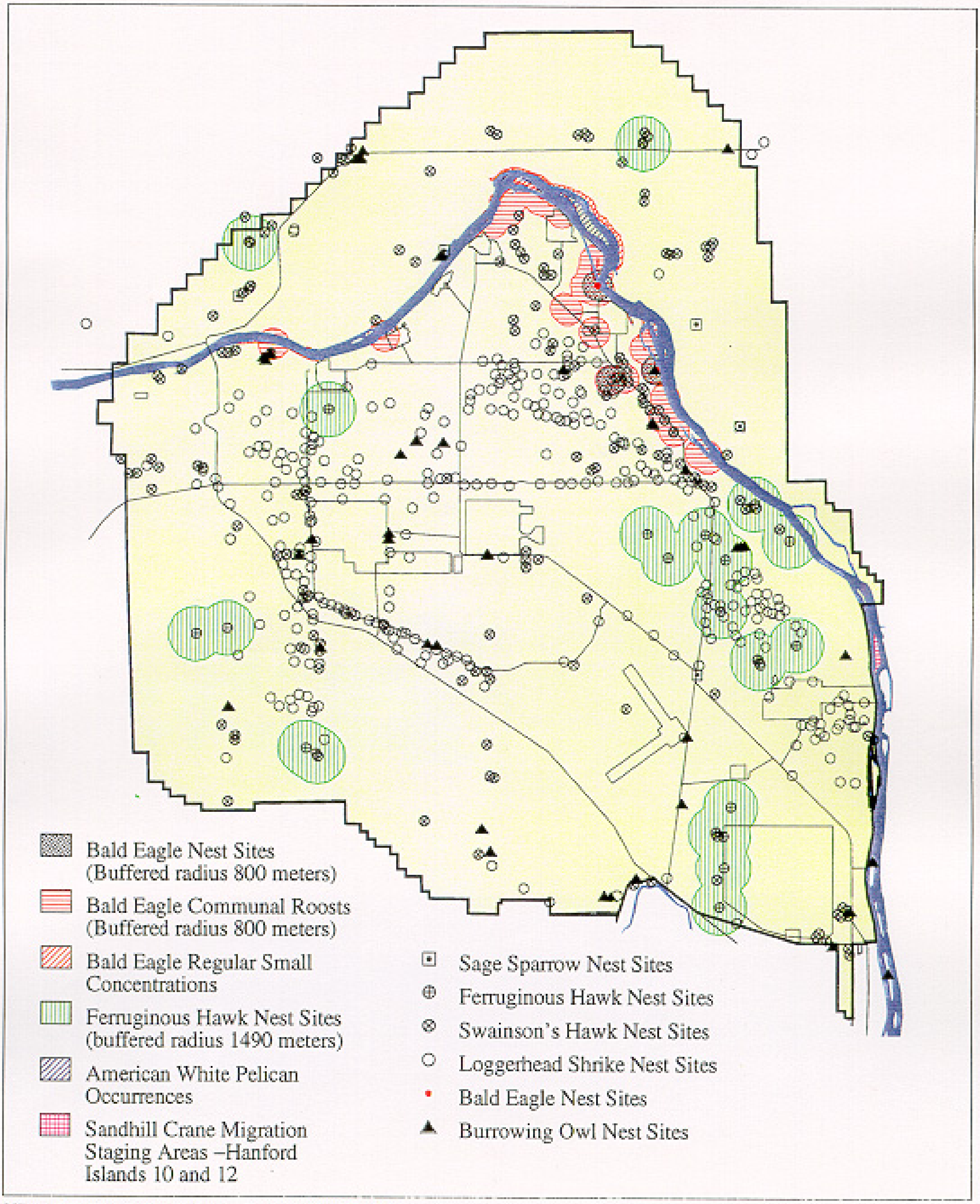
Counties and cities may use information prepared by the WDFW to classify and designate locally important habitats and species. While these priorities are those of the Department, they and the data on which they are based may be considered by counties and cities when developing their land-use plans under the *Growth Management Act* (GMA) (WAC 365-180-080).

Figure 4-16. WDFW Priority Habitats on the Hanford Site.



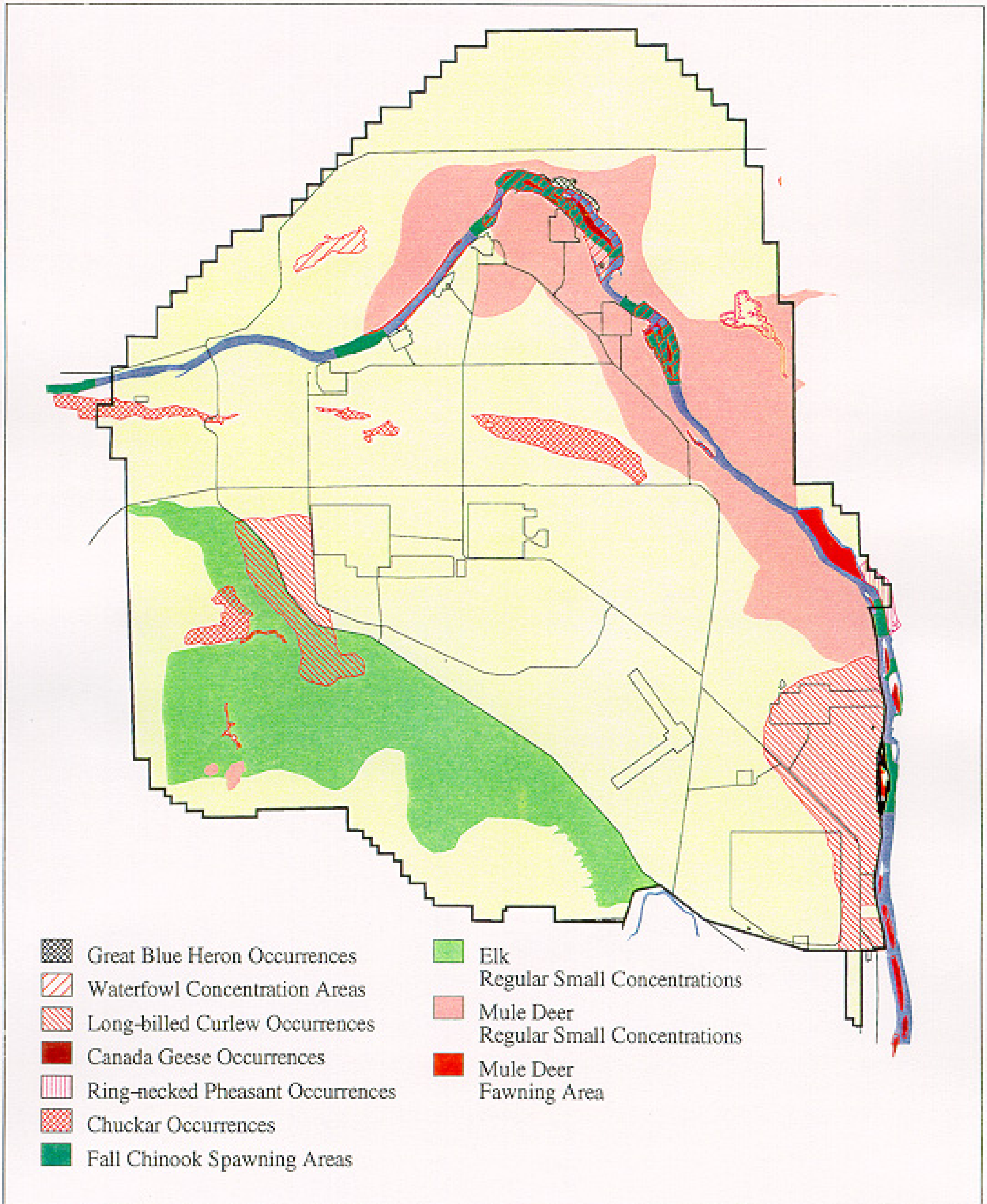
BHI:rpp 07/06/98 draft_2/wadfw1.aml   Database: 03-AUG-1998

Figure 4-17. WDFW Priority Species: State Listed and Candidates.



BHI:rpp 07/06/98 draft_2/wadfw2.aml   Database: 03-AUG-1998

Figure 4-18. WDFW Priority Species: Vulnerable Aggregations and Species of Recreation, Commercial, and/or Tribal Importance.



BHI:rpp 07/07/98 draft_2/wadfw3.aml Database: 31-AUG-1998

The Hanford Site is located within a region known as the Columbia Basin ecoregion, which occupies an extensive area south of the Columbia River between the Cascade Range and Blue Mountains in Oregon and roughly two-thirds of the area of Eastern Washington. This region has been botanically characterized as a shrub-steppe ecosystem, with various shrub and bunchgrass associations playing dominant roles. The region is often referred to as high desert, northern desert shrub, or desert scrub (Franklin and Dyrness 1973).

> ***What is Shrub-Steppe?***
>
> The shrub-steppe ecosystem is a vegetation zone occupying most of central and southeastern Washington, part of northeastern Oregon, and portions of Idaho, Utah, and Nevada. It is a region whose native, pre-settlement vegetation consisted primarily of shrubs, perennial bunchgrasses, and a variety of forbs. Typical shrubs include several sagebrush species, rabbitbrush, and bitterbrush. Dominant grasses were bluebunch wheatgrass, Idaho fescue, needle-and-thread grass, and Sandberg's bluegrass. Before European settlement, at least 4.2 million hectares (10.4 million acres) of unaltered shrub-steppe habitat covered much of central and southeastern Washington. With the advent of dryland wheat farming, intensive livestock grazing, irrigation, and altered fire regimes, the landscape is changed to such an extent that the amount of natural shrub-steppe remaining is a small fraction of the original acreage. The average cover of big sagebrush was about 10 percent prior to the introduction of livestock into Washington. Because livestock do not eat it, sagebrush often increases in density in grazed areas, replacing most other plants in badly degraded ranges. Hanford is unique in that it contains large expanses of relatively undisturbed shrub-steppe vegetation and has become a refuge for the native species and habitats comprising the shrub-steppe.

Settlement during the late 19th and early 20th century has resulted in significant changes to vegetation patterns through activities such as farming, dam development, and regional settlement. The State of Washington is rapidly losing much of its remaining steppe habitat and losses are projected to be high for the next 50 years. It has been estimated that approximately 60 percent of the original acreage (4.2 million ha/10.4 million ac) (42,000 km^2/ 16,250 mi^2) of shrub-steppe vegetation in Washington has been lost, primarily to agriculture (DOE-RL 1996c) (see text box, *"What is Shrub-Steppe?"*).

An illustration of this habitat alteration can be seen through the use of satellite-based remote sensing data, which can provide images of land surfaces and existing vegetation cover. Using these data, the WDFW has developed land cover classification maps (historic and current) of a portion of the Columbia Basin ecoregion (Figures 4-19 and 4-20, respectively). As indicated in Figure 4-20, the Hanford Site and the Department of Defense Yakima Training Center (located to the west of the Hanford Site) contain the largest remaining remnant of shrub-steppe vegetation in the Columbia Basin.

The Hanford Site is a relatively large, undisturbed area of shrub-steppe habitat that contains numerous plant and animal species adapted to the semi-arid environment in the region. The Hanford Site consists of mostly undeveloped land, with widely spaced clusters of industrial buildings located along the western shoreline of the Columbia River and at several locations in the interior of the Hanford Site. The industrial buildings are interconnected by roads, railroads, and electrical transmission lines. The major facilities and activities occupy about 6 percent of the total available land area, and their impact on the surrounding ecosystems is minimal from direct discharges or releases attributable to DOE. Most of the Hanford Site has not experienced tillage or livestock grazing since the early 1940s. The Columbia River flows through the Hanford Site, and although the river flow is not directly impeded by dams within the Hanford Site, the historical daily and seasonal water fluctuations have been changed by dams upstream and downstream of the Hanford Site (Cushing 1995).

The Columbia River and other water bodies on the Hanford Site provide valuable habitat for aquatic organisms. Several large portions of the Site are administered in a manner to protect and preserve biological resources, such as the ALE Reserve and the Wahluke Slope (Figure 4-21).

Figure 4-19. Historic Distribution and Extent of Land Cover Classes within a Portion of the Columbia Basin Ecoregion (DOE-RL 1996c).

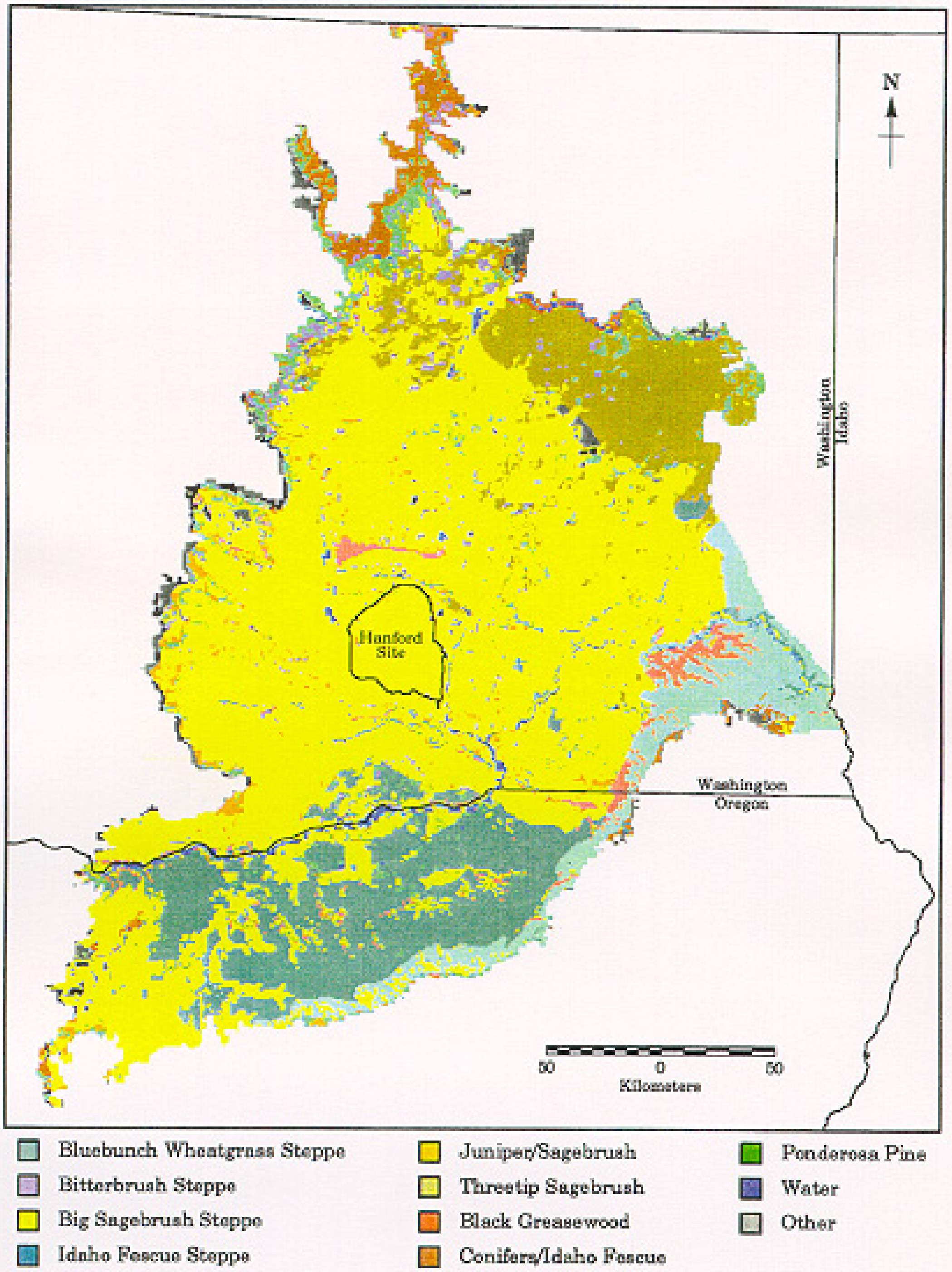


Figure 4-20. Current Distribution and Extent of Land Cover Classes within a Portion of the Columbia Basin Ecoregion (DOE-RL 1996c).

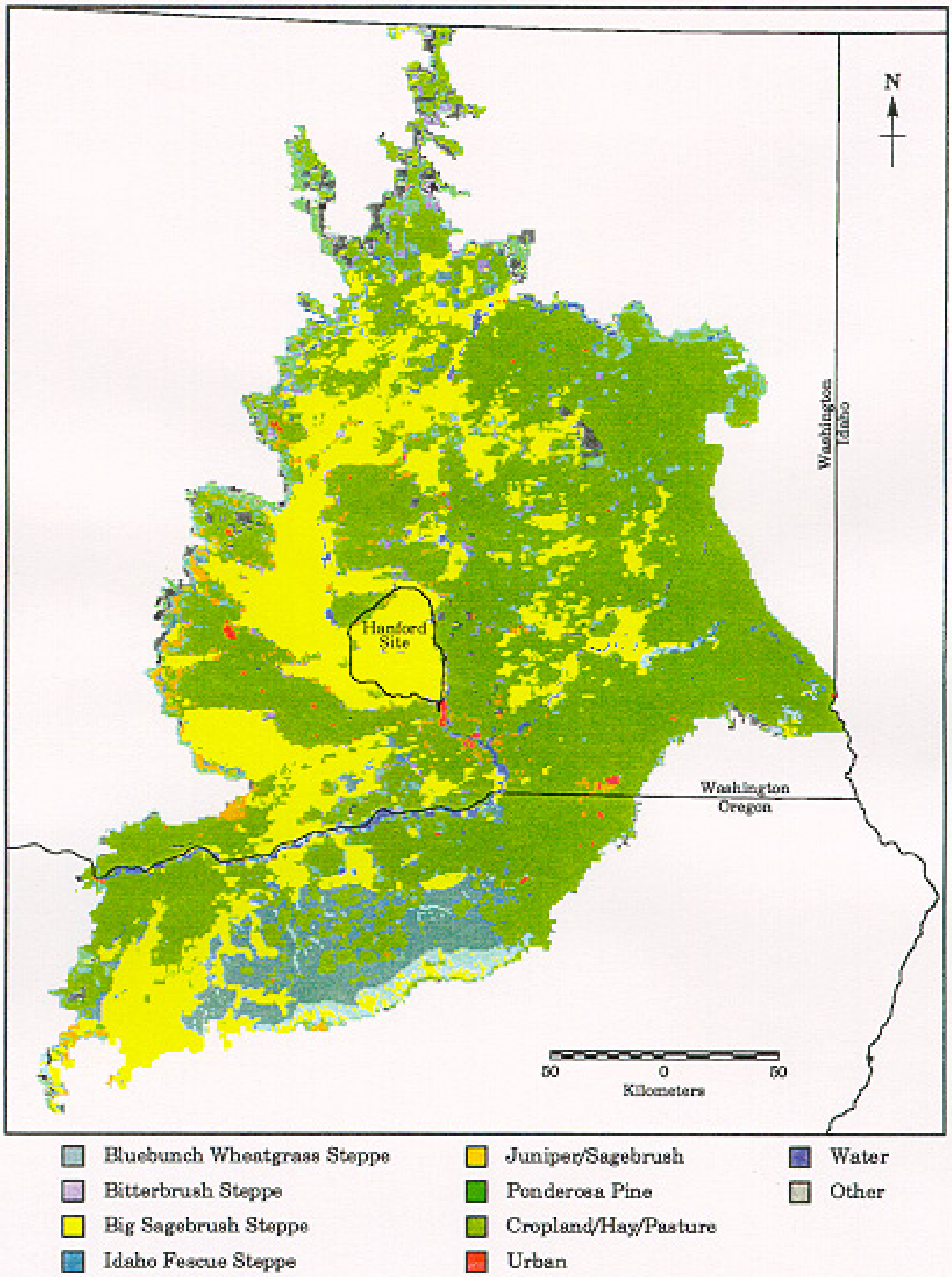
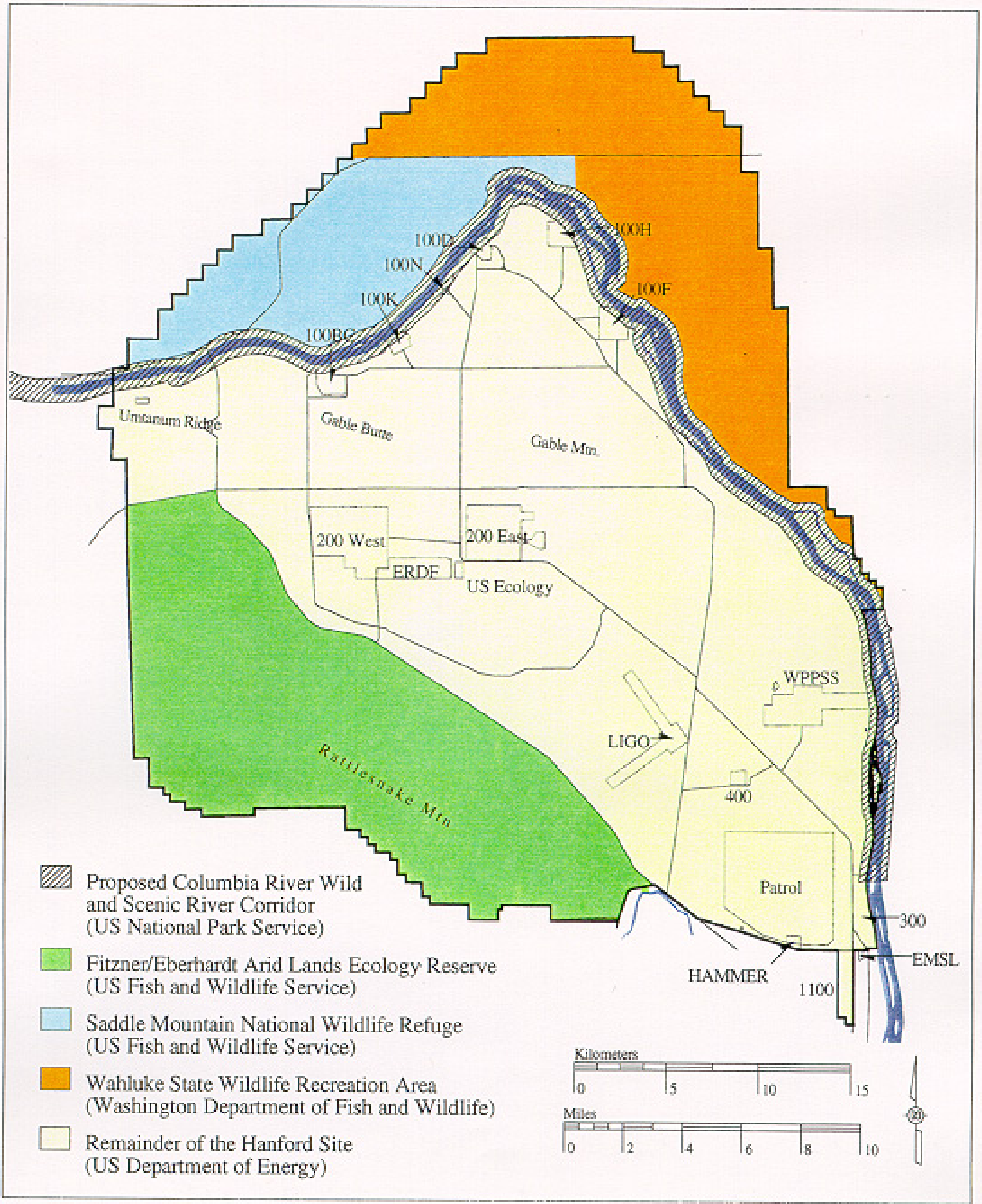


Figure 4-21. Designated Administrative Areas for the Hanford Site.



BHI:rpp 04/22/96 clup/brmap_d24.aml Database: 03-AUG-1998

4.5.1 Administrative Designations for Natural Resource Protection

In 1977, the U.S. Energy Research and Development Agency (a predecessor to DOE) designated the entire Hanford Site as one of seven National Environmental Research Park (NERP) sites located in the United States. In addition, two other portions of the Hanford Site are administered under special designations.

The Wahluke Slope encompasses approximately 365 km^2 (140 mi^2) and is administered as two wildlife areas known as the Saddle Mountain NWR and the Wahluke Wildlife Recreation Area. Under an agreement made between the WDFW and the USFWS in April 1999, the Wahluke State Wildlife Recreation Area will be combined with the Saddle Mountain NWR and managed as a unit by the USFWS. These areas are operated under the terms of a permit issued by the AEC on November 30, 1971, to provide for management of Hanford lands north and east of the Columbia River.

According to the terms of the permit, the USFWS is required to keep the lands managed as the Saddle Mountain NWR closed to all public access. The closure ensured a security zone for the N Reactor and encompassed an area within a 8.8-km (5.5-mi) radius of the reactor (NPS 1994). Although N Reactor is being decommissioned and doesn't require an extensive buffer, the K Basins still require an exclusion zone until the spent nuclear fuel is removed from the basins.

The ALE Reserve has been used for ecological research dating back to 1952, but it was not until 1967 that the Richland Office of the AEC established the ALE Reserve by administrative order (PNL 1993b). As a result of a Federal interagency cooperative agreement, the ALE Reserve was designated as the Rattlesnake Hills Research Natural Area in 1971. The ALE Reserve currently retains its status as an administratively protected environment and as a valuable ecological study site. Through a MOA with DOE, the USFWS is responsible for management and protection of the ALE Reserve.

4.5.2 Terrestrial Vegetation and Habitats

The Hanford Site has been botanically characterized as a shrub-steppe ecosystem. In the early 1800s, the dominant plant in the area was big sagebrush with an understory of perennial bunchgrasses, especially Sandberg's bluegrass and bluebunch wheatgrass. With the advent of horses in the 1700s and settlement in the 1800s that brought livestock grazing and crop raising, the natural vegetation mosaic was opened to a persistent invasion by non-native annual species, especially cheatgrass. Of the 590 species of vascular plants recorded for the Hanford Site, approximately 20 percent of all species are considered nonnative. Cheatgrass is the dominant nonnative species. It is an aggressive colonizer and has become well established across the site (Neitzel 1998). Today, cheatgrass is the dominant plant on fields that were cultivated 50 years ago. Cheatgrass is also well established on rangelands at elevations less than 244 m (800 ft) (Cushing 1995).

The dryland areas of the Hanford Site were treeless in the years before land settlement; however, for several decades before 1943, trees were planted and irrigated on most of the farms to provide windbreaks and shade. Some of the trees died when the farms were abandoned in 1943, but others have persisted, presumably because their roots are deep enough to contact groundwater. Today these trees serve as nesting platforms for several species of birds (e.g., hawks, owls, ravens, magpies, and great blue herons), and as night roosts for wintering bald eagles (Cushing 1995). The vegetation mosaic of the Hanford Site currently consists of a variety of diverse plant communities.

The State of Washington has designated large and small blocks of shrub-steppe as priority habitat because these areas possess unique or significant value to many species. The State identifies priority habitats based on the quality of the habitat with respect to the following attributes: comparatively high fish and wildlife density; comparatively high fish and wildlife species diversity; important fish and wildlife breeding habitat; important fish and wildlife seasonal ranges; important fish and wildlife movement corridors; limited availability; high vulnerability to habitat alteration; and unique or dependent species (WDFW 1995). Although Washington State priority habitat designations have no associated legal requirements for habitat protection, DOE Order 430.1 (DOE 1995c) requires that DOE consider ecosystem management and preservation values during all phases of Hanford Site operations.

The DOI National Biological Service identifies native shrub and grassland steppe in Washington and Oregon as an endangered ecosystem (with an 85 to 98 percent decline) (DOI 1995). Almost 600 species of plants have been identified on the Hanford Site (PNNL 1996a). The dominant plants are big sagebrush, rabbitbrush, cheatgrass, and Sandberg's bluegrass, with cheatgrass providing half of the total plant cover on much of the Hanford Site. Cheatgrass and Russian thistle, annuals introduced to the United States from Eurasia in the late 1800s, invade areas where the ground surface has been disturbed. Mosses and lichens appear on undisturbed soil surface; lichens commonly grow on the shrub stems and on basalt outcrops. The important desert shrubs, big sagebrush and bitterbrush, are widely spaced and usually provide less than 20 percent canopy cover. The important native understory plants are grasses, especially Sandberg's bluegrass, Indian ricegrass, June grass, and needle-and-thread grass.

As compared to other semi-arid regions in North America, primary productivity is relatively low and the number of vascular plant species also is low. This situation is attributed to the low annual precipitation (16 cm [6 in.]), the low water-holding capacity of the rooting substrate (sand), and the hot, dry summers and occasionally very cold winters.

The 100 Areas are located in the vicinity of the Columbia River and encompass both riparian and upland habitats. Riparian habitats are found along the shoreline, slack water, and slough areas. Riparian vegetarian includes both woody and herbaceous species. Common plant species occurring in the riparian zone include black cottonwood, mulberry, willow, dogbane, and a variety of grasses and forbs (Cushing 1992). Scattered groves of white mulberry, black locust, Siberian elm, apricot, juniper, and willow were noted in an ecological investigation within the 100-BC-5 and 100-HR-3 operable units (WHC 1992c). The upland vegetation within the 100 Areas is dominated by the non-native annuals, cheatgrass, and tumble mustard on former agricultural lands that were abandoned in 1943 (DOI 1995).

More than 100 species of plants have been identified on the Central Plateau (Cushing 1992). Common plant species include sagebrush, rabbitbrush, cheatgrass, and Sandberg's bluegrass. The dominant vegetation type consists of big sagebrush with an understory of cheatgrass and Sandberg's bluegrass (PNNL 1996a). Cheatgrass provides approximately 50 percent of total plant cover. Most of the waste disposal and storage sites are covered by non-native vegetation or are kept in a vegetation-free condition.

In recent years, a die-off of big sagebrush has been noted on the Hanford Site. A preliminary investigation of the nature and extent of die-off has been conducted. Although the cause remains unknown, early indications focus on the possibility that the die-off might be the result of disease or weather-related stress. The die-off area is estimated to be 1,776 ha (4,390 ac) (Cushing 1992).

Other vegetation within the Central Plateau includes wetland species associated with man-made ditches and ponds on the Central Plateau and introduced perennial grasses (e.g., Siberian wheatgrass) that were planted to revegetate disturbed areas. Wetland species (e.g., cattail and reeds) and trees (e.g., willow, cottonwood, and Russian olive) are established around some of these ponds (PNNL 1996a). However, several of the ponds have been decommissioned, resulting in the elimination of wetland habitat as the supply of industrial waste water feeding the ponds was terminated.

Sixteen different plant community types have been identified on the Wahluke Slope. Cheatgrass and other nonnative species dominate, most likely because of disturbances caused by military training activities, historical livestock grazing, dry soil, and multiple fires. However, the Wahluke Slope still possesses extensive remnants of the original shrub-steppe ecosystem. For example, the most extensive and highest quality antelope bitterbrush and Indian ricegrass plant community in the State of Washington is found on the Wahluke Slope (TNC and Pabst 1995). In 1994, The Nature Conservancy discovered a new plant species of the genus *Lesquerella*. In 1997 field surveys, eight new populations of four taxa were located on the Wahluke Unit Columbia Basin Wildlife Area. All of these populations were located on the White Bluffs. One of the new *Gilia leptomeria* populations is the largest currently known in Washington. Also, the remainder of the only known occurrence of *Lesquerella tuplashensis* was mapped and counted. These discoveries, along with its high habitat quality, illustrate the potential ecological value of the Wahluke Slope.

4.5.2.1 Newly Documented Plant Species. During a 1997 rare plant survey of the Hanford Site conducted by The Nature Conservancy, a total of 35 new populations were found of 14 rare plant taxa identified in Washington as either endangered, threatened, sensitive, or Review Group 1 by the State of Washington. (Review Group 1 includes taxa for which more field work is needed to assess their rarity and the degree to which they are threatened.) One species was newly documented at the Hanford Site, and 10 occurrences of eight taxa were revisited and remapped. Finally, a population of an unlisted plant species, previously unknown from Washington, was discovered. A brief review of significant findings from the 1997 survey in regard to individual species is provided below.

- ***Eriogonum codium*** – Previous to biodiversity surveys, this species was undescribed. It is listed as endangered by the state of Washington and identified as a species of concern by the USFWS. Originally discovered during 1995, the only known occurrence of *Eriogonum codium* was resurveyed, remapped, and recounted during 1997. A total of 5200 plants was estimated to be present. Long-term demographic monitoring was initiated on this species in 1997.

- ***Lesquerella tuplashensis*** – Previous to biodiversity surveys, this species also was undescribed, and is listed as endangered by the state of Washington and identified as a species of concern by the USFWS. During 1997 the remainder of the only known occurrence of *Lesquerella tuplashensis* was mapped and counted. The total count of adult plants was estimated to be 50,000 plants. Infestations of a noxious weed, *Centaurea solstitialis* (yellow starthistle), were located within the middle portion of the *Lesquerella* population. Long-term demographic monitoring was initiated on this species in 1997.

Hanford Site populations of two previously undocumented plant species were identified during 1997 field surveys. The two species are described below:

- ***Camissonia minor*** -- This annual species has a scattered distribution within the Columbia Basin. Its range includes most western states. In Washington, it is at the northern end of its range and is known from only Benton and Kittitas Counties. *Camissonia minor* generally occurs on very dry, often barren, and sometimes disturbed sites. Six relatively small populations were documented. On the Hanford Site, *Camissonia minor* occurred in conjunction with a number of other rare plant species. In Washington State, it is currently placed in Review Group 1.

- ***Myosurus* x *clavicaulis*** – This annual species (little mousetail; an "x" before the species name indicated that the species evolved as a hybrid of two other species) was previously unknown in the State of Washington. Its assumed range included Baja California, California, and Oregon. *Myosurus* x *clavicaulis* typically inhabits vernal pools. It occurred on the Hanford Site at a single vernal pool location (see Section 4.3.1). The species also was located during the 1997 field season at five additional vernal pool sites in northeastern Washington. At some locales in the Central Valley of California, the taxonomic status of *Myosurus* x *clavicaulis* is complicated by the presence of other species of *Myosurus*, whose hybrids produce progeny identical to *Myosurus* x *clavicaulis*. At Hanford, however, the *Myosurus* x *clavicaulis* population was self-sustaining and did not occur in the presence of its parental species. The species has no current conservation status in Washington; however, *Myosurus* x *clavicaulis* will be recommended for future tracking by the Washington Natural Heritage Program.

The two major vegetation types occurring along the Hanford Reach of the Columbia River are riparian and upland (NPS 1994). Riparian habitats are found along the shoreline, slack water and slough areas, and on islands in the river. Riparian vegetation at these locations includes both woody and herbaceous species maintained by the high water table immediately adjacent to the river. Common plant species occurring in the riparian zone include black cottonwood, mulberry, willow, dogbane, and a variety of grasses and forbs (Cushing 1992). Sensitive habitats within the riparian zone include islands and cobbled shorelines occurring as a narrow band along the Hanford Reach. Plant species occurring in these areas include perennial summer-blooming forbs adapted to seasonal changes in water levels (NPS 1994). Upland habitats along the Hanford Reach are composed of shrub-steppe vegetation similar to that found on the rest of the Hanford Site.

The ALE Reserve supports one of the largest remnants of relatively undisturbed shrub-steppe ecosystem in the State of Washington. Vegetation on the ALE Reserve includes largely undisturbed stands of several plant communities (e.g., sagebrush-bluebunch wheatgrass, blue bunch wheatgrass, sagebrush-Sandberg's bluegrass, sagebrush-bitterbrush-needle-and-thread grass, cheatgrass, and cottonwoods and willows) (PNL 1993c). Extensive wildfires have removed the shrub component from large areas of the ALE Reserve. These areas now support stands of perennial bunchgrasses at the upper elevations and cheatgrass and bunchgrasses at the lower elevations (PNL 1993c).

Special topographic features of the Hanford Site include Gable Butte and Gable Mountain north of the Central Plateau and an extensive series of active sand dunes in the southeast portion of the Site. Vegetation occurring on scree slopes, outcrops, and scarps on Gable Butte and Gable Mountain is limited to scattered individuals or groups of plants. Plant species include squaw currant, bluebunch wheatgrass, rock buckwheat, and thyme buckwheat. Rigid sagebrush occurs at the Hanford Site only on Gable Mountain and Umtanum Ridge (PNL 1993c).

4.5.2.2 Fire. Plant communities within the shrub-steppe have evolved in the presence of natural wildfires. Typically, shrubs are killed by fire, but the perennial bunchgrasses are not killed. The severity of the damage depends upon the intensity and extent of the fire. Hot fires incinerate entire shrubs and damage grass crowns. Less intensive fires leave dead shrub stems standing with prompt recovery of grasses and forbs. The most recent and extensive wildfire on

Figure 4-22. Distribution of Vegetation Types and Cover Classes on the Hanford Site.

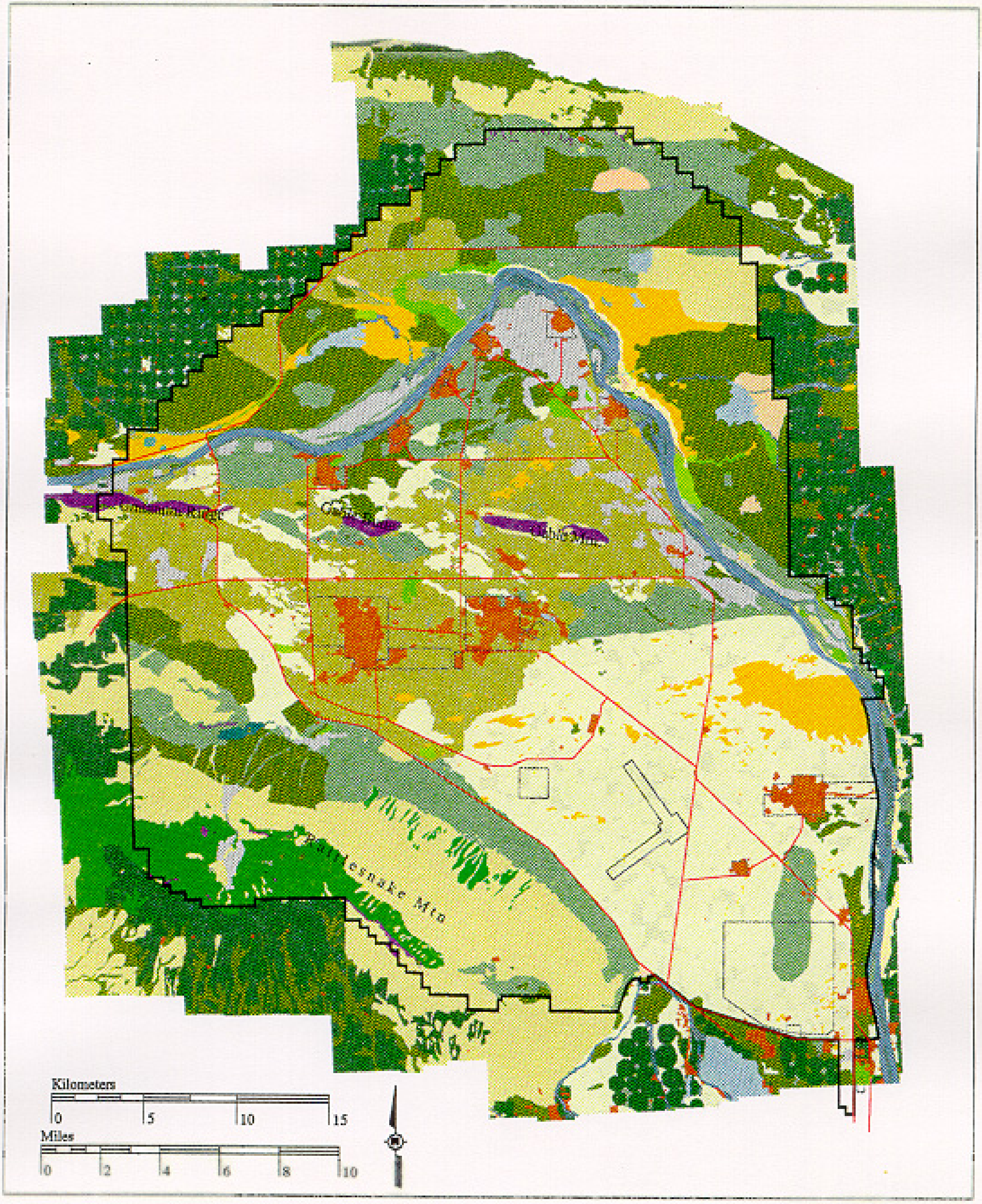


Figure 4-22. Distribution of Vegetation Types and Cover Classes on the Hanford Site (Legend).

- Post-Fire Shrub-Steppe on the Columbia River Plain
- Rabbitbrush / Bunchgrasses
- Rabbitbrush / Cheatgrass
- Big Sagebrush / Bunchgrasses –Cheatgrass
- Big Sagebrush –Spiny Hopsage / Bunchgrasses –Cheatgrass
- Threetip Sagebrush / Bunchgrasses
- Spiny Hopsage / Bunchgrasses
- Spiny Hopsage / Cheatgrass
- Black Greasewood / Sandberg's Bluegrass
- Winterfat / Bunchgrasses
- Winterfat / Cheatgrass
- Snow Buckwheat / Indian Ricegrass
- Bunchgrasses
- Cheatgrass –Sandberg's Bluegrass
- Planted Non-native Grass
- Bitterbrush / Bunchgrasses Sand Dune Complex
- Bitterbrush / Cheatgrass
- Alkali Saltgrass –Cheatgrass
- Riparian
- Basalt Outcrops
- Agricultural Areas
- White Bluffs Cliffs
- Buildings / Parking Lots / Gravel Pits / Disturbed Areas
- Abandoned Old Fields and Farms
- Riverine Wetlands and Associated Deepwater Habitats
- Non-Riverine Wetlands and Associated Deepwater Habitats

the Hanford Site occurred in the summer of 1998 and burned approximately 4,047 ha (10,000 ac). Previous fires occurred in 1957, 1973, and 1981, and 1984 (see Figure 4-22). The presence of non-native plant species and changing land-use practices have altered the frequency and severity of wildfires. Less frequent and more severe fires have reduced the ability of the native habitat to recover from fire, as well as the development of late successional shrub-steppe habitat.

4.5.2.3 Weeds. Non-native weedy species have invaded many areas on the Hanford Site. In particular, weeds have invaded areas that have been disturbed by natural (e.g., fire) and human factors (e.g., pre-Hanford agricultural activities, road and facility construction, etc.). The weed species include, but are not limited to, cheatgrass; Russian thistle; Russian, spotted, and diffuse knapweed; yellow star thistle; Rush skeletonweed; and puncture vines. Cheatgrass and Russian thistle, annuals introduced from Eurasia in the late 1800s, invade areas where the ground surface has been disturbed.

4.5.3 Wildlife

Major habitat types occurring on the Hanford Site include basalt outcrops, scarps and screes, riparian and riverine areas, shrub-steppe, sand dunes and blowouts, and abandoned fields (PNL 1993c). These habitat types support a variety of wildlife.

4.5.3.1 Mammals. Approximately 40 species of mammals have been identified on the Hanford Site (PNNL 1996a). The major predator inhabiting the Hanford Site is the coyote, which ranges all across the Hanford Site. Coyotes have been a major cause of destruction for the nests of Canadian geese on Columbia River islands, especially islands upstream from the abandoned Hanford townsite. Bobcats, cougars, and badgers also inhabit the Hanford Site in low numbers.

Black-tailed jackrabbits are common on the Hanford Site and are mostly associated with mature stands of sagebrush. Cottontail rabbits also are common but appear to be more closely associated with the buildings, debris piles, and equipment laydown areas associated with the onsite laboratory and industrial facilities.

Townsend’s ground squirrels occur in colonies of various sizes scattered across the Hanford Site. The most abundant mammal inhabiting the Site is the Great Basin pocket mouse. The mouse occurs all across the Columbia River plain and on the slopes of the surrounding ridges. Other small mammals include the deer mouse, harvest mouse, grasshopper mouse, montane vole, vagrant shrew, and Merriam’s shrew.

The Hanford Site has 14 species of bats that are known to be or are potential inhabitants, most of which may be present year-round (PNL 1993d). The pallid bat frequents deserted buildings and is thought to be the most abundant. Other species include the hoary bat, silver-haired bat, California brown bat, little brown bat, Yuma brown bat, and Pacific western big-eared bat.

A herd of Rocky Mountain elk is present on the ALE Reserve. It is believed these animals migrated to the reserve from the Cascade Mountains in the early 1970s. This herd grew from approximately eight animals in 1975 to approximately 420 animals in December 1996 (after the hunting season).[1] Current projections indicate that the elk herd is composed of approximately 800 animals and is still growing. The herd tends to congregate on the ALE Reserve in the winter and disperses during the summer months onto the Site proper, private land to the west of the ALE Reserve, and the Yakima Firing Center. Although lack of water and the high level of human activity presumably inhibit the elk from using other areas of the Hanford Site, the elk are occasionally seen

[1] Personal communication with Brett Tiller, Pacific Northwest National Laboratory, September 22, 1997.

on the 200 Area Plateau and have been sighted at the White Bluffs boat launch. Despite the arid climate, these elk appear to be very healthy; antler and body size for some age classes are among the highest recorded for this species (Neitzel 1997). In addition, reproductive output of this species is also among the highest recorded.

Mule deer are found throughout the Hanford Site, although areas of highest concentrations are on the ALE Reserve and along the Columbia River. Deer populations on the Hanford Site appear to be relatively stable. Islands in the Hanford Reach are used extensively as fawning sites by the deer (Neitzel 1997) and are a very important habitat for this species. Hanford Site deer frequently move offsite and are killed by hunters on adjacent public and private lands (Neitzel 1997).

4.5.3.2 Birds. In general, bird species on the Hanford Site include a variety of raptors, songbirds, and other species associated with riparian, riverine, and upland habitats. The Nature Conservancy recently summarized its findings for birds and mammal surveys. These surveys fall short of the number of species that have been documented on site historically. For example, 178 species were observed in the bird surveys in 1997. This number falls short of the 246 species identified historically (Neitzel 1998). Species of birds found at or near the Hanford Site include common species and accidental species.

Twenty-six species of raptors have been sighted on the Hanford Site, 11 of which are known to nest on the Hanford Site (PNL 1981). The nesting species include the great horned owl, long-eared owl, short-eared owl, barn owl, burrowing owl, northern harrier, ferruginous hawk, Swainson’s hawk, red-tailed hawk, prairie falcon, and American kestrel. In 1994, nesting by red-tailed, Swainson’s, and ferruginous hawks included 41 nests located across the Hanford Site in relation to high voltage transmission towers, trees, cliffs, and basalt outcrops. In recent years the number of nesting ferruginous hawks on the Hanford Site has increased, as a result in part to their acceptance of steel powerline towers in the open grass and shrubland habitats (Neitzel 1998).

Raptors that may occur year-round on the Hanford Site are the northern harrier, red-tailed hawk, golden eagle, prairie falcon, American kestrel, barn owl, great horned owl, long-eared owl, and burrowing owl (Fitzner and Gray 1991). Raptors use a variety of habitats for nesting and foraging at the Hanford Site. Depending on raptor size and species, prey may include small mammals, birds, reptiles (e.g., snakes), and insects.

Passerine species known to occur in the shrub-steppe vegetation on the Hanford Site include the loggerhead shrike, sage sparrow, western meadowlark, grasshopper sparrow, horned lark, and sage thrasher. The western meadowlark, sage sparrow, and horned lark are the most abundant shrub-steppe passerine bird species that breed on the Hanford Site (Rickard and Poole 1989). The western meadowlark and horned lark nest on the ground in the open, while shrub-steppe species (e.g., the sage sparrow, sage thrasher, and loggerhead shrike) require sagebrush or bitterbrush for nesting habitat.

Common upland game species that occur in shrub and grassland habitat include the chukar partridge, California quail, and Chinese ring-necked pheasant. Chukars are most numerous in the Rattlesnake Hills, Yakima Ridge, Umtanum Ridge, Saddle Mountains, and Gable Mountain areas of the Hanford Site. Less common species include western sage grouse, Hungarian partridge, and scaled quail. Western sage grouse were historically abundant on the Hanford Site; however, populations have declined since the early 1800s because of the conversion of sagebrush-steppe habitat. Surveys conducted by the WDFW and PNNL during late winter and early spring 1993, and biodiversity inventories conducted by The Nature Conservancy in 1997 did not reveal presence of western sage grouse in sagebrush-steppe habitat at ALE (Neitzel 1998). The McGee Ranch area is viewed by the WDFW as habitat critical to the natural re-establishment of sage grouse populations on the ALE Reserve by providing a habitat corridor to the U.S. Army’s

Yakima Training Center.

In addition to upland bird species, numerous species associated with wetlands and riparian habitats are found along the Columbia River and at isolated wetlands on the Hanford Site. Ring-billed and California gulls, Forster's terns, and Canadian geese all form nesting colonies on islands in the Hanford Reach. Large numbers of swallows depend on the Columbia River riparian areas during the summer months, eating flying aquatic insects such as caddis flies and collecting mud from wetted areas to build their nests. The Hanford Site is located in the Pacific flyway and, during the spring and fall months, the Hanford Reach serves as a resting area for neotropical migrants, migratory waterfowl, and shorebirds. During the fall and winter months, large numbers of migratory ducks and geese find refuge along the Hanford Reach. Other species observed during winter months include white pelicans, double-crested cormorants, and common loons.

4.5.3.3 Reptiles and Amphibians. Fifteen species of reptiles and amphibians are known to occur on the Hanford Site (PNNL 1996a). The side-blotched lizard is the most abundant reptile and can be found throughout the Hanford Site. Short-horned and sagebrush lizards are also common in selected habitats. The most common snakes are the gopher snake, the yellow-bellied racer, and the Pacific rattlesnake, all of which are found throughout the Hanford Site. Striped whipsnakes and desert night snakes are rarely found, but some sightings have been recorded for the Site. Toads and frogs (e.g., Great Basin spadefoot toad, Woodhouse's toad, bullfrog, and the Pacific tree frog) are found near the permanent water bodies and along the Columbia River.

4.5.3.4 Insects. Many species of insects occur throughout all habitats on the Hanford Site. Butterflies, grasshoppers, and darkling beetles are among the more conspicuous of the approximately 1,500 species of insects that have been identified from specimens collected on the Hanford Site. The actual number of insect species occurring on the Hanford site may reach as high as 15,000. The recent surveys performed by The Nature Conservancy included the collection of 30,000 specimens and have resulted in the identification of 42 new taxa and 172 new findings in the State of Washington (Neitzel 1998). Insects are more readily observed during the warmer months of the year (see text box, *"Hanford Site Quick Facts: Wildlife"*).

> ***Hanford Site Quick Facts: Wildlife***
>
> - 44 species of fish
> - 40 species of mammals
> - Approximately 238 species of birds
> - 15 species of reptiles and amphibians
> - Approximately 1,500 species of insects

4.5.4 Terrestrial Wildlife and Habitat

Terrestrial wildlife species use both shoreline riparian and shrub-steppe habitats occurring along the Columbia River and on the islands occurring in the Hanford Reach. Wildlife reported to use the Hanford Reach include 184 species of birds, 36 species of mammals, nine species of reptiles, and four species of amphibians (NPS 1994). Canada geese use the islands along the Hanford Reach extensively for nesting. Studies on the nesting habits of geese that use the Hanford Site have been ongoing since 1953. These studies indicate a general decline over the years in the number of nests on the islands in the Hanford Reach because of heavy predation by coyotes (PNNL 1996a). Mule deer use the islands and other riparian areas for fawning habitat. Wildlife occurring on the shoreline habitat includes 46 species that use willow communities and 49 species that use grass areas (NPS 1994).

Terrestrial wildlife species found in the 100 Areas generally are the same species found across the Hanford Site (Cushing 1992). Coyotes occurring along the Columbia River reportedly feed on carp and small mammals such as the Great Basin pocket mouse, northern pocket gopher, Nuttall's cottontail, and black-tailed jack rabbit (Fitzner and Gray 1991). Mule deer may occur almost anywhere on the Hanford Site but prefer habitats along the Columbia River where riparian areas provide abundant food and cover. Mule deer forage on mulberry, Russian olive, and cottonwood trees, and shrubs such as willow (WHC 1992c).

Wildlife likely to occur in riparian habitat adjacent to the Columbia River includes a variety of birds, mammals, reptiles, and amphibians (Fitzner and Gray 1991). The three known species of amphibians at the Hanford Site use riparian habitat along permanent water bodies and the Columbia River. Medium-size mammals using riparian habitat are the muskrat, raccoon, beaver, weasel, skunk, otter, and porcupine; small mammals include the vagrant shrew and montane meadow mouse. Upland birds likely to occur in habitats in the 100 Areas along the Columbia River are the California quail and ring-necked pheasant (Cushing 1992). Trees along the river, including those found in the 100 Areas, provide habitat for several species of birds. These include the great blue heron, which has colonial nest sites (rookeries) near the White Bluffs ferry landing, and the bald eagle, which uses selected trees for perching and night roosts during the winter (PNNL 1996a).

Terrestrial wildlife species common to the Hanford Site also can be found in the Central Plateau (Cushing 1992). A characterization study of small mammals that occur near the 100-B/C cribs (located south of the 200 East Area) resulted in five species being trapped: Great Basin pocket mouse, deer mouse, northern grasshopper mouse, sagebrush vole, and western harvest mouse (PNL 1977). The Great Basin pocket mouse represented more than 90 percent of the mammals caught. Medium and large-size mammals that may occur in the Central Plateau include rabbits, coyotes, badgers, and mule deer (PNL 1977). Mammals potentially using areas associated with ponds and ditches in the 200 East and 200 West Areas include muskrats, porcupines, and raccoons.

Many common bird species, such as the western meadowlark and sage sparrow, are likely to occur on the Central Plateau where suitable habitats exist. Thirty-seven species of terrestrial birds were recorded during surveys conducted in the 200 East and 200 West Areas of the Hanford Site in 1986 (Schuller et al. 1993). Bird studies associated with waste water ponds in the Central Plateau reveal that a large number of species, particularly waterfowl, use these ponds during migration (PNL 1977).

Unique habitats can be found on Columbia River islands, sand dunes, the cliffs of White Bluffs, and on Gable Butte and Gable Mountain situated north of the Central Plateau (Figure 4-23). The Gable Butte and Gable Mountain unique habitats include basalt outcrops, scarps, and scree slopes. Birds likely to occur in these habitats are the prairie falcon, rock wren, poorwill, and chukar; small mammals include the yellow-bellied marmot and wood rat; reptiles include rattlesnakes, gopher snakes, and horned lizards (PNL 1993c).

4.5.5 Species of Concern on the Hanford Site

Species of concern on the Hanford Site include federally listed threatened or endangered species, state-listed threatened or endangered species, and state candidate species (see text box, *"Hanford's Federal Threatened and Endangered Species"*).

Hanford's Federal Threatened and Endangered Species

Several federally threatened or endangered species might be found at the Hanford Site, including the following:

- Steelhead (Upper Columbia River run)
- Chinook salmon (Upper Columbia River spring-run)
- Steelhead (Middle Columbia River run)
- Aleutian Canada goose*
- Bald eagle*
- Peregrine falcon[1]
- Ute Ladies'-tresses

*To be delisted within two years.
[1]Was delisted August 25, 1999.

Figure 4-23. Plant Communities of Concern on the Hanford Site.

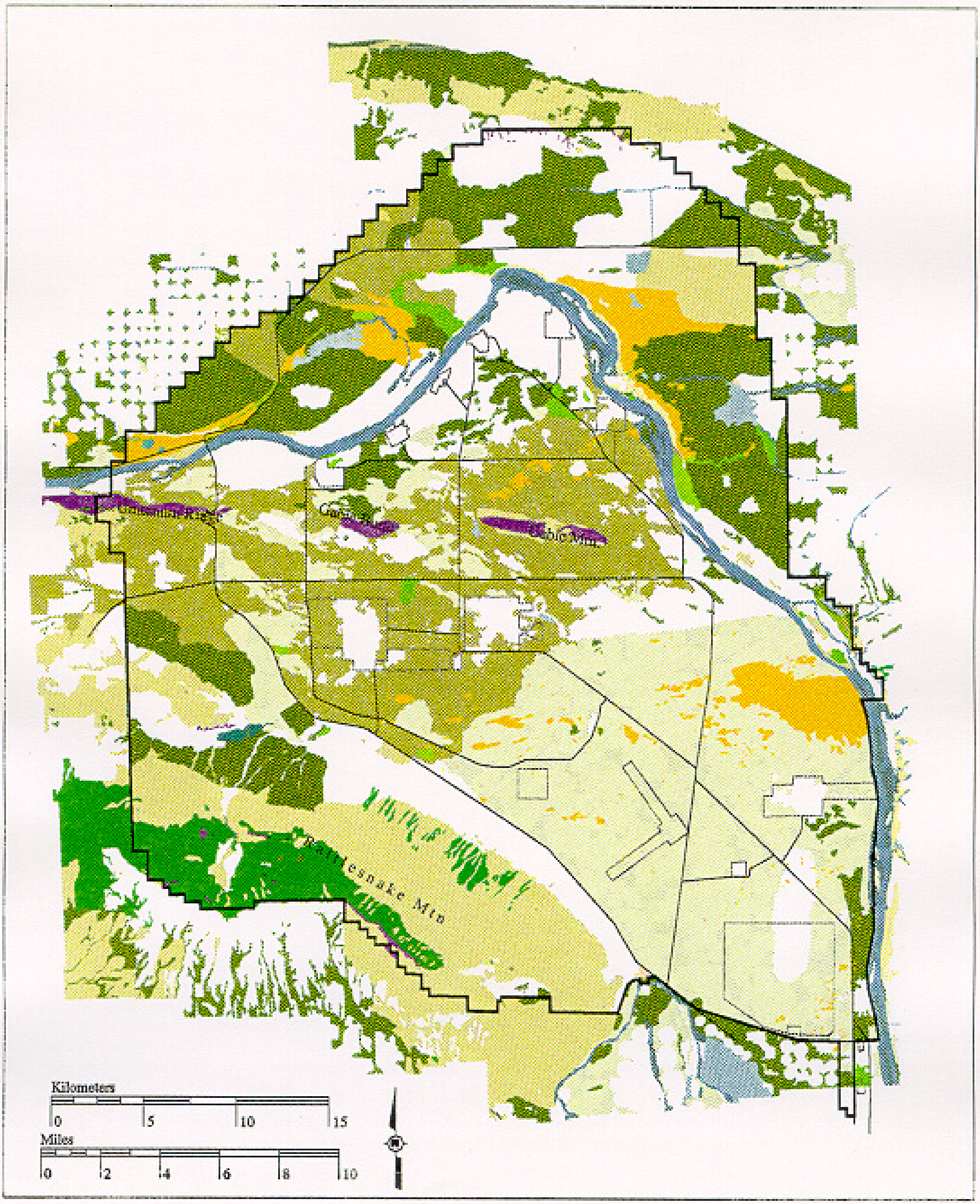


Figure 4-23. Plant Communities of Concern on the Hanford Site (Legend).

- Post-Fire Shrub-Steppe on the Columbia River Plain
- Rabbitbrush / Bunchgrasses
- Big Sagebrush / Bunchgrasses –Cheatgrass
- Big Sagebrush –Spiny Hopsage / Bunchgrasses –Cheatgrass
- Threetip Sagebrush / Bunchgrasses
- Spiny Hopsage / Bunchgrasses
- Spiny Hopsage / Cheatgrass
- Black Greasewood / Sandberg's Bluegrass
- Winterfat / Bunchgrasses
- Winterfat / Cheatgrass
- Snow Buckwheat / Indian Ricegrass
- Bunchgrasses
- Planted Non-native Grass
- Bitterbrush / Bunchgrasses Sand Dune Complex
- Bitterbrush / Cheatgrass
- Alkali Saltgrass –Cheatgrass
- Riparian
- Basalt Outcrops
- White Bluffs Cliffs
- Riverine Wetlands and Associated Deepwater Habitats
- Non-Riverine Wetlands and Associated Deepwater Habitats

- Habitats of Low Value
  - Rabbitbrush / Cheatgrass
  - Cheatgrass –Sandberg's Bluegrass
  - Agricultural Areas
  - Abandoned Old Fields and Farms
  - Buildings / Parking Lots / Gravel Pits / Disturbed Areas

No plants or mammals listed in “Federal List of Endangered and Threatened Wildlife and Plants” (50 CFR 17) are known to occur on the Hanford Site. There are, however, two species of birds, two fish species (two ESU for steelhead) and one suspected plant that are federally listed, and several species of plants and animals are under consideration for formal listing by the State of Washington.

Candidate species occurring on the Hanford Site are considered in the preparation of DOE NEPA documentation. Species of concern occurring on the Hanford Site are listed in Tables 4-6 and 4-7; the tables also include definitions of each category of species of concern.

No federally listed threatened or endangered plant species occur on the Hanford Reach. Nine species of Hanford Site plants are included in the Washington State listing as threatened or endangered (see Table 4-6). Columbia milk-vetch occurs on dry-land benches along the Columbia River near Priest Rapids Dam, Midway, and Vernita; it also has been found atop Umtanum Ridge and in Cold Creek Valley near the ALE Reserve. Dwarf evening primrose has been found north of Gable Mountain, near the Vernita Bridge, Ringold, and on steep talus slopes near Priest Rapid Dam, Midway, and Vernita. Yellowcress occurs in the wetted zone of the water's edge along the Hanford Reach. Northern wormwood is known to occur near Beverly and could inhabit the northern shoreline of the Columbia River across from the 100 Areas. Umtanum desert buckwheat and White Bluffs bladderpod occur on the Hanford Site and no where else in the world. Leoflingia occurs north of Gable Mountain (Neitzel et al. 1998).

Wildlife species of concern that may occur along the Hanford Reach include several species of birds associated with riparian and aquatic habitat (PNL 1993c), the Upper Columbia River spring-run chinook salmon and the Upper and Middle Columbia River runs of steelhead from the confluence of the Yakima River and upstream. The Federal government lists the Aleutian Canada goose, the bald eagle, and Middle Columbia River steelhead as threatened, and the Upper Columbia River steelhead, and Upper Columbia River spring-run chinook salmon as endangered. The State of Washington lists, in addition to the peregrine falcon and Aleutian Canada goose, include the white pelican, sandhill crane, and pygmy rabbit as endangered, and the ferruginous hawk and the bald eagle as threatened. The peregrine falcon is a casual migrant to the Hanford Site and does not nest there. The bald eagle is a regular winter resident and forages on dead salmon and waterfowl along the Columbia River; it does not nest on the Hanford Site although it has attempted to for the past several years (see Table 4-7) (Neitzel et al. 1998).

The bald eagle, a Federal and Washington State threatened species, is the only federally listed wildlife species known to regularly use the 100 Areas. Bald eagles use groves of trees (e.g., black locust, white poplar, and Siberian elm) along the Hanford Reach for winter perching, night roosts, and nesting sites (DOE-RL 1994b). Buffer zones around primary night roosts and nest sites have been established in consultation with the USFWS. While the night-roost locations are consistent from year to year, the nesting sites have varied and are readjusted in consultation with the USFWS each year (see Figure 4-24).

Steelhead and salmon are regulated as evolutionary significant units (ESUs) by the National Marine Fisheries Service based on their historic geographic spawning areas. The Upper Columbia River steelhead ESU was listed as threatened in August 1997. Adult steelhead migrate upstream through the Hanford Reach to spawn in upriver tributaries and juvenile pass through the Hanford Reach on their outward migration to the sea. In March 1999, Upper Columbia River spring run chinook salmon ESU were added as endangered, and the Middle Columbia River steelhead ESU were added as threatened. These races of salmonids utilize habitat in the mid-Columbia River and its tributaries.

Table 4-6. Plant Species of Concern Occurring on the Hanford Site (adapted from PNNL 1996a). (2 pages)

Common Name	Scientific Name	Federal Status	State Status
Ammania	*Ammania robusta*		R1
Annual Paintbrush	*Castilleja exilis*		R1
Bristly Combseed	*Pectocarya setosa*		W
Bristly cryptantha	*Cryptantha spiculifera (= C. interrupta)*		S
Brittle prickly-pear	*Opuntia fragilis*		R1
Canadian St. John wort	*Hypericum majus*		S
Chaffweed	*Centunculus minimus*		R1
Columbia milk-vetch	*Astragalus columbianus*		T
Columbia river mugwort	*Artemisia lindleyana*		E
Columbia yellowcress	*Rorippa columbiae*		E
Coyote tobacco[a]	*Nicotiana attenuata*		S
Crouching milkvetch	*Astragalus succumbens*		W
Dense sedge[a]	*Carex densa*		S
Desert Cryptantha	*Cryptantha scoparia*		R1
Desert dodder	*Cuscuta denticulata*		S
Desert evening primrose	*Oenothera caespitosa*		S
Dr. Bill's Locoweed	*Astragalus conjunctus var. novum*		R1
Dwarf evening primrose	*Oenothera pygmaea*		T
False pimpernel	*Lindernia dubia anagallidea*		R2
Few-flowered collinsia[a]	*Collinsia sparsiflora var. bruciae*		S
Fuzzy beardtongue	*Penstemon eriantherus whitedii*		R1
Geyer’s milkvetch	*Astragalus geyeri*		S
Gray cryptantha	*Cryptantha leucophaea*		S
Great Basin Gilia	*Gilia leptomeria*		R1
Hedge Hog Cactus	*Pediocactus sempsonii var. robustior (=P. nigrispinus)*		R1
Hoover’s desert parsley	*Lomatium tuberosum*		T
Kittitas Larkspur	*Delphinium multiplex*		W
Loeflingia	*Loeflingia squarrosa var. squarrosa*		T
Medic milkvetch[a]	*Astragalus speirocarpus*		W
Northern wormwood[b]	*Artemisia campestris borealis var. wormskioldii*		E

Table 4-6. Plant Species of Concern Occurring on the Hanford Site (adapted from PNNL 1996a). (2 pages)

Common Name	Scientific Name	Federal Status	State Status
Palouse milkvetch[a]	*Astragalus arrectus*		S
Palouse thistle	*Cirsium brevifolium*		W
Piper's daisy	*Erigeron piperianus*		S
Purple Mat	*Nama densum var. parviflorum*		R1
Robinson's onion	*Allium robinsonii*		W
Rosy balsamroot	*Balsamorhiza rosea*		W
Rosy calyptridium	*Calyptridium roseum*		S
Scilla onion	*Allium scillioides*		W
Shining flatsedge	*Cyperus bipartitus (rivularis)*		S
Small-flowered evening primrose	*Camissonia (Oenothera) minor*		R1
Small-flowered Hemicarpha	*Lipocarpha (=Hemicarpha) aristulata*		R1
Smooth cliffbrake	*Pellaea glabella simplex*		W
Southern mudwort	*Limosella acaulis*		W
Stalked-pod milkvetch	*Astragalus sclerocarpus*		W
Suksdorf's monkeyflower	*Mimulus suksdorfii*		S
Thompson's sandwort[a]	*Arenaria franklinii thompsonii*		R2
Toothcup	*Rotala ramosior*		R1
Umtanum desert buckwheat	*Eriogonum codium*		E
Ute ladies'-tresses[a]	*Spiranthes diluvialis*	T	
White Bluffs bladderpod	*Lesquerella tuplashensis*		E
White eatonella	*Eatonella nivea*		T
Winged combseed	*Pectocarya linearis*		R1

[a] May inhabit the Hanford Site but have not been recently collected, or the known collections are questionable in terms of location and/or identification.
[b] Likely not currently occurring on the Hanford Site.
R1 = Review Group 1. Taxa for which there are insufficient data to support listing as threatened, endangered, or sensitive.
R2 = Review Group 2. Taxa with unresolved taxonomic questions; once resolved these taxa could qualify for listing as endangered, threatened, sensitive.
S = Sensitive. Taxa that are vulnerable or declining, and could become threatened or endangered without active management or removal of threats.
T = Threatened; a species native to Washington State likely to become endangered within the foreseeable future throughout significant portions of its range within the state without cooperative management or the removal of threats. Threatened species are designated in WAC 232-12-011.
E = Endangered; a species native to Washington State that is seriously threatened with extinction throughout all or a significant portion of its range within the state. Endangered species are designated in WAC 232-12-014.

Table 4-7. Wildlife Species of Concern Occurring on the Hanford Site (adapted from Cushing 1995).

Common Name	Scientific Name	Federal Status	State Status
Molluscs			
Columbia pebble snail	*Fluminicola* (= *Lithoglyphus*) *columbiana*		C
Shortfaced lanx	*Fisherola* (= *Lanx*) *nuttalli*		C
Fish			
Steelhead (Upper Columbia River run)	*Onchorhynchus mykiss*	E	
Steelhead (Middle Columbia River run)	*Onchorhynchus mykiss*	T	
Chinook salmon (Upper Columbia spring run)	*Onchorynchus tshawytscha*	E	
Birds			
Aleutian Canada goose[b]	*Branta canadensis leucopareia*	T	E
American white pelican	*Pelecanus erythrorhynchos*		E
Bald eagle	*Haliaeetus leucocephalus*	T	T
Ferruginous hawk	*Buteo regalis*		T
Peregrine falcon[b]	*Falco peregrinus*		E
Sandhill crane[b]	*Grus canadensis*		E
Burrowing owl	*Athene cunicularia*		C
Common loon	*Gavia immer*		C
Flammulated owl[b]	*Otus flammeolus*		C
Golden eagle	*Aquila chrysaetos*		C
Lewis' woodpecker[b]	*Melanerpes lewis*		C
Loggerhead shrike	*Lanius ludovicianus*		C
Northern goshawk[b]	*Accipiter gentilis*		C
Sage sparrow	*Amphispiza belli*		C
Sage thrasher	*Oreoscoptes montanus*		C
Western sage grouse[b]	*Centrocercus urophasianus*		C
Insects			
Columbia River tiger beetle[b]	*Cicindela columbica*		C
Juniper hairstreak	*Mitoura siva*		C
Silver-bordered bog fritillary	*Boloria selene atrocastalis*		C
Reptiles			
Striped whipsnake	*Masticophis taeniatus*		C
Mammals			
Merriam's shrew	*Sorex merriami*		C
Pacific (Townsend's) western big-eared bat[b]	*Corynorhinus townsendii* (also known as *Plecotus townsendii)*		C
Pygmy rabbit[a]	*Brachylagus idahoensis*		E
Washington ground squirrel	*Spermophilus washingtoni*		C

[a] Likely not occurring on the Hanford Site.
[b] Reported as possibly occurring on the Hanford Site.
C = Candidate; a native species that the state or Federal Departments of Fish and Wildlife has enough substantial information on biological vulnerability to support proposals to list them as endangered or threatened species.
E = Endangered; a species that is seriously threatened with extinction throughout all or a significant portion of its range. Endangered species are designated in WAC 232-12-014 or 50 CFR 17.
T = Threatened; a species that is likely to become endangered within the foreseeable future throughout significant portions of its range without cooperative management or the removal of threats. Threatened species are designated in WAC 232-12-011 or 50 CFR 17.

4.5.6 Aquatic Species and Habitat

There are two primary types of natural aquatic habitats on the Hanford Site: (1) the Columbia River, which flows along the northern and eastern edges of the Hanford Site; and (2) the small spring-streams and seeps located mainly in the Rattlesnake Hills. Several artificial water bodies, both ponds and ditches, have been formed as a result of waste water disposal practices associated with the operation of the reactors and separation facilities. These bodies of water are temporary and will vanish with cessation of activities, but while present, the ponds form established aquatic ecosystems (except the West Pond), complete with representative flora and fauna. The West Pond, also known as West Lake, is created by a rise in the water table in the Central Plateau and is not fed by surface flow; thus, the pond is alkaline and has low species diversity.

Forty-four species of fish representing 13 families are known to occur in the Hanford Reach (PNNL 1996a). Of these species, chinook salmon, sockeye salmon, coho salmon, steelhead, and Pacific lamprey use the Columbia River as a migration route to upstream spawning areas. Other fish of importance to sport fishermen are whitefish, sturgeon, small-mouth bass, catfish, walleye, and perch. Large populations of rough fish also are present, including carp, shiners, suckers, and squawfish (PNNL 1996a).

The Hanford Reach represents the only remaining significant mainstream Columbia River spawning habitat for stocks of Upper Columbia River summer/fall-run chinook salmon and white sturgeon (PNL 1990a). Since 1948, an annual census of salmon spawning on the Hanford Reach indicates that over 60 percent of fall chinook spawning occurs at Vernita Bar and the Locke Island area near White Bluffs (PNL 1993c). The numbers of fall chinook spawning sites (redds) in the Hanford Reach increased between the late 1940s and the 1980s. In 1988, the Hanford Reach served as the spawning area for 50 to 60 percent of the total fall chinook salmon runs in the Columbia River (Figure 4-25) (PNNL 1996a).

The Upper Columbia River run of steelhead has been federally listed as endangered. These fish spawn in and migrate through the Hanford Reach. Recent population estimates indicate that Upper Columbia River steelhead run has declined to fewer than 1,400 fish, prompting listing by the National Marine Fisheries Service (62 FR 43974). On March 16, 1999, the Upper Columbia River spring-run chinook salmon was added as endangered, and the Middle Columbia River steelhead was added as threatened.

Figure 4-24. Bald Eagle Primary Night Roosts and Nest Sites (PNNL database).

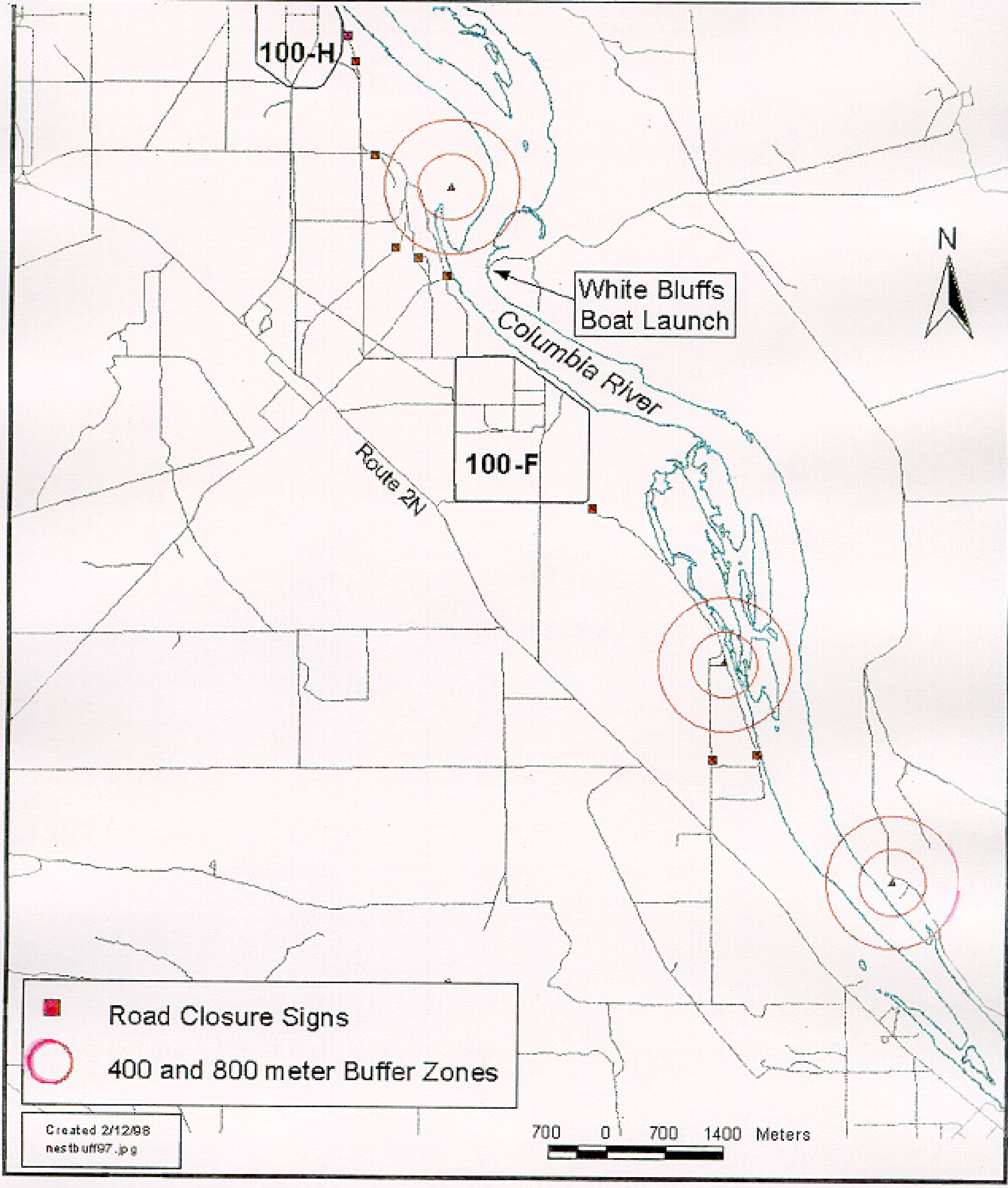
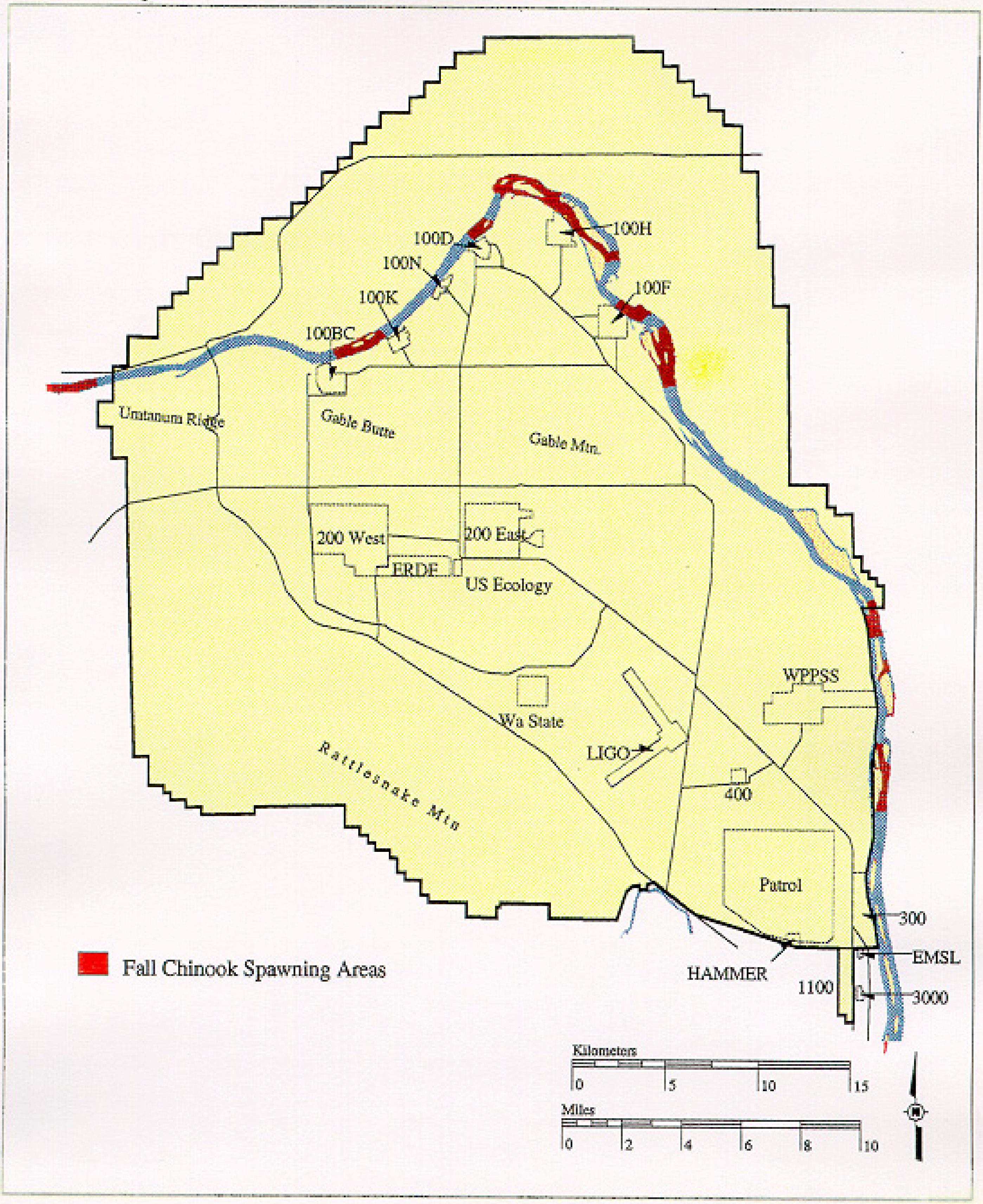


Figure 4-25. Key Fall Chinook Salmon Spawning Areas.



Steelhead follow a life cycle similar to salmon, but with one distinct difference; salmon die after spawning, but steelhead migrate back to the ocean and a small percentage return in subsequent years to spawn again. Little is known about the quality and quantity of steelhead spawning, rearing, and adult holding habitat in the Hanford Reach. Counts from 1972 and 1988 indicate that about 20,000 steelhead passed McNary Dam but did not pass Priest Rapids or Ice Harbor Dam. Some of these fish would enter the Yakima River while others would be caught in the Hanford Reach sport fishery. The remainder represent potential spawners. A substantial number of steelhead do terminate their migration in the Hanford Reach.

Aquatic plants in the Hanford Reach include water milfoil, waterweed, pondweed, Columbia yellowcress, watercress, and duckweed (PNNL 1996a). Aquatic plants generally are more prevalent where currents are less swift (e.g., in slack water areas like sloughs) (WHC 1992c). Aquatic plants are important to resident fish because they provide food, cover, and spawning areas for a variety of species. Water milfoil, an aggressive introduced aquatic plant, is becoming a nuisance in the Columbia River because of its rapid growth and lack of natural control.

Other aquatic species found in the Hanford Reach include a variety of microflora, zooplankton, and benthic invertebrates. Microflora include both sessile types (periphyton) and free-floating types (phytoplankton). Microflora species include diatoms, golden or yellow-brown algae, green algae, blue-green algae, red algae, and dinoflagellates. Dominant zooplankton taxa include *Bosmina*, *Diaptomus*, and *Cyclops*. Benthic invertebrate taxa occurring in the Hanford Reach include insect larvae such as caddis flies, midge flies, black flies, snails, freshwater sponges, limpets, and crayfish (PNNL 1996a).

The small spring-streams, such as Rattlesnake and Snively Springs, contain diverse biotic communities and are extremely productive (PNNL 1996a). Dense blooms of watercress occur and are not lost until a major flash flood occurs. The aquatic insect production is fairly high as compared to that in mountain streams (PNNL 1996a). The macrobenthic biota varies from site to site and is related to the proximity of colonizing insects and other factors.

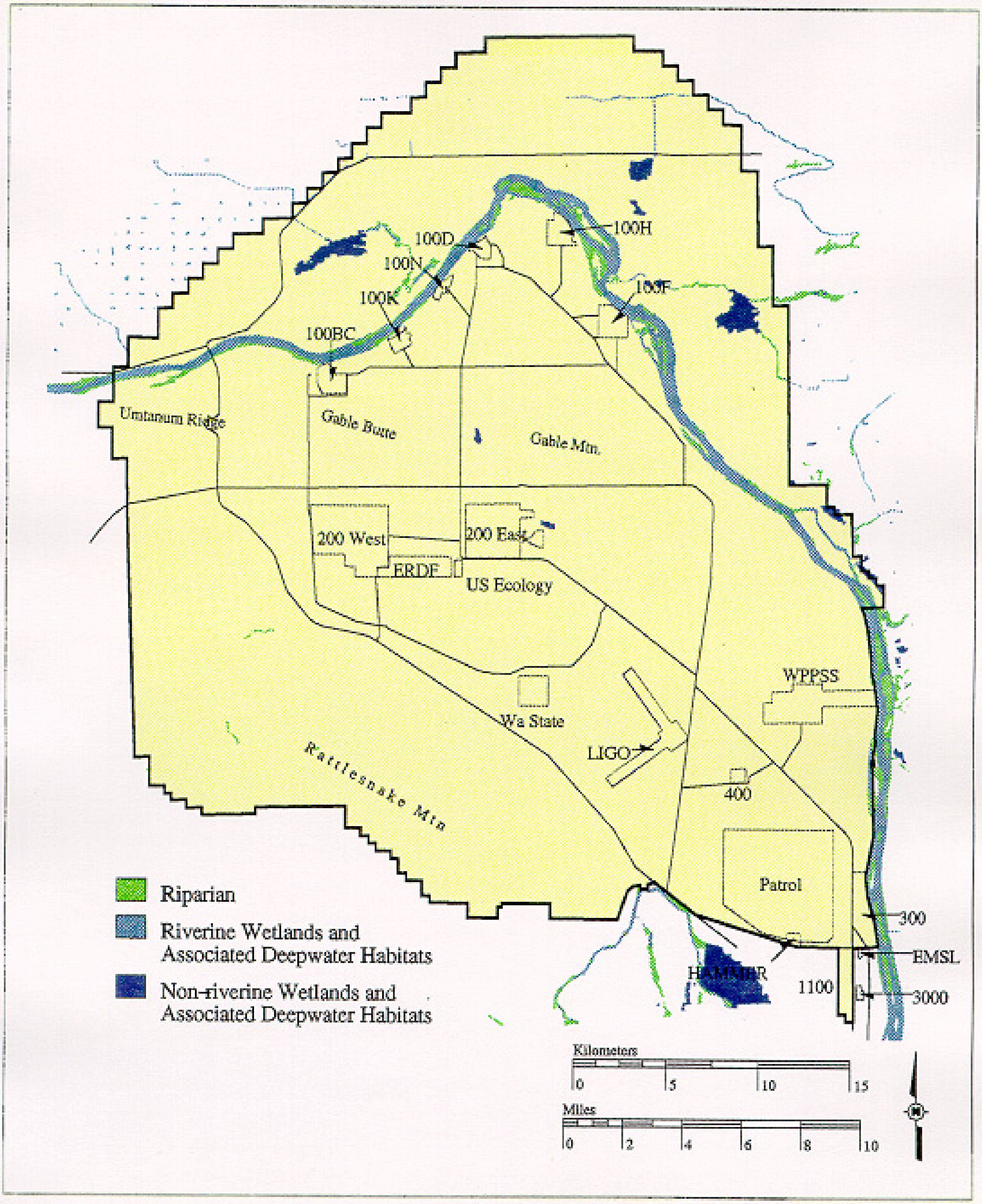
4.5.7 Wetland Habitat

Wetlands include transitional lands occurring between terrestrial and aquatic ecosystems (Figure 4-26) where the water table usually is close to the surface or where shallow water covers the surface. The primary jurisdictional wetlands found on the Hanford Site occur along the Hanford Reach and include the riparian and riverine habitats located along the river shoreline. Riparian habitat includes the uplands immediately adjacent to the Hanford Reach or its backwater sloughs and supports vegetation typical of a high water table (NPS 1994). Common riparian species found along the Hanford Reach include a variety of woody and herbaceous plant species.

Other wetland habitats found on the Hanford Site are associated with man-made ponds and ditches occurring on the Hanford Site, including the B Pond Complex located near the 200 East Area and a small cooling and waste water pond in the 400 Area. The B Pond complex was constructed in 1945 to receive cooling water from facilities in that area. Since that time, effluent flow to the B Pond has halted. One lobe of the pond received cooling water until very recently; the rest of the B Pond complex is slowly reverting to a shrub-steppe ecosystem.

The West Lake, a shallow, highly saline, and alkaline pond located southwest of Gable Mountain, fluctuates in size with changes in the water table (PNL 1991b) and is currently less than 2 ha (5 ac) in size. Unlike other ponds on the Hanford Site, West Lake does not receive direct effluent discharges from Hanford Site facilities (PNL 1993a). Wetland vegetation found at West Lake is limited to scattered patches of emergent macrophytes, such as cattails and bulrushes.

Figure 4-26. Wetlands on the Hanford Site.



4.5.8 Biological Resources Management

The DOE is currently in the process of developing and implementing an overall management strategy for the conservation of fish, wildlife, and plant populations and their habitats on the Hanford Site. The Draft *Hanford Site Biological Resources Management Plan* (BRMaP) (DOE-RL 1996c) was developed to provide DOE and its contractors with a consistent approach to protect biological resources and to monitor, assess, and mitigate impacts from Hanford Site development, and environmental cleanup and restoration activities. The primary purposes of the BRMaP are (1) to support DOE Hanford missions; (2) to provide a mechanism for ensuring compliance with laws that relate to the management of potential impacts to biological resources; (3) to provide a framework for ensuring appropriate biological resource goals, objectives, and tools are in place to make DOE an effective steward of the Hanford Site biological resources; and (4) to implement an ecosystem management approach for biological resources on the Site.

Plant communities of concern have been identified for the Hanford Site using classifications from BRMaP. These classifications associate different management actions (i.e., monitoring, impact assessment, mitigation, and preservation) with particular sets of biological resources. The BRMaP classifies Hanford Site biological resources into four levels of management concern (Figure 4-27), which can be summarized as follows:

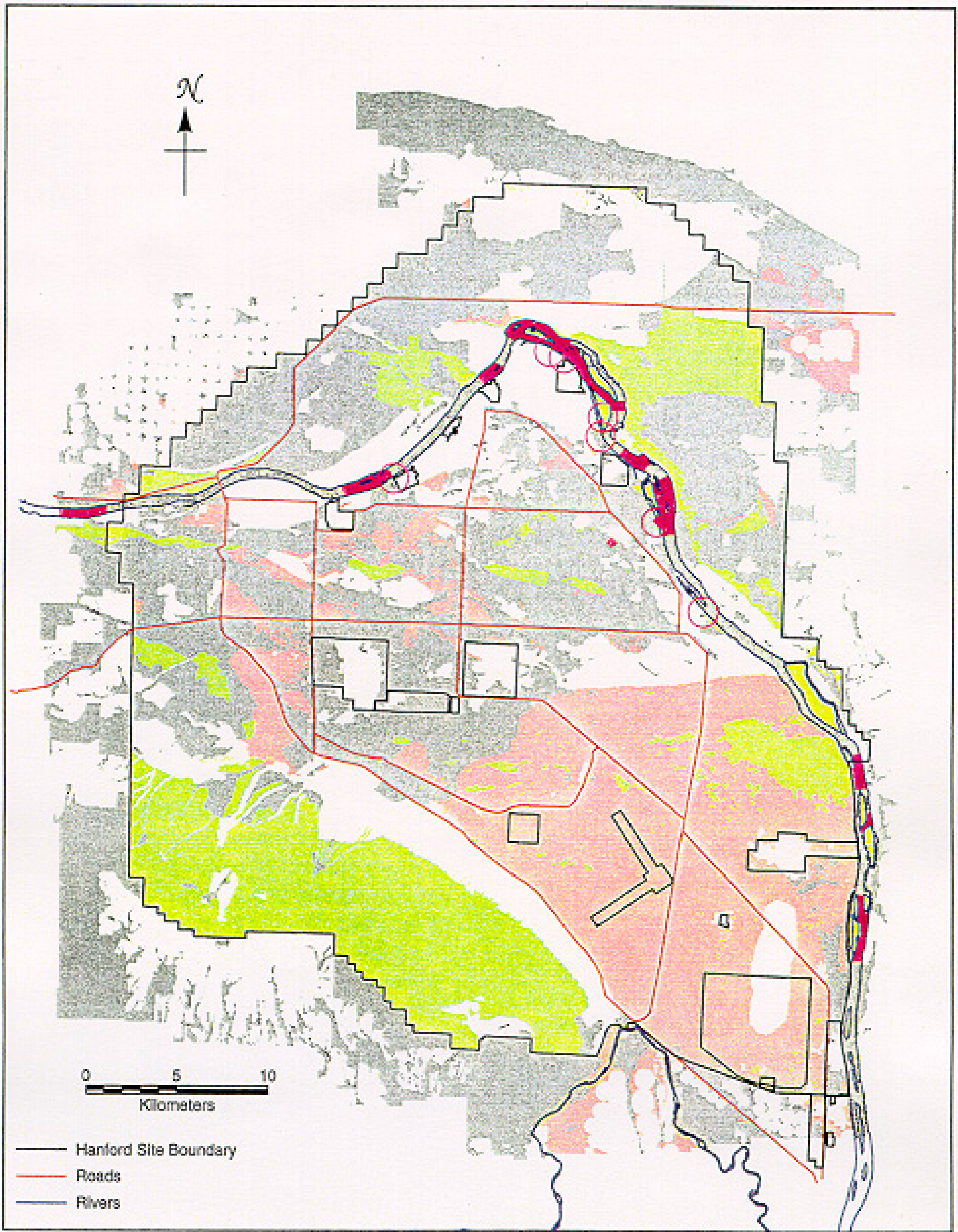
- **Level I** biological resources are resources that require some level of status monitoring because of the recreational, commercial, or ecological role or previous protection status of the resources. Level I includes Washington State Monitor 3 species (DOE-RL 1996).

- **Level II** biological resources require consideration of potential adverse impacts from planned or unplanned Hanford Site actions for compliance with procedural and substantive laws such as NEPA, CERCLA, and the *Migratory Bird Treaty Act of 1918*. Mitigation of potential impacts by avoidance and/or minimization is appropriate for this level; however, additional mitigation actions are not required. Level II resources include Washington State Monitor 1 and 2 species and early successional habitats.

- **Level III** biological resources require mitigation because the resource is listed by the State of Washington; is a candidate for Federal or state listing; is a plant, fish, or wildlife species with unique or significant value; has a special administrative designation (e.g., the ALE Reserve); or is environmentally sensitive. When avoidance and minimization are not possible, or application of these measures still results in adverse residual impacts above a specified threshold value, mitigation by rectification and/or compensation is required. Maintenance of Level III resource values may prevent more restrictive and costly management prescriptions in the future. Level III resources include Washington State candidate and sensitive species, threatened and endangered species, Federal candidate species, wetlands and deep-water habitats, and late-successional habitats.

- **Level IV** biological resources that justify preservation as the primary management option because these resources are federally protected or have regional and national significance. The plant communities and habitats that are defined as belonging to this level are of such high quality and/or rarity that damages to these resources cannot be mitigated except through compensatory mitigation by acquiring and protecting in-kind resources. The legally protected species that are included in Level IV cannot be impacted without the concurrence of the USFWS, so these types of impacts do not jeopardize the continued existence of the

Figure 4-27. Composite Map of Level II, Level III, and Level IV Biological Resources.



Map Created: September 1996/Pacific Northwest National Laboratory

Level II Resources

Level III Resources (Species-Based Resources Not Separately Shown)

Level IV Habitat-Based Resources

Level IV Species-Based Resources

species. Level IV resources include Federal threatened and endangered species and those species proposed for listing, rare habitats such as the White Bluffs, active and stabilized sand dunes, and basalt outcrops.

The BRMaP provides a broad, but comprehensive, direction that specifies DOE biological resource policies, goals, and objectives and prescribes how they would be met. Two subordinate implementing documents outline specific management actions necessary to meet the policies, goals, and objectives, as described below:

- The *Ecological Compliance Assessment Management Plan* (DOE-RL 1995a) outlines the methods to be used to evaluate and quantify environmental impacts.

- The Draft *Hanford Site Biological Resources Mitigation Strategy Plan* (BRMiS) (DOE-RL 1996) is designed to aid DOE in balancing its primary missions of environmental restoration, technology development, and economic diversification with its stewardship responsibilities for the biological resources it administers. The BRMiS would (1) ensure consistent and effective implementation of mitigation recommendations and requirements; (2) ensure that mitigation measures for biological resources meet the responsibilities of DOE under both the *National Environmental Policy Act of 1969* (NEPA) and the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA); (3) enable Hanford Site development and cleanup projects to anticipate and plan for mitigation needs through early identification of mitigation requirements; (4) provide guidance to Hanford personnel in implementing mitigation in a cost-effective and timely manner; and (5) preserve Hanford biological resources while facilitating balanced development and Site restoration activities.

These draft management plans are currently in trial use at the Hanford Site for a one-year period. The plans are presented as guidance, not requirements. The plans have been issued to various resource agencies, organizations, and stakeholders for review and comment, and it is expected that once comments are received and on-the-ground implementation experience is gained, the plans would be revised and issued as Hanford Site requirements.

4.5.9 Biodiversity

The principles of ecosystem management and sustainable development are the foundation upon which DOE manages its lands and facilities. Comprehensive plans guide land- and facility-use decisions by addressing ecological, social, and cultural factors, as well as Site mission and economics. This DOE policy would result in land and facility uses that support DOE's mission at Hanford, while stimulating the economy and protecting the environment (CEQ 1993).

Biodiversity, a critical component of comprehensive land-use planning, has been defined as the diversity of ecosystems, species, and genes, and the variety and variability of life (CEQ 1993). Major components of biodiversity are plant and animal species, micro-organisms, ecosystems and ecological processes, and the inter-relationships between and among these components. Biodiversity also is a qualitative measure of the richness and abundance of ecosystems and species in a given area (NPS 1994).

Features contributing to biodiversity on the Hanford Site include one of the largest undisturbed tracts of native shrub-steppe habitat left in Washington State and the Hanford Reach, which is the last free-flowing nontidal stretch of the Columbia River in the United States (PNNL 1996a). Other influencing factors include topographic features such as Rattlesnake Mountain, Gable Butte, and Gable Mountain; a variety of soil textures ranging from sand to silty and sandy loam; and most importantly, the lack of human use and development over much of the Hanford Site. Specialized terrestrial habitats contributing to the biodiversity of the Hanford Site include areas of sagebrush-steppe, basalt outcrops, scarps (cliffs), scree slopes, and sand dunes. Aquatic components of biodiversity are mainly associated with the Columbia River and include aquatic habitat, wetland and riparian areas, and riverine habitat along Hanford Reach shoreline and islands in the Columbia River. Ecologically important plant and animal species on the Hanford Site include species of concern; commercial and recreational wildlife species (e.g., anadromous fish, mule deer, and upland game birds); and plant species used as a source of food, medicine, fiber, and dye by native peoples of the Columbia Basin (WHC 1992d).

In 1992, DOE and The Nature Conservancy entered into a Memorandum of Understanding that called for a cooperative and coordinated inventory of plants, animals, and ecologically significant areas at the Hanford Site. In 1994, DOE awarded The Nature Conservancy a grant to conduct a partial inventory of the Hanford Site on the ALE Reserve and the Wahluke Slope. The inventory, which was conducted from March 1994 to March 1995, showed that the Hanford Site supports a rich mosaic of relatively unaltered and increasingly uncommon native habitats, the quality and extent of which are unequaled within the Columbia Basin (TNC and Pabst 1995). Significant numbers of plant, bird, and insect species, many of which are rare or in declined numbers in Washington State, were found to be associated with or dependent on these habitats. The Hanford Site serves as a genetic bank for both the common and unusual plants and animals that comprise the shrub-steppe ecosystem. This initial inventory can provide only a rough indication of the quality of biodiversity that is to be found on the main part of the Hanford Site, which is more extensively disturbed than the ALE Reserve or the Wahluke Slope. Additional inventories are being performed of the main part of the Hanford Site and may include studies of small mammals, reptiles and amphibians, and nonvascular plants.

The central portion of the Hanford Site has not been farmed or grazed by livestock for over 50 years, allowing the Hanford Site to serve as a refuge for various plant and animal species (PNNL 1996a). However, the invasion and spread of non-native plant species into previously disturbed areas represents a potential threat to biodiversity through displacement of native species, simplification of plant communities, and fragmentation of habitat. Introduced plant species account for approximately 21 percent of the vascular plants found on the Hanford Site and include species such as cheatgrass, Russian thistle, and most of the tree species found on the Hanford Site (WHC 1992f). Most of the disturbed areas on the Hanford Site, including abandoned farmland and areas burned by wildfire, are dominated by nearly pure stands of cheatgrass where the native shrub component has been modified severely or replaced altogether (Cushing 1992).

Human activities may have profound effects on the biodiversity of an ecosystem or community. Among other factors, these human activities include habitat modification or destruction and habitat fragmentation. Destruction or modification of a habitat can occur when undisturbed areas are harvested or converted to other uses, such as agriculture or industrial facilities. Habitat fragmentation occurs when disturbed areas break up a large community into smaller isolated undisturbed areas. When fragmentation occurs, biodiversity is impacted because the smaller undisturbed areas may not be capable of supporting the same number of species. The edges of the undisturbed area also may be strongly affected by proximity to the disturbed area, further reducing the size of the area that is truly undisturbed. Furthermore, the disturbed areas may serve as migration barriers for some species, effectively blocking recolonization of areas where small localized extinctions have occurred. Areas such as the Hanford Site serve to preserve regional biodiversity by providing refuges for species that have been eliminated by human activities in the surrounding region.

4.6 Cultural Resources

The Hanford Site is known to be rich in cultural resources, with numerous, well-preserved archaeological sites representing the period since American Indian contact with Euro-Americans, and the period prior to that contact. These periods are often referred to as “prehistoric” and “historic,” but these terms do not recognize the fact that members of Tribal Nations have maintained an active oral history for a long period of time that predates the contact with Euro-Americans. For this reason, the EIS will use the terms “post-contact” and “pre-contact” to describe these periods when appropriate. Management of the Hanford Site cultural resources follows the Draft *Hanford Cultural Resources Management Plan* (CRMP) (DOE-RL 1999) and is conducted for DOE by the Cultural Resources staff of the Environmental Restoration Contractor team, in partnership with the Fluor Daniel Hanford, Inc., staff historian and the Hanford Cultural Resources Laboratory (HCRL) of PNNL (see text box, *“Hanford Site Quick Facts: Cultural Resources*”).

Hanford Site Quick Facts: Cultural Resources

About 8 percent of the Hanford Site has been surveyed. From those surveys, 964 cultural resource sites and isolated finds have been recorded to date. Each find of one or more features (nonportable, nondiscrete artifacts), or of three or more artifacts within 10 m (33 ft) of each other, will be designated as a site and duly recorded in the files of the Washington State Office of Archaeology and Historic Preservation. All other objects are isolated finds (i.e., isolates). Forty-nine properties are listed on the National Register.

The CRMP, which was approved by the State Historic Preservation Office (SHPO) in 1989, was developed to establish guidance for the identification, evaluation, recordation, curation, and management of archaeological, historic, and traditional cultural resources as individual entities or as contributing properties within a district. The plan specifies methods of consultation with affected Tribes and Tribal Historic Preservation Officers, government agencies, and interested parties, and includes strategies for the preservation and/or curation of representative properties, archives, and objects.

Cultural resources are defined as any district, Site, building, structure, or object considered to be important to a culture, subculture, or community for scientific, traditional, religious or other reasons. For the purpose of this Final HCP EIS, these resources are divided into several categories: pre-contact and post-contact archaeological resources, architectural resources, and traditional (American Indian) cultural resources. Significant cultural resources are those that are eligible or potentially eligible for listing in *The National Register of Historic Places* (National Register) (NPS 1988).

Consultation is required to identify the traditional cultural properties that are important to maintaining the cultural heritage of American Indian Tribes. Under separate treaties signed in 1855, the Confederated Tribes and Bands of the Yakama Nation and the Confederated Tribes of the Umatilla Indian Reservation ceded lands to the United States that include the present Hanford Site. Under the treaties, the Tribes reserved the right to fish at usual and accustomed places in common with the citizens of the territory, and retained the privilege of hunting, gathering roots and berries, and pasturing horses and cattle upon open unclaimed land. The Tribes also reserved the right to erect temporary buildings at usual and accustomed places. The Treaty of 1855 with the Nez Perce Tribe includes similar reservations of rights, and the Hanford Reach is identified as the location of usual and accustomed places. The Wanapum People are not signatory to any treaty with the United States and are not a federally recognized Tribe; however, the Wanapum People were historical residents of the Hanford Site, and their interests in the area have been acknowledged.

The methodology for identifying, evaluating, and mitigating impacts to cultural resources is defined by Federal laws and regulations including the *National Historic Preservation Act of 1966*, the *Archaeological Resources Protection Act of 1979*, the *Native American Graves Protection and Repatriation Act of 1990*, and the *American Indian Religious Freedom Act of 1978*. A project affects a significant resource when it alters the characteristics of the property, including relevant features of its environment or use, that qualify it as significant according to the National Register criteria. These effects may include those listed in 36 CFR 800.9. Impacts to traditional American Indian properties can be determined only through consultation with the affected American Indian groups.

In 1995, 964 cultural resource sites and isolated finds were recorded in the files of the Hanford Cultural Resources Laboratory (HCRL) (PNNL 1996a). Forty-eight archaeological sites and one building are included on the National Register. National Register nominations have been prepared for several archaeological districts and sites considered to be eligible for listing on the National Register. While many significant cultural resources have been identified, only a small portion of the Hanford Site has been surveyed by cultural resource specialists and few of the known sites have been evaluated for their eligibility for listing in the National Register. Many additional cultural resources may remain unidentified. Cultural resource reviews are conducted when projects are proposed in areas that have not been previously surveyed. About 100 to 120 reviews were conducted annually through 1991; this figure rose to more than 360 reviews during 1995 (PNNL 1996a).

4.6.1 Pre-Contact Archaeological Resources

People have inhabited the middle Columbia River region since the end of the glacial period. More than 8,000 years of precontact human activity in this largely arid environment have left extensive archaeological deposits. Certain areas inland from the river show evidence of concentrated human activity, and recent surveys indicate extensive, although dispersed, use of arid lowlands for hunting. Graves are common in various settings, as are spirit quest monuments (Neitzel et al. 1998). Throughout most of the region outside of Hanford, hydroelectric development, agricultural activities, and domestic and industrial construction have destroyed or covered the majority of these deposits. Amateur artifact collectors have had an immeasurable impact on the remainder of the resources. Within the Hanford Site, from which the public is restricted, archaeological resources found in the Hanford Reach and on adjacent plateaus and mountains have been spared some of the disturbances that have befallen other sites. The Hanford Site is, thus, a *de facto* reserve of archaeological information of the kind and quality that has been lost elsewhere in the region.

Currently, about 320 prehistoric archaeological sites have been recorded on the Hanford Site. Forty eight of these sites are included on the National Register of Historic Places; two are single sites and the remainder are located in seven archaeological districts. In addition, several National Register nominations are pending and nine individual archaeological sites have been determined to be eligible for listing. Archaeological sites include the remains of numerous pithouse villages, campsites and graves, spirit quest monuments, hunting camps, game drive complexes, quarries, hunting and kill sites, and small temporary camps (Neitzel et al. 1998).

Recorded sites were found during archaeological reconnaissance projects conducted between 1926 and 1968. Systematic archaeological surveys conducted from the middle 1980s through 1995 are responsible for the remainder. The 100 Areas were surveyed in the early 1990s, revealing other archaeological sites (DOI 1995a).

4.6.2 American Indian Cultural Resources

In pre-contact and early contact periods, the Hanford Reach was populated by American Indians of various Tribal affiliations. The Wanapum People and the Chamnapum Band lived along the Columbia River from south of Richland upstream to Vantage (DOI 1995a). Some of their descendants still live nearby at Priest Rapids, and others have been incorporated into the Yakama and Umatilla Reservations. Palus People, who lived on the lower Snake River, joined the Wanapum, Nez Perce, and Chamnapum to fish the Hanford Reach, and some inhabited the east bank of the river (DOI 1995a). Walla Walla and Umatilla People also made periodic visits to fish in the area. These people retain traditional secular and religious ties to the region, and many have knowledge of the ceremonies and lifeways of their culture. The Washani, or Seven Drums religion, which originated among the Wanapum on what is now the Hanford Site, is still practiced by many people on the Yakama, Umatilla, Warm Springs, and Nez Perce Reservations. Native plant and animal foods, many of which are abundant on the Hanford Site, are used in the ceremonies performed by sect members of this religion, as well as other American Indians who conduct traditional activities (Neitzel et al. 1998).

During public scoping of this EIS, Tribal governments emphatically expressed an interest in renewing their use of these resources in accordance with the Treaties of 1855. The DOE is attempting to address the Tribal governments' concerns by allowing access for the purposes of religious activities and gathering foods and medicines to the extent that these activities are consistent with DOE missions. From a traditional American Indian viewpoint, nature is intrinsically spiritual, as sacredness is embedded in natural phenomena, landforms, plants, and animals. People are one of the thousands of species in a single interconnected system of species relationships. This system of relationships is considered to be based on a sense of reciprocity, and a threat to the land or environment can be perceived as a threat to the entire culture. Impacts to the natural landscape also might be considered impacts to the self-identity of a Tribal community.

Spirituality is expressly interwoven in the Tribal community's way of life. This attachment to land and water means that sacred sites are not always confined or precisely located and are numerous and diverse in form (DOI 1995a).

The Hanford Site possesses traditional cultural significance for many members of Columbia Plateau Tribes. Certain sites demonstrate traditional cultural significance for the following reasons:

- American Indians associate certain locations with traditional beliefs about their origin, their cultural history, or the nature of the world.

- American Indian religious practitioners historically have gone, and continue to go, to these locations to perform ceremonial activities in accordance with traditional cultural rules.

- American Indians make use of natural resources in the conduct of traditional activities. Use can be as food, medicine, barter and exchange items (currency), and for artistic and religious purposes. The act and method of gathering, processing, and exchange and use can all carry important cultural significance.

4.6.3 Post-Contact Archaeological and Architectural Resources

The first Euro-Americans who came to this region were Lewis and Clark, who traveled along the Columbia and Snake rivers during their 1803 to 1806 exploration of the Louisiana Territory. Lewis and Clark were followed by fur trappers, military units, and miners who also passed through on their way to more productive lands upriver and downstream and across the Columbia Basin. It was not until the 1860s that merchants set up stores, a freight depot, and the White Bluffs Ferry on the Hanford Reach. Chinese miners began to work the gravel bars for gold. Cattle ranches opened in the 1880s and farmers soon followed. Several small, thriving towns, including Hanford, White Bluffs, and Ringold, were established along the riverbanks in the early 20th century. Other ferries were established at Wahluke and Richland. The towns and nearly all other structures were razed after the U.S. government acquired the land for the original Hanford Engineer Works in the early 1940s (Neitzel 1997).

A total of 390 post-contact archaeological sites, 89 post-contact isolated finds, and numerous post-contact properties have been recorded by the HCRL on the Hanford Site. Of these sites, one is included in the National Register. Properties from the pre-Hanford Site era include semi-subterranean structures near McGee Ranch; the Hanford Irrigation and Power Company pumping plant at Coyote Rapids; the Hanford Irrigation Ditch; the old Hanford townsite, pumping plant, and high school; Wahluke Ferry; the White Bluffs townsite and bank; the Richland Ferry; Arrowsmith townsite; a cabin at East White Bluffs ferry landing; the White Bluffs road; the Chicago, Milwaukee, St. Paul, and Pacific Railroad (Priest Rapids-Hanford Line) and associated whistle stops; and the Bruggerman fruit warehouse (Cushing 1995). Historic archaeological sites, including the East White Bluffs townsite and associated ferry landings and an assortment of trash scatters, homesteads, corrals, and dumps, have been recorded by the HCRL since 1987. Minor test excavations have been conducted at some of the historic sites, including the Hanford townsite locality. In addition to the recorded sites, numerous unrecorded areas of gold mine tailings along the river bank and the remains of homesteads, farm fields, ranches, and abandoned U.S. Army installations are scattered over the entire Hanford Site.

More recent historic structures are the defense reactors and associated materials processing facilities that are present on the Hanford Site. The first reactors (B, D, and F) were constructed in 1943 as part of the Manhattan Project. Plutonium for the first atomic explosion and the bomb that destroyed Nagasaki to end World War II was produced at the B Reactor. Additional reactors and processing facilities were constructed after World War II during the Cold War. All reactor containment buildings still stand, although many ancillary structures have been removed. The B Reactor is listed on the National Register and was given the National Historic Landmark Award (Cushing 1995). About 45 other buildings have been evaluated for National Register eligibility by the SHPO.

A Historic Buildings Task Force was established to coordinate future evaluations among DOE and the Hanford Site contractors. This task force established the Hanford Site Historic District, identified all contributing and noncontributing buildings and structures within the District, and prepared an Historic Buildings Programmatic Agreement to direct the documentation of the contributing properties.

After negotiation, the Programmatic Agreement was approved by the Advisory Council on Historic Preservation, the SHPO, and DOE in August 1996. The Programmatic Agreement outlines the methods agreed to by these parties to preserve and protect significant historical resources on the Hanford Site. The Programmatic Agreement stipulates that DOE will document the contributing historic buildings and structures identified in Appendix C of the Programmatic Agreement, which includes about 190 buildings considered to be historically significant. These buildings will require mitigation (i.e., to document the historical character of the building) prior to activities that might adversely affect historic characteristics. The Programmatic Agreement also identifies the form of mitigation required and exemptions to the requirement for mitigation. Evaluation and mitigation will proceed for the identified buildings in accordance with the Programmatic Agreement.

The Programmatic Agreement allows for: the exemption of property types from review and documentation requirements; the exemption of classes of action from review; the designation of an Historic District; the mitigation of all actions on Site, up to and including demolition of properties, through production of a Site-wide process/events history. Provisions in the Programmatic Agreement are implemented through the “Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan.”

For the purpose of this discussion, the cultural resources present along the Columbia River and in the 100 Areas are considered together. This allows a discussion of sensitive cultural resources, without providing information sufficient to allow the discovery and/or adverse impact of these resources by unauthorized personnel. Much of the following information has been obtained from the *Hanford Site National Environmental Policy Act (NEPA) Characterization* (PNNL 1996a).

Intensive field surveys were completed in the 100 Areas from 1991 to 1993. Much of the surface area within and near the 100 Areas fencelines has been disturbed by the industrial activities that have taken place during the past 50 years. Numerous archaeological sites have been encountered, and many are potentially eligible for the National Register. A complete inventory of 100 Area buildings and structures was completed during fiscal year 1996. The former community of Wahluke, which was at the landing of a ferry of the same name, is situated on the north bank of the river.

The principal post-contact site in the vicinity is the East White Bluffs ferry landing and former townsite, which has been considered for nomination to the National Register. The site was the upriver terminus of shipping during the early and mid-19th century. It was at this point that supplies for trappers, traders, and miners were off-loaded, and commodities from the interior were transferred from pack trains and wagons to river boats. The first store and ferry of the mid-Columbia region were located at this site. A log cabin, thought by some to have been a blacksmith shop in the mid-19th century, still stands. The structure has been recorded according to standards of the Historic American Buildings Survey. The only remaining structure associated with the White Bluffs townsite (near the railroad) is the White Bluffs Bank. A revised historic property inventory form for the bank was completed in 1995. Two Manhattan Project buildings, 105-F and 108-F, remain in the 100-F Area. The 108-F Biology Laboratory, originally a chemical pump house, has been determined eligible for the National Register.

In the vicinity of 100-F, post-contact sites were recorded during 1992, 1993, and 1995 and include 20th century farmsteads, household dumps, and military encampments. None of the sites have been evaluated for eligibility to the National Register. Only three buildings associated with the Cold War era remain in this area. These buildings were inventoried and evaluated in 1996.

In the 100-K Area, historic sites containing the remains of farms are found in the nearby area; four historic sites and three isolated finds have been recorded as of 1994. Two important linear features, the Hanford Irrigation Ditch and the former Priest Rapids-Hanford railroad, also are present in the 100-K Area. Remnants of the Allard community and the Allard pump house at Coyote Rapids are located west of the K Reactor compound. The Historic Buildings Task Force has recommended that the 105-KW Reactor and the 1706-KE and 1706-KER water recirculation study facilities be listed in the National Register.

Knowledge about the archaeology of the 100-N Area is based largely on reconnaissance-level archaeological surveys conducted within the last 30 years (PNNL 1996a). These surveys are not complete inventories of the areas covered. Intensive surveys of surrounding areas were conducted during 1991. The Hanford Generating Plant vicinity also has been surveyed intensively for archaeological resources.

The most common evidence of activities now found near the 100-N Area consists of gold mine tailings on riverbanks and archaeological sites where farmsteads once stood. The significance of the 100-N buildings, their role in the Cold War, and their eligibility for listing in the National Register, have been documented through *The Hanford Site N Reactor Buildings Task Identification and Evaluation of Historic Properties* (BHI 1996a), which was conducted during fiscal year 1995. Buildings 105-N, 109-N, 155-N, 185-N, and 1112-N have been determined eligible for the National Register by DOE and the SHPO. Additional determinations for contributing buildings have been submitted to the SHPO, as well as a mitigation plan for the 100-N Reactor complex.

An archaeological survey conducted of all undeveloped portions of the 200 East Area and a 50 percent random sample conducted of undeveloped portions of the 200 West Area have indicated no findings of archaeological sites (PNL 1990b). However, some small sites are known to exist within the boundaries of the 200 East and 200 West Area (PNL 1990b). The only evaluated historic site is the old White Bluffs freight road that crosses diagonally through the 200 West Area. The road, which was originally an American Indian trail, has been in continuous use as a transportation route since pre-contact history and has played a role in Euro-American immigration, regional development, agriculture, and the recent Hanford Site operations. As such, the property has been determined to be eligible for the National Register, although the segment that passes through the 200 West Area is considered to be a noncontributing element. A 100-m (328-ft) restricted zone has been created to protect the road from uncontrolled disturbance. In addition, 49 buildings in the 200 East and 200 West Areas have been evaluated; nine of these buildings have been determined as eligible for the National Register.

Most of the 300 Area has been highly disturbed by industrial activities. Five recorded archaeological sites including campsites, house pits, and a historic trash scatter are recorded at least partially within the 300 Area; any more may be located in subsurface deposits. The historic site contains debris scatter and road beds associated with farmsteads. One archaeological site is recognized as eligible for listing in the National Register. The majority of the buildings in the 300 Area were constructed in the Manhattan Project and Cold War eras (1943 through 1989). A total of 158 buildings/structures in the 300 Area have been inventoried on historic property inventory forms. Of that number, 47 buildings/structures have been determined eligible for the National Register as contributing properties within the Historic District recommended for mitigation (Neitzel et al. 1998).

Most of the 400 Area has been subjected to intensive development-related construction activities. Archaeologists surveying the site in 1978 were able to find only 12 ha (30 ac) that were undisturbed. No cultural resources were found within that small area and no sites have been recorded or are known to exist within 2 km (1.2 mi) of the 400 Area (Cushing 1995). The FFTF and its associated structures have been evaluated by the Historic Buildings Task Force. Buildings 405, 4703, and 4710 have been recommended as contributing properties to the Hanford Site Historic District.

The 600 Area contains diverse cultural resource sites and traditional cultural properties. Project-driven surveys have been conducted throughout the area, but much of the 600 Area remains unsurveyed.

Five anti-aircraft artillery sites have been determined eligible for the National Register. Because of the proposed remediation of these sites, mitigation to reduce the adverse effects will be carried out. The Central Shops Complex, in the 600 Area, was determined to be ineligible for the National Register in 1995 (Cushing 1995).

Historic cultural resources have been identified in or near the 1100 Area. These resources include remnants of homesteads and agricultural structures predating the establishment of the Hanford Site.

4.7 Socioeconomic Environment

Activity on the Hanford Site plays a dominant role in the socioeconomics of the Tri-Cities and other parts of Benton and Franklin counties. The Tri-Cities serves as a market center for a much broader area of eastern Washington, including Adams, Columbia, Grant, Walla Walla, and Yakima counties. The Tri-Cities also serves parts of northeastern Oregon, including Morrow, Umatilla, and Wallowa counties. Socioeconomic impacts of changes at Hanford are mostly confined to the immediate Tri-Cities community and Benton and Franklin counties (and Yakima County, to a lesser extent) (PNL 1984; PNL 1987). However, because of the significance of the wider agricultural region and surrounding communities in the Tri-Cities economic base, this section briefly discusses the wider region as well (Figure 4-28). Table 4-8 summarizes the regional (Benton and Franklin counties) jobs from 1995 to 1996.

Due to the changing Hanford mission, it has been necessary to develop a facility transition plan. The first step would be conversion, which transitions the process from facilities that were developed to support DOE's nuclear production mission to either new Federal or private development. There have been many obstacles to the successful implementation of a facility reuse plan. The objectives of a successful conversion are as follows:

- Retraining and re-employment of those who have lost jobs, directly or indirectly, as a result of the Federal mission change

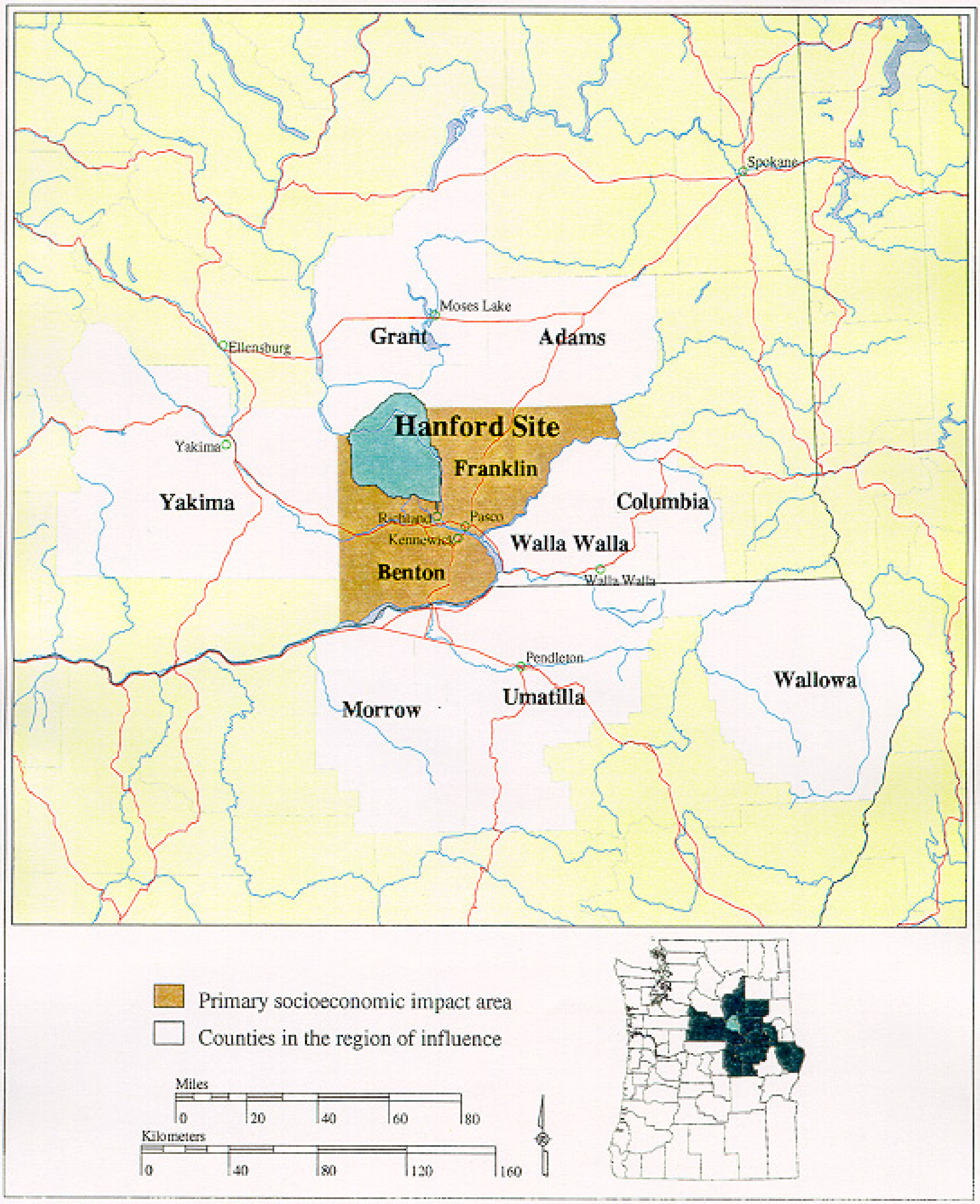
- Creation of jobs to replace the revenue lost directly through reductions in payroll taxes and property taxes, as well as through indirect impacts, such as lost sales tax revenue

- Reuse of the facilities on the Hanford Site so the local government might generate revenue to cover the costs involved in its newly acquired responsibilities of maintaining and servicing those facilities, such as the provision of police and fire services and municipal utilities (e.g., water service)

- Using the closure as an opportunity to revitalize the local community

- Mitigating the impacts on the community at large, both from the business and social service perspectives.

Figure 4-28. Areas of Washington and Oregon Where Socioeconomic Resources Might Be Affected (DOE 1995b).



BHI:rpp 02/11/98 clup/socioecon1.aml Database: 03-AUG-1998

Table 4-8. Nonagricultural Workers in Benton and Franklin Counties, 1996 to 1997 (Neitzel et al. 1998).

Industry	1996 Annual Average	1997 Annual Average	% Change 1996-1997
Nonagricultural wage laborers	70,200	70,100	-0.1
Manufacturing	5,800	5,700	-1.7
Construction	4,100	4,100	-0.0
Public utilities	2,900	9000	[b]
Wholesale and retail trade	15,600	16,100	3.2
Finance, insurance, and real estate	2,200	2,200	0.0
Services	26,100	19,600	[b]
Government	13,400	13,500	0.7
Agricultural[a]	5,500		

[a] Source: TRIDEC Tri-City demographics.
[b] Reflects change in reporting.

There are several steps that a community may have to take to achieve the objectives of a successful conversion, including some of those outlined below:

- Improvement of marketing of facilities (i.e., buildings, transportation, and utilities) to new employers
- Training of potential employees
- Negotiation of property transfer and leases
- Negotiation of care and custody agreements
- Supporting environmental remediation to enable the transfer of property
- Acquisition of funding for continued conversion efforts (e.g., planning and implementation)
- Conducting feasibility studies to assist in the successful implementation of specific components of the reuse plan, such as the creation of a historic district or educational programs.

The Hanford Community is working on the Hanford facilities reuse problem through a collation of local cities, port districts, and counties, with assistance from DOE's Office of Worker and Community Transition.

4.7.1 Demographics

Estimates for 1996 placed population totals for Benton and Franklin counties at 134,100 and 43,900, respectively (Neitzel et al. 1998). When compared to the 1990 census data in which Benton County had 112,560 residents and Franklin County population totaled 37,473, the current population totals reflect the continued growth occurring in these two counties.

The 1997 estimates distributed the Tri-Cities population as follows: Richland, 36,500; Pasco, 35,300; and Kennewick, 49,090. The combined populations of Benton City, Prosser, and West Richland totaled 13,905 in 1997 (see text box, *"Hanford Site Quick Facts:*

Hanford Site Quick Facts: Populations (1996 Estimates)

- Kennewick: 48,010
- Richland: 35,990
- Pasco: 22,370

Populations [1996 Estimates]"). The unincorporated population of Benton County was 34,555. In Franklin County, incorporated areas other than Pasco have a total population of 3,385. The unincorporated population of Franklin County was 15,215 (Neitzel et al. 1998).

Benton and Franklin counties accounted for 2.4 percent of the population in Washington State (Neitzel et al. 1998). In 1997, the population demographics of Benton and Franklin counties were quite similar to those found within the State of Washington. In 1997, 54.1 percent of the population of Benton and Franklin counties was under the age of 35, compared to 50.3 percent for the State of Washington. In general, the population of Benton and Franklin counties is somewhat younger than that of Washington State. The 0- to 14-year-old age group accounts for 26.5 percent of the total bi-county population as compared to 22.6 percent for Washington State. In 1996, the 65-year-old and older age group constituted 9.6 percent of the population of Benton and Franklin counties compared to 11.5 percent for the State of Washington.

4.7.1.1 Demographics of Minority Populations. Demographic information obtained from the U.S. Bureau of Census was used to identify minority populations and low-income communities within an 80-km (50-mi) radius surrounding the Hanford Site. For the evaluation of environmental justice impacts, the area defined by this 80-km (50-mi) radius is considered the zone of potential impact.

4.7.1.1.1 Definitions. The demographic analysis used the following definitions to develop community characteristics:

- Census tract -- An area defined for the purpose of monitoring census data that is usually comprised of between 2,500 and 8,000 persons, with 4,000 persons being ideal. When first delineated, census tracts are designed to be homogeneous with respect to population characteristics, economic status, and living conditions. Census tracts do not cross county boundaries. Spatial census tract size varies widely depending on the density of settlement. Census tract boundaries are delineated with the intention of being maintained over a long period of time so statistical comparisons can be made from census to census.

- Census block group -- An area defined for the purpose of monitoring census data that generally consists of between 250 and 550 housing units.

- Minority populations -- A group of people and/or communities experiencing common conditions of exposures or impact that consists of persons classified by the U.S. Bureau of Census as Negro/Black/African American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other non-White persons, based on self-classification by the people according to the race with which they most closely identify. For the purposes of analysis, minority populations are defined as those census tracts within the zone of impact where the percent minority population exceeds the percentage minority population within the entire zone of impact. Census tracts where the percent minority population exceeds 50 percent are also considered minority populations. In the case of migrant or dispersed populations, a minority population consists of a group that is greater than a 50 percent minority.

- Low-income community -- An area where the median household income is 80 percent or more below the median household income for the metropolitan statistical area (urban) or county (rural). The 80 percent threshold was used based on definitions used by the U.S. Department of Housing and Urban Development.

- Population base -- Census tracts were included in the analysis if 50 percent of the geographic area of the tract fell within the 80-km (50-mi) radius of the Hanford Site.

4.7.1.1.2 Minority and Low-Income Populations Near Hanford. Demographic maps were prepared using 1990 census data resolved to the census group tract level (USBC 1992).

A total population of approximately 384,000 people reside within an 80-km (50-mi) radius of the Hanford Site. The minority population within the area consists of approximately 95,000 people and represents approximately 25 percent of the population in the assessment area. The ethnic composition of the minority population is primarily Hispanic (approximately 80 percent) and American Indian (8 percent). Census tracts where the percentage of minority persons within the population exceeds 20 percent are located to the southwest and northeast of the Hanford Site and within the City of Pasco, Washington (Neitzel et al. 1998).

The low-income population within the 80-km (50-mi) area of impact represents approximately 42 percent of the households in the area of impact. Census tracts where the percentage of the population consisting of low-income households exceeds 25 percent are principally located to the southwest and north of the Hanford Site and within the City of Pasco, Washington (Neitzel et al. 1998). Considerable overlap between low-income populations and minority populations exists in the vicinity of the Hanford Site.

4.7.1.1.3 Limitations of Demographic Data. Characterization of minority and low-income populations residing within a geographical area is sensitive to the basic definitions and assumptions used to identify those populations. Consequently, the number of individuals identified as minority and/or low-income individuals within the population around a particular site may vary from analysis to analysis. Several different approaches to identification of minority and low-income populations have been used in recent DOE EISs. The approach presented in this EIS is consistent with the approach used in the *Hanford Site National Environmental Policy Act (NEPA) Characterization* (Neitzel et al. 1998). Other demographic studies may use different assumptions and, consequently, report a different total population, minority population, or low-income population depending on the assumptions used to identify each population.

4.7.2 Economics

This section summarizes pertinent economic activity within the region of interest, including information on the general economy, employment, income, and impact of the Hanford Site. Historically, the primary industries within the region have been related to agriculture — a multitude of crops encompassing many fruits, vegetables, and grains are grown each year.

4.7.2.1 Employment in the Tri-Cities. Three major sectors have been the principal driving forces of the economy in the Tri-Cities since the early 1970s: (1) DOE and Hanford Site contractors; (2) Energy Northwest (formerly known as WPPSS) in its construction and operation of nuclear power plants; and (3) agriculture, including a substantial food-processing industry. With the exception of a minor amount of agricultural commodities sold to local area consumers, the goods and services produced by these sectors are exported from the Tri-Cities. In addition to direct employment and payrolls, these major sectors also support a sizable number of jobs in the local economy through the procurement of equipment, supplies, and business services.

- ***DOE and Hanford Contractors*** -- An average of 11,104 employees worked for DOE and its Hanford contractors in 1997. This number is down from over 19,000 in 1994 due to downsizing activities, which has reduced employment at Hanford by 7,700 through FY 1996 (source: Hanford Site Internet homepage). In addition to downsizing by Hanford contractors in 1996, DOE created a new Project Hanford Team in an effort to produce cleanup results more cost effectively over a shorter time period, and to help diversify and stabilize the Tri-Cities economy. This team is made up of the overall management contractor Fluor Daniel Hanford Company, Fluor's six major subcontractors, and six newly created "enterprise companies." Fluor Daniel Hanford Company is responsible for integrating and directing cleanup tasks. The actual cleanup work is conducted by the six subcontractors. The "enterprise companies" provide services to the six major subcontractors.

As of December 31, 1997, the official employment count for Hanford was 10,690, which includes Fluor Daniel Hanford Company; Fluor's six major subcontractors, Pacific Northwest National Laboratory, Bechtel Hanford, Inc., Hanford Environmental Health Foundation, ICF Kaiser; and local DOE employees. The "enterprise companies," which have a combined employment of just over 2,200, were not included in this count. The Hanford payroll has a widespread impact on the Tri-Cities and state economies, in addition to providing direct employment.

- ***Energy Northwest (formerly known as WPPSS)*** – Although activity related to nuclear power plant construction ceased with the completion of the WNP-2 reactor in 1983, Energy Northwest (formerly known as WPPSS) continues to be a major employer in the Tri-Cities area. Headquarters personnel based in Richland oversee the operation of one generating facility and perform a variety of functions related to two mothballed nuclear plants and one generating facility. In 1995 and 1996, downsizing activities at Energy Northwest headquarters decreased employment to about 1,164 workers (down from more than 1,900 in 1994). Energy Northwest activities generated a payroll of approximately $81 million in the Tri-Cities during 1996. Alternate uses or decommissioning of the two mothballed Washington Nuclear Plants (WNP-1 and WNP-4) are expected to begin in the next few years. These activities are expected to reduce the number of employees necessary to maintain these facilities (PNNL 1996a).

- ***Agriculture*** -- In 1996, agricultural activities in Benton and Franklin counties were responsible for approximately 10,446 jobs, or 13 percent of the total employment in the area. According to the U.S. Department of Commerce Regional Economic Information System, about 2,317 people were classified as farm proprietors in 1995. Farm proprietors' income, according to this same source, was estimated to be $69 million (Neitzel et al. 1998).

In 1997, the counties of Benton, Franklin, and Walla Walla counties averaged 7,448 seasonal farm workers, ranging from 1,809 workers during the winter pruning season to 17,221 workers at the peak of harvest. An estimated average of 6,553 seasonal workers were classified as local (ranging from 1,251 to 14,388); an average of 64 were classified as intrastate (ranging from 0 to 355); and an average of 832 were classified as interstate (ranging from 122 to 2,830). Most intrastate workers resided elsewhere in Benton, Franklin, Walla Walla, and Yakima counties, although the peak harvest season saw an influx of workers from around eastern and central Washington.

Area farms and ranches generate a sizable number of jobs in supporting sectors, such as agricultural services (e.g., application of pesticides and fertilizers or irrigation system development) and sales of farm supplies and equipment. Although formally classified as a manufacturing activity, food processing is a natural extension of the farm sector. More than 20 food processors in Benton and Franklin counties produce items such as potato products, canned fruits and vegetables, wine, and animal feed.

In addition to the three major employment sectors (Hanford-related, power marketing, and agricultural), five other employers in 1996 were readily identified as contributors to the economic base of the Tri-Cities economy: (1) Iowa Beef Processing Inc., which employed 1,500 workers (this company lies outside of Benton and Franklin counties, but most of the workforce resides in the Tri-Cities); (2) Lamb Weston, which employed 1,700 workers; (3) Siemens Nuclear Power Corporation, which employed 730 workers; (4) Boise Cascade/Paper Group, which employed 511 workers (like Iowa Beef Processors, Boise Cascade's Wallula mill lies outside both Benton and Franklin counties, but most of its workforce resides in the area); and (5) Burlington Northern Santa Fe Railroad, which employed 350 workers. Approximately 4791 workers were employed by these businesses in Benton and Franklin counties in 1997 (Neitzel et al. 1998).

4.7.2.1.1 Tourism. The Tri-Cities Visitors and Convention Bureau reported that approximately 214 conventions were held in the Tri-Cities in 1997, with 66,150 attending visitors spending an estimated $22 million.

Overall tourism expenditures in the Tri-Cities were roughly $184 million in 1995, with travel-generated employment of about 3,220 and an estimated $34 million in payroll in Benton and Franklin counties.

4.7.2.1.2 Retirees. Although Benton and Franklin counties have a relatively young population (approximately 54 percent under the age of 35), 17,141 people over the age of 65 resided in Benton and Franklin counties in 1997. The portion of the total population 65 years and older in Benton and Franklin counties accounts for 9.6 percent of the total population, slightly below that of the State of Washington (11.5 percent). This segment of the population supports the local economy on the basis of income received from government transfer payments and pensions, private pension benefits, and individual savings.

Although information on private pensions and savings is not available, data is available regarding the magnitude of government transfer payments. The U.S. Department of Commerce Regional Economic Information System has estimated transfer payments by various programs at the county level. A summary of estimated major government pension benefits received by the residents of Benton and Franklin counties in 1995 is shown in Table 4-9.

Table 4-9. Government Retirement Payments in Benton and Franklin Counties in 1995 ($ million) (Neitzel et al. 1998).

Source	Benton County	Franklin County	Total
Social security (including survivors and disability)	139.3	41.5	180.8
Railroad retirement	4.1	4.6	8.7
Federal civilian retirement	13.4	2.9	16.3
Veterans pension and military retirement	20.8	4.2	25.0
State and local employee retirement	33.2	6.5	39.7
Total	210.8	60.2	269.5

About two-thirds of the social security payments go to retired workers; the remainder of the payments are for disability and other types of payments. The historical importance of government activity in the Tri-Cities area is reflected in the relative magnitude of the government employee pension benefits as compared to total payments (Neitzel et al. 1998).

4.7.2.2 Income Sources. Total personal income is comprised of all forms of income received by the populace, including wages, dividends, and other revenues. Per capita income is roughly equivalent to total personal income divided by the number of people residing in the area. Median household income is the point at which half of the households have an income greater than the median and half of the households have less. The source for total personal income and per capita income was the U.S. Department of Commerce Regional Economic Information System, while median income figures for Washington State were provided by the Office of Financial Management (PNNL 1996a).

In 1995, the total personal income for Benton County was $2,952 million, Franklin County was $747 million, and the State of Washington was $129.1 billion. Per capita income in 1995 for Benton County was $22,072, Franklin County was $16,356, and Washington State was $23,709. Median household income in 1995 for Benton County was estimated to be $43,562, Franklin County was estimated $31,141, and the State of Washington was estimated at $39,206 (Neitzel et al. 1998).

4.7.2.3 Hanford Site Employment. An average of 11,140 employees worked for DOE and its Hanford contractors in 1997 (Neitzel et al. 1998). Future downsizing in Hanford Site employment is anticipated, although the extent of this downsizing is unknown at this time.

In 1996, Hanford employment accounted directly for 20 percent of total nonagricultural employment in Benton and Franklin counties and about 0.7 percent of all statewide nonagricultural jobs. In 1997, the Hanford Site total wage payroll was $537 million and accounted for a significant percentage of the payroll dollars earned in the area (Neitzel et al. 1998) (see text box on next page, *“Hanford Site Quick Facts: Economic Multipliers”*).

Previous studies have revealed that each Hanford job supports about 1.2 additional jobs in the local service sector of Benton and Franklin counties (about 2.2 total jobs) and about 1.5 additional jobs in the state service sector. Similarly, each dollar of Hanford income supports about 2.1 dollars of total local incomes and about 2.4 dollars of total statewide incomes. Based on these multipliers, Hanford directly or indirectly accounts for more than 40 percent of all jobs in Benton and Franklin counties (Neitzel et al. 1998).

Hanford Site Quick Facts: Economic Multipliers

Each Site job supports:

- 1.2 jobs in the local service sector
- 1.5 jobs in the state service sector

Each Site dollar supports:

- 2.1 dollars in total local incomes
- 2.4 dollars in total state incomes

Based on employee residence records as of December 1997, 93 percent of the direct employment of Hanford is comprised of residents of Benton and Franklin counties. Approximately 76 percent of the employment is comprised of residents who reside in one of the Tri-Cities. More than 37 percent of the employment is comprised of Richland residents, 30 percent of Kennewick residents, and 9 percent of Pasco residents. West Richland, Benton City, Prosser, and other areas in Benton and Franklin counties account for 17 percent of total employment. Table 4-10 contains the estimated percent of Hanford employees residing in each of the counties within the region of influence.

Table 4-10. Hanford Employee Residences by County.

County	Percent of Employees in Residence (%)
Adams	0.18
Benton	84.16
Columbia	0.01
Franklin	9.07
Grant	0.25
Walla Walla	0.21
Yakima	5.08
Morrow	0.01
Umatilla	0.01

The DOE and Hanford Site contractors procured nearly $298 million of goods and services (45.6 percent of total procurements of $653 million) from Washington firms in 1993. About 18 percent of Hanford Site orders were filled by Tri-Cities firms.

The DOE and Hanford Site contractors paid a total of $10.9 million in state taxes on operations and purchases during fiscal year 1988 (the most recent year available). Estimates show that Hanford employees paid $27.0 million in state sales tax, use taxes, and other taxes and fees in fiscal year 1988. In addition, the Hanford Site paid $0.9 million to local governments in Benton, Franklin, and Yakima counties in local taxes and fees (PNNL 1996a).

4.7.3 Emergency Services

Police protection in Benton and Franklin counties is provided by county sheriff departments, local municipal police departments, and the Washington State Patrol Division, which is headquartered in Kennewick. Table 4-11 shows the number of commissioned officers and patrol cars in each department in April 1997. The Kennewick, Richland, and Pasco municipal departments maintain the largest staffs of commissioned officers with 73, 50, and 44, respectively.

Table 4-11. Police Personnel in the Tri-Cities for 1998 (Neitzel et al. 1998).

Area	Commissioned Officers	Reserve Officers	Patrol Cars
Kennewick Municipal	73	15	45
Pasco Municipal	44	33	15
Richland Municipal	50	13	13
West Richland Municipal	12	10	11
Benton County Sheriff	47	15	55
Franklin County Sheriff	19	17	22

Table 4-12 indicates the number of firefighting personnel, both paid and unpaid, on the staffs of fire districts in the area.

Table 4-12. Fire Protection in the Tri-Cities for 1998 (Neitzel et al. 1998).

Station	Firefighting Personnel	Volunteers	Total	Service Area
Kennewick	63	0	63	City of Kennewick
Pasco	30	0	30	City of Pasco
Richland	48	0	48	City of Richland
BCRFD 1	9	94	103	Kennewick Area
BCRFD 2	3	37	40	Benton City
BCRFD 4	5	30	35	West Richland

BCRFD = Benton County Rural Fire Department

The Hanford Fire Department, operated by Hanford Site contractors for DOE, has 93 firefighters who are trained to dispose of hazardous waste and to fight chemical fires, in addition to their regular firefighting duties. During a 24-hour duty period, the 1100 and 300 Areas have seven firefighters; the 200 East and 200 West Areas have eight firefighters; the 100 Areas have five firefighters; and the 400 Area, which includes Energy Northwest (formerly known as WPPSS), has six firefighters (Neitzel et al. 1997). To perform their responsibilities, each station has access to a hazardous material response vehicle that is equipped with chemical fire-extinguishing equipment, an attack truck that carries foam and Purple-K dry chemical, a mobile air truck that provides air for respirators, and a transport tanker that supplies water to six brushfire trucks. The Hanford Fire Department owns five ambulances and maintains contact with local hospitals.

4.7.4 Health Care

The Tri-Cities have three major hospitals, all of which offer general medical services and include a 24-hour emergency room, basic surgical services, intensive care, and neonatal care.

Kadlec Medical Center, located in Richland, has 124 beds and functioned at 54 percent capacity (6,055 admissions) in 1997. Non-Medicare and Medicaid patients accounted for 60 percent of their annual admissions in 1997. An average stay of 4.04 days per admission was reported for 1997.

Kennewick General Hospital maintains a 46.7 percent occupancy rate of its 70 beds with 4,670 admissions in 1995. Non-Medicare and Medicaid patients in 1997 represented 45.6 percent of its total admissions. An average stay of 3.2 days per admission was reported in 1997.

Our Lady of Lourdes Health Center, a 132-bed medical facility located in Pasco, provides acute, sub-acute, skilled nursing and rehabilitation, and alcohol and chemical dependency services. Our Lady of Lourdes also operates the Carondolet Psychiatric Care Center, a 32-bed psychiatric hospital located in Richland, which provides a significant amount of outpatient and home health services. For calender year 1997, Our Lady of Lourdes had a total of 4,528 admissions, of which 35 percent were non-Medicare and Medicaid admissions. An average acute care length of stay of 3.0 days was reported (Neitzel et al. 1998).

4.7.5 Housing

In 1996, 91 percent of all housing (44,488 total units) in the Tri-Cities was occupied. Single-unit housing, which represents nearly 58 percent of the total units, has a 95 percent occupancy rate throughout the Tri-Cities. Multiple-unit housing, defined as housing with two or more units, has an occupancy rate of 85 percent. Pasco had the lowest occupancy rate in all categories of housing with 89 percent, followed by Kennewick with 90 percent, and Richland with 92 percent. Mobile homes, which represent 11 percent of the housing-unit types, have the lowest occupancy rate at 84 percent. Table 4-13 shows a detailed listing of total units and occupancy rate by type in the Tri-Cities.

Table 4-13. Total Units and Occupancy Rates, 1996 Estimates (Neitzel et al. 1998).

City	All Units	Rate (%)	Single Units	Rate (%)	Multiple Units	Rate (%)	Manufactured Homes	Rate (%)
Richland	15,859	92	10,722	96	4,284	84	853	88
Pasco	8,419	89	4,104	95	2,956	85	1,359	83
Kennewick	20,210	90	10,887	95	6,660	85	2,241	84
Total for Tri-Cities	44,488	91	27,213	95	13,900	85	4,875	84

Recent Hanford Site downsizing has resulted in occupancy rates lower than in the recent past throughout the Tri-Cities. Statistics from February 1996 indicated that the Tri-Cities apartment occupancy rates are significantly lower: Richland apartment occupancy was 80.2 percent, Kennewick apartment occupancy was 85.4 percent, and Pasco apartment occupancy was 83.7 percent (TCH 1996a).

4.7.6 Human Services

The Tri-Cities offers a broad range of social services. State human service offices in the Tri-Cities include the job services office of the Employment Security Department, food stamp offices, the Division of Developmental Disabilities, financial and medical assistance, Child Protective Services, emergency medical service, a senior companion program, and vocational rehabilitation.

The Tri-Cities also are served by a large number of private agencies and voluntary human services organizations. The United Way, which is an umbrella fund-raising organization, incorporates 22 participating agencies offering more than 46 programs. These member agencies had a cumulative budget total of $23 million in 1997. In addition, there were 488 organizations that received funds as part of the United Way-Franklin County donor designation program (Neitzel et al. 1998).

4.7.7 Educational Services

Primary and secondary education are served by the Tri-Cities and Kiona-Benton School Districts. The combined 1997 fall enrollment for all districts was approximately 32,500 students, an increase 1.7 percent from the 1996 total of 31,970 students. The 1997 total includes 8,974 from the Richland School District, 8,066 students from the Pasco School District, 13,745 students from the Kennewick School District, and 1,715 from Kiona-Benton. Private schools total approximately 3,000 students. In 1997, Richland was operating over capacity at the elementary level, at capacity at their middle schools, and slightly under capacity at the high school level. A bond issue was recently passed to build a new elementary school, which should open in 1999. Pasco was at capacity for primary education but has room for more students at the secondary level. Pasco also passed an elementary school bond issue, and currently has three buildings under construction. Kennewick and Kiona-Benton schools are operating at capacity (Neitzel et al. 1998).

Post-secondary education in the Tri-Cities area is provided by a junior college, Columbia Basin College (CBC), and the Tri-Cities branch campus of Washington State University (WSU-TC). WSU-TC offers a variety of upper-division, undergraduate, and graduate degree programs. The 1997 fall/winter enrollment was approximately 6,869 at CBC and 1,334 at WSU-TC. Many of the programs offered by these two institutions are geared toward the vocational and technical needs of the area. Currently, 27 associate degree programs are available at CBC, and WSU-TC offers 10 undergraduate and 16 graduate programs, as well as access to eight additional graduate programs via satellite (Neitzel et al 1998).

4.7.8 Transportation

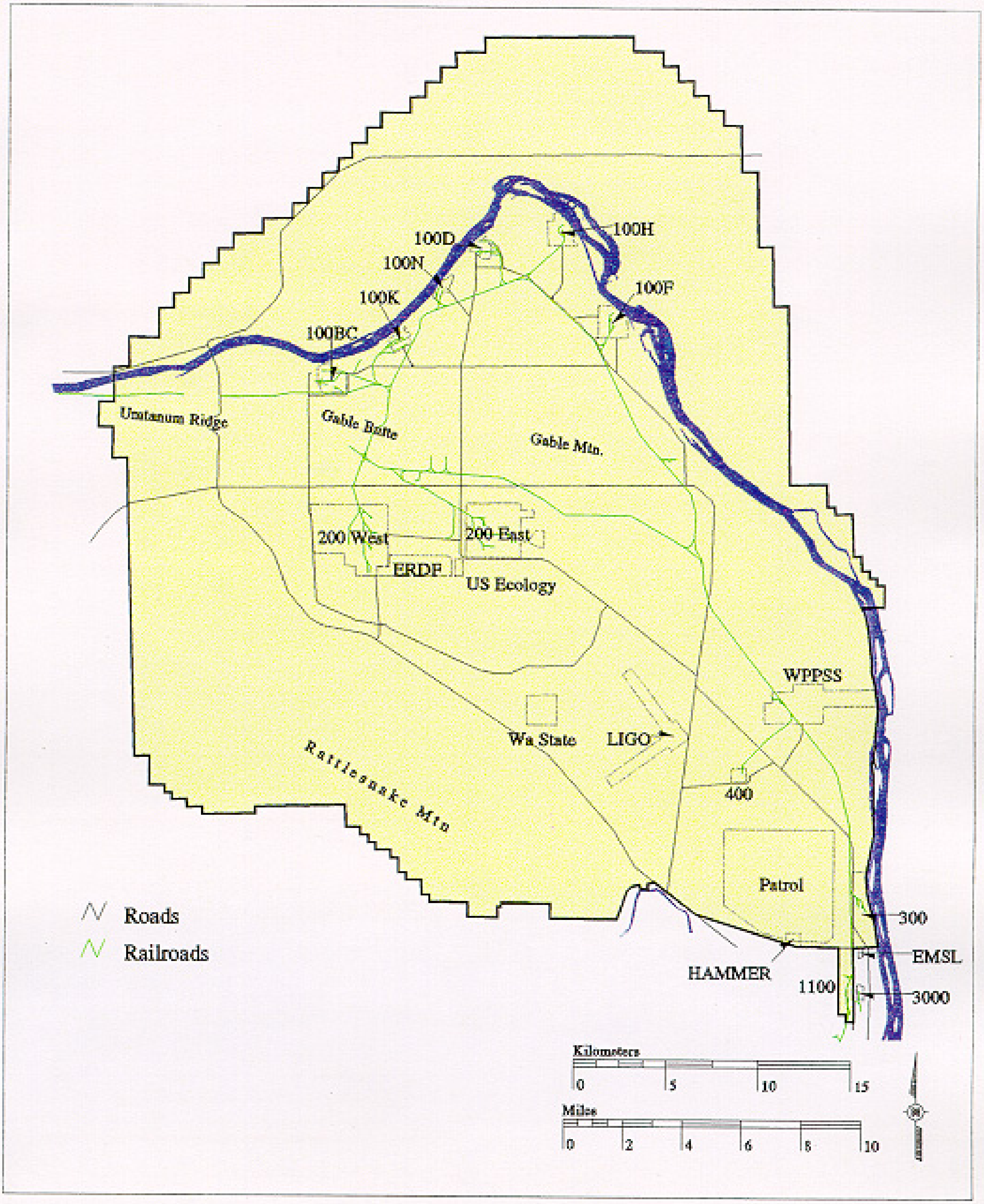
The Tri-Cities serve as a regional transportation and distribution center with major air, land, and river connections (Figure 4-29). The Tri-Cities have direct rail service, provided by Burlington Northern Santa Fe and Union Pacific, which connects the area to more than 35 states. Union Pacific operates the largest fleet of refrigerated rail cars in the United States and is essential to food processors that ship frozen food from this area. Passenger rail service is provided by Amtrak, which has a station in Pasco (Neitzel et al. 1997).

Docking facilities at the Ports of Benton, Kennewick, and Pasco are important aspects of the regional infrastructure. These facilities are located on the 525-km (325.5-mi)-long commercial waterway, which includes the Snake and Columbia rivers and extends from the Ports of Lewiston-Clarkston in Idaho to the deep-water ports of Portland, Oregon, and Vancouver, Washington. The average shipping time from the Tri-Cities to these deep-water ports by barge is 36 hours (PNNL 1996a).

Daily air passenger and freight services connect the area with most major cities through the Tri-Cities Airport, which is located in Pasco. The airport is currently served by one national and three commuter-regional airlines. There are two runways: a main and minor crosswind. The main runway is equipped for precision instrumentation landings and takeoffs. Each runway can accommodate landings and takeoffs by medium-range commercial aircraft, such as the Boeing 727-200 and Douglas DC-9. The Tri-Cities Airport handled approximately 182,978 passengers in 1997, which is up 4.3 percent from 1996. Projections indicate that the terminal can serve nearly 300,000 passengers annually. Two additional airports, located in Richland and Kennewick, are limited to serving private and airfreight aircraft (Neitzel et al. 1998).

The regional transportation network in the Hanford vicinity (Figure 4-29) includes the areas in Benton and Franklin counties from which most of the commuter traffic associated with the Hanford Site originates. Interstate highways that serve the area are I-82, I-182, I-84, and I-90. Interstate-82 is 8 km (5 mi) south-southwest of the Hanford Site. Interstate-182, a 24-km (15-mi)-long urban connector route, located 8 km (5 mi) south-southeast of the Hanford Site, provides an east-west corridor linking I-82 to the Tri-Cities area. Interstate-90, located north of the Hanford Site, is the major link to Seattle and Spokane and extends to the east coast; I-82 serves as a primary link between Hanford and I-90 and I-84. I-84, located south of the Hanford Site in Oregon, is the major link to Portland and extends eastward. SR 224, south of the Hanford Site, serves as a 16-km (10-mi) link between I-82 and SR 240.

Figure 4-29. Transportation Network on the Hanford Site (DOE-RL 1990a).



SR 24 enters the Hanford Site from the west, continues eastward across the northern-most portion of the Hanford Site, and intersects SR 17 approximately 24 km (15 mi) east of the Hanford Site boundary. SR 17 is a north-south route that links I-90 to the Tri-Cities and joins U.S. Route 395, which continues south through the Tri-Cities. SR 14 connects with I-90 at Vantage, Washington, and provides ready access to I-84 at several locations along the Oregon and Washington border. SRs 240 and 24 traverse the Hanford Site and are maintained by Washington State. Other roads within the Hanford Site are maintained by DOE (PNNL 1996a).

4.7.9 Utilities

The principal source of water in the Tri-Cities and the Hanford Site is the Columbia River. The potable water systems of Richland, Pasco, and Kennewick drew a large portion of the 50.6 billion L (13.43 billion gal) used in 1996 from the Columbia River. Each city operates its own supply and treatment system. The Richland water supply system derives about two-thirds of the water used from the Columbia River, while the remainder is split between a well field in North Richland and other groundwater wells. Total usage by the City of Richland in 1997 was 26.1 billion L (6.9 billion gal). This usage represents approximately 65 percent of the maximum supply capacity. The City of Pasco system also draws water from the Columbia River. In 1995, Pasco consumed 9.5 billion L (2.6 billion gal). The Kennewick system uses two wells and the Columbia River as a water supply. These wells serve as the sole source of water between November and March and can provide approximately 43 percent of the total maximum supply of 30 billion L (8 billion gal). Total 1997 usage in Kennewick was 12.7 billion L (3.36 billion gal). (Neitzel et al. 1998).

The major incorporated areas of Benton and Franklin counties are served by municipal wastewater treatment systems, whereas the unincorporated areas are served by onsite septic systems. The Richland waste water treatment system is designed to treat a total capacity of 45.5 million L/day (12 million gal/day) and processed an average flow of 23.5 million L/day (6.2 million gal/day) in 1997. The Kennewick system similarly has significant excess capacity; with a treatment capability 32.9 million L/day (8.7 million gal/day) and 1997 usage of 19.3 million L/day (5.13 million gal/day). The Pasco waste treatment system processed an average 4.9 million L/day (1.3 million gal/day), while the system is capable of treating 16.3 million L/day (4.3 million gal/day) (Neitzel et al. 1998)

Natural gas, provided by the Cascade Natural Gas Corporation, serves a small portion of Tri-Cities residents, with 6,182 residential customers in April 1998 (Neitzel et al. 1998).

In the Tri-Cities, electricity is provided by the Benton County Public Utility District, Benton Rural Electrical Association, Franklin County Public Utility District, and City of Richland Energy Services Department. All of the power provided by these utilities in the local area is purchased from the BPA, a Federal power marketing agency. The average rate for residential customers served by the four local utilities is approximately $0.049/kWh. Electrical power for the Hanford Site is purchased wholesale from the BPA. Energy requirements for the Hanford Site during fiscal FY 1997 exceeded 319 million kWh, for a total cost of nearly $7.7 million (Neitzel et al. 1998).

In the Pacific Northwest, hydropower (and to a lesser extent, coal and nuclear power), constitute the regional electrical generation system. The system is capable of delivering approximately 20,300 average megawatts of guaranteed energy; of that amount, approximately 62 percent is derived from hydropower, 16 percent from coal, and less than 7 percent from nuclear plants. One commercial nuclear power plant (WNP-2) remains in service in the Pacific Northwest, with an average generating capability of 833 megawatts. The Trojan Nuclear Power Plant in Oregon was permanently shut down on January 4, 1993, and is being buried at Hanford's commercial low-level waste (LLW) facility.

The regional electrical power system, more than any other system in the nation, is dominated by hydropower. In a given peak-demand hour, the hydropower system is capable of providing nearly 30,000 megawatts of capacity. Variable precipitation and limited storage capabilities alter system output from 12,300 average megawatts under critical water conditions to 20,000 average megawatts in record high-water years. The reliance on hydroelectric power in the Pacific Northwest means that the system is more constrained by seasonal variations in peak demand than in meeting momentary peak demand.

Additional constraints on hydroelectric production are measures designed to protect and enhance the production of salmon, as many salmon runs have dwindled to the point of being threatened or endangered. These measures, outlined by the Northwest Power Planning Council (NPPC) Columbia River Basin Fish and Wildlife Program, include minimum flow levels and a "water budget," which refers to water in the Columbia and Snake rivers that is released to speed the migration of young fish to the sea. Generation capacity of the hydroelectric system is decreased with these measures, as less water is available to pass through the turbines.

Throughout the 1980s, the Pacific Northwest had a surplus of electric power. This surplus has been exhausted, however, and the system only supplies enough power to meet regional electricity needs. In the 1991 Northwest Power Plan, the NPPC set a goal of purchasing more than 1,500 megawatts of energy savings by the year 2000 to help the existing system meet the rising electricity demand. The NPPC estimates that the Pacific Northwest will need an additional 2,000 megawatts over 1991 consumption by the turn of the century (PNNL 1996a).

4.7.10 Site Infrastructure

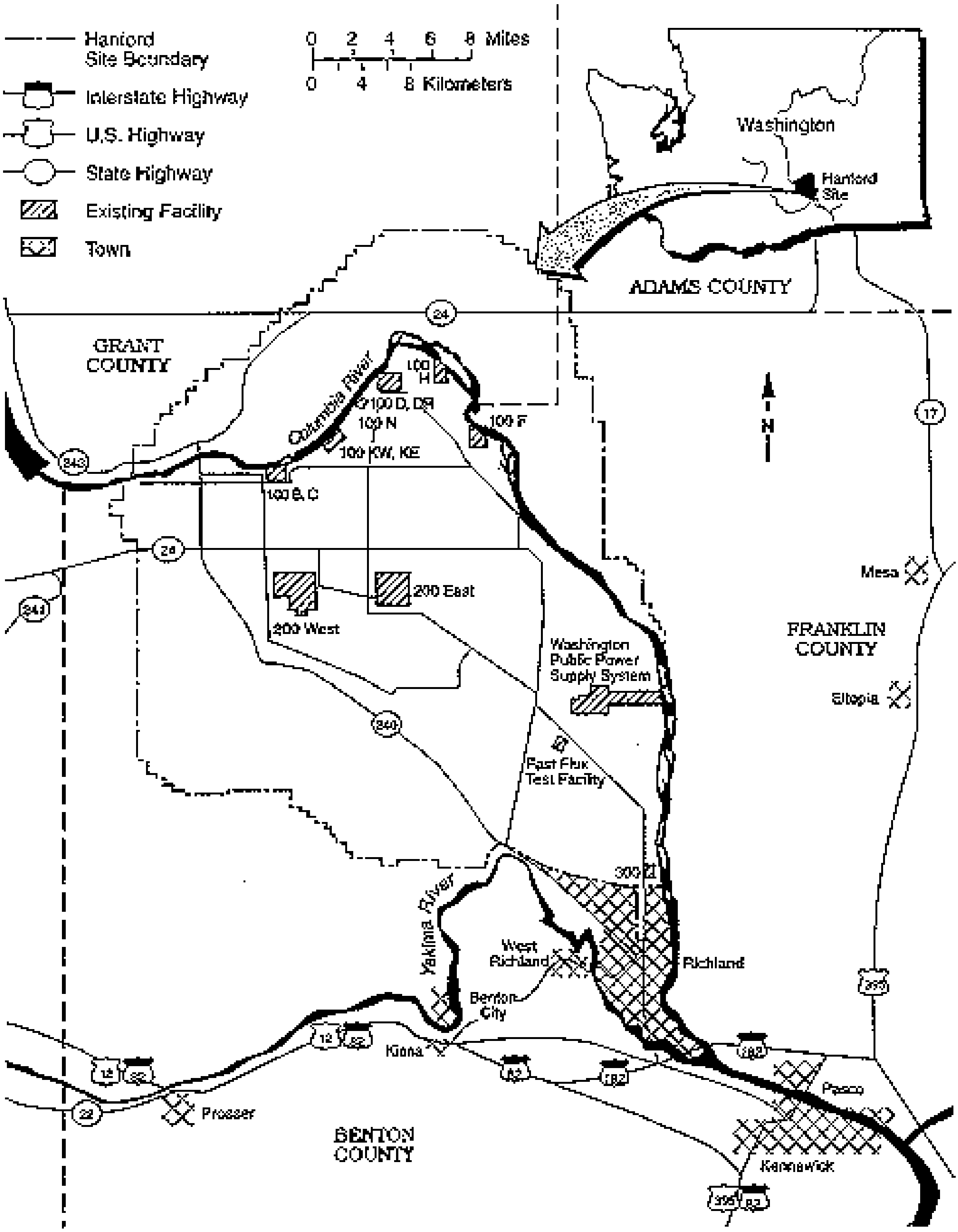
The Hanford Site infrastructure is a significant resource for furthering industrial development of the region. Key elements of this infrastructure include facilities, road and rail systems, utilities, and support services (DOE-RL 1994a).

4.7.10.1 Facilities. Onsite programmatic (60 percent) and general purpose facilities (40 percent) provide 600,000 m^2 (6.5 million ft^2) of space. General purpose facilities include offices, laboratories, shops, warehouses, and other facilities. The programmatic space supports an evaporator, filter, waste recovery, waste treatment, waste storage, and R&D laboratories. Many of these facilities are over 30 years old; however, upgrades and expansion of some facilities could occur as remediation progresses.

4.7.10.2 Road and Rail Systems. The transportation network is well developed on the Hanford Site with approximately 460 km (approximately 288 mi) of roads onsite (Figure 4-29). SR 24 crosses the Hanford Site primarily on the Wahluke Slope. SR 240 crosses the Hanford Site on the southwest and serves as the boundary between the ALE Reserve and the rest of the Site. A Site access road from SR 240 to the 200 West Area was completed in December 1994. Upgrades are planned for road capacities north of the Wye Barricade in support of remediation activities. Road maintenance will continue on all active roads. The 1100 Area roads were recently upgraded to improve traffic circulation and access.

There are approximately 204 km (127 mi) of rail line on the Hanford Site (see Figure 4-30). The rail system begins at the Richland Junction (Columbia Center), where it joins the Union Pacific commercial tracks and runs to the abandoned Chicago, Milwaukee, St. Paul, and Pacific right-of-way near the Vernita Bridge, located on the north boundary of the Hanford Site. Approximately 35 km (22 mi) of track are in "out-of-service" condition. The in-service track accommodates 4,000 movements of 1,500 rail cars annually. A railroad spurline from the 1100 Area to the City of Richland's Horn Rapids Industrial Park is planned to serve new industrial development in the Park. The Hanford railroad between the Richland Junction and Horn Rapids Road was has been transferred from DOE to the Port of Benton along with the 1100 Area.

Figure 4-30. Transportation Routes in the Vicinity of the Hanford Site.



4.7.10.3 Utilities. The Hanford Site water system includes numerous buildings, pumps, valve houses, reservoirs, wells, and a distribution piping system that delivers water from the Columbia River to all areas of the Hanford Site. The export water system, which is the largest, delivers water to the 100, 200, and parts of the 600 Areas from the Columbia River (Figure 4-31). The 300 Area and Energy Northwest (formerly known as WPPSS) also draw water directly from the Columbia River. Water is purchased from the City of Richland for the 700, 1100, and intermittently provided to the 300 Area, while the 400 Area and part of the 600 Area draw some water from groundwater wells.

The BPA, a Federal power marketing agency, sells electricity to the Hanford Site and the agencies that serve the Tri-Cities. The BPA provides electrical power to three distinct systems on the Hanford Site (Figure 4-32). The systems are located in the 100, 200, 300, and 400 Areas. Power for the 700 and 1100 Areas is provided by the City of Richland. Major upgrades or replacements of these systems to accommodate Hanford Site remediation are being implemented or planned.

The DOE has recently replaced the 200 East Area, 200 West Area, and 300 Area centralized steam plants by individual package boilers at specific facilities to supply heat and process steam. The steam in the 200 Areas is produced by oil-fired package boilers, while steam in the 300 Area is produced by natural gas-fired package boilers. A new underground natural gas line was installed from south Richland to the 300 Area to supply natural gas in support of operating the 300 Area package boilers. With these changes, the Hanford railroad is no longer needed to transport coal to the steam plants.

4.7.10.4 Support Services. Other support services on the Hanford Site include sewers, fire stations, telecommunications, landfills, and safeguards and security. Businesses in the City of Richland provide a number of important services such as laundry of radioactively contaminated protective clothing.

4.7.10.4.1 Sewer. Sanitary wastes in the 200 East and 200 West Areas are currently disposed of through septic tanks and drain fields. A central collection and treatment evaporation plant is being constructed in the 200 East and 200 West Areas to handle the sanitary sewer system. The sewer system in the 300 Area was recently connected to the City of Richland's sewer system. The 400 Area septic tank and drain field were recently closed and sanitary sewer effluent liquid was rerouted to the Energy Northwest (formerly known as WPPSS) sanitary sewer system.

4.7.10.4.2 Fire Stations. Fire stations are located in the 100, 200, and 300 Areas. Water supply, alarm, and sprinkler system upgrades are planned for the 300 Area laboratory and general support buildings. New and upgraded fire protection systems are planned for the 100-K Area facilities currently in use for interim fuel storage.

4.7.10.4.3 Telecommunications. A new fiber optic communications network was recently installed on the Hanford Site. This system provides a fully connected internal network of shared computing resources and capabilities to support future voice and data communication requirements.

4.7.10.4.4 Environmental Restoration Disposal Facility. A 65 ha (160 ac) landfill operates directly south of the 200 East and 200 West Areas to address the disposal of radioactive, hazardous, asbestos, polychlorinated biphenyls (PCBs), and mixed wastes resulting from the remediation of operable units on the Hanford Site. The facility can be expanded as needed, to a maximum of 414 ha (1.6 mi^2).

Figure 4-31. *Export Water System for the Hanford Site (DOE-RL 1990a).*

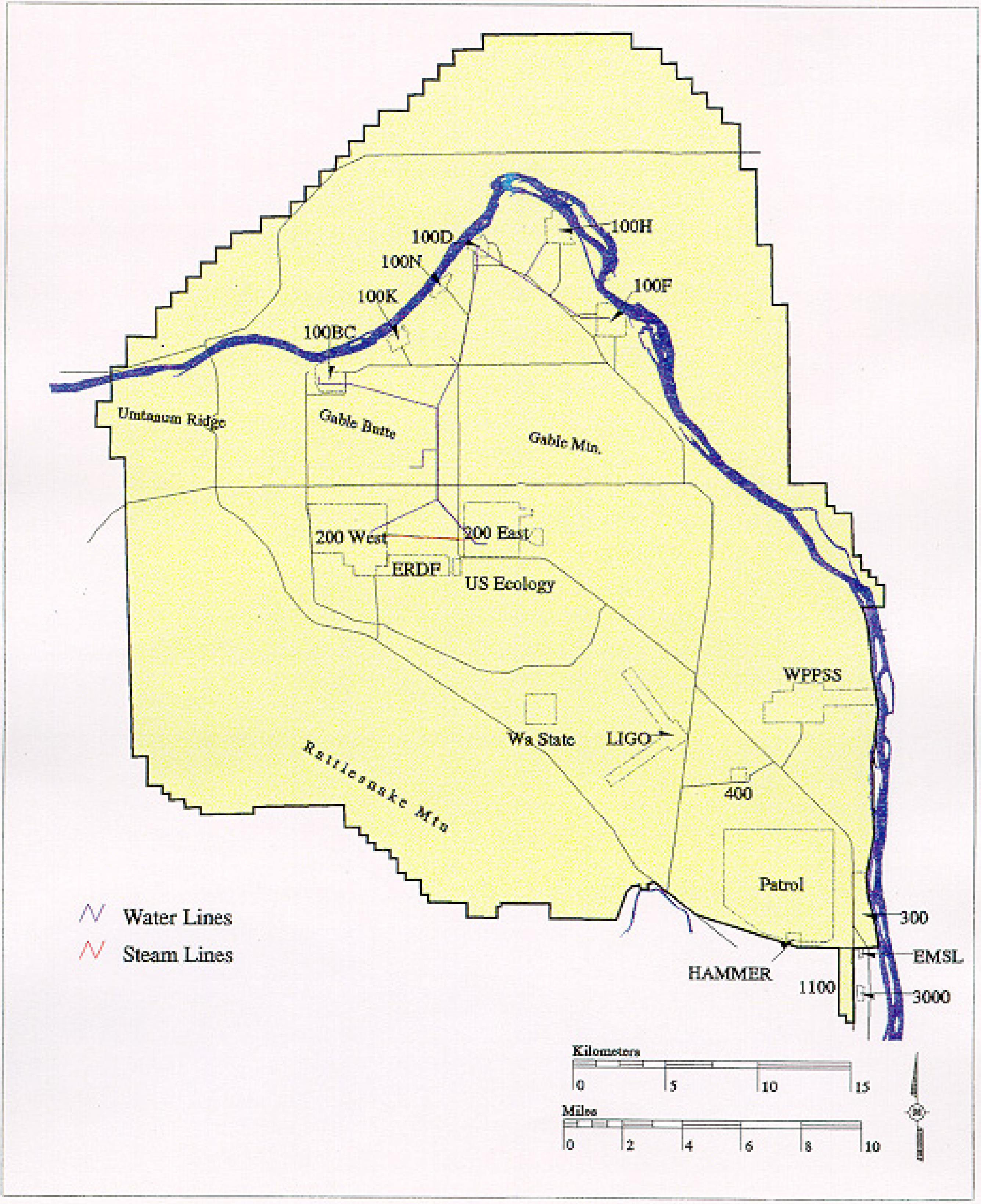
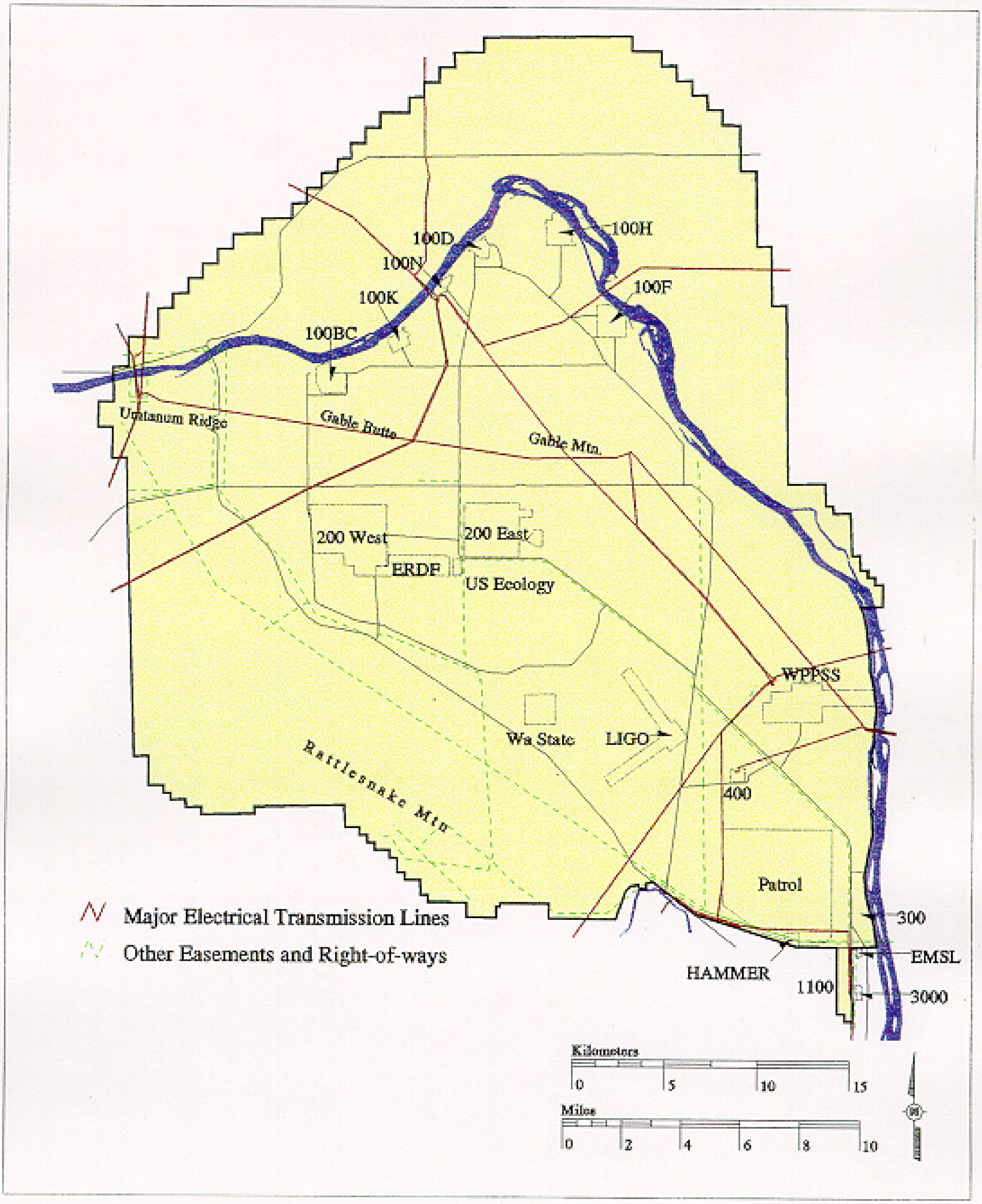


Figure 4-32. Electrical System for the Hanford Site (DOE-RL 1990b).



4.7.10.4.5 Safeguards and Security. A security force is employed onsite and a number of systems are in place to control Hanford Site access, and protect classified and business-sensitive information, property and personnel. The Benton County Sheriff's Office provides traffic enforcement, criminal enforcement, and investigations onsite.

4.8 Visual and Aesthetic Resources

The land in the vicinity of the Hanford Site is generally flat with little relief. Rattlesnake Mountain, rising to 1,060 m (3,477 ft) above mean sea level, forms the southeastern boundary of the Hanford Site. Gable Mountain and Gable Butte are the highest land forms within the Hanford Site (Figure 4-33). The view toward Rattlesnake Mountain is visually pleasing, especially in the springtime when wildflowers are in bloom. Large rolling hills are located to the west and north.

The Columbia River, flowing across the northern part of the Site and forming the eastern boundary, is generally considered scenic, with its contrasting blue against a background of dark basaltic rocks and desert sagebrush. The White Bluffs, steep whitish-brown bluffs adjacent to the Columbia River, are a striking natural feature of the landscape (see text box, *"Hanford Site Quick Facts: Visual and Aesthetic Resources"*).

Hanford Site Quick Facts: Visual and Aesthetic Resources
Prominent natural features include the Columbia River, Saddle Mountains, Gable Butte, Rattlesnake Mountain, White Bluffs, and Gable Mountain.

SR 24 provides public access through the northern portion of the Hanford Site, primarily on the north side of the Columbia River. Viewsheds along this highway include limited views of the Columbia River when the road drops down into the river valley, crosses the river over the Vernita Bridge, and climbs up out of the valley to a level plateau north of the river. A turnout on the north side of the river offers views of the river and the B and C Reactors, with an interpretive sign located nearby. A rest stop along the road just to the south of the river provides views of the Umtanum Ridge to the west, the Saddle Mountains to the north, and the Columbia River valley to the east and west.

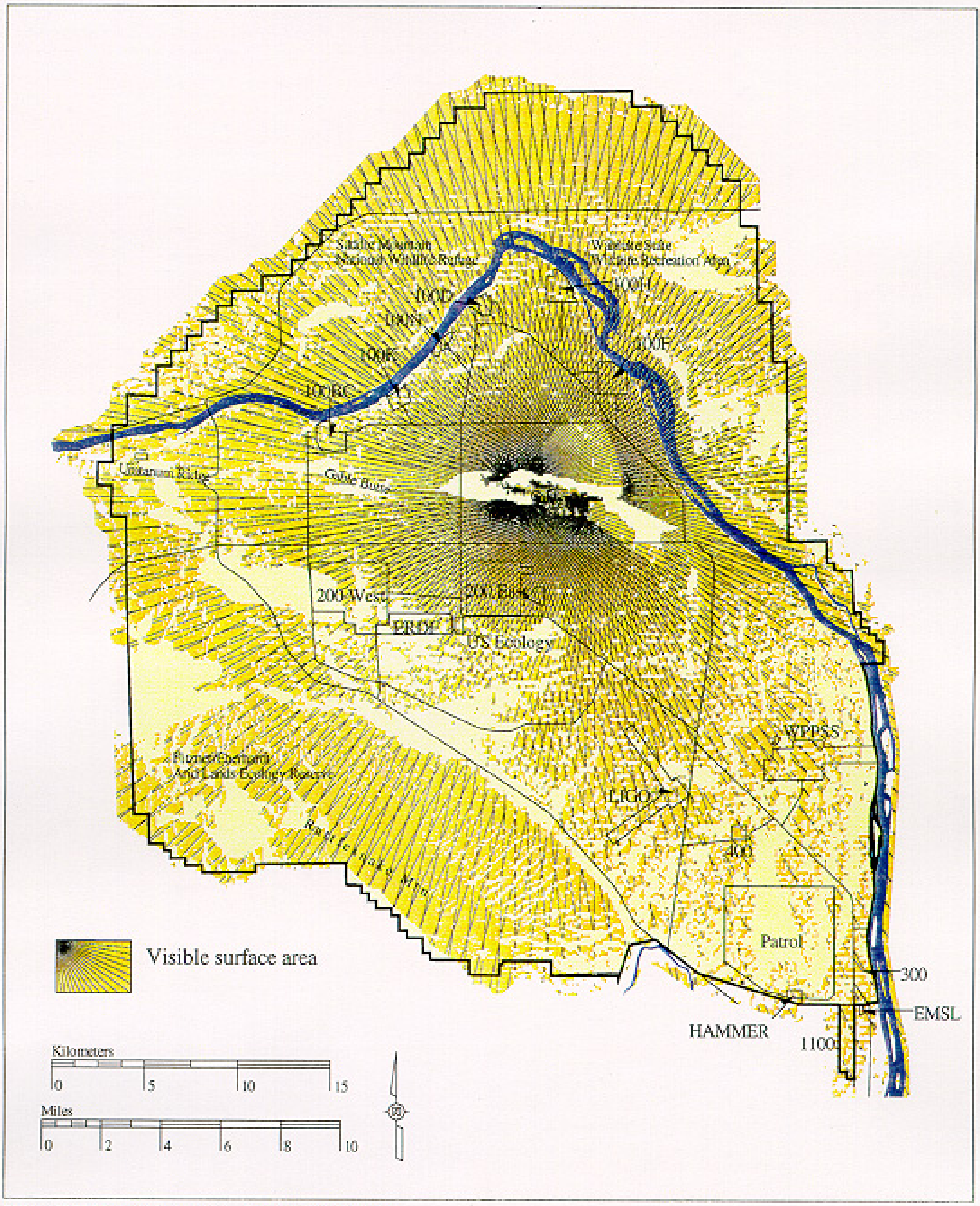
4.9 Noise

This EIS defines noise as "any undesirable or unwanted sound or audible disturbance that interferes with normal activity." Typically, intrusive noise events are those that disrupt normal human activity, especially verbal communication. Under certain circumstances, people are willing to endure noise as a trade-off for accomplishing some meaningful activity or because certain noises represent tangible evidence of progress. In the context of transportation systems, a certain amount of noise also is usually considered tolerable.

4.9.1 Public Health Implications

Noise impacts on public health usually are analyzed in terms of a dose-response relationship because noise effects are cumulative. Prolonged exposure to loud noises can impair hearing. The impairment can be temporary or permanent, depending on intensity and duration of the noise. Normally, hearing degeneration does not occur if the duration of the event is brief. Off-property noise impacts are the sound-exposure levels that interfere with normal speech, disrupt sleep, or produce secondary effects such as increased levels of stress among community members.

Figure 4-33. Viewshed from Gable Mountain.



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4.9.2 Hanford Site Sound Levels

Most industrial facilities on the Hanford Site are located far enough away from the Site boundary that noise levels at the boundary are not measurable or are barely distinguishable from background noise levels. Modeling of environmental noises has been performed for commercial reactors and traffic on SR 240 through the Hanford Site. These data are not concerned with background levels of noise and are not reviewed here.

Two studies of environmental noise were performed at the Hanford Site. One study reported environmental noise measurements taken in 1981 during Site characterization of the Skagit/Hanford Nuclear Power Plant Site (Cushing 1995). The second consisted of a series of Hanford Site characterization studies performed in 1987 that included measurement of background environmental noise levels at five locations on the Hanford Site. Noise can be disruptive to wildlife and studies have been performed to compile noise data in remote areas.

Recently, the potential impact of traffic noise resulting from Hanford Site activities has been evaluated for a draft environmental impact statement (EIS) addressing the siting of a proposed New Production Reactor (Cushing 1995). While the draft EIS did not include any new baseline measurements, it did address the traffic component of noise and provides modeled “baseline” measurements of traffic noise for the Hanford Site and adjacent communities. Baseline noise estimates were determined for two locations: SR 24, leading from the Hanford Site west to Yakima; and State Highway 240, south of the Site and west of Richland where maximum traffic volume exists. Traffic volumes were predicted based on the presence of both operational and construction work forces. Noise levels were expressed in Leq for one-hour periods in dBA at a receptor located 15 m (49 ft) from the road. Adverse community responses would not be expected at increases of 5 dBA over background noise levels.

To provide noise data for the Energy Northwest (formerly known as WPPSS) plants, measurements of environmental noise were taken in June 1981 before the construction of the Energy Northwest plants on the Hanford Site. Monitoring was conducted at 15 sites, showing point noise levels reading ranging from 30 to 60.5 dBA. The corresponding values for more isolated areas ranged from 30 to 38.8 dBA. Measurements taken in the vicinity of the sites where Energy Northwest (formerly known as WPPSS) was constructing nuclear power plants ranged from 50.6 to 64 dBA, reflecting operation of construction equipment. Measurements taken along the Columbia River near the intake structures for WNP-2 were 47.7 and 52.1 dBA, compared to more remote river noise levels of 45.9 dBA (measured about 4.8 km [3 mi] upstream of the intake structures). Community noise levels from point measurements in North Richland (at Horn Rapids Road and Stevens Road [Route 240]) were 60.5 dBA, which was largely attributed to traffic.

To support the Basalt Waste Isolation Project, background noise levels were determined at five sites located within the Hanford Site. Noise levels are expressed as equivalent sound levels for 24 hours (Leq-24). The average noise level for these five sites was 38.8 dBA on the dates tested. The wind was identified as the primary contributor to background noise levels, with winds exceeding 19 km/hr (12 mi/hr) significantly affecting noise levels. This study concluded that background noise levels in undeveloped areas at the Hanford Site are generally in the range of 24 to 36 dBA (Cushing 1992). Periods of high wind, which normally occur in the spring, would elevate background noise levels.

In addition to the project-driven studies described above, the Hanford Environmental Health Foundation has monitored noise levels resulting from several routine operations performed in the field at the Hanford Site. These included well drilling, pile driving, compressor operations, and water-wagon operation. Occupational sources of noise propagated in the field from outdoor activities ranged from 74.8 to 125 dBA (PNNL 1996a).

4.10 Environmental Monitoring Programs

Environmental surveillance at the Hanford Site consists of monitoring for potential radiological and nonradiological constituents and includes monitoring of external radiation, air, surface water, groundwater, soil, vegetation, wildlife, and regional food and farm products. Monitoring is performed to ensure protection of human health and safety and is conducted in compliance with DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990a), and DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993a). A detailed discussion of the Hanford Site environmental monitoring program is found in the *Hanford Site Environmental Monitoring Plan* (DOE-RL 1991a), and monitoring data are presented in annual reports, such as the *Hanford Site Environmental Report for Calendar Year 1995* (PNNL 1996b).

The Hanford Environmental Health Foundation (HEHF) provides occupational health services to Hanford personnel through health risk management and occupational health monitoring. The HEHF’s Health Risk Management Program is used to identify and analyze the hazards that Hanford personnel face in the work environment and bring an awareness to worker health and safety issues at Hanford. HEHF’s occupational health services provide occupational medicine and nursing, medical monitoring and surveillance, ergonomics assessment, exercise physiology, case management, psychology and counseling, fitness for duty evaluations, health education, infection control, immediate health care, industrial hygiene, and health, safety, and risk assessments.

4.11 Contamination

Three operating areas of the Hanford Site (the 100, 200, and 300 Areas) are still included on the EPA’s National Priorities List (NPL), while the 1100 Area has been fully remediated and removed from the EPA’s NPL. Radioactive and hazardous materials have been disposed to the ground throughout the period of active Hanford Site operations, resulting in extensive contamination of the vadose zone and groundwater.

Under the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989), the more than 1,000 inactive waste disposal and unplanned release sites were grouped into groundwater and source operable units, based on geographic proximity or similarity of waste disposal history. In addition, a number of *Resource Conservation and Recovery Act of 1976* (RCRA) treatment, storage, and/or disposal (TSD) units are included in the Tri-Party Agreement, which will be closed or permitted to operate in accordance with the State of Washington’s “Dangerous Waste Regulations” (WAC 173-303). Some of these waste sites and TSD units are sources of environmental contamination.

The DOE holds interim status for the operation of hazardous waste management facilities by virtue of having submitted a RCRA Part A application to EPA on November 18, 1980. On November 6, 1985, DOE submitted a RCRA Part B application to Ecology and the EPA Region 10 for the TSD of hazardous wastes at Hanford. Supplemental and revised RCRA applications have been submitted to Ecology in accordance with the schedule established in the Tri-Party Agreement. A final status permit covering several units at the Hanford Site was issued in August 1994. This permit will be amended over a period of years to add additional interim status TSD units.

Hanford surface waste sites, based on data from the Hanford Geographic Information System (HGIS) and Waste Information Data System (WIDS) database, are shown in Figure 4-34. Included is vadose zone contamination, primarily in the 100, 200, and 300 Areas. The vadose zone contamination, while not necessarily occurring from all waste sites, is a result of the disposal of wastes to surface disposal structures such as the following:

- **Tanks and vaults** – Used to store radioactive liquid wastes generated by uranium and plutonium processing activities in the 200 Areas. Tanks include catch tanks, settling tanks, and storage tanks. The catch tanks are generally associated with diversion boxes and other transfer units and were designed to accept overflow and spills; wastes collected in catch tanks were transferred to storage tanks. Settling tanks were used to settle particulates in liquid wastes prior to transfer to cribs. Storage tanks were used to collect and store large quantities of liquid wastes. Storage tanks include single-shell tanks and double-shell tanks.

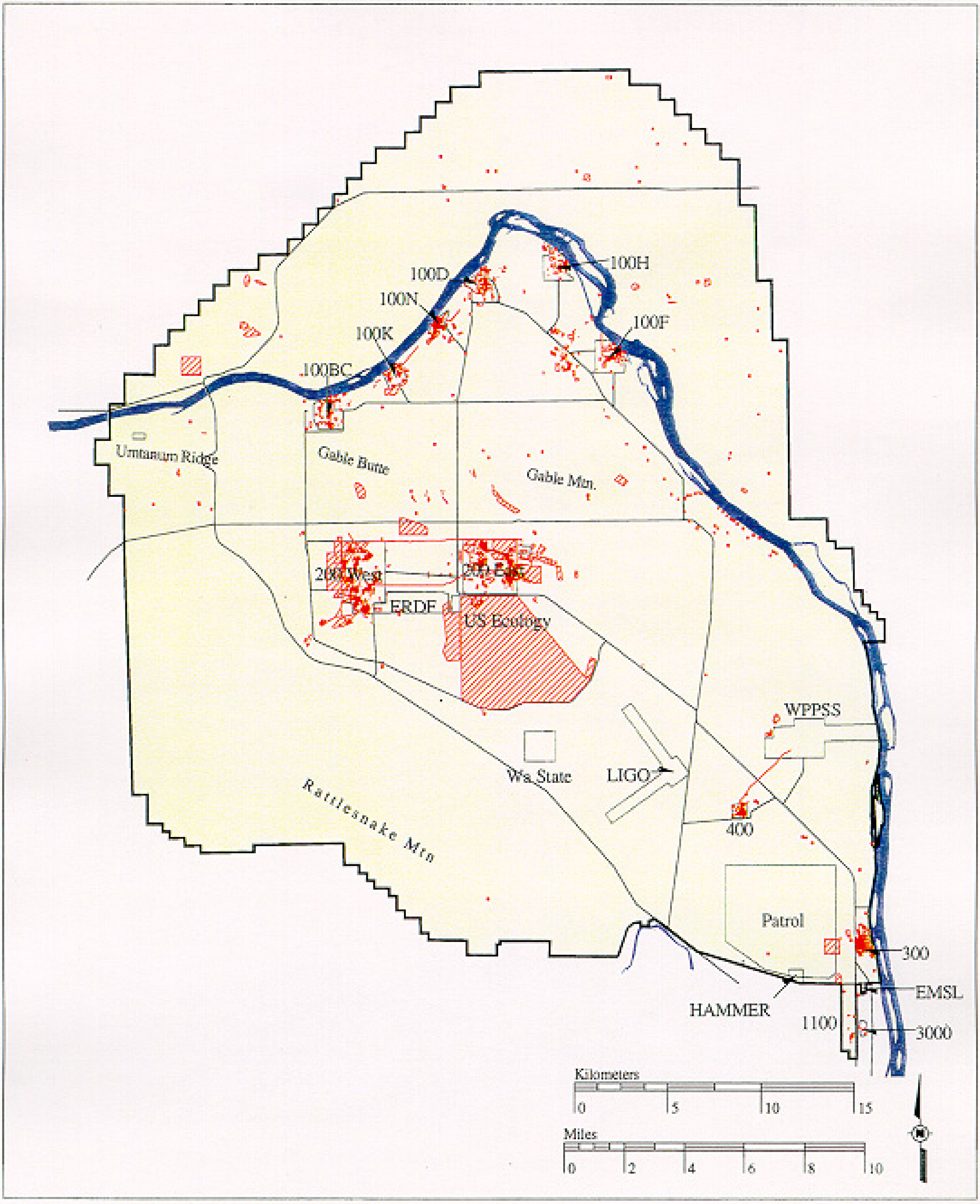
- **Vaults** – Typically are deep underground concrete structures that contain tanks as well as associated pumps, valves, and agitators. Vaults do not hold wastes but instead provide containment for other types of storage features and associated plumbing.

- **Cribs and drains** – Were designed to percolate low-level radioactive process waste into the ground without exposing the waste to the open air. Cribs and drain fields are shallow excavations that were either backfilled with permeable material or held open by wooden structures, both of which are covered with an impermeable layer. Water flows directly into the backfilled material or covered open space and percolates into the soil. French drains generally deliver waste water at a greater depth (up to 12.2 m [40 ft]) and are constructed of steel or concrete pipes that are either left open or filled with gravel.

- **Ponds, ditches, and trenches** – Were designed to percolate high volumes of low-level liquid wastes into the soil. Ditches are long, unlined excavations used to convey wastes to the ponds. Trenches are generally open, unlined, shallow excavations used for disposal of low-liquid discharges, such as sludge, which has a high salt content. Trenches were used for short periods and were deactivated when the discharge rate exceeded the soil infiltration rate.

- **Burial grounds** – Were used for disposal of solid wastes. Although the burial grounds received a variety of contaminated debris and solid wastes packed in barrels and boxes, there is currently no evidence of vadose zone contamination occurring from the disposal of solid wastes in burial grounds. Vadose contamination typically occurs when there is a driving force for the contamination, such as is found with the disposal of liquids.

Figure 4-34. Hanford Surface Waste Sites (Past and Present).



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4.11.1 Hanford Groundwater Contamination

There are a variety of contaminants present in the groundwater of the Hanford Site (Figures 4-35 and 4-36 and Table 4-14). The extent of major radionuclides at levels above the interim drinking water standards (DWSs) is shown in Figure 4-35. Tritium, iodine-129, technetium-99, and strontium-90 were present at levels above EPA or State of Washington interim DWSs. Uranium exceeded EPA's proposed maximum contaminant level (MCL). Minor radiological contamination DWS included carbon-14 (in the 100-K Area), cesium-137, and plutonium (in the 200 East Area, near injection well 216-B-5). Derived concentration guide levels (DCGLs) were exceeded for strontium-90 in the 100-K, 100-N, and 200 East Areas (near injection well 216-B-5), and near the former Gable Mountain Pond. The DCGL for uranium was exceeded near U Plant. The DCGL for tritium was exceeded in one well near cribs that received effluent from the Plutonium-Uranium Extraction (PUREX) Plant, and in another well near waste management area TX-TY. The DCGL for plutonium was exceeded in one well in the 200 East Area (near injection well 216-B-5). Cobalt-60 levels exceeded the 100 pCi/L interim DWS in recent years but were below the DWS in fiscal year 1998 (PNNL 1998).

The extent of major chemical constituents at levels above the primary MCLs is shown in Figure 4-36. Nitrate, carbon tetrachloride, and trichloroethylene were the most widespread. Chloroform, cis-1,2-dichloroethylene, cyanide, fluoride, chromium, and other metals also were present at levels above their MCLs. Tetrachloroethylene exceeded its 5 µg/L MCL in the 300 Area in fiscal year 1998 for the first time since the 1980s (PNNL 1998).

The area of Hanford contaminant plumes with concentrations exceeding an MCL or DWS was estimated to be approximately 245 million m^2 (95 mi^2) in fiscal year 1998. This equates to a volume of approximately 1.4 billion m^3, which is the same as fiscal year 1997. The volume estimate has a high uncertainty because of a lack of knowledge of the vertical extent of contaminant plumes. Plume thickness is estimated to be 20 m (66 ft), except in the 100 and 300 Areas and the North Richland area, where the plume is estimated to be 5 m (16 ft). The porosity of the aquifer is not well-characterized; for the purpose of the calculation, the porosity was assumed to be 30 percent. This estimate does not include water in the vadose zone.

Tritium, iodine-129, and nitrate plumes originating in the Central Plateau are quite widespread, reaching the Columbia River to the east. Other contaminants are not as widespread but exist in the groundwater at many different locations. Examples of these contaminants include strontium-90, uranium, technetium-99, and chromium. Contaminant plume migration is affected in part by the degree to which individual contaminants are mobile in groundwater and in part on hydrogeologic conditions. Natural groundwater flow at the Hanford Site has been altered in some areas due to past Hanford Site operations; this alteration is due in large part to groundwater mounds that were created by extensive artificial recharge at some wastewater disposal facilities. Although these groundwater mounds are dissipating, groundwater flow patterns are still affected by past wastewater discharges on the Hanford Site

.***4.11.1.1 Groundwater Ingestion Dose and Risk Estimates.*** Results of groundwater monitoring are compared to the DWSs for individual radiological constituents (see Table 5-14). These interim DWSs use the methodology set out in 40 CFR 141, 40 CFR 142, and 40 CFR 143 to estimate the concentration in water that could result in a potential radiological dose of 4 mrem/yr from consumption of each individual constituent. Similarly, DCGLs provide estimates of activities that could result in a 100 mrem/yr dose, as defined in DOE Order 5400.5. However, the potential dose is actually the sum of the doses from the individual constituents. An estimate of this cumulative dose, which could result from consumption of groundwater from different onsite locations, can be calculated from the extent of contamination.

Figure 4-35. Distribution of Radionuclides in Groundwater within the Hanford Site (PNNL 1998).

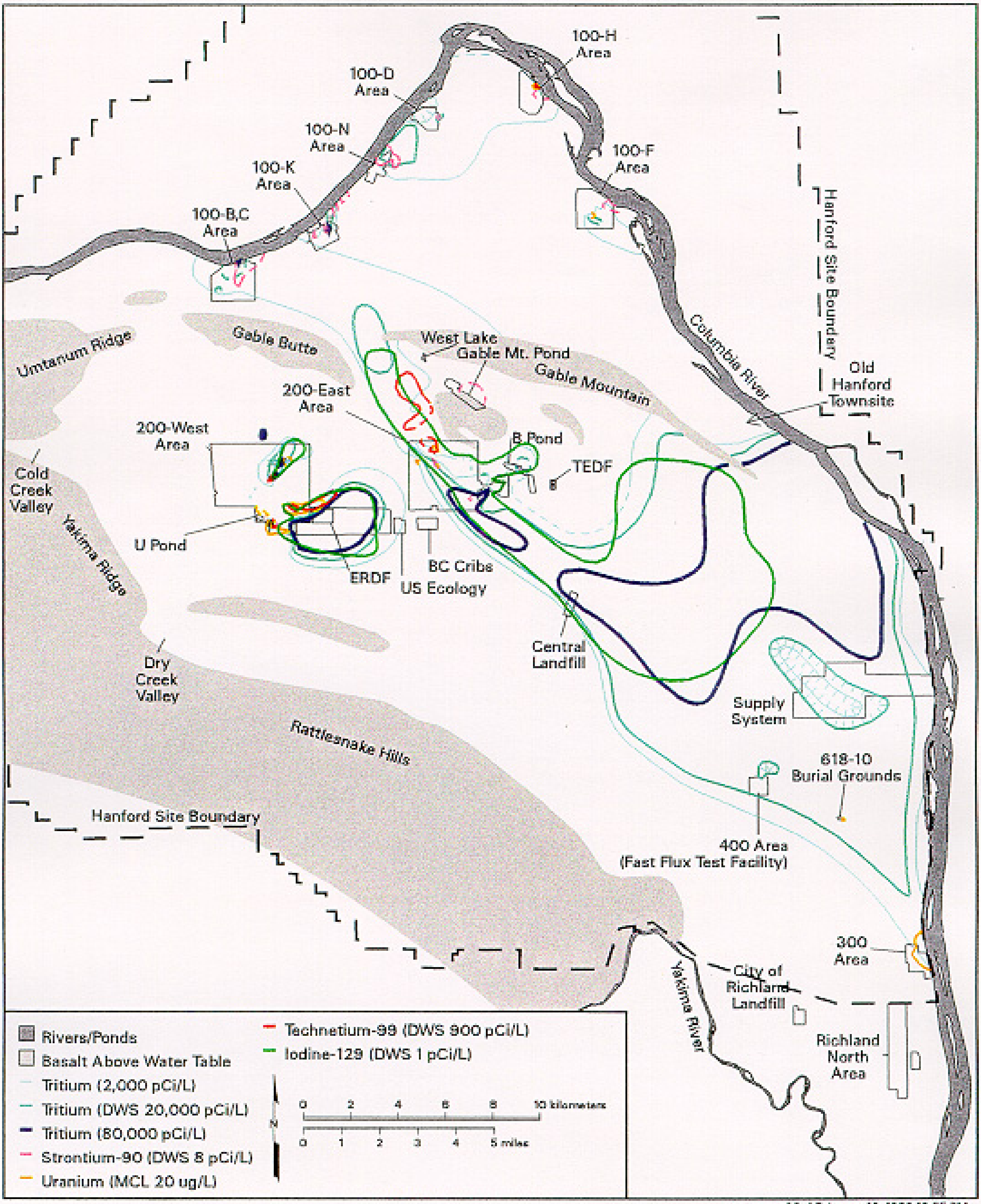

Figure 4-36. Distribution of Hazardous Chemicals of Concern in Groundwater within the Hanford Site (PNNL 1998).

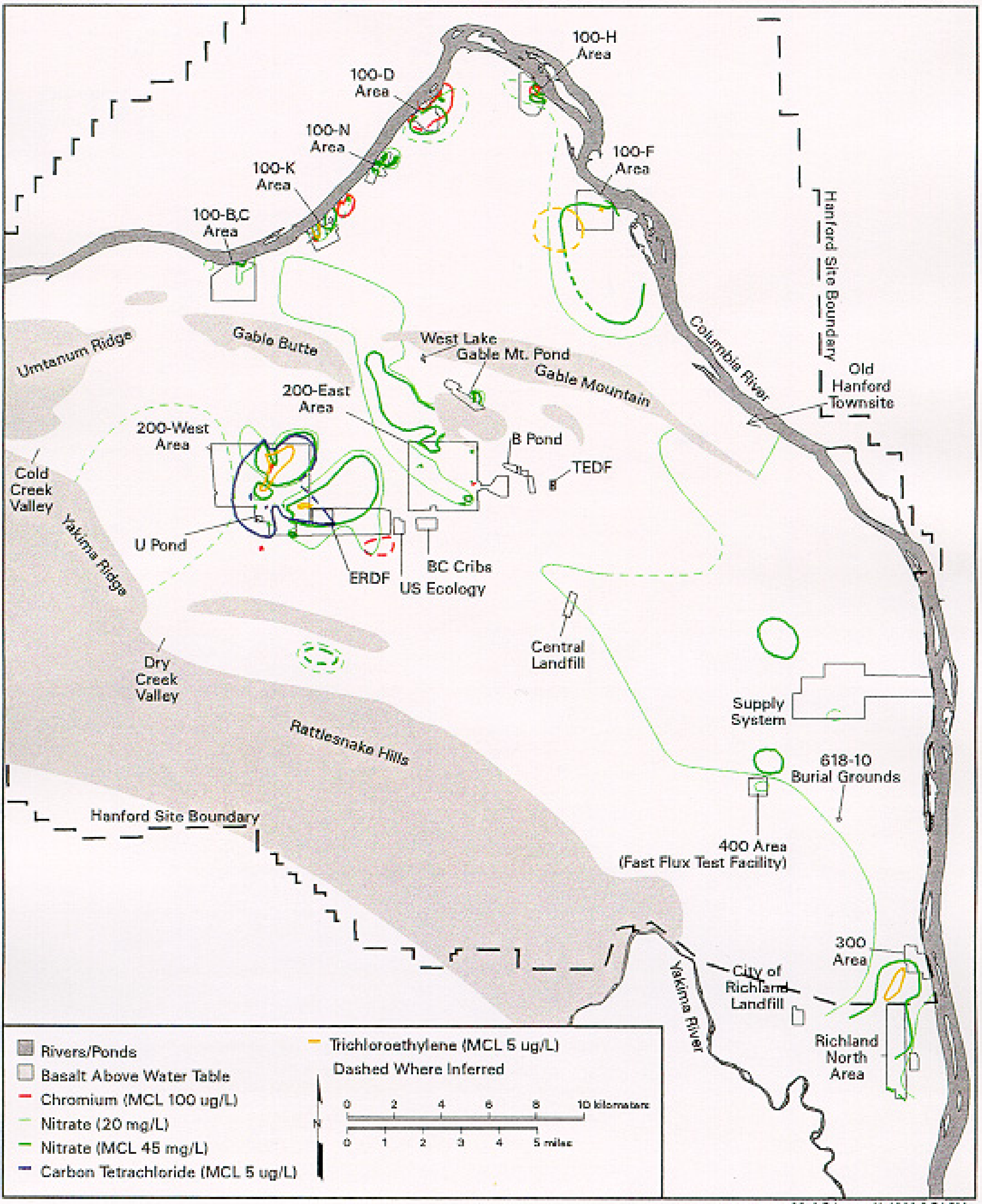

Table 4-14. Detected Concentrations Greater Than Drinking Water Standards: 1995 Groundwater Sampling Rounds (adapted from PNL 1995). (2 pages)

Area Name	Plume Constituent	Units	Maximum Plume Concentration	EPA DWS	Washington Water Quality Standard
100-B/C	Chromium	ug/L	>50.0	100	50
	Strontium-90	pCi/L	56.7	8	8
	Tritium	pCi/L	28,000	20,000	20,000
100-D/DR	Chromium	ug/L	1,360	100	50
	Nitrate	mg/L	205	45	45
	Strontium-90	pCi/L	44.0	8	8
	Tritium	pCi/L	69,000	20,000	20,000
100-F	Chromium	ug/L	82.4	100	50
	Nitrate	mg/L	110.0	45	45
	Uranium	ug/L	133.0	20	20
	Strontium-90	pCi/L	20.5	8	8
	Tritium	pCi/L	98,300	20,000	20,000
	Trichloroethylene	ug/L	27.0	5	N/A
100-H	Chromium	ug/L	300.0	100	50
	Nitrate	mg/L	730.0	45	45
	Strontium-90	pCi/L	28.0	8	8
100-KE/KW	Chromium	ug/L	210.0	100	50
	Nitrate	mg/L	110.0	45	45
	Strontium-90	pCi/L	803.0	8	8
	Tritium	pCi/L	1,040,000	20,000	20,000
	Trichloroethylene	ug/L	20.0	5	N/A
100-N	Chromium	ug/L	200.0	100	50
	Cobalt-60	pCi/L	732.0	100	N/A
	Nitrate	mg/L	65	45	45
	Strontium-90	pCi/L	4,030	8	8
	Tritium	pCi/L	74,200	20,000	20,000
200 East	Chromium	ug/L	73.0	100	50
	Nitrate	mg/L	120.0	45	45
	Cyanide	ug/L	39.5	200	200
	Strontium-90	pCi/L	9,740	8	8
	Cesium-137	pCi/L	2,310	10	10
	Tritium	pCi/L	3,370,000	20,000	20,000
	Cobalt-60	pCi/L	40.1	100	N/A
	Iodine-129	pCi/L	11.8	1	1
	Plutonium-239/240	pCi/L	2,670	1	N/A
	Technetium-99	pCi/L	3,700	900	900
	Uranium	ug/L	64.3	20	20

Table 4-14. Detected Concentrations Greater Than Drinking Water Standards: 1995 Groundwater Sampling Rounds (adapted from PNL 1995). (2 pages)

Area Name	Plume Constituent	Units	Maximum Plume Concentration	EPA DWS	Washington Water Quality Standard
200 West	Cesium-137	pCi/L	21.8	10	10
	Cobalt-60	pCi/L	13.2	100	N/A
	Cyanide	ug/L	20.0	200	200
	Chromium	ug/L	500.0	100	50
	Nitrate	mg/L	1,700	45	45
	Fluoride	mg/L	5.1	4	4
	Tritium	pCi/L	2,400,000	20,000	20,000
	Iodine-129	pCi/L	86.1	1	1
	Technetium-99	pCi/l	23,700	900	900
	Uranium	ug/L	2,720	20	20
	Carbon tetrachloride	ug/L	5,200	5	0.3
	Chloroform	ug/L	107.0	100	7
	Strontium-90	pCi/L	14.5	8	8
	Trichloroethylene	ug/L	44	5	N/A
300 Area	Chromium	ug/L	<100.0	100	50
	Uranium	ug/L	150	20	20
	Trichloroethylene	ug/L	6.1	5	N/A
600 Area (All Other Areas)	Cyanide	ug/L	110.0	200	200
	Chromium	ug/L	>100.0	100	50
	Nitrate	mg/L	100	45	45
	Strontium-90	pCi/L	994.0	8	8
	Technetium-99	pCi/L	4,310	900	900
	Tritium	pCi/L	257,000	20,000	20,000
	Trichloroethylene	ug/L	25	5	N/A

DWS = drinking water standard
EPA = U.S. Environmental Protection Agency
ug/L = 1 part per billion (ppb) or microgram per liter
mg/L = 1 part per million (ppm) or milligram per liter
pCi/L = picocurie per liter
N/A = not applicable

Figure 4-37 shows the cumulative dose estimates from ingestion of groundwater from the unconfined aquifer system on the Hanford Site. These estimates were made by summing the interpolated carbon-14, strontium-90, technetium-99, iodine-129, cesium-137, plutonium, tritium, and uranium activities in groundwater. The automatic interpolation process sometimes resulted in peak grid values that were lower than the measured maximum values because it averaged in other lower values. In these cases, the value at the grid node closest to the measured peak value was increased to match the measured peak. Factors to convert activities to ingestion dose equivalents were taken from DOE Order 5400.5. The dose presented in Figure 4-37 represents the cumulative dose equivalent from all major radionuclides in Hanford Site groundwater.

The dose estimates presented in Figure 4-37 show that areas above the 100 mrem/yr dose standard are restricted to localized parts of the 100-K, 100-N, and 200 Areas. Areas above

4 mrem/yr are more restricted than the area above the interim DWS for individual constituents because the dose map used more recent conversion factors than those used in calculating the interim DWSs. Dose estimates for portions of the 100, 200, 300, and 600 Areas exceed 4 mrem/yr.

Figure 4-38 illustrates the estimated lifetime incremental cancer risk that would be experienced by a person drinking water contaminated with chemicals and radionuclides at concentrations that have been measured in groundwater across the Hanford Site. Cancer-risk estimates were made by summing interpolated groundwater concentrations of the radionuclides listed above plus carbon tetrachloride, chloroform, trichloroethylene, cis-1,2-dichloroethylene, nitrate, and hexavalent chromium. The calculation assumes that a person weighing 70 kg (154 lbs) consumes 2 L (0.5 gal) of groundwater every day for 30 years (DOE/RL-91-45, Rev. 3; IRIS 1997). Cancer risks exceeding 0.0001 are present in portions of the 100, 200, 300, and 600 Areas, and this contour closely resembles the cumulative dose map (see Figure 4-37). An additional area of cancer risk >0.0001 is observed in the 200 West Area, a result of the carbon tetrachloride plume.

Figure 4-39 shows the estimated hazard quotient that would be experienced by an individual drinking water contaminated with chemicals at concentrations that have been measured in groundwater across the Hanford Site. The hazard quotient relates the potential human health hazards associated with exposure to noncarcinogenic substances or carcinogenic substances with systemic toxicities other than cancer (in Hanford Site groundwater, these include nitrate, hexavalent chromium, uranium, and strontium). The calculation assumes that a person weighing 70 kg (154 lbs) consumes 2 L (0.5 gal) of groundwater every day for 30 years (DOE/RL-91-45, Rev. 3; IRIS 1997). The only part of the Hanford Site with a >5 hazard quotient is a small portion of the 200 West Area. Hazard quotients >0.3 are present in all of the operational areas and in parts of the 600 Area, primarily those areas with nitrate contamination.

4.11.2 Columbia River Contamination

The Columbia River has received radiological and chemical contamination as a result of past operations at the Hanford Site. Columbia River water that was used to cool the Hanford Site nuclear production reactors subsequently was contaminated with chemical and radiological constituents. The contaminated water entered the Columbia River primarily through direct effluent discharge. In addition to direct discharges of contaminated cooling water, the Columbia River received and continues to receive contaminants indirectly through soil column waste disposal units, leaks from pipelines, and possibly leaks from tanks that are carried by the groundwater and discharged through springs and seeps along the shoreline (DOE 1993a).

Sediments in the Columbia River contain low levels of Hanford radionuclides (i.e., cobalt-60, uranium-238, and europium-154) and metals; and radionuclides from nuclear weapons testing fallout, which collect in slack water habitats. Analyses of sediments showed detectable, though low, levels of metals in Columbia River sediments. Chromium concentrations in sediment along the Hanford Reach appeared to be slightly elevated when compared to upstream samples (PNNL 1996c).

Contaminated areas within the Columbia River are generally located in slack water areas, such as sloughs and portions of the islands. These contaminated areas have been identified by aerial gamma-ray surveys. Riverbed sediments and floodplain soils of the Hanford Reach constitute a sink for many of the pollutants released to the environment by past Hanford operations. Shoreline activities that affect the flow of the Columbia River could remobilize contaminants entombed within river sediments.

Figure 4-37. Potential Dose Estimates from Ingestion of Groundwater, Fiscal Year 1998 (PNNL 1998).

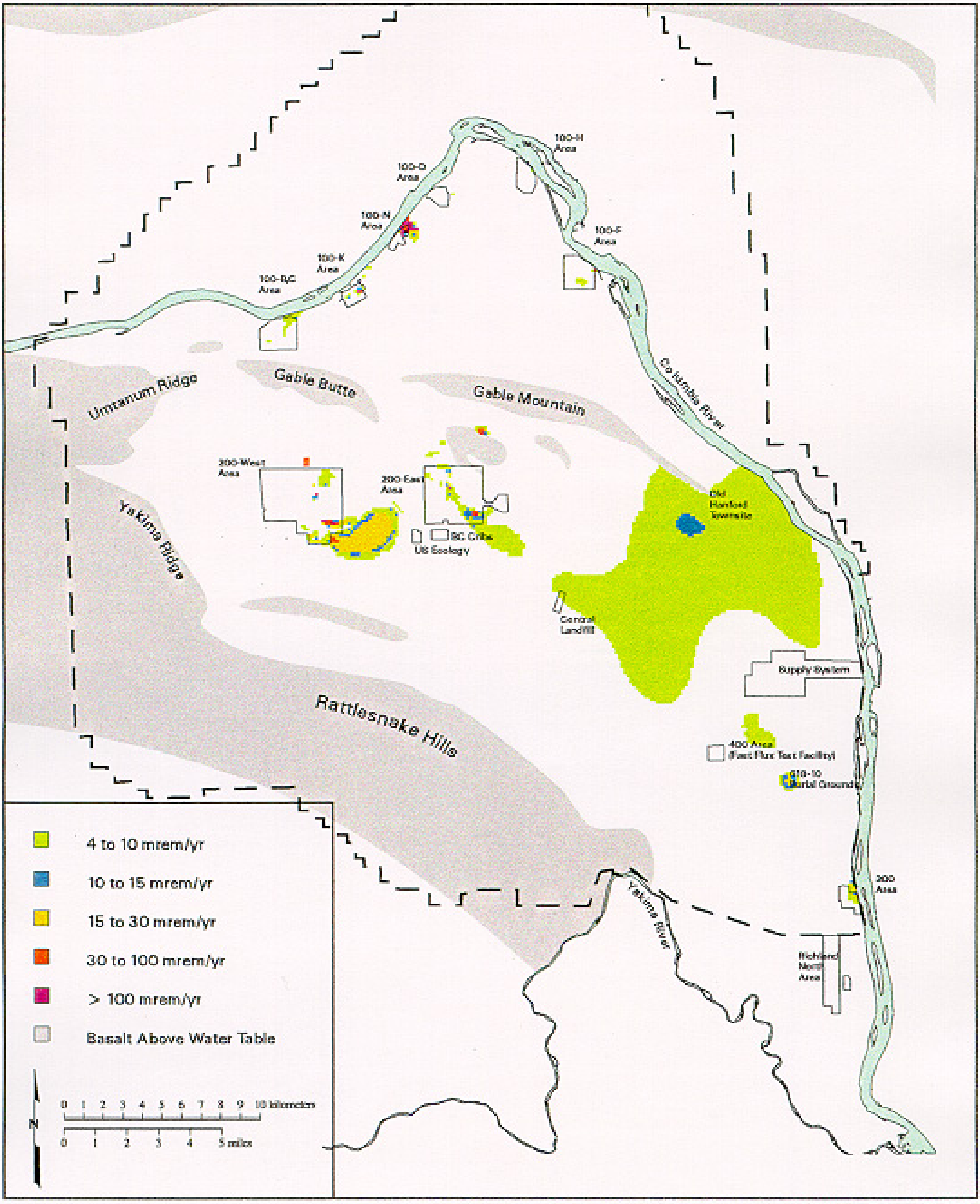

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Figure 4-38. Potential Cancer Risk Estimates from Ingestion of Groundwater, Fiscal Year 1998 (PNNL 1998).

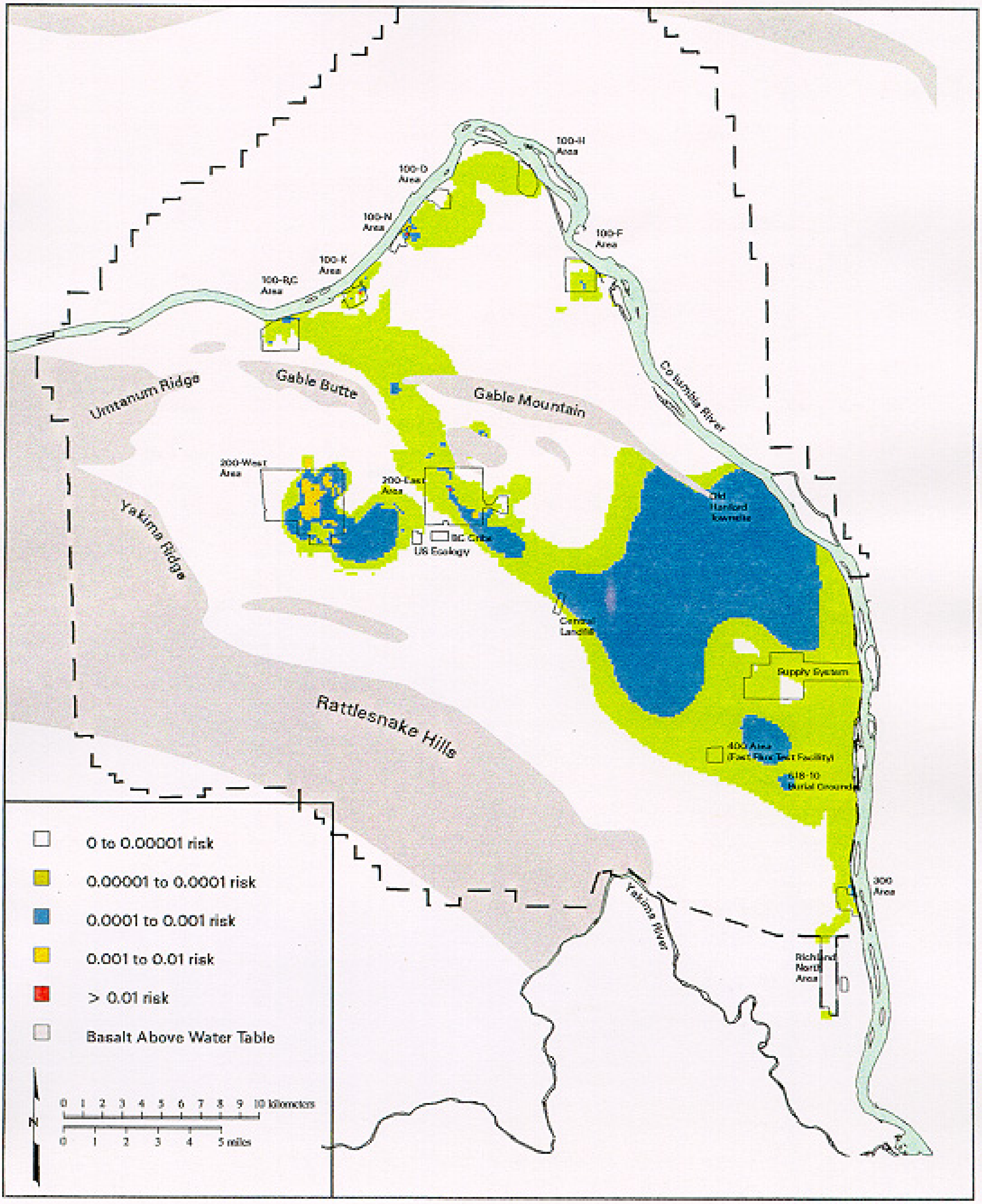

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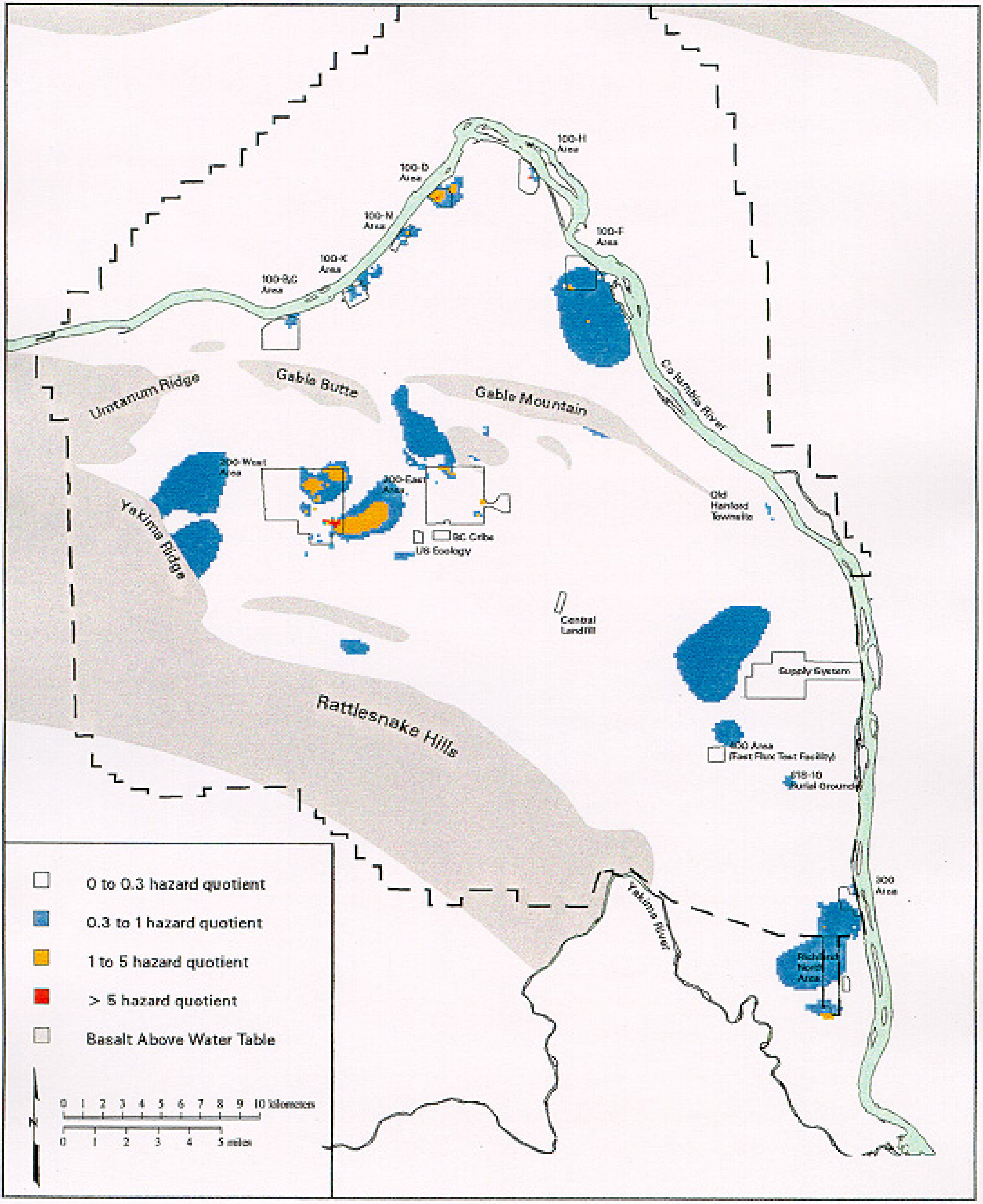
Figure 4-39. Potential Hazard Quotient Estimates from Ingestion of Groundwater, Fiscal Year 1998 (PNNL 1998).



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River water used for cooling flowed through the Hanford reactor to the Columbia River, carrying nuclear fission products and neutron-activated stellites (i.e., cobalt-60 particles). The extent and amount of discrete cobalt-60 particles in the river have never been thoroughly investigated and the actual amount of neutron-activated material transported to the Columbia River is not known. Based on Stokes Law and the physical properties of sand and stellite (Sula 1980; Cooper 1995), cobalt-60 particles (stellite) entrained into the river bedload have preferentially settled in areas dominated by sand-size grains. The sandy areas of the Hanford Reach have never been thoroughly examined for the presence of radionuclides. For example, the sandy portion of D Island has not received a detailed survey for discrete radioactive particles (WDOH 1996). Randomly placed surveys have been conducted, but the deposition of cobalt-60 particles by the Columbia River may not be a random process, and use of a random sampling pattern may actually underestimate the concentration of cobalt-60 particles in the Columbia River shoreline.

Due to shielding by soil, water, vegetation, and air (as well as the motion of the detector), aerial gamma-ray surveys lack the sensitivity and resolution required to aid in the determination of concentration of cobalt-60 particles. The non-random distribution of the cobalt-60 particles into discrete areas and the presence of water within the detector's "field of view" (Sula 1980) further reduces the utility of aerial gamma-ray surveys in determining the potential for cobalt-60 particles.

4.11.3 Soil Contamination

The 100 Areas include nine retired plutonium production reactors, effluent lines from each reactor complex, 33 surplus facilities, more than 200 WIDS database past-practice waste sites, and six TSD units. Extensive contamination exists in some areas of surface soils, subsurface soils, and groundwater (EPA 1995a). Strontium-90, tritium, nitrate, and chromium are detected at many of the 100 Area operable units.

The Central Plateau has been used for fuel reprocessing, waste management, and disposal activities and is the most extensively contaminated area at the Hanford Site. More than 400 WIDS database past-practice waste sites, 13 TSD units, and numerous groundwater contaminant plumes occur in the 200 Areas. This area is the site of the Hanford Central Waste Complex and the Tank Waste Remediation System facilities, which support present and future Hanford waste management activities (EPA 1995a). There have been known releases from the Central Waste Complex to the soil column. Contaminants include extensive groundwater plumes of technetium-99, iodine-129, nitrate, tritium, uranium-238, and chlorinated hydrocarbons (e.g., carbon tetrachloride, chloroform, and trichloroethylene). Carbon tetrachloride in particular poses a complex remediation problem; it is estimated that about 580 to 920 metric tons (640 to 1,014 tons) of carbon tetrachloride have been disposed to the vadose zone where it exists in a vapor phase above the water table, a liquid phase above and below the water table, and as a solute within the water.

The 600 Area presents a diverse range of existing contamination. Parts of the 600 Area vadose zone are essentially uncontaminated, while nearby operating areas, such as the 300 Area, present significant environmental remediation challenges. Several small, isolated surface waste sites have been remediated as expedited response actions under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA). Extensive groundwater contamination (i.e., nitrate, tritium, technetium-99, and iodine-129) occurs in the 600 Area.

Although some information on soil contamination is available, DOE recognizes that a comprehensive and integrated vadose zone characterization effort is needed at the Hanford Site to adequately assess risk during waste retrieval and treatment activities, and eventual closure of the 200 Area tank farms. Therefore, in April 1996, DOE brought together Hanford's Vadose Zone Expert Panel, comprised on representatives from state government, national laboratories, and the private sector. The Panel was convened primarily to assess how cesium-137 reached depths of

39 m (130 ft) in the vadose zone under the SX tank farm. An integrated vadose zone program plan for the entire Hanford Site is under development (DOE-RL 1998). This project will account for the entire waste inventory on the Hanford Site. Better understanding of vadose zone transport mechanisms may require land-use restrictions where soil contamination is left at depth after remediation.

4.11.4 Hanford Site Protective Safety Buffer Zones

Existing and planned waste disposal sites, waste processing facilities, and hazardous or radiological materials storage facilities are found throughout the Hanford Site. To protect the public from routine or accidental releases of radiological contaminants and/or hazardous materials, protective measures for waste remediation, processing, and disposal facilities are required by DOE Order 420.1 Facility Safety, DOE Order 151.1, *Comprehensive Emergency Management System* (DOE 1996f), and Occupational Safety and Health Administration (OSHA) regulations 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response (Site Safety and Control Plan)," 29 CFR 1910.119, "Process Safety Management (PSM) Rule" the PSM complement, EPA's Risk Management Planning (RMP) under the Clean Air Act, 40 CFR 68.10(a), and WAC 246-247. These buffer zones limit public exposure to radiological and hazardous chemicals from routine operations and accidents. A methodology that used the air dispersion model GXQ with 95-percent meteorological conditions based on the Nuclear Regulatory Commission's Regulatory Guide 1.145 was developed to determine the location, size, shape, and characteristics of the buffer zones needed for the Hanford Site, using existing safety analysis reports, hazard assessments, and emergency planning zone studies. This methodology allows decision makers to restrict potential land uses in areas where hazardous or radioactive material handling could pose an unacceptable risk to human health. Actual DOE facility siting decisions would be made with site-specific wind data at 99.5-percent meteorological conditions.

Buffer zones necessary to protect human health and safety in potential accidents are divided into two main components — an inner exclusive-use zone (EUZ) and an emergency planning zone (EPZ).

- DOE Orders 420.1 and 5480.23, along with the guidance document DOE-ST-3009, require that a hazard analysis be developed as the basis for a conclusion that off-site personnel are sufficiently protected from accidents at a nuclear facility. That conclusion is to be reached through analysis showing that the estimated individual dose off-site from any design basis accident or evaluation basis accident would be less than some guideline amount. No guideline value has been issued by DOE, but a value of 25 rem committed effective dose equivalent (CEDE) is frequently used by DOE's contractors in the absence of a specified value (DNFSB/TECH-20). The EUZ is an area designated for operation activities associated with a waste site or facility. In DOE O 420.1, Section 4.1.1.2, *Design Requirements*, each DOE nuclear facility is required to "be sited and designed in such a manner that gives adequate protection for the health and safety of the public and for workers, including those at adjacent facilities, from the effects of potential facility accidents involving the release of radioactive materials (DOE Order 420.1)."

  Hanford contractors have interpreted this requirement as to maintain a public buffer zone where 25 rem would not be exceeded in the event of an unmitigated low probability accident (10^{-4} to 10^{-6}), where 5 rem would not be exceeded in the event of an unmitigated medium probability accident (10^{-2} to 10^{-4}), or where 0.5 rem would not be exceeded in the event of an unmitigated high probability accident (10^{-2} to 1) (WHC-85M00-JCVK-95008). The EUZ is reserved for DOE or other hazardous operations with severely restricted public access. This zone extends from the facility fence line to a distance at which threats to the public from routine and accidental releases diminish to the point where public access can be routinely allowed while ensuring the intent of DOE O 420.1 is achieved. The EUZ is located inside the EPZ.

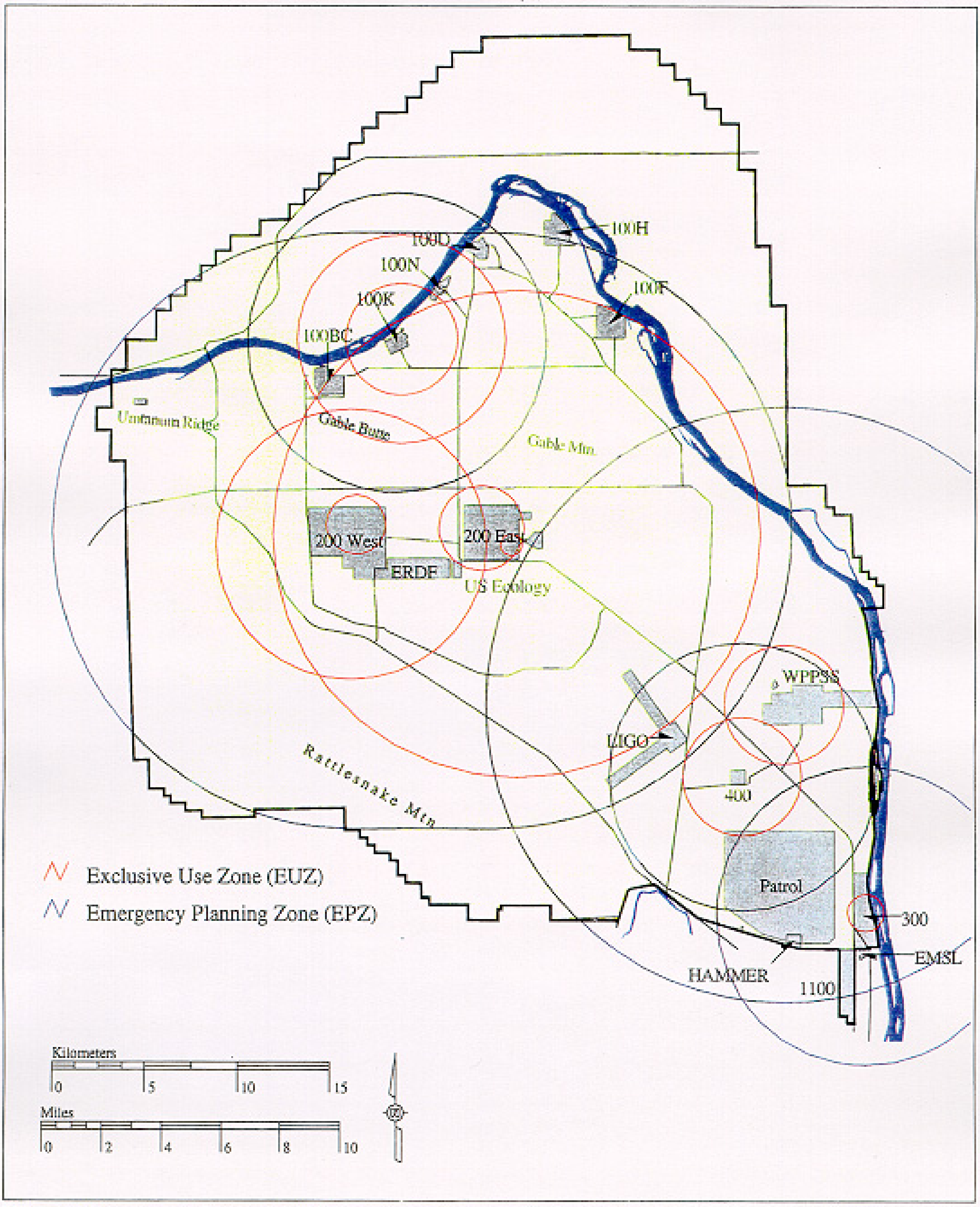
- The EPZ is an area surrounding a facility for which emergency planning and preparedness efforts are carried out per DOE's *Comprehensive Emergency Management System Order* (DOE Order 151.1) to ensure that prompt and effective actions can be taken to minimize the impact to onsite personnel, public health and safety, and the environment in the event of an operational emergency. The EPZ begins at the boundary of the facility and ends at a distance for which special planning and preparedness efforts are no longer required. Access restrictions are not required within an EPZ; however, DOE would be responsible for ensuring adequate planning and preparedness efforts.

The protective buffer zones for the Hanford Site (Figure 4-40) were established using boundaries calculated for individual limiting facilities (i.e., facilities with accidents of maximum potential public health impact). Accidents initiated by sabotage are not applicable to EPZs. Information about the limiting facilities, controlling contaminants, and credible accidents is presented in Table 4-15.

In addition to the known risks (e.g., K-Basins could have the fuel elements removed in about six years), RODs for the Hanford Site burial grounds are upcoming. It is very difficult to adequately characterize heterogenous burial grounds created over 40 years ago (e.g., in a surprise to everyone, the 618-4 burial ground had 1500 barrels of uranium fines packed in mineral oil). In the spirit of DOE O 420.1's defense in depth policy, it is prudent for DOE to reserve land for operational safety and/or remediation/stewardship buffer zones until the known risks and the unknown risks are dispositioned. The boundaries provide a conservative buffer zone based on risk and consequence management that is expected to be sufficient to address protective zone needs for the multiple facilities present in each area on the Hanford Site. As the cleanup mission progresses, the extent of these EUZ's is expected to shrink in size and eventually migrate inward to the Central Plateau. This expectation is reflected in section 6.3.1, *Overall Policy*, number 5, *Reduce exclusive use zone (EUZ) areas to maximize the amount of land available for alternate uses while still protecting the public from inherently hazardous operations*.

In an effort to consider non-Hanford protective buffer zone requirements that could be affected by Hanford Site public access and land-use decisions, the emergency preparedness needs of Energy Northwest (formerly WPPSS) were considered. Under U.S. Nuclear Regulatory Commission procedures, the Energy Northwest WNP-2 Reactor requires a 16-km (10-mi) EPZ and a 1.9-km (1.2-mi) EUZ.

Figure 4-40. Protective Safety Buffer Zones.



BHI:rpp 04/2296 clup/sar1.aml Database: 21-OCT-1998

Table 4-15. Protective Safety Buffer Zones (Exclusive Use Zones and Emergency Planning Zones).

Limiting Facility	Coordinates WASP-X	Coordinates WASP-Y	EUZ Boundary (m)	Credible Accident	Controlling Contaminant	EPZ Boundary (m)	Limiting Accident	Controlling Contaminant
100-K Area								
K-Basin	569184.3	146717	3,000	Chlorine cylinder valve failure	Cl	8,100	Sabotage	Cl, Pu, Cs-137
			5,600	Fuel processing for dry storage	Cs-137			Sr-90, Am-241
200 West Area								
PFP	566474.3	135652.7	7,300	Seismic event with ventilation	Pu	16,100	Waste tank sabotage and PFP seismic accident	Pu, Am-241
Tank Farms	566777	136734.1	1,600	Single-shell tank hydrogen deflagration	Cs-1373	16,100	Waste tank sabotage and PFP seismic accident	Pu, Am-241
200 East Area								
B Plant/WESF	573504.9	136548.1	2,300	Cross-contamination from K-3 to K-1 filter banks	Sr-90, Cs-137	16,100	Waste tank sabotage	Pu, Am-241
Tank Farms	575422.2	136203.9	13,150	Double-shell tank filter blowout	Cs-137	16,100	Waste tank sabotage	Pu, Am-241
Limiting Proposed Facility - Tank Waste Vitrification Plant	575118.1	135636.9	600	Earthquake	Am-241	16,100	Waste tank sabotage	Pu, Am-241

Table 4-15. Protective Safety Buffer Zones (Exclusive Use Zones and Emergency Planning Zones).

Limiting Facility	Coordinates WASP-X	Coordinates WASP-Y	EUZ Boundary (m)	Credible Accident	Controlling Contaminant	EPZ Boundary (m)	Limiting Accident	Controlling Contaminant
300 Area								
324 Bldg. B-Cell	594247.4	115784.7	1,000	Earthquake 324 Bldg. w/o B-cell upset	Sr-90		(315 Bldg. accident dominates)	
315 Bldg.	594480.3	115761.7		(324 Bldg. accident dominates)		8,100	1,920 lbs. chlorine incident in the 315 Bldg.	Cl
400 Area								
FFTF	587604.9	123117.5	3,200	Sodium Storage Safety Class 2	Sodium hydroxide	7,300	Sodium sabotage	Sodium hydroxide

[a] If K Basin fuel is not stable enough to move to the 200 Area before processing for dry storage, this larger EUZ may be needed.
[b] The 324 B-cell accident dominated the credible (>10^{-6} probability) accident calculations for the 300 Area EUZ; the 315 Building chlorine accident dominated the incredible (<10^{-6} probability) accident calculations for the 300 Area EPZ.
EPZ = emergency planning zone
EUZ = exclusive use zone
FFTF = Fast Flux Test Facility
PFP = Plutonium Finishing Plant
WESF = Waste Encapsulation and Storage Facility

Within portions of the EUZ, certain types of public access would be restricted, while other types of public access within that same area might be acceptable. Six different types of public access have been defined for the EUZ (WHC 85M00-JCVK-95008). These types of access are presented below:

- ***Very Limited Access*** -- Very limited access, such as passing through on transportation corridors. Special arrangements would be required to leave the designated access point. The evacuation time for this type of access would be no more than 30 minutes. The maximum amount of time the maximally exposed individual (MEI)[1] would spend in this area is estimated to be about 100 hr/yr.

- ***Restricted Routine Access*** -- This type of access area would include activities such as industrial and commercial usage of a specifically designated area. It could also include short special interest uses, such as short nature trails. All users of the area must have ready access to transportation to facilitate a rapid evacuation. Evacuation time for this type of access would be no more than 1 hour. The maximum amount of time the MEI would spend in this area is estimated to be about 3,000 hr/yr.

- ***Restricted Short-Term Access*** -- This type of access may include locations adjacent to transportation corridors. Public access might involve short stops to view sights or engage in short duration activities. Access to areas more than 0.4 km (0.25 mi) from a

[1] The maximally exposed individual (MEI) is defined as a hypothetical person who lives near the Hanford Site, who, by virtue of location and living habits, could receive the highest possible dose.

designated access point would be prohibited. The evacuation time for this type of access would be no more than 1.5 hours. The maximum amount of time the MEI would spend in this area is estimated to be about 200 hr/yr.

- ***Moderately Restricted Periodic Access*** -- This type of access would allow for periodic activities, such as limited agricultural activities. Public access to this area would tend to be more periodic and seasonal. No permanent residences, schools, or hospitals would be allowed. The evacuation time for this type of access would be no more than 2 hours. The maximum amount of time the MEI would spend in this area is estimated to be about 3,000 hr/yr.

- ***Moderately Restricted Occasional Access*** -- This type of access area would allow for more diverse activities for a longer, but controlled, periods of time than those defined for the Moderately Restricted Periodic Access areas. For example, overnight stays for short periods would be allowed. The evacuation time for this type of access would be no more than 2.5 hours. The maximum amount of time the MEI would spend in this area is estimated to be about 1,000 hr/yr.

- ***Moderately Restricted Access*** -- This type of access requires only minimal access restrictions to ensure timely evacuation. This type of access would consider limited residential-type usage of the area and could accommodate small schools and commercial businesses. The evacuation time for this type of access would be 2.5 hours. The maximum amount of time the MEI would spend in this area is estimated to be about 8,700 hr/yr.

In addition to DOE's desire for land to isolate from the public hazardous processes and facilities that could produce a 25 rem radiological dose under an accident condition, the current Hanford Site boundary has been used to identify and design safety class systems, structures and components that are required to keep an accident from exceeding 500 mrem at the Site boundary. The current Site boundary is also the point-of-compliance for protection of the public to assure that routine releases from all DOE activities are less than 100 mrem (DOE Order 5400.5), and that not more than 10 mrem is from airborne sources (40 CFR 61) or that not more than 4 mrem are from groundwater sources (40 CFR 141). In addition to radiological accident conditions, DOE also uses the current Hanford Site boundary to protect the public from potential hazardous chemical accidents such as a chlorine gas leak. If the CLUP policies and implementing procedures on EUZs are adopted in the ROD, then DOE expects to use DOE's annual review of safety and environmental permitting documentation to be the basis for implementing the EUZ policies (see Chapter 6).

5.0 Environmental Consequences

This chapter describes the potential environmental consequences associated with the future land-use alternatives (including the No-Action Alternative) discussed in Chapter 3. These analyses focus on the environmental resource categories described in Chapter 4, "Affected Environment."

5.1 Analysis Approach

The alternatives developed by U.S. Department of Energy (DOE) and the cooperating agencies and consulting Tribal governments would allow a range of uses for Hanford Site lands. These land uses would have impacts to natural and cultural resources and could affect the socioeconomic environment in the region surrounding the Hanford Site. The potential environmental impacts of each land use would depend on the nature of the use, its location with respect to the resources, and the amount of land affected by the land use. Because the location and scale of specific future uses (e.g., a sand and gravel quarry or a metal fabrication plant) cannot be readily predicted, the impacts of these uses on specific resources cannot be accurately quantified. As described in Chapter 6, impacts of specific projects would be analyzed under the *National Environmental Policy Act of 1969* (NEPA); NEPA-integrated *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) and *Resource Conservation and Recovery Act of 1976* (RCRA) documentation; and, where applicable, local *State Environmental Policy Act of 1971* (SEPA) processes as part of the implementation of the Hanford Comprehensive Land-Use Plan (CLUP).

Question #18 of the Council on Environmental Quality's (CEQ) "40 Most Asked Questions" (46 FR 18026) provides guidance regarding the uncertain effects of future actions (see text box, *"CEQ's 40 Most Asked Questions: Uncertainties About Future Actions"*). The analysis in this chapter was based on the CEQ guidance and focuses on identifying and describing the impacts of reasonably foreseeable future uses in light of land-use trends in the Hanford region. For some land uses, information was readily available on possible development plans. For example, the Wahluke 2000 Plan provided information on proposed agricultural development of the Wahluke Slope (Wahluke 2000 Committee 1992), and DOE's 1996 Strategic Plan (DOE-RL 1996b) provided information on proposed DOE development. For other uses, assumptions could be made on the basis of data available for trends in the region (e.g., industrial development in the Tri-Cities).

CEQ's 40 Most Asked Questions: Uncertainties About Future Actions

18.Q. How should uncertainties about indirect effects of a proposal be addressed, for example, in case of disposal of Federal lands, when the identity or plans of future landowners is unknown?

A. The EIS must identify all the indirect effects that are known and make a good faith effort to explain the effects that are not known but are "reasonably foreseeable" Section 1508.8(b). In the example, if there is total uncertainty about the identity of future land owners or the nature of future land uses, then of course, the agency is not required to engage in speculation or contemplation about their future plans. But, in the ordinary course of business, people do make judgments based upon reasonably foreseeable occurrences. It will often be possible to consider the likely purchasers and the development trends in that area or similar areas in recent years; or the likelihood that the land will be used for an energy project, shopping center, subdivision, farm, or factory. The agency has the responsibility to make an informed judgment, and to estimate future impacts on that basis, especially if trends are ascertainable or potential purchasers have made themselves known. The agency cannot ignore these uncertain but probable effects of its decisions.

Although the analysis in this chapter is necessarily more qualitative than quantitative, it has been designed to provide adequate information to support the decisions to be made and to allow for meaningful comparison of the alternatives. The following sections describe the methods used to identify, describe, and compare the impacts of the alternatives.

5.1.1 Geographic Information System Analysis

A geographic information system (GIS) was used to organize the environmental data and identify and quantify the resources potentially affected under each alternative. The following source documents were used to obtain this data.

- Draft *Hanford Site Biological Resources Management Plan* (BRMaP) (DOE-RL 1996c) for biological elements including salmonid spawning areas; hawk and eagle nesting, perching, and roosting sites; floodplains; wetlands; and plant communities of concern (BRMaP Levels I, II, III, and IV)

- Waste Information Data System (WIDS)

- Hanford Geographic Information System (HGIS)

- Draft *Hanford Cultural Resources Management Plan* (CRMP) (DOE RL 1999) for cultural resources, including pre-contact and post-contact sites

- *Site Evaluation Report for Candidate Basalt Quarry Sites* (BHI 1995c) for geologic resources (analysis of basalt outcrops only)

- *Hanford Site Groundwater Monitoring for Fiscal Year 1997* (PNNL 1997b)

- *Hanford Site Development Plan* (DOE-RL 1994a) and other area development plans (DOE-RL 1990a, and DOE-RL 1991a) for Site infrastructure, including buildings, roads, and utilities

- *Hanford Site Environmental Report* (PNNL 1997a).

The GIS system includes spatial data on the distribution of resources, habitats, and infrastructure and allows these elements to be mapped and quantified. The GIS system was also used to quantify the land areas under each land-use designation for each alternative. The land areas, in hectares, acres, square miles, and percent of total acreage, are presented in Table 3-3. By combining the data sets for the resource elements listed above and the land areas for each land-use designation, the amount of each resource element that could potentially be affected under a given land-use designation was quantified. The GIS data tabulated for BRMaP Levels II, III, and IV resources are further discussed in Section 5.2.3.

The GIS analysis has limitations for determining the impacts to a resource from future land uses. For example, although approximately 16,833 hectares (ha) (41,595 acres [ac]) of BRMaP Level III habitat fall under the Conservation (Mining) land-use designation under the Preferred Alternative, it cannot be assumed that all of this habitat would be impacted by mining. Future mining operations under this alternative could impact BRMaP Level III habitat, but the size of the impact area cannot be quantified at this time. What can be determined at this time is (1) those areas designated for Preservation would not be disturbed by mining in the future, and (2) the mineral resources that are there are committed for Preservation.

5.1.2 Identification of Key Resources, Unique Features, and Species and Habitats of Concern

The analysis of the alternatives was focused on resource elements that were identified as important to DOE, the cooperating agencies, affected Tribal governments, and members of the public. These elements were identified through public scoping, comments on the August 1996 *Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan* (HRA-EIS) (DOE 1996), and discussions with representatives of cooperating agencies and

American Indian Tribes. Generally, the resource elements can be categorized as follows:

- **Key resources**, including surface water (e.g., the Columbia River), groundwater, economically viable geologic resources, and industrial infrastructure

- **Unique features**, including the White Bluffs, basalt outcrops, active and stabilized sand dunes and bergmounds and ripple marks created by the cataclysmic Pleistocene Missoula Floods, viewing locations, viewsheds, archaeological and historic sites, and areas of cultural and religious importance to American Indian Tribes

- **Species and habitats of concern**, including plant communities of concern, wildlife and wildlife habitat, aquatic species and habitat, wetlands, and biodiversity.

Plant communities of concern were identified using the classifications from BRMaP. These classifications associate different management actions (i.e., monitoring, impact assessment, mitigation, and preservation) with particular sets of biological resources. The BRMaP classifies Hanford Site biological resources into four levels of management concern (Figure 4-27), which can be summarized as follows:

- **Level I** biological resources are resources that require some level of status monitoring because of the recreational, commercial, or ecological role or previous protection status of the resources. Level I includes Washington State "Monitor 3" species (DOE-RL 1996c).

- **Level II** biological resources require consideration of potential adverse impacts from planned or unplanned Hanford Site actions for compliance with procedural and substantive laws such as NEPA, CERCLA, and the *Migratory Bird Treaty Act of 1918*. Mitigation of potential impacts by avoidance and/or minimization is appropriate for this level; however, additional mitigation actions are not required. Level II resources include Washington State Monitor 1 and 2 species and early successional habitats.

- **Level III** biological resources require mitigation because the resource is listed by the State of Washington; is a candidate for Federal or state listing; is a plant, fish, or wildlife species with unique or significant value; has a special administrative designation (e.g., the Fitzner/Eberhardt Arid Lands Ecology Reserve [ALE Reserve]); or is environmentally sensitive. When avoidance and minimization are not possible, or application of these measures still results in adverse residual impacts above a specified threshold value, mitigation by rectification and/or compensation is required. Maintenance of Level III resource values may prevent more restrictive and costly management prescriptions in the future. Level III resources include Washington State candidate and sensitive species, threatened and endangered species, Federal candidate species, wetlands and deep-water habitats, and late-successional habitats.

- **Level IV** biological resources justify preservation as the primary management option because these resources are federally protected or have regional and national significance. The plant communities and habitats that are defined as belonging to this level are of such high quality and/or rarity that damages to these resources cannot be mitigated except through compensatory mitigation by acquiring and protecting in-kind resources. The legally protected species that are included in Level IV cannot be impacted without the concurrence of the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service so these types of impacts do not jeopardize the continued existence of the species. Level IV resources include Federal threatened and endangered species and those species proposed for listing, rare habitats such as the White Bluffs, active and stabilized sand dunes, and basalt outcrops.

The analysis of impacts to biological resources included an evaluation of effects on BRMaP Levels II, III, and IV plant communities.

5.1.3 Description of Impacting Activities

The nine land-use designations used to develop the alternatives discussed in Chapter 3 are each unique in defining allowable future uses. However, impacts to resources would be similar for several land-use designations. For example, the Industrial, Industrial-Exclusive, Research and Development, and High-Intensity Recreation land-use designations would each involve siting and construction of facilities with surface disturbance, increased traffic, and other similar impacts. Therefore, to simplify the analysis, the possible impacts under the nine land-use designations were organized into five impacting activities, defined as follows:

- **Mining**, including removal of vegetation, surface and subsurface disturbance, changes in groundwater hydrology, and increased dust and noise generation under the Conservation (Mining) and Conservation (Mining and Grazing) land-use designations

- **Livestock grazing**, including changes to vegetation cover and plant species composition under the Conservation (Mining and Grazing) land-use designation

- **Cultivated agriculture**, including removal of vegetation, surface disturbance (e.g., soil tillage), use of agricultural chemicals, increased water usage, changes to groundwater hydrology, and increased dust and noise generation under the Agriculture land-use designation

- **Development**, including removal of vegetation, surface disturbance, construction and operation of facilities, increased traffic, increased dust and noise generation, increased water usage, and changes in groundwater hydrology under the Industrial, Industrial-Exclusive, Research and Development, and High-Intensity Recreation land-use designations

- **Recreation**, including increased traffic and increased fishing, hunting, boating, bicycling, hiking, and picnicking, under the Low-Intensity Recreation, Conservation (Mining and Grazing), Conservation (Mining), and Preservation land-use designations.

These five impacting activities were used in the analysis to identify and describe, in general terms, the potential impacts to resource elements under each land-use designation.

5.1.4 Consideration of the Comprehensive Land-Use Plan Policies and Implementing Procedures

With the exception of the No-Action Alternative, impacts to resources from the activities described above likely would be mitigated through the application of the CLUP policies and implementing procedures described in Chapter 6. For example, a Use Request involving a proposed sand and gravel quarry in an area designated for Conservation (Mining) would be subject to review as described in Section 6.4. After completing the review, DOE may deny the request or issue a conditional use permit with project modifications to avoid protected resources or to mitigate damages to those resources. For the purpose of this analysis, the impacts of the alternatives are compared without consideration of the possible mitigating effects of the CLUP policies and implementing procedures discussed in Chapter 6. This approach allows for clearer comparisons of the potential impacts from each alternative and does not take credit for policies and implementing procedures that are actually part of the alternatives (except the No-Action Alternative) and not fully developed or in place. The CLUP policies and implementing procedures are discussed along with other possible mitigation measures under each resource section.

5.1.5 Identification of Impacted Resources

The potential environmental impacts of proposed land-use designations under each alternative were evaluated by comparing the locations of impacting activities under each alternative to the locations of key resources, unique features, and species and habitats of concern on the Hanford Site. This enabled the generation of tables showing which resource elements would be affected by impacting activities under each alternative. Tables found in Section 5.2 provide an overview of the potential environmental consequences of each alternative and allow for simple comparisons of the alternatives. The identification of the affected resource elements provides a focus for the discussion of impacts under each alternative.

5.1.6 Methods and Assumptions for Estimating Socioeconomic Impacts

The possible socioeconomic impacts of each alternative were analyzed by focusing on the possible opportunities for economic development posed by each alternative. This approach provides for meaningful comparison of the alternatives without attempting to predict specific impacts, such as changes in demand for housing, schools, or other services. These types of impacts are best assessed on a project-by-project basis, through the appropriate local planning processes.

The study area for this analysis was limited to Benton, Franklin, and Grant counties, including the cities of Kennewick, Pasco, Richland (the Tri-Cities), and West Richland which are most likely to be affected by land-use changes. The assumptions used for and the general socioeconomic effects of each land-use designation are discussed below.

5.1.6.1 Industrial. The potential socioeconomic impacts of the Industrial land-use designation were evaluated by comparing the amount of land available for industrial use under each alternative to the estimated land needs for future industrial development. The land needs for future private industrial development were estimated by the Benton County Planning Department by correlating industrial land needs with projected population growth (BCPD 1997). For the purpose of this analysis, it was assumed that future industrial land needs would be met using lands on the Hanford Site and not other lands in the study area that are currently zoned for industrial use.

Assumptions are that annual population growth in the study area would continue at a rate of 2 percent during the 50-year planning period. This growth rate was extrapolated from the Washington State Office of Financial Management “medium series” population projections for Benton County for the period between the years 2010 and 2020. This growth rate corresponds to a population increase of approximately 193,000 for Richland, West Richland, Kennewick, and Pasco. Using a factor of 6 ha (15 ac) per 1,000 population, the Benton County Planning Department estimated that approximately 1,200 ha (3,000 ac) would be needed for industrial development to support the population growth. This estimate was increased to 1,620 ha (4,050 ac) to account for interior roads, railroads, and utility corridors needed to support the industries. The amount of land designated for industrial use under each alternative was compared to the estimated need for 1,620 ha (4,050 ac).

The amount of land under the Industrial land-use designation for each alternative was correlated with potential employment levels using data on Tri-Cities industrial development compiled by the Benton County Planning Department. Possible levels of employment, expressed as ranges, were determined for each alternative using data on the percentage of lands under industrial zoning designations that are currently developed, and scaling factors similar to those described in Section 5.1.5.4 for the Research and Development land-use designation. The ranges of predicted employment levels used were less than 100 employees, 100 to 1,000 employees, and over 1,000 employees.

Because DOE has a continuing mission at the Hanford Site and because Site lands are under Federal ownership, the potential for future federally sponsored industrial projects also must be considered. These projects may include DOE activities for current or future missions, DOE-sponsored privatization efforts, interagency training facilities such as the Hazardous Materials Management and Emergency Response Facility (HAMMER) Training and Education Center, or projects sponsored by other agencies. Because the land needs for future Federal projects are not currently known, the alternatives cannot be evaluated to determine whether they would meet these needs. Therefore, the alternatives are evaluated and compared based on the amount of land available to support DOE's mission or for other federally sponsored industrial development, over and above the estimated need projected by the Benton County Planning Department for private industrial development.

5.1.6.2 Industrial-Exclusive. The Industrial-Exclusive land-use designation applies to the Central Plateau, where DOE would continue waste management activities. Although all the alternatives being considered would accommodate current waste management activities, the alternatives differ in the amount of acreage available for future waste management activities. The extent to which these differences would affect future development and the resulting economic impacts are discussed.

5.1.6.3 Agricultural. The impacts of the Agricultural land-use designation were evaluated based on the increase in land available for agriculture use, as a percentage of total agricultural land in Benton, Franklin, and Grant counties. The increase in land available was correlated to increased sales of agricultural products. These correlations were made using data from the Census of Agriculture (USDA-NASS 1992), and the Benton County Agricultural Extension Office (Watson et al. 1991), and did not consider impacts on prices due to scales of economy or market share.

Although it is impossible to predict any commodity market over the next 50 years, the markets for apples, potatoes, and wheat are currently soft. For example, an estimated 105 million 42-pound boxes of apples were picked In 1998, whereas in an average year, such as 1997, about 78 million boxes were picked. Currently there is a market for only 80 to 90 million boxes, and Washington apple growers are faced with the option of leaving apples unpicked, reducing orchards, or paying for increased marketing in an attempt to gain market share (TCH 1998a) (see Table 3-2).

Three scenarios for agricultural development on the Wahluke Slope were identified, as follows:

- **Scenario 1** -- All lands under the Agricultural land-use designation, except those lands in the Bureau of Reclamation's (BoR's) Red Zone, would be used to produce a mix of crops similar to those currently produced in the three-county study area, and lands in the Red Zone would be used for grazing.

- **Scenario 2** -- All lands under the Agricultural land-use designation, including those lands in the Red Zone, would be used to produce a mix of crops similar to those currently produced in the three-county study area.

- **Scenario 3** -- All lands under the Agricultural land-use designation, except those lands in the Red Zone, would be used to produce specialty crops such as irrigated vegetables and irrigated fruit orchards, and lands in the Red Zone would be used for grazing.

5.1.6.4 Research and Development. The Research and Development land-use designation involves the siting of large-scale facilities in clusters or campus-like developments. Other research and development (R&D) facilities are similar to industrial development, such as the facilities located in the 300 Area. These types of R&D facilities are compatible with industrial land uses and are addressed in the Industrial land-use designation; however, in some cases, R&D facilities may require large safety zones or may require separation from other facilities to minimize noise, dust, or vibrational impacts. For these reasons, development on lands under the Research and Development land-use designation is assumed to occur at a lower density than for the Industrial land-use designation. Because R&D facilities often require large capital investments and provide relatively high salaries compared to other industries, the economic impacts could be significant.

The Research and Development land-use designation was evaluated by estimating potential employment levels that could be supported by the research and development land base under each alternative. This method, which was developed by the Benton County Planning Department, involved correlating acreage available for research and development uses with employment levels using data from existing research and development projects associated with the Hanford Site. These data include total acreage for each project, total square footage of facilities, and total number of employees (Table 5-1). The average square footage per employee and the average facility area-to-land area ratio shown in Table 5-1 were used to estimate employment levels that would be associated with the research and development land base under each alternative. Because of the uncertainties associated with predicting levels of future use and the wide ranges represented by the data shown in Table 5-1, predicted employment levels for Research and Development were represented as ranges, rather than as point estimates. The predicted employment levels under each alternative were predicted to fall within one of three ranges: up to 100 research and development employees, 100 to 300 research and development employees, and over 300 research and development employees.

5.1.6.5 High-Intensity Recreation. High-Intensity Recreation allows infrastructure development such as potable water systems, septic systems, irrigation systems, paved parking lots, and buildings to support the intended recreational or other seasonal activities. For the purposes of impact analysis, the Benton County Planning Department High-Intensity Recreation assumptions include establishment of the B Reactor Museum, a 27-hole golf course, and a destination resort with a 350-room hotel and conference center and a recreational vehicle/trailer park at Vernita Terrace, which is located near Vernita Bridge (BCPD 1997). The economic impacts of intensive recreational use were estimated using available data for recreational visitor days at Vernita Bridge, regional averages of recreational expenditures per visitor day, and data from golf courses in the study area. These data and their sources are presented in Table 5-2.

In other alternatives, the High-Intensity Recreation land-use designation may also include developed Tribal fishing sites. In the *Columbia River Treaty Access Fishing Sites Final Phase Two Evaluation Report and Finding of No Significant Impact/Environmental Assessment* (USACE 1995), in-lieu fishing sites (i.e., in-lieu fishing sites are provided by the Federal government to affected treaty Tribes “in-lieu” of their traditional sites that were covered by the Federal dam reservoirs) ranged from 21.6 ha to 0.36 ha (53.4 ac to 0.9 ac) and included paved or gravel parking lots, boat ramps, restrooms, drinking water, fish cleaning stations, net repair areas and fish drying sheds, and storage sheds.

Table 5-1. Calculation of Ratios for Estimating Employment Under the Research and Development Land-Use Designation.

Facility	Facility Area m^2 (ft^2)	No. of Employees	Facility Area per Employee m^2 (ft^2)	Total Land Area ha (ac)	Facility Area to Land Area Ratio
Environmental Molecular Sciences Laboratory	17,995 (199,940)	230	78 (870)	8 (20)	1:4
Laser Interferometer Gravitational Wave Observatory	561,519 (6,239,099)	20	28,076 (311,955)	594 (1,486)	1:10
Waste Sampling and Characterization Facility	1,293 (14,375)	65	20 (221)	0.4 (1)	1:3
Fast Flux Test Facility	101,025 (1,122,500)	700	144 (1,604)	3,164 (7,909)	1:307
Superconducting Magnetic Energy Storage Facility[a]	19,602 (217,800)	30	653 (7,260)	19 (207)	1:41
Average			5,794 (64,382)		1:73

[a] The Superconducting Magnetic Energy Storage Facility - Engineering Test Model is no longer being proposed for siting at the Hanford Site.

Table 5-2. Data Used to Estimate Recreational Impacts.

Data Category	Datum	Source
Recreational Use on the Columbia River and Wahluke Slope		
Total, Hanford Reach	50,000 visits per year	NPS 1994
Sport fishing	30,800 visits per year	
Other day use	19,200 visits per year	
Persons per vehicle	2.3	
Recreational User Expenditures (per person)		
Sport fishing	$39.06 per day	DOE et al. 1994
Overnight (used for RV park guests)	$35.38 per day	
Day use	$10.19 per day	
Golf Courses		
Number of golfers	150 per day	Phone survey of Tri-Cities golf courses, May 1997
Season	365 days/yr	
Expenditures per golfer	$25/day	

5.1.6.6 Low-Intensity Recreation. The Low-Intensity Recreation land-use designation would increase opportunities for recreational activities in the study area. The socioeconomic impacts of this land-use designation were evaluated using the data for sport fishing and day-use activities provided in Table 5-2. Low-Intensity Recreation allows little to no infrastructure development to support the intended recreational activities.

5.1.6.7 Conservation (Mining and Grazing) and Conservation (Mining). Although the two Conservation land-use designations are focused on habitat and resource conservation, limited mining and commercial grazing, if permitted by DOE, would be allowed. The economic impact of commercial grazing was evaluated by correlating the increased land available to the increase in the number of cattle that could be supported over the current baseline. Conversion factors of 0.17 animal-unit-months (AUMs) per hectare (0.067 AUM/acre) and $12/AUM (1998 dollars) were used to estimate the economic impacts of grazing.

The economic effects of limited mining under the two Conservation land-use designations were not quantitatively evaluated because of the speculative nature of developing mineral and natural gas deposits and the lack of data on mining in the study area. The amount and location of lands designated for Conservation uses under each alternative could indirectly affect remediation costs by affecting the costs of obtaining geologic materials for constructing barriers over waste sites. These cost impacts are discussed for each alternative.

5.1.6.8 Preservation. The Preservation land-use designation is reasoned to have little direct impact, although indirect impacts may include improvements in the quality of life, new educational and research opportunities, and benefits associated with ecotourism.

5.1.7 Methodology for Evaluating Environmental Justice Impacts

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629), directs Federal agencies to consider environmental justice during the NEPA process, and to incorporate environmental justice as part of the agency mission. Federal agencies are specifically directed to identify and address disproportionately high and adverse human health or environmental effects of programs, policies, and activities on minority and low-income populations to the greatest extent practicable and permitted by law.

5.1.7.1 Definitions. The following definitions were used to identify potential environmental justice impacts.

- **Census block group**: An area defined for the purpose of monitoring census data that generally consists of between 250 and 550 housing units.

- **Minority population**: A group of people and/or communities experiencing common conditions of exposure or impact that consists of persons classified by the U.S. Bureau of the Census as Negro/Black/African American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other non-White persons, based on self-classification by the people according to the race with which they most closely identify. For purposes of analysis, minority populations are defined as those census tracts within the zone of impact where the percent minority population exceeds the percentage minority population within the entire zone of impact. Census tracts where the percent minority population exceeds 50 percent also are considered minority populations. In the case of migrant or dispersed populations, a minority population consists of a group that is greater than 50 percent minority.

- **Low-income community**: An area where the median household income is at least 80 percent or more below the median household income for the metropolitan statistical area (urban) or county (rural). The 80 percent threshold was used based on definitions used by the U.S. Department of Housing and Urban Development.

- **Population base**: Census tracts were included in the analysis if 50 percent of the geographic area of the tract fell within the 80-kilometer (km) (50-mile [mi]) radius of the Hanford Site.

- **Disproportionately high and adverse human health effects**: Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal impacts to human health. Disproportionately high and adverse human health effects occur when the risk or rate for a minority population or low-income population from exposure to an environmental hazard significantly exceeds the risk or rate to the general population and, where available, to other appropriate comparison groups.

- **Disproportionately high and adverse environmental impacts**: An adverse environmental impact is an environmental impact determined to be unacceptable or above generally accepted norms. A disproportionately high impact refers to an impact (or risk of an impact) in a low-income or minority community that significantly exceeds the impact on the larger community.

5.1.7.2 Demographic Data. Demographic information obtained from the U.S. Bureau of Census was used to identify minority populations and low-income communities within an 80-km (50-mi) radius surrounding the 200 East Area on the Hanford Site at the census block group level (Neitzel et al. 1997). For the evaluation of environmental justice impacts, the area defined by this 80-km (50-mi) radius was considered the zone of potential impact.

Characterization of minority and low-income populations residing within a geographical area is sensitive to the basic definitions and assumptions used to identify those populations. Federal guidance on environmental justice with regard to the definition of an area that has a minority or low-income population large enough to act as a test for a disproportionate impact has not been developed. Consequently, the number of individuals identified as minority and/or low-income individuals within the population around a particular site may vary from analysis to analysis. Several different approaches to identification of minority and low-income populations have been used in recent DOE environmental impact statements (EISs). The approach presented in this Final HCP EIS is consistent with the approach used in the *Hanford Site National Environmental Policy Act (NEPA) Characterization* (Neitzel et al. 1997). Other demographic studies may use different assumptions and, consequently, report a different total population, minority population, or low-income population, depending on the assumptions used to identify each population.

5.2 Resource Impacts

The CLUP would consist of three parts: land-use maps, policies, and implementing procedures. Because of the mitigating influences of the policies and implementing procedures presented in Chapters 3 and 6, relying solely on the land-use map designation to determine impacts would be misleading. While the policies and implementing procedures in Chapter 6 provide a certain level of flexibility in Site development (e.g., Special Use Permits and Plan Amendments), resources would be managed and protected through the application of the policies and implementing procedures ensuring that future development would be orderly and reflective of the policies and implementing procedures limitations.

5.2.1 Geologic Resources

The Hanford Site includes geologic resources that are unique or have economic value. The unique features include the White Bluffs and basalt outcrops with their talus slopes, such as

Gable Mountain and Gable Butte; Missoula Floods features; and active and stabilized sand dunes, which have aesthetic, historic, and ecological value or are valuable for scientific study. Many of these features also have cultural resource value and are discussed in Section 5.2.4. Soils on the Hanford Site can also be considered to have ecological value. Key geologic resources include soil, sand and gravel, pea gravel, basalt, and natural gas deposits, which are needed to support remedial activities or have economic value for future development. Geologic materials required to support remediation at the Hanford Site are discussed further in Appendix D.

Impacts of the alternatives on unique geologic features on the Hanford Site are described in the following sections and summarized in Table 5-3. Impacts of the alternatives on the availability of key geologic resources are summarized in Table 5-4. The primary impacts to unique geologic features would occur from mining under the Conservation land-use designations. Development under the Industrial, Research and Development, and High-Intensity Recreation land-use designations could also result in destruction of unique features. Grazing is not anticipated to have impacts on these features, although overgrazing could result in increased erosion of some features.

5.2.1.1 No-Action Alternative. Under the No-Action Alternative, unique geologic features could be impacted by mining. Basalt outcrops could be developed as quarry sites for obtaining geologic materials for remediation although the CRMP would require extensive consultation that could result in stopping the proposed use. According to an engineering assessment (Appendix D), Gable Mountain and Gable Butte represent the most economic and technically feasible basalt sources available for remediation. In the absence of a land-use plan, features such as active and stabilized sand dunes and Missoula Floods features could be impacted by commercial sand and gravel operations. These features could also be impacted by industrial development. Soils on the Hanford Site could be impacted by mining, grazing, and cultivated agriculture, which would increase soil compaction and erosion. Industrial development in the southeast portion of the Hanford Site would destroy dune stabilizing vegetation that could result in activation of sand dunes.

The No-Action Alternative would permit the commercial development of geologic resources on most of the Hanford Site, and would not restrict use of geologic resources needed to support remediation activities. The current administrative designations for the Saddle Mountain National Wildlife Refuge (NWR) and the Wahluke Slope do not preclude mining; in fact, some mining is occurring on those lands. The administrative designation for the ALE Reserve also would not preclude development of existing natural gas claims on the Reserve.

5.2.1.2 Preferred Alternative. Under the Preferred Alternative, unique geologic features, including Gable Mountain and Gable Butte, the White Bluffs, and the active sand dunes would be protected under the Preservation land-use designation. Missoula Floods features could be impacted by sand and gravel operations. Mining could result in soil compaction and increased erosion around quarry sites. Industrial development in the southeast portion of the Hanford Site could destroy dune stabilizing vegetation that could result in activation of the sand dunes.

The Preferred Alternative would not exclude the commercial development of existing natural gas claims on the ALE Reserve. However, the Preservation land-use designation for the areas of the ALE Reserve surrounding those claims would preclude construction of an access road to the claims, and could make future development costly.

Table 5-3. Potential Adverse Impacts of Land-Use Alternatives on Unique Geologic Features.

Alternative	Impacting Activity	Impacts to Unique Geologic Features (T = impact)[a]				
		Soils	Basalt Outcrops	White Bluffs	Missoula Floods Features	Sand Dunes
No-Action	Mining	T	T		T	T
	Livestock grazing	T				T
	Cultivated agriculture	T		T		
	Development				T	T
	Recreation					
Preferred Alternative	Mining	T			T	T
	Livestock grazing					
	Cultivated agriculture					
	Development					T
	Recreation					
Alternative One	Mining	T				T
	Livestock grazing					
	Cultivated agriculture					
	Development					T
	Recreation					
Alternative Two	Mining					
	Livestock grazing					
	Cultivated agriculture					
	Development					
	Recreation					
Alternative Three	Mining	T			T	T
	Livestock grazing	T				
	Cultivated agriculture	T		T		
	Development				T	T
	Recreation					
Alternative Four	Mining	T				T
	Livestock grazing					
	Cultivated agriculture					
	Development					T
	Recreation					

[a] Checkmarks do not represent adverse impacts of comparable significance; refer to accompanying text for significance of impacts.

Table 5-4. Opportunities for Geologic Resource Development Under the Alternatives.

Alternative	Development of Geologic Resources Allowed (T = yes)				
	Soil	Basalt	Pea Gravel	Sand and Gravel	Natural Gas
No-Action	T	T	T	T	T[a]
Preferred Alternative	T[b]	T[b]	T	T[b]	T[a]
Alternative One	T[b]	T[b]		T[b]	T[a]
Alternative Two					T[a]
Alternative Three	T	T	T	T	T[a]
Alternative Four	T[b]	T[b]		T[b]	T[a]

[a] Development of existing natural gas claims held by the Big Bend Alberta Mining Company could not be precluded under any alternative.

[b] Under this alternative, basalt, sand, and gravel resources could be quarried to support governmental purposes, and could not be commercially developed.

Although basalt quarrying would not be permitted at Gable Mountain or Gable Butte, other viable sources, such as the below-grade ALE Reserve quarry (located along State Highway 240), could be developed to provide geologic materials for remediation and construction supporting future DOE missions and other governmental purposes. However, development of these sources could result in higher remediation costs than quarries at Gable Mountain or Gable Butte (see Appendix D). Geologic resources on approximately 30 percent (44,183 ha [109,179 ac]) of Hanford lands would be available for commercial development under the Preferred Alternative; however, those geologic features that have unique characteristics could be excluded from development by the permitting process.

5.2.1.3 Alternative One. Under Alternative One, unique geologic features, including Gable Mountain and Gable Butte, the White Bluffs, Missoula Floods features, the active sand dunes and most of the stabilized sand dunes, would be protected under the Preservation land-use designation. Mining of geologic materials to support remediation could increase soil compaction and erosion around quarry sites.

Alternative One would allow mining in areas around the Laser Interferometer Gravitational-Wave Observatory (LIGO) and the Fast Flux Test Facility (FFTF), and in other scattered locations in the 100 and 600 Areas. Mining would be allowed in these areas to support Hanford Site remediation activities, future DOE missions, and other uses. As with the Preferred Alternative, Alternative One would allow commercial development of the existing natural gas claims on the ALE Reserve, but Alternative One would not allow any other commercial development of geologic resources.

5.2.1.4 Alternative Two. Under Alternative Two, unique geologic features (including Gable Mountain and Gable Butte, White Bluffs, Missoula Floods features, and active and stabilized sand dunes) would be protected under the Preservation land-use designation. This land-use designation would also minimize soil erosion by maintaining the existing vegetation cover.

As with the Preferred Alternative, Alternative Two would allow commercial development of the existing natural gas claims on the ALE Reserve. Alternative two would preclude the development of any other geologic resources on the Hanford Site. Geologic resources required to support remediation activities would have to be obtained from locations off the Hanford Site, which could increase remediation costs (see Appendix D).

5.2.1.5 Alternative Three*.* Under Alternative Three, unique geologic features could be impacted by mining. Basalt outcrops, including Gable Mountain and Gable Butte, could be developed as quarry sites for obtaining geologic materials for remediation, future DOE missions and other uses. Missoula Floods features and active and stabilized sand dunes could be impacted by sand and gravel quarrying. These features could also be impacted by industrial development in the southern and eastern portions of the Hanford Site. Industrial development in the southeast portion of the Hanford Site would destroy dune stabilizing vegetation and may activate the sand dues. Mining and grazing under Alternative Three could result in soil compaction and increased soil erosion. Cultivated agriculture under Alternative Three would increase soil erosion through removal of the existing vegetation cover and tillage. Soil productivity could also decline with intensive cropping.

Alternative Three could result in increased landslide activity at White Bluffs by allowing agricultural development on the Wahluke Slope. Previous studies (discussed in the Hanford Reach EIS [NPS 1994]) suggest that irrigation of crops east of the White Bluffs has raised the local water table, saturating the sedimentary materials in the bluffs and increasing the instability of slopes along the Columbia River. Previous landslides at the White Bluffs have resulted in increased sediment loading to the Columbia River. New development of irrigated agriculture on the Wahluke Slope could contribute additional groundwater to the area, increasing slope instability and the potential for additional landslides.

Alternative Three would allow basalt quarrying, mining of sand and gravel and pea gravel resources, and development of natural gas deposits on the ALE Reserve. The Conservation land-use designation on the ALE Reserve would not preclude construction of an access road to existing natural gas claims. Under Alternative Three, geologic resources on approximately 53 percent (195,612 ha [483,368 ac])of Hanford lands would be available for commercial development; however, those geologic features that have unique characteristics could be excluded from development by the permitting process.

5.2.1.6 Alternative Four. Under Alternative Four, unique geologic features (including basalt outcrops, the White Bluffs, Missoula Floods features, and active and stabilized sand dunes) would be protected under the Preservation land-use designation. This land-use designation would also minimize soil erosion, although some soil compaction and increased soil erosion could occur as a result of mining geological materials for remediation. Industrial development in the southeast portion of the Hanford Site would destroy dune stabilizing vegetation that could result in activation of sand dunes

As with the Preferred Alternative, Alternative Four would allow commercial development of the existing natural gas claims on the ALE Reserve. Alternative Four would not allow any other commercial development of geologic resources. Mining would be limited to basalt and sand and gravel quarries developed to support remediation activities at the Hanford Site. These quarries would be located in the south-central portion of the Site, in the areas designated as Conservation (Mining). Basalt quarrying would not be permitted at Gable Mountain or Gable Butte under this alternative, but the ALE Reserve quarry located along State Route 240 could be developed to provide geologic materials for remediation.

5.2.1.7 Mitigation Measures. Future development of and access to Hanford Site geologic resources would require review under the CLUP policies and implementing procedures described in Chapter 6. These procedures, which would be implemented under any of the alternatives being considered except the No-Action Alternative, would require avoidance or minimization of the impacts of mining or quarrying. Proposed mining or quarrying activities would be controlled through the issuance of special-use permits to be consistent with the CLUP policies and implementing procedures requiring the protection of natural and cultural resources. Other mitigation measures that could reduce impacts to unique geologic features include the following:

- Researchers could be invited to make observations before and during excavation or mining of unique features such as Missoula Floods features so the scientific value of the features would not be lost.

- Efficient irrigation methods could be employed to minimize groundwater recharge in the area of the White Bluffs.

- Rotational grazing methods could be employed to minimize soil erosion.

- Conservation tillage, fallowing, and other techniques could be used to reduce soil erosion from croplands.

- Mining operations could be required to remove, stockpile, and replace topsoil.

- Soil stabilization techniques would be used around mining and development sites to contain wind erosion.

5.2.2 Water Resources

Key water resources at the Hanford Site include surface water and groundwater. The primary surface water feature is the Columbia River. Other surface water features include springs and seeps. Groundwater is found throughout the subsurface of the Hanford Site at depths ranging from approximately 250 meters (m) (820 feet [ft]) in the central portion of the Site to approximately 15 m (50 ft) near the Columbia River.

Surface water resources could be impacted by future land uses in several ways. Water quality could be degraded as a result of point source pollution from industrial waste water discharges and non-point source pollution from runoff. Future industrial development and R&D activities could increase waste water discharges to the Columbia River.

The Columbia River is classified as a “Class A” body of water by the State of Washington, which requires that permitted discharges of waste water from point sources to the river be as clean as, or cleaner, than the water in the river. Consequently, under normal circumstances, industrial discharges to the river would be unlikely to impact water quality in the river. Nevertheless, the potential for water quality impacts from new industrial activities must be considered because of the potential for inadvertent releases and permit violations. Contamination of groundwater from industrial development could also indirectly affect surface water through groundwater discharges to the Columbia River. Industrial development could also increase water withdrawals from the Columbia River.

Non-point source degradation of surface water could occur as a result of runoff of agricultural chemicals from cultivated fields or a golf course. Surface water could also be degraded through trampling of wetland vegetation by livestock congregating in the vicinity of the water during dry periods. Loss of this vegetation could lead to increased siltation and water quality degradation.

Impacts to groundwater could occur as a result of consumptive use or contamination. Consumptive use could lead to draw down of aquifers and could change local groundwater flow patterns. Groundwater flow could also be altered by infiltration of water used to irrigate crops under the Agriculture land-use designation. Infiltration from irrigation could also mobilize contaminants in the vadose zone and increase contamination of groundwater. Contamination could occur as a result of infiltration of chemicals from spills. Groundwater contamination could also occur as a result of infiltration of agricultural chemicals applied to crops, landscaped areas, or golf courses.

Groundwater flow and contaminant transport models are used to simulate future groundwater-flow conditions and predict the migration of contaminants through the groundwater pathway. During the past several years, a Site-wide, three-dimensional, flow and transport model has been under development by Pacific Northwest National Laboratory's (PNNL's) Groundwater Monitoring Project.

Two-dimensional flow models have been used extensively at the Hanford Site. These models were generally adequate for predicting aquifer head changes and directions of groundwater flow prior to cessation of large wastewater-disposal operations because the groundwater levels were somewhat stable across the Hanford Site. However, in the early 1990s, it was recognized that a three-dimensional model was needed for accurate calculation of future aquifer head changes, directions of groundwater flow, mass transport, and predictions of contaminant concentrations. The three-dimensional model was needed because there is significant vertical heterogeneity in the unconfined aquifer, and the water table is dropping over most of the Hanford Site in response to cessation of large wastewater discharges. The unconfined aquifer system is composed of a series of conductive units that are separated from each other in most places by extensive mud units with relatively low hydraulic conductivities. Accounting for this vertical heterogeneity is particularly important as the water table drops, because the water table is currently near the contact between the Hanford formation and the underlying and much-less-conductive Ringold Formation over a large part of the Hanford Site. Dewatering of the highly permeable Hanford formation sediments in some areas (PNL-10196) may result in aquifer transmissivity changes. These changes would be an order of magnitude or more that would not be properly accounted for by two-dimensional flow and transport models.

The Site-wide, three-dimensional model was used during fiscal year 1998 to support the composite analysis for low-level waste disposal in the Hanford Site (PNNL-11800). The composite analysis involved simulation of future transport of radioactive contaminants that are expected to exist on the Hanford Site following site closure. Site closure was assumed to occur in the year 2050, followed by a 1,000-year compliance period. Only sources within a designated waste management area on the Central Plateau were considered because other potential sources are assumed to be remediated before site closure to the level that they would not pose a hazard. During the 1,000-year compliance period, potential exposure to radioactive contaminants outside the waste management area must be within regulatory limits and maintained "as low as reasonably achievable" (PNNL-11800). These future groundwater conditions would be potential impacts common to all alternatives and are shown as Figures 5-1 through 5-9, which include the following:

- Figure 5-1 -- Water Table Elevations Predicted for 2350 Compared to the Inferred 1944 Water Table
- Figure 5-2 -- Predicted Tritium Plume from the 200 Areas for 2050
- Figure 5-3 -- Predicted Iodine-129 Plume from the 200 Areas for 2049
- Figure 5-4 -- Predicted Technetium-99 Plume from the 200 Areas for 2049
- Figure 5-5 -- Predicted Uranium Plume from the 200 Areas for 2049
- Figure 5-6 -- Predicted Strontium-90 Plume from the 200 Areas for 2049

- Figure 5-7 -- Predicted Strontium-90 Plume from the 200 Areas for 2049
- Figure 5-8 -- Predicted Chlorine-36 Plume from the 200 Areas for 2049
- Figure 5-9 -- Predicted Selenium-79 Plume from the 200 Areas for 2049.

The potential for impacts to groundwater under each alternative is identified in Table 5-5, and the potential for impacts to surface water is identified in Table 5-6.

5.2.2.1 No-Action Alternative. Under the No-Action Alternative, mining operations could be undertaken within the All Other Areas geographic area and could occur in the vicinity of the Columbia River. Runoff from mining operations located close to the Columbia River could lead to water quality degradation because of erosion and release of silt to the river. Also, potential fuel or chemical spills on quarry sites could contaminate groundwater or surface water if the sites are located close to the Columbia River. Mining operations could also require water for material washing and dust control. Water use by mining operations would be minor compared to agricultural or industrial uses, and would be less likely to result in changes to groundwater hydrology. Quarry sites could collect surface water runoff, and provide a favorable infiltration surface thereby increasing recharge and mobilizing contaminants in the vadose zone below the quarry sites.

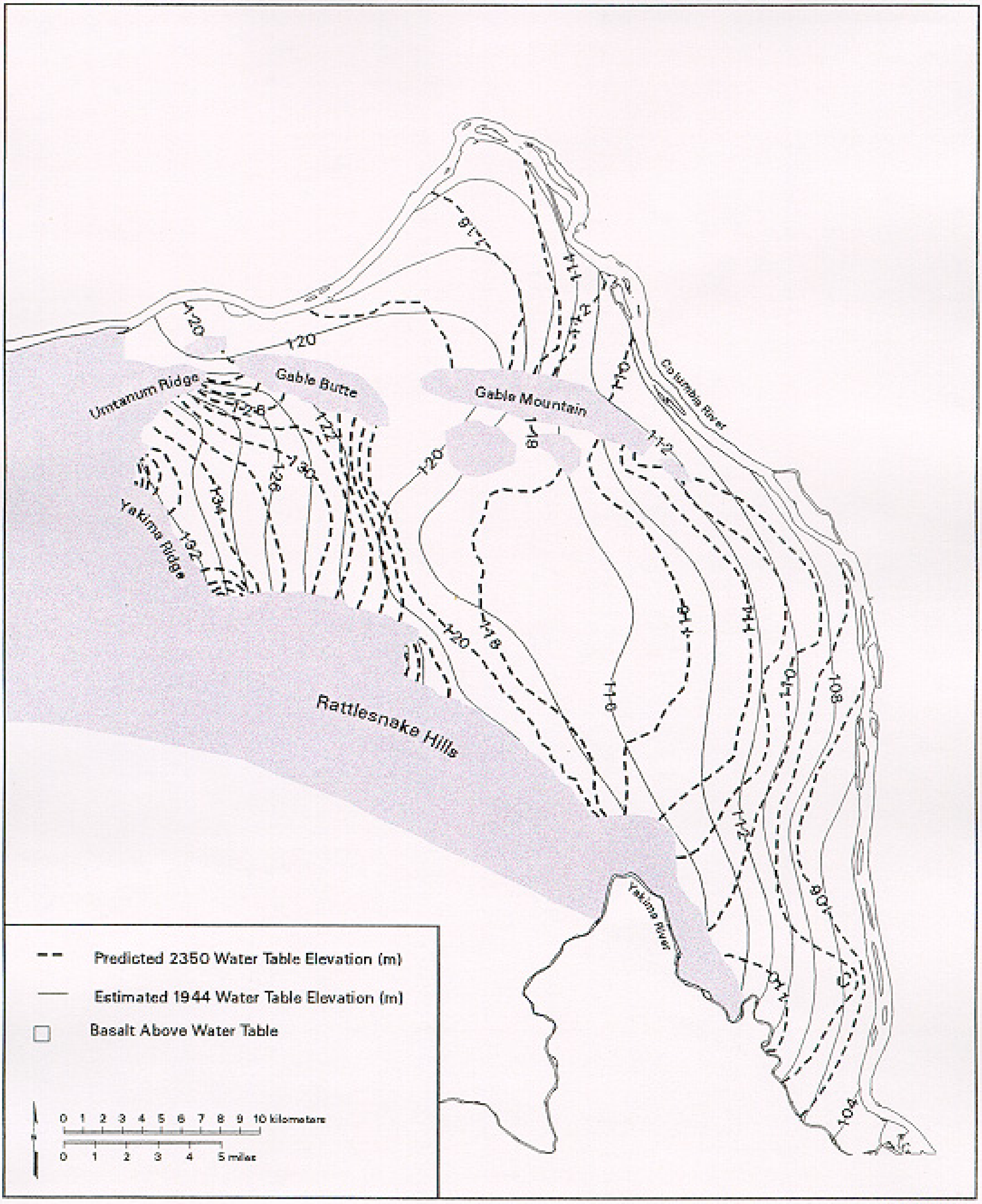
Grazing under the No-Action Alternative could occur in the vicinity of the Columbia River and could reduce riparian vegetation cover. Reduced cover could destabilize the river banks and increase sediment loading to the river. Grazing use under the No-Action Alternative would also require development of water sources. However, water consumption for grazing would be relatively small compared to other uses, such as agriculture or industrial development.

The No-Action Alternative could allow conversion of lands to cultivated agriculture in the All Other Areas geographic area. Agricultural development would most likely occur near the Columbia River, which would provide a clean source of irrigation water. Irrigation water could also be provided by groundwater wells, which would alter groundwater flow patterns through aquifer drawdown. Irrigation of crops could leach agricultural chemicals and residual Hanford Site contaminants from the vadose zone to the groundwater. Runoff from agricultural land could also degrade water quality in the Columbia River through release of agricultural chemicals and increased siltation.

The No-Action Alternative would allow industrial development throughout the All Other Areas geographic area. Future development would most likely occur in the South 600 Area because supporting infrastructure is available in this area. Water to support development could be obtained from on-site groundwater wells, as is the case in the 400 Area, provided by the City of Richland (as it is in the 300 Area), or withdrawn from the Columbia River. Consumptive use of groundwater to support development could lead to changes in groundwater flow patterns as a result of aquifer drawdown. Water quality degradation from new industrial point sources would be minimal because discharges (e.g., septic systems) to groundwater would require state or county permits, and because Federal permit discharges to the Columbia River must be as clean or cleaner than water in the river. However, water quality could be affected by accidental releases to the soil column or the Columbia River or Yakima River from industrial sites.

The No-Action Alternative would not increase recreational access to the Columbia River over existing conditions and, therefore, is unlikely to result in increased impacts to water quality from recreational activities.

Figure 5-1. Water Table Elevations Predicted for 2350 Compared to the Inferred 1944 Water Table.



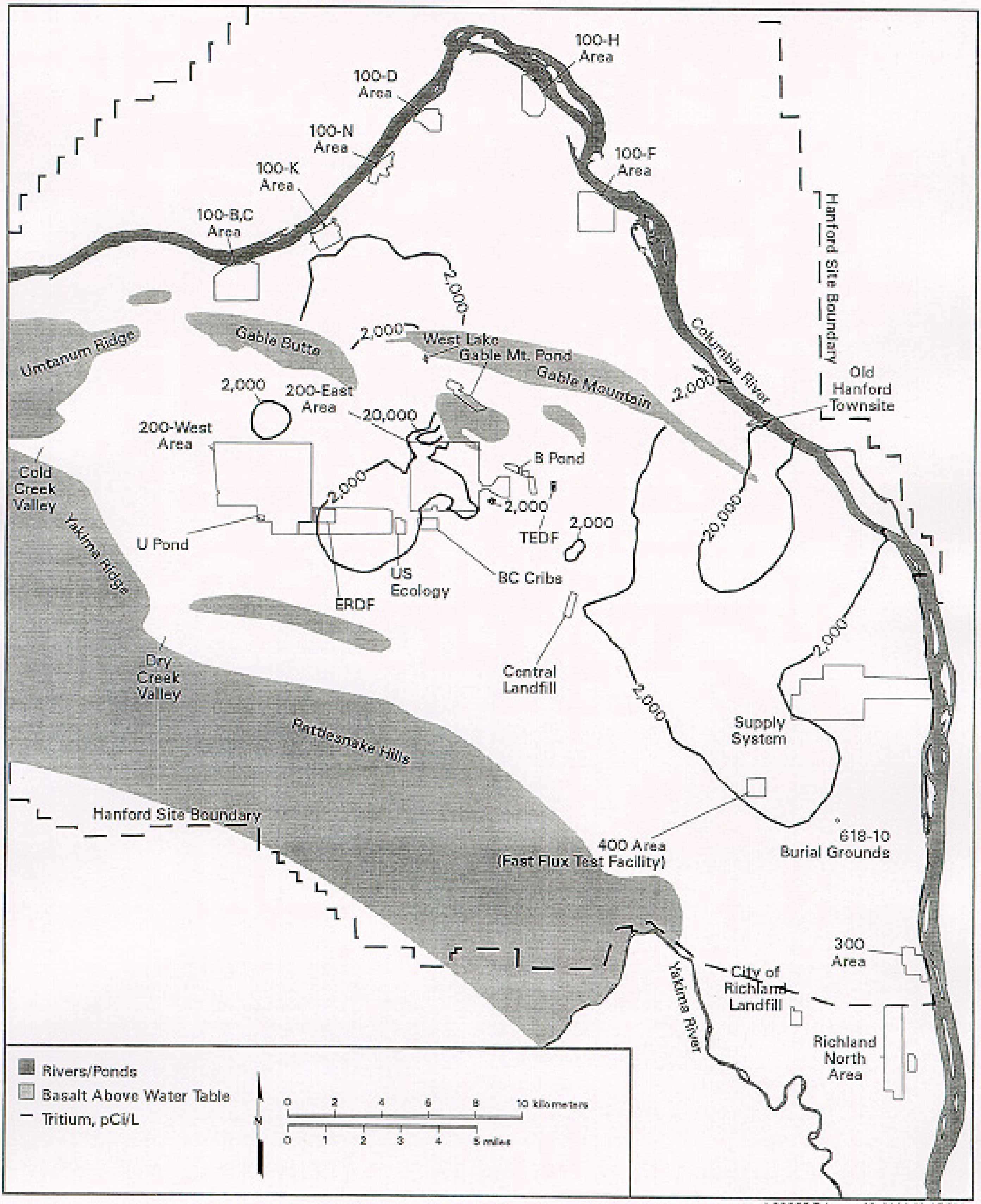
pdt99013.eps

1 *Figure 5-2. Predicted Tritium Plume from the 200 Areas*

3 *for 2050.*

4

5



pdt99002 February 13, 1999 12:25 PM

Figure 5-3. Predicted Iodine-129 Plume from the 200 Areas for 2049.

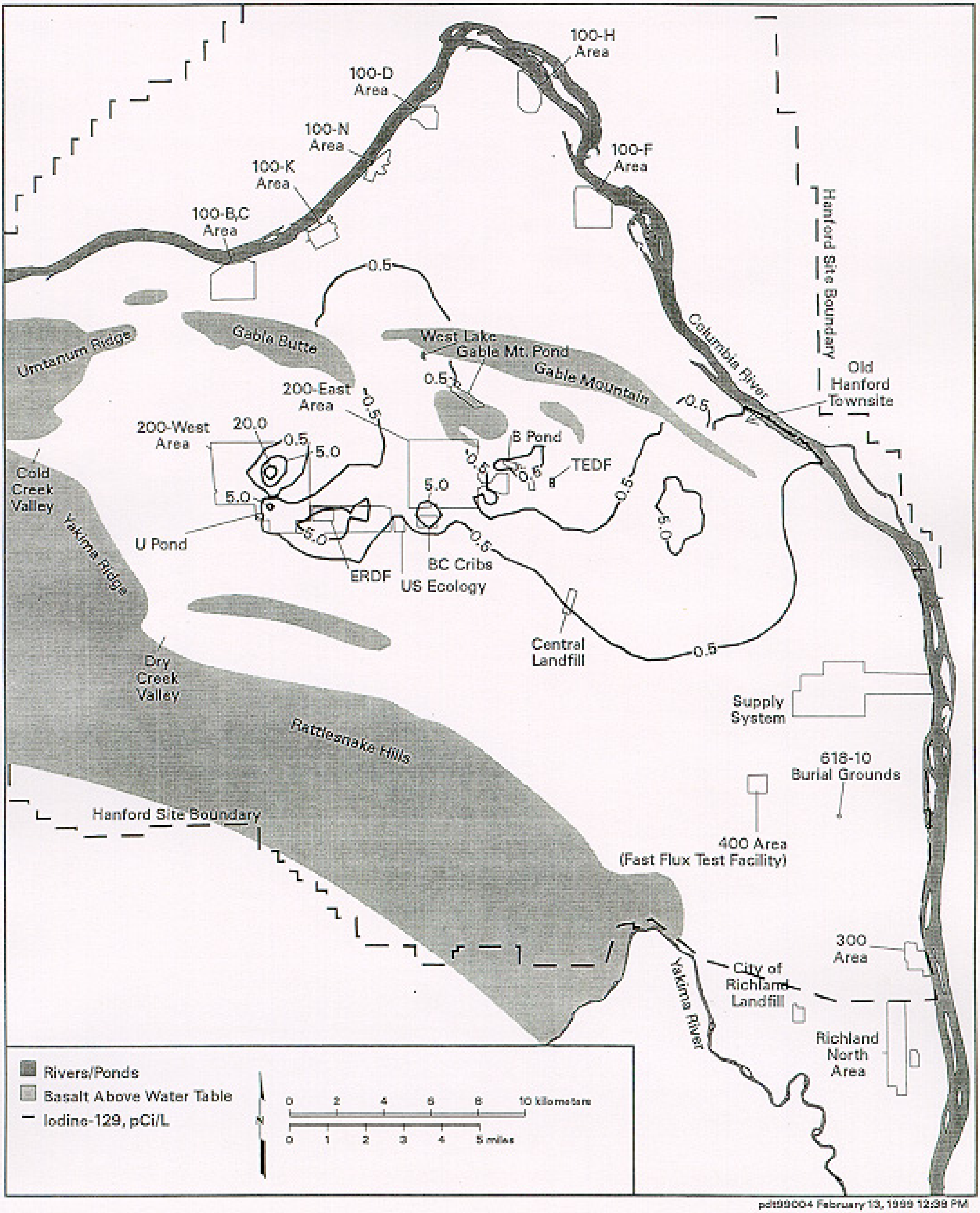
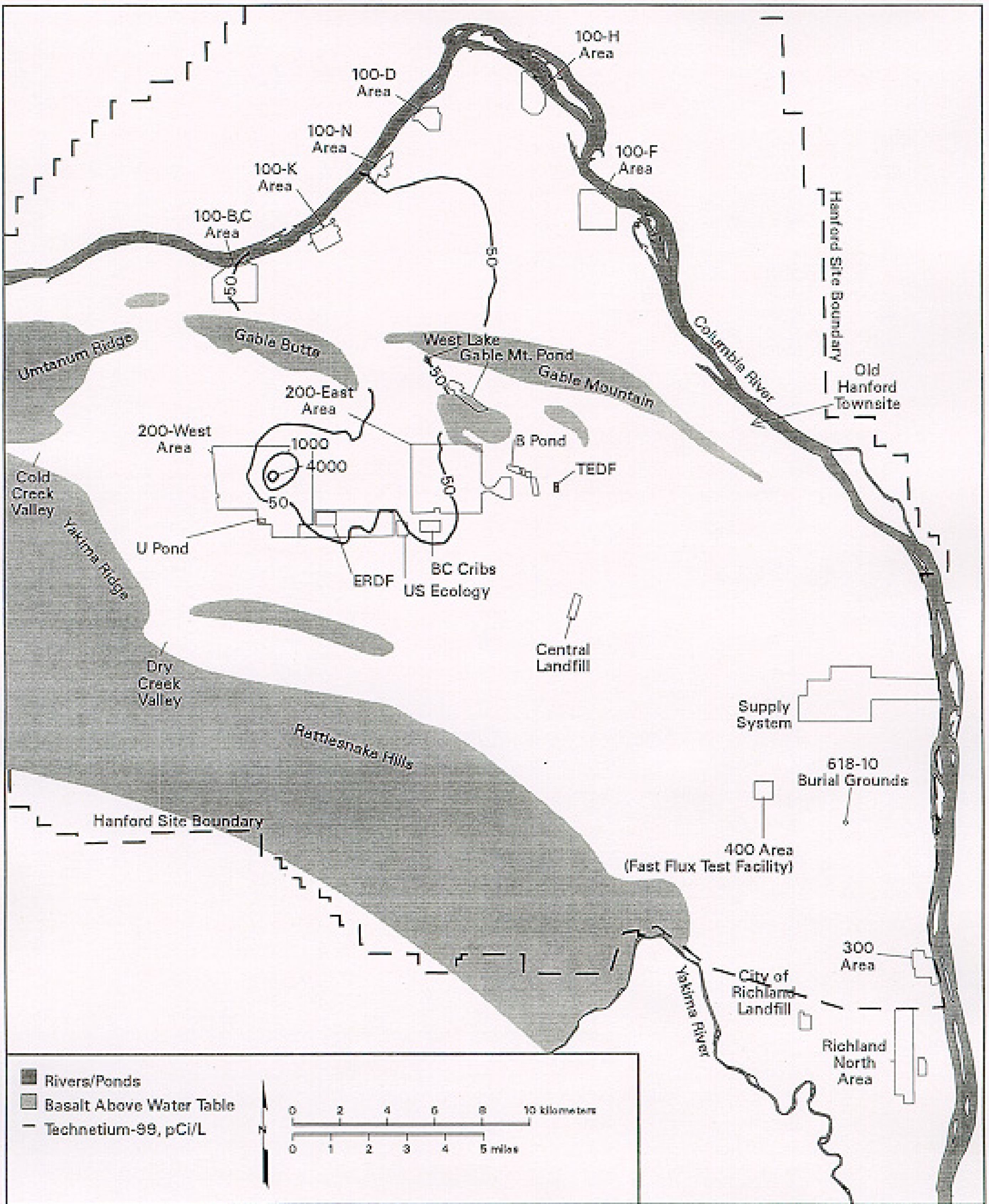


Figure 5-4. Predicted Technetium-99 Plume from the 200 Areas for 2049.



pdt99003 February 13, 1999 12:26 PM

Figure 5-5. Predicted Uranium Plume from the 200 Areas for 2049.

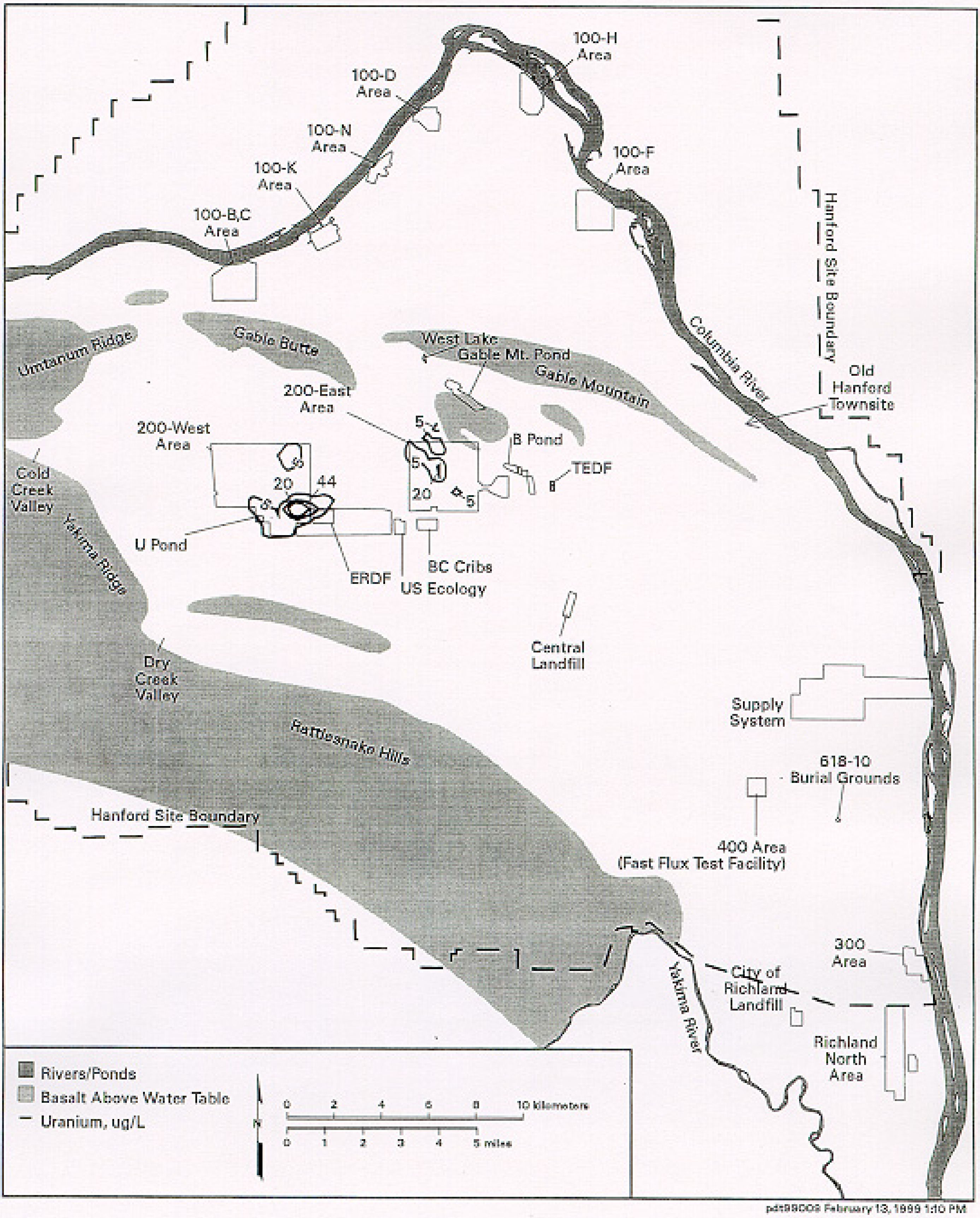
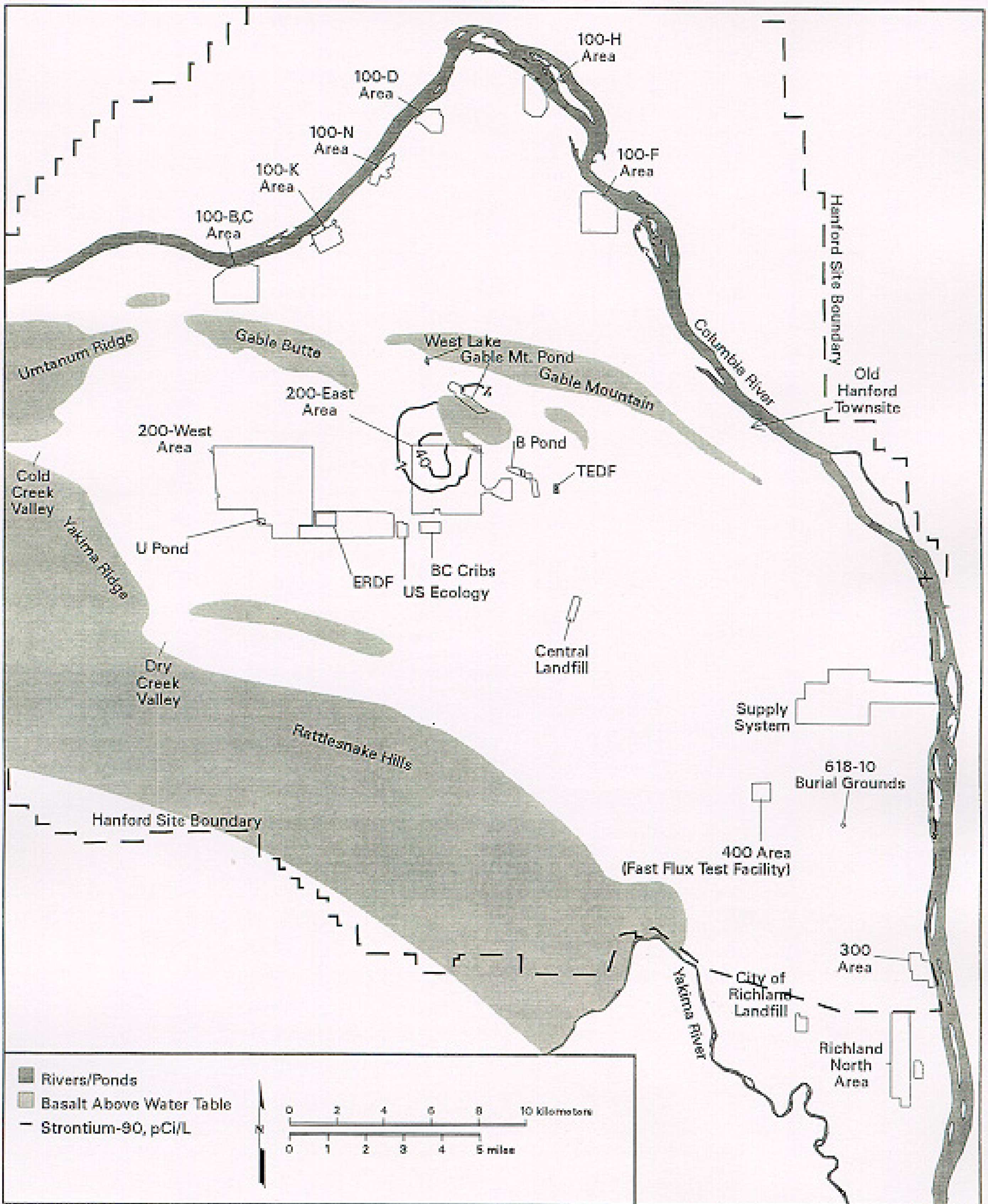


Figure 5-6. Predicted Strontium-90 Plume from the 200 Areas for 2049.



pdl99005 February 13, 1999 12:42 PM

Figure 5-7. Predicted Carbon-14 Plume from the 200 Areas for 2049.

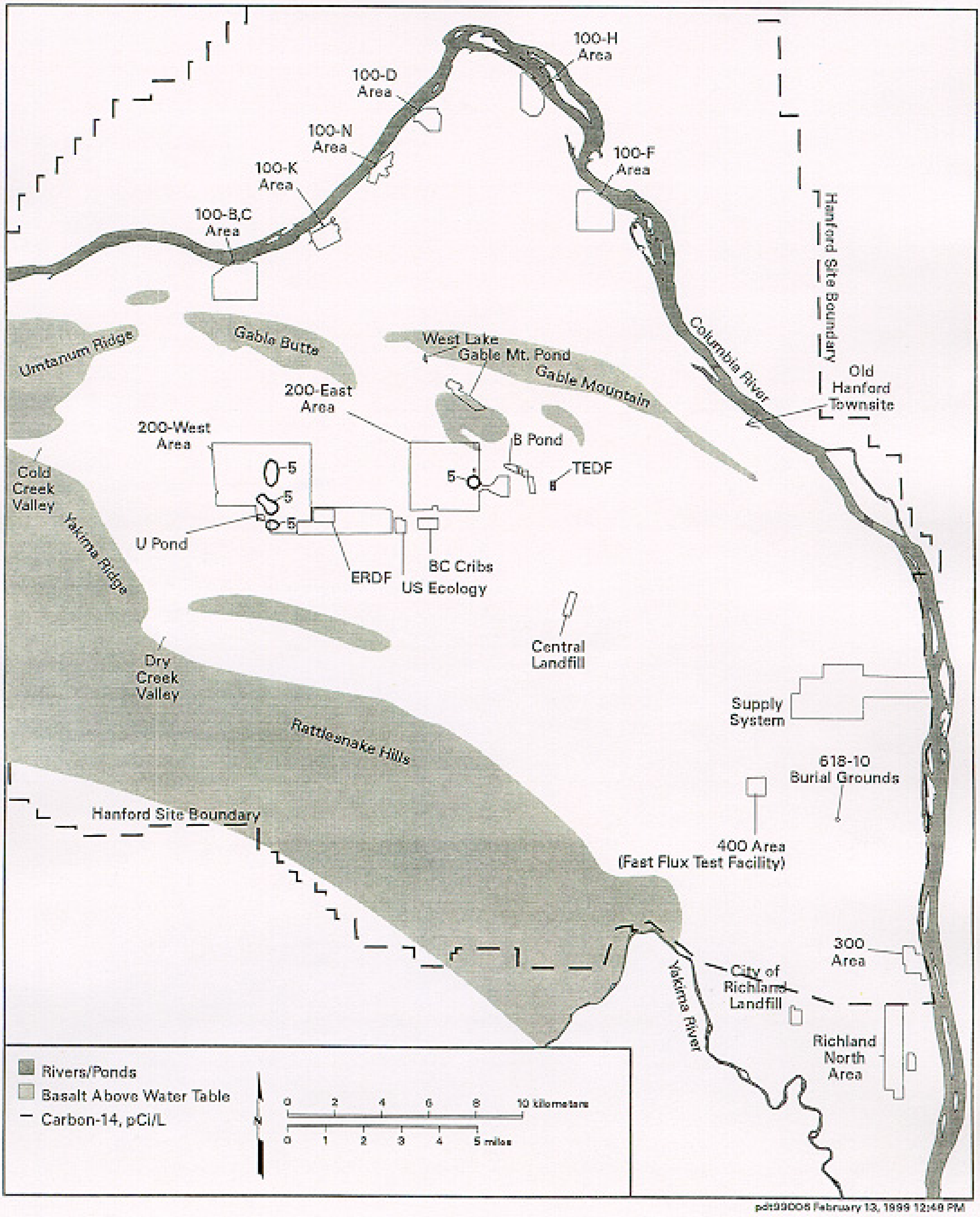


Figure 5-8. Predicted Chlorine-36 Plume from the 200 Areas for 2049.

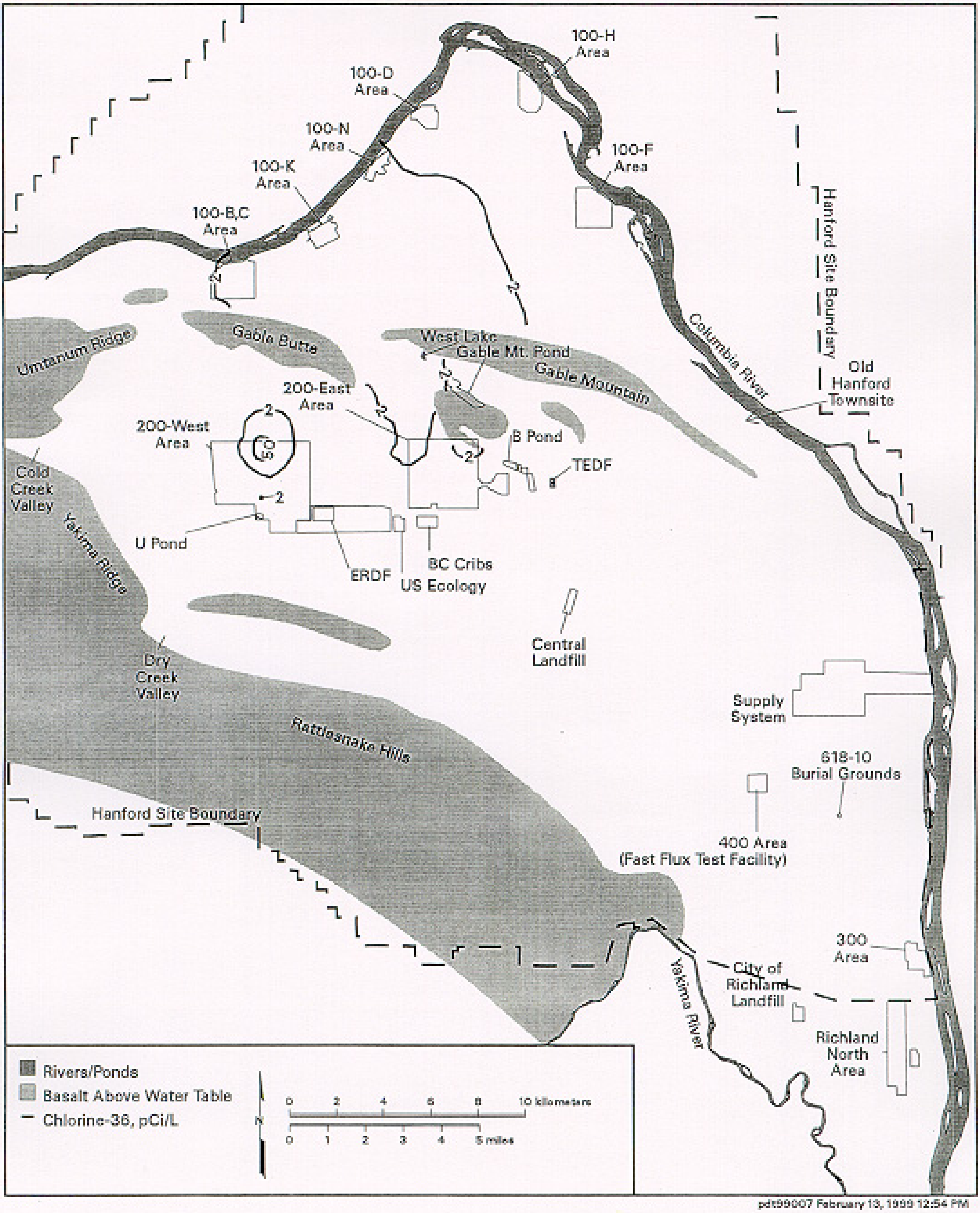


Figure 5-9. Predicted Selenium-79 Plume from the 200 Areas for 2049.

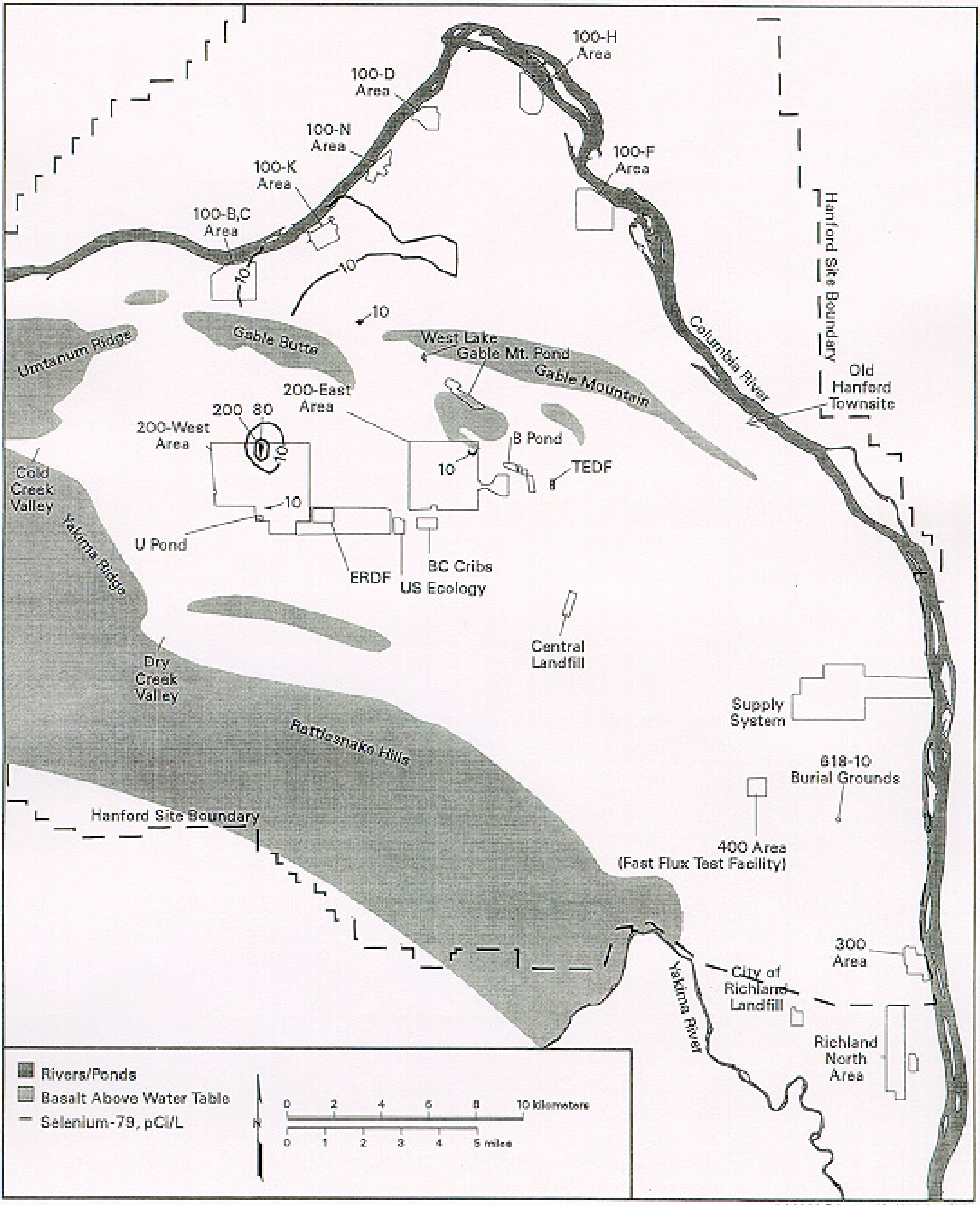


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Table 5-5. Potential Impacts of Alternatives on the Vadose Zone and Groundwater.

Plan Map	Impacting Activity	Impacts to Vadose Zone and Groundwater (T = impact)[a]				
		Consumptive Use	Contamination (Spills)	Contamination (Agricultural Chemicals)	Mobilization of Contaminants	Changes to Hydrology
No-Action Alternative	Mining	T	T		T	T
	Livestock grazing					
	Cultivated agriculture	T	T	T	T	T
	Development	T	T		T	T
	Recreation					
Preferred Alternative	Mining	T	T		T	T
	Livestock grazing					
	Cultivated agriculture					
	Development	T	T		T	T
	Recreation					
Alternative One	Mining	T	T		T	T
	Livestock grazing					
	Cultivated agriculture					
	Development	T	T		T	T
	Recreation					
Alternative Two	Mining					
	Livestock grazing					
	Cultivated agriculture					
	Development	T	T			
	Recreation					
Alternative Three	Mining	T	T		T	T
	Livestock grazing	T				
	Cultivated Agriculture	T	T	T	T	T
	Development	T	T		T	T
	Recreation					
Alternative Four	Mining	T	T		T	T
	Livestock Grazing					
	Cultivated Agriculture					
	Development	T	T		T	T
	Recreation					

[a] Checkmarks do not represent adverse impacts of comparable significance; refer to accompanying text for significance of impacts.

Table 5-6. Potential Impacts of the Alternatives on Surface Water.

Plan Map	Impacting Activity	Impacts to Surface Water (T = impact)[a]			
		Consumptive Use	Degradation by Point Sources	Degradation by Non-Point Sources	Degradation by Sediment Loading
No-Action Alternative	Mining			T	T
	Grazing	T			T
	Agriculture	T		T	T
	Development	T	T	T	T
	Recreation				
Preferred Alternative	Mining	T		T	T
	Grazing				
	Agriculture				
	Development	T	T	T	
	Recreation				
Alternative One	Mining				
	Grazing				
	Agriculture				
	Development	T	T		
	Recreation				
Alternative Two	Mining				
	Grazing				
	Agriculture				
	Development		T	T	
	Recreation				
Alternative Three	Mining				
	Grazing	T			T
	Agriculture	T		T	T
	Development	T	T	T	
	Recreation				
Alternative Four	Mining				
	Grazing				
	Agriculture				
	Development	T	T	T	
	Recreation				

[a] Checkmarks do not represent adverse impacts of comparable significance; refer to accompanying text for significance of impacts.

5.2.2.2 Preferred Alternative. Under the Preferred Alternative, mining operations could occur throughout much of the All Other Areas geographic area and on a portion of the ALE Reserve. Potential impacts to water resources as a result of mining operations would be similar to the potential impacts described for the No-Action Alternative.

The Preferred Alternative would allow industrial development in the eastern and southern portions of the Hanford Site. As with the No-Action Alternative, industrial development under this alternative could alter groundwater flows through increased withdrawals. Industrial discharges to the soils column could mobilize contaminants in the vadose zone and accidental releases from industrial sites could contaminate the groundwater or the Columbia or Yakima Rivers. The potential for immediate contamination of the Columbia River is limited, however, as the 300 Area is the only Industrial land-use designation adjacent to the river under this alternative.

Recreational access to the Columbia River would be increased under the Preferred Alternative through adding new boat ramps and upgrading existing boat ramps. The Preferred Alternative would add three new access points to the Hanford Reach of the Columbia River, and would allow development of tribal fishing villages with supporting facilities. Increased access could increase boating activity on the river, which could increase shoreline erosion from wakes generated by motorized water craft. Increased boating activity could also generate additional pollutants (e.g., oil, gas, and engine exhaust).

5.2.2.3 Alternative One. Under Alternative One, mining would be limited to upland areas away from the Columbia River, and would have minimal affects on water quality.

Industrial development under Alternative One would be restricted to areas that have already been developed, the City of Richland urban growth area (UGA), and an area between the Energy Northwest (formerly known as the Washington Public Power Supply System, or WPPSS) site and the City of Richland UGA. Industrial development in these areas could have impacts such as those described for the Preferred Alternative, including changes in groundwater flows through drawdowns and groundwater contamination through accidental releases. However, these impacts are less likely to occur under Alternative One, as less land would be available for industrial development. Contamination of surface water from new point sources would be minimal under this alternative, as most areas designated for Industrial land use are located away from the Columbia and Yakima Rivers.

Alternative One would increase recreational access to the Columbia River by adding one new access point to the river at Vernita Bridge and maintaining an existing unimproved boat ramp at White Bluffs. The increased access could have impacts to water quality such as those described for the Preferred Alternative, although impacts under Alternative One may be less extensive because it would not provide access to as many areas.

5.2.2.4 Alternative Two. Under Alternative Two, mining, commercial grazing, and agriculture would not be allowed, and no impacts to water resources would occur as a result of these activities.

Areas proposed for industrial development under this alternative include the City of Richland UGA and areas that have already been developed. The potential for new impacts to water resources under this alternative is minimal; however, Alternative Two would allow experimental aqua-culture in the K Reactor area, and discharge of waste water from fish farming activities could add to the nutrient load in the Columbia River.

Alternative Two would not increase recreational access to the Columbia River and is unlikely to result in increased impacts to water quality from recreational uses.

5.2.2.5 Alternative Three. Alternative Three would allow mining activities in the All Other Areas geographic area and on the ALE Reserve, with impacts to groundwater similar to those described for the No-Action Alternative and the Preferred Alternative. Mining would not be permitted within 400 m (0.25 mi) of the Columbia River, and would be unlikely to affect river water quality.

Grazing under Alternative Three would be permitted in some areas on the Wahluke Slope, including wetland areas associated with irrigation water return flows. Grazing could reduce vegetation cover in wetlands and increase siltation in flows entering the Columbia River.

However, grazing under this alternative would not be allowed directly adjacent to the bank of the Columbia River.

Alternative Three would allow cultivated agriculture on much of the Wahluke Slope but would not allow agriculture within a corridor along the Columbia River. This buffer zone would minimize the potential for non-point source runoff of agricultural chemicals and eroded soils into the Columbia River. However, infiltration of agricultural chemicals could contaminate groundwater underlying cropland, and agriculture on the Wahluke Slope could also alter groundwater flow patterns. Increased groundwater recharge from irrigation would increase slumping along the White Bluffs, reducing their scientific, aesthetic, and cultural value. Increased slumping would add large quantities of sediment to the Columbia River, which could bury salmonid spawning areas and would alter flow patterns in the river and could mobilize contaminants, causing erosion of banks and islands.

Water resource impacts due to industrial development under Alternative Three would be similar to those described for the Preferred Alternative and could include changes in groundwater flow, mobilization of vadose zone contaminants, and possible groundwater and surface water contamination through accidental releases.

Recreational development under this alternative could include a golf course and destination resort on the Vernita Terrace. Runoff from parking lots and runoff or infiltration of agricultural chemicals from the golf course could impact water resources. However, development would not be permitted within 400 m (0.25 mi) of the Columbia River, which would minimize the potential affects of runoff on river water quality. The recreational development would involve consumption of large amounts of groundwater for culinary and sanitary uses at the resort and for irrigation of the golf course. Groundwater wells at the destination resort could result in changes in groundwater flows from aquifer drawdown, as well as possible groundwater mounding under sewage treatment facilities.

Alternative Three would increase recreational access to the Columbia River, with potential impacts from increased boating activity such as those described for the Preferred Alternative. However, Alternative Three would concentrate the increased recreational activity on the upper end of the Hanford Reach and at a location near the Yakima River. This could result in water quality impacts with higher intensity in these areas, but lower intensity in the lower portion of the Hanford Reach.

5.2.2.6 Alternative Four. As with Alternative One, Alternative Four would limit mining to upland areas away from the Columbia River and would result in minimal impacts to water quality from mining.

Water resource impacts due to industrial development under Alternative Four would be similar to those described for the Preferred Alternative and could include changes to groundwater flow from drawdown, mobilization of vadose zone contaminants, and possible contamination from accidental releases. However, these impacts may be less likely to occur, as less land would be available for industrial development.

Alternative Four would increase recreational access to the Columbia River by adding two new access points to the river at White Bluffs and Vernita Bridge, which would be associated with tribal fishing villages and support facilities. The increased access could have impacts to water quality such as those described for the Preferred Alternative, although impacts under Alternative Four may be less extensive because it would not provide access to as many areas.

5.2.2.7 Mitigation Measures. With the exception of the No-Action Alternative, the CLUP policies and implementing procedures described in Chapter 6 would be used to screen development proposals for Hanford Site lands. Some activities with the potential to impact water resources would not be permitted by DOE and others would be required to incorporate mitigation measures to reduce impacts. Mitigation measures that could reduce impacts to water resources include the following activities.

- Minimizing the use of groundwater so that water withdrawal would not alter groundwater flow and influence existing contamination plumes.

- Restricting irrigated agriculture on the Wahluke Slope, requiring hydrogeologic studies, or requiring efficient irrigation methods to minimize the potential for increased slumping of the White Bluffs.

- Designating "no wake" zones along the Columbia River in areas where the riverbank is subject to erosion.

- Employing agricultural practices that minimize the use of pesticides, fertilizers, and herbicides, thereby minimizing the potential for infiltration or runoff of these chemicals to groundwater or surface water.

- Requiring a demonstration of no adverse affect on vadose zone contaminants or contaminated groundwater plumes prior to allowing irrigation or industrial discharges to the soil column.

- Employing agricultural practices that minimize soil erosion.

- Using silt fences around development sites to contain soil erosion around those sites and minimize the potential for release of silt to surface water.

- Using soil stabilizing techniques around mining and development sites to contain wind erosion.

- Implementing water conservation measures wherever possible to minimize water use.

- Implementing spill control and cleanup measures to minimize the risk of contaminating water resources from accidental releases.

- Managing commercial grazing activities to minimize livestock access to wetlands and riverbanks (e.g., development of off-stream water sources).

- Requiring a demonstration of no adverse impact on groundwater due to increased infiltration and transportation of vadose zone contamination resulting from development.

5.2.3 Impacts to Biological Resources

Sensitive biological resources are present on the Hanford Site in association with the Columbia River, basalt outcrops with their talus slopes such as Gable Butte and Gable Mountain, sand dunes, low elevation deep soils, and other unique features. Biological resources considered for each alternative in this analysis include terrestrial vegetation and habitat, especially habitats identified through consideration of plant communities of concern; wildlife and wildlife habitat; aquatic species and habitat; wetlands; and biodiversity. The potential impacts of activities allowed under the alternatives on these biological resources are identified in Table 5-7.

Table 5-7. Potential Impacts of the Alternatives on Sensitive Biological Resources.

Alternative	Impacting Activity	Impacts to Biological Resources (T = impact)				
		Terrestrial Vegetation and Habitat	Wildlife and Wildlife Habitat	Aquatic Species and Habitat[a]	Wetlands	Biodiversity
No-Action	Mining	T	T	T	T	
	Livestock grazing	T	T	T	T	T
	Cultivated agriculture	T	T	T	T	T
	Development	T	T	T		T
	Recreation					
Preferred Alternative	Mining	T	T	T	T	
	Livestock grazing					
	Cultivated agriculture					
	Development	T	T			T
	Recreation			T		
Alternative One	Mining	T	T			
	Livestock grazing					
	Cultivated agriculture					
	Development	T	T			
	Recreation			T		
Alternative Two	Mining					
	Livestock grazing					
	Cultivated agriculture					
	Development	T	T			
	Recreation					
Alternative Three	Mining	T	T			
	Livestock grazing	T	T	T	T	T
	Cultivated agriculture	T	T	T	T	T
	Development	T	T			T
	Recreation			T		
Alternative Four	Mining	T	T			
	Livestock grazing					
	Cultivated agriculture					
	Development	T	T			T
	Recreation			T		

[a] Aquatic species and habitats includes creeks, springs, riparian, and riverine (deep water) habitat. Checkmarks do not represent adverse impacts of comparable significance; refer to accompany text for significance of impacts.

Biological resources at the Hanford Site are also classified by level of concern under BRMaP (DOE-RL 1996c). This analysis is focused on resources classified as BRMaP Levels II, III, and IV, defined as follows:

- Level II resources include Washington State Monitor 1 and 2 species and early successional habitats.

- Level III resources include Washington State candidate, sensitive, threatened, and endangered species, Federal candidate species, wetlands and deep-water habitats, and late-successional habitats.

- Level IV resources include Federal threatened and endangered species and those species proposed for listing, and rare habitats such as the White Bluffs, active and stabilized sand dunes, and basalt outcrops.

Table 5-8 presents the potential impacts on biological resources that have been defined in BRMaP as Levels II, III, and IV from activities allowed under the alternatives. The amount of acreage of each BRMaP level under each land-use designation is tabulated from GIS spatial data in Table 5-9.

5.2.3.1 No-Action Alternative. The No-Action Alternative would allow continued development of the All Other Areas geographic area on a project-by-project basis. Without a land-use plan in place, it is less likely that facility siting would be coordinated to share utility corridors and conserve space. Biological resources would be damaged in localized areas where future development occurred. Construction of new facilities would require surface clearing and grading, which would eliminate vegetation and wildlife habitat present on the construction site and allow weed species to become established. New utility corridors could fragment habitats. Scattered development under the No-Action Alternative could also increase the risk of wildfire, which could result in large-scale losses of habitat. Future industrial development under the No-Action Alternative could affect biological resources associated with BRMaP Levels II, III, and IV, as shown in Table 5-9.

The No-Action Alternative would not preclude development of quarries on basalt outcrops such as the Umtanum Ridge, Gable Mountain, and Gable Butte, which could damage sensitive habitats in these locations. This alternative would also allow sand and gravel quarrying in most of the All Other Areas geographic area, and could affect BRMaP Levels II, III, and IV resources. Because basalt and sand and gravel quarries are typically limited in size, it is unlikely that habitat losses would be large enough to affect biodiversity. Conversely, mining of topsoil for covering and reclaiming remediation sites could disturb large areas and could affect biodiversity. Under the No-Action Alternative, the McGee Ranch could be developed as a quarry site for remediation. Large-scale soil mining at McGee Ranch could affect the connection between the large tracts of shrub-steppe habitat on the Hanford Site and those on the Yakima Training Center to the west. Mining at McGee Ranch could eliminate the wildlife movement corridor between these areas and increase habitat fragmentation. Isolating these two habitat remnants could reduce the genetic diversity of plant and animal species associated with shrub-steppe habitat and reduce regional biodiversity in the long term.

Although the No-Action Alternative does not designate lands for cultivated agriculture, this alternative would not preclude future agricultural development of Hanford Site lands. Assuming that cultivated agriculture would be established near the Columbia River to facilitate irrigation, the conversion to cropland could displace rare plants, riparian plant communities, and other BRMaP Level III and IV resources associated with the free flowing Hanford Reach. Cultivated agriculture adjacent to the Columbia River would increase sediment loading to the river, potentially affecting salmonid spawning areas. Agricultural chemicals in runoff from croplands could damage sensitive wetland and aquatic habitats.

Table 5-8. Potential Impacts to Biological Resources as Defined by BRMaP.

Alternative	Activity	Impact to BRMaP Resource Level of Concern (T = impact)[a]		
		II	III	IV
No-Action	Mining	T	T	T
	Livestock grazing	T	T	T
	Cultivated agriculture	T	T	T
	Development	T	T	T
	Recreation			
Preferred Alternative	Mining	T	T	T
	Livestock grazing			
	Cultivated agriculture			
	Development	T	T	
	Recreation		T	T
Alternative One	Mining			T
	Livestock grazing			
	Cultivated agriculture			
	Development	T	T	
	Recreation			
Alternative Two	Mining			
	Livestock grazing			
	Cultivated agriculture			
	Development	T	T	
	Recreation			
Alternative Three	Mining	T	T	T
	Livestock grazing	T	T	T
	Cultivated agriculture	T	T	T
	Development	T	T	
	Recreation	T	T	T
Alternative Four	Mining	T	T	T
	Livestock grazing			
	Cultivated agriculture			
	Development	T	T	
	Recreation		T	T

[a] Checkmarks do not represent adverse impacts of comparable significance; refer to accompany text for significance of impacts.

Table 5-9. Distribution of BRMaP Level II, III, and IV Resources Under the Nine Land-Use Designations for the Alternatives. (2 pages)

Land-Use Designation	No-Action Alternative	Preferred Alternative	Alternative One	Alternative Two	Alternative Three	Alternative Four
BRMaP II	**Hectares (35,909 total)**					
Preservation	1,113	3,297	24,414	34,427	381	13,664
Conservation (Mining)	0	15,940	10,806	0	14,309	13,462
Conservation (Mining & Grazing)	15,807	0	0	0	93	0
Industrial	18,840	11,590	538	744	12,495	4,610
Industrial-Exclusive	146	146	134	134	146	146
Research and Development	0	4,885	11	599	7,885	4,022
Low-Intensity Recreation	3	6	3	3	105	3
High-Intensity Recreation	0	45	2	0	355	1
Agriculture	0	0	0	0	139	0
BRMaP III	**Hectares (66,744 total)**					
Preservation	26,857	44,096	61,306	61,539	3,548	56,842
Conservation (Mining)	0	16,833	209	0	37,096	4,166
Conservation (Mining & Grazing)	33,396	0	0	0	3,578	0
Industrial	1,108	385	75	260	706	310
Industrial-Exclusive	3,115	3,115	2,672	2,672	3,115	3,115
Research and Development	0	<1	194	4	13	<1
Low-Intensity Recreation	2,268	2,295	2,287	0	2,379	6
High-Intensity Recreation	0	19	<1	1	56	37
Agriculture	0	0	0	0	16,251	0
BRMaP IV	**Hectares (9,260 total)**					
Preservation	7,180	7,895	7,905	9,260[a]	1,178	9,260[a]
Conservation (Mining)	0	0	0	0	6,450	0
Conservation (Mining & Grazing)	721	0	0	0	65	0
Industrial	4	0	0	0	0	0
Industrial-Exclusive	0	0	0	0	0	0
Research and Development	0	0	0	0	0	0
Low-Intensity Recreation	1,355[a]	1,355[a]	1,355[a]	0	1,355[a]	0
High-Intensity Recreation	0	<1	0	0	<1	0
Agriculture	0	0	0	0	211	0

[a] Area includes Columbia River surface area.

Although the No-Action Alternative would not preclude cultivated agriculture, mining, or industrial development adjacent to the Columbia River, such developments would have to be reviewed by the National Park Service for compatibility with the proposed Wild and Scenic River designation for the Columbia River. This review may prevent the siting of impacting activities near the river, and effectively provide protection of biological resources in the Columbia River Corridor under any of the alternatives being considered.

Grazing of livestock on the Wahluke Slope under the No-Action Alternative could alter terrestrial vegetation communities by eliminating or reducing the cover of some species, encouraging the growth of grazing-tolerant species, and providing opportunities for weed species to become established. These changes could adversely affect associated wildlife species. Cessation of grazing could increase the fire danger by providing flash and step fuel biomass such as cheatgrass that carries a range fire between brushy areas. Wetland and riparian plant communities could be damaged where livestock congregate near water sources.

Although the No-Action Alternative would continue to allow recreational use of the Hanford Reach, no new boat ramps or other recreational development would be planned. The No-Action Alternative is not likely to result in increased recreational impacts to biological resources associated with the Columbia River.

5.2.3.2 Preferred Alternative. Industrial development under the Preferred Alternative could disturb previously undisturbed land areas, including areas containing BRMaP Level II and III resources in the southern portion of the All Other Areas geographic area. Construction of new facilities would require surface clearing and grading, which would eliminate vegetation and wildlife habitat present on the construction site and provide opportunities for weed species to become established. Industrial development in the southeast portion of the Hanford Site would destroy dune stabilizing vegetation and encourage dune activation. The Preferred Alternative, through implementation of the CLUP's policies and implementing procedures (see Chapter 6), would mitigate the disturbance, encouraging the clustering of future developments and sharing of utility corridors, conserving space and minimizing disturbance. Industrial development under the Preferred Alternative would be less likely to fragment habitats or affect biodiversity than under the No-Action Alternative.

The Preferred Alternative would designate much of the All Other Areas geographic area for Conservation (Mining). In addition, a small portion of the ALE Reserve, which has been identified as an alternative basalt source, would be designated for Conservation (Mining). Biological resources located at quarry sites would be damaged or destroyed. The area in the ALE Reserve where mining would be permitted contains BRMaP Level I and II resources.

The Preferred Alternative would increase recreational access to the Columbia River by allowing additional boat launch facilities to be constructed. Increased boating activity on the river could adversely affect salmonid spawning areas, aquatic plant communities and other BRMaP Level III and IV resources. Development of biking and hiking trails and other recreational facilities could also damage plant communities of concern, and disturb bald eagle roosts and great blue heron rookeries along the Hanford Reach. With increased access, there would also be an increase in the probability of a wildfire occurring.

The Preferred Alternative would assign the Preservation land-use designation to approximately 53 percent (78,127 ha [193,056 ac]) of the Hanford Site, including the Wahluke Slope, most of the ALE Reserve, the basalt outcrops, the McGee Ranch area, the shoreline of the Columbia River, river islands, and the active sand dunes. The Preservation land-use designation would protect approximately 66 percent (44,096 ha [108,964 ac]) of BRMaP Level III and 85 percent (7,895 ha [19,509]) of BRMaP Level IV resources on the Hanford Site.

5.2.3.3 Alternative One. Industrial development under Alternative One would be allowed in areas where development has already impacted sensitive habitats and in an area south of the Energy Northwest (formerly known as WPPSS) site where cheatgrass dominates the vegetation cover. These areas consist mainly of BRMaP Level I and II resources. Industrial development under Alternative One would result in destruction of habitat, but the impacts would be less extensive and to lower quality habitat than under the Preferred Alternative or the No-Action Alternative because of the limited areas available for development.

Alternative One would minimize the area designated for Industrial-Exclusive use to preserve the maximum amount of high-quality, late-successional shrub-steppe habitat located west of the 200 West Area. An additional 443 ha (1,108 ac) of BRMaP Level III resources would be protected under the Preservation land-use designation in this area, as compared to the Preferred Alternative and the No-Action Alternative.

Under Alternative One, the Conservation (Mining) land-use designation would be assigned to areas around LIGO and FFTF, and in other scattered locations in the 100 and 600 Areas. Biological resources at many of these locations have been previously impacted and are classified as BRMaP Level I and II. Other areas contain BRMaP Level III and IV resources that could be damaged by basalt and sand and gravel quarrying. Impacts to these resources are less likely than under the Preferred Alternative or No-Action Alternative, however, because mining under Alternative One would be limited to supporting remediation activities.

Alternative One would increase recreational access to the Columbia River by allowing an additional boat launch facility to be constructed. Increased boating activity on the river could adversely affect biological resources associated with the Hanford Reach. Impacts would be less extensive than under the Preferred Alternative because access would not be provided to as many locations.

Alternative One would assign the Preservation land-use designation to approximately 84 percent (124,517 ha [307,688 ac]) of Hanford Site, including most of the ALE Reserve, the basalt outcrops, the McGee Ranch area, the Saddle Mountain NWR, the entire Columbia River Corridor, and the active and most stabilized sand dunes. The Preservation land-use designation would protect approximately 92 percent (61,306 ha [151,490 ac]) of BRMaP Level III and 85 percent (7,905 ha [19,534 ac]) of BRMaP Level IV resources.

5.2.3.4 Alternative Two. Under Alternative Two, lands designated for industrial development are mostly occupied by existing facilities, although some BRMaP Level II and Level III resources are included under the Industrial and Research and Development land-use designations. Industrial development under Alternative Two could result in destruction of habitat, but the impacts would be less extensive than under any of the other alternatives being considered because of the limited areas available for development. By limiting the amount of area to be developed, Alternative Two (by land-use designation rather than by CLUP policies and implementing procedures), advocates the clustering of future development.

Alternative Two, like Alternative One, would minimize the area designated for Industrial-Exclusive use in order to preserve the maximum amount of high-quality, late-successional shrub-steppe habitat located west of the 200 West Area. An additional 443 ha (1,108 ac) of BRMaP Level III resources would be protected under the Preservation land-use designation in this area, as compared to the Preferred Alternative and the No-Action Alternative.

Alternative Two would not increase recreational access to the Columbia River, and would be unlikely to result in increased impacts to biological resources associated with the river.

Alternative Two would assign the Preservation land-use designation to approximately 95 percent (140,767 ha [347,843 ac]) of Hanford Site, including the ALE Reserve, Wahluke Slope, Columbia River Corridor, and much of the All Other Areas geographic area. The Preservation land-use designation would protect approximately 92 percent (61,539 ha [152,066 ac]) of the BRMaP Level III and 100 percent (9,260 ha [22,882 ac]) of the BRMaP Level IV resources.

5.2.3.5 Alternative Three. Under Alternative Three, the Industrial and Research and Development land-use designations would be larger than under any of the other alternatives, but would mainly consist of BRMaP Level I and II resources. Impacts to biological resources from industrial development under Alternative Three would be similar to those described for the Preferred Alternative.

Alternative Three would designate the ALE Reserve and much of the All Other Areas geographic area as Conservation (Mining). Basalt and sand and gravel quarries developed in these areas could impact rare plants and sensitive plant communities, depending on their relative locations, but CLUP policies and implementing procedures would mitigate against such impacts. Basalt and sand and gravel quarrying could affect BRMaP Level II, III, and IV resources. Because basalt and sand and gravel quarries are typically limited in size, it is unlikely that habitat losses would be large enough to affect biodiversity.

Under Alternative Three, lands in the Wahluke Slope could be converted to agriculture, which would involve conversion of native plant communities to cropland, pasture land, and orchards. Habitats of concern, including BRMaP Level II, III, and IV resources, would be damaged or destroyed. Conversion of native plant communities to cropland would reduce biodiversity by replacing complex plant communities with monocultures and allowing invasion of non-native species. Biodiversity also could be affected on portions of the Wahluke Slope designated for Conservation (Mining and Grazing), where livestock grazing could alter native plant communities. Converting the Wahluke Slope to irrigated agriculture could accelerate the collapse of the White Bluffs and destroy salmon spawning areas by siltation of the spawning gravels in the Columbia River.

Alternative Three would allow High-Intensity Recreational development of the Vernita Terrace, and Low-Intensity Recreational use of a large portion of the 100 Areas near the Columbia River. Development of a destination resort at Vernita Terrace would impact mostly BRMaP Level I resources, as this area consists of cheatgrass and abandoned fields. Construction of Low-Intensity Recreational facilities, such as the proposed recreational trail along the river, could result in habitat losses, including BRMaP Level II, III, and IV resources. However, such trails and other facilities would be sited according to the CLUP policies and implementing procedures to minimize impacts to BRMaP Level II, III, and IV resources. Increased recreational access to the Columbia River under this alternative would increase boating activity and could result in impacts to salmonid spawning areas, bald eagle roosts, great blue heron rookeries, and aquatic plant communities. Increased access could also result in the increased probability of wildfire. Recreational facilities would be located at least one-quarter mile from the river with Low-Intensity access points.

Alternative Three would assign the Preservation land-use designation to approximately 6 percent (9,002 ha [22,244 ac]) of Hanford Site lands, primarily along the Columbia River corridor. The Preservation land-use designation would protect approximately 5 percent (3,548 ha [8,767 ac]) of BRMaP Level III and 13 percent (1,178 ha [2,911 ac]) of BRMaP Level IV resources on the Hanford Site. As with the other alternatives being considered, Alternative Three would also protect sensitive biological resources through the Conservation (Mining) land-use designation with mining only by DOE's special-use permit, as described in Chapter 6 policies and implementing procedures. Under Alternative Three, the Conservation (Mining) land-use designation includes 56 percent (37,096 ha [91,666 ac]) of BRMaP Level III and 70 percent (6,450 ha [15,938 ac]) of BRMaP Level IV resources on the Hanford Site.

5.2.3.6 Alternative Four. Alternative Four would allow industrial development in the City of Richland UGA, in previously developed sites, such as Energy Northwest (formerly known as WPPSS), FFTF, 300 Area, and undisturbed areas north of the City of Richland UGA, which contain mainly BRMaP Level I and II resources. Construction of new industrial or R&D facilities would require surface clearing and grading, which would eliminate vegetation and wildlife habitat present on the construction site and provide opportunities for weed species to become established. Industrial development in the southeast portion of the Hanford Site would destroy dune stabilizing vegetation. Industrial development under Alternative Four would be less likely to fragment habitats and affect biodiversity than the Preferred Alternative or Alternative Three, because the areas available for development would be smaller, of lesser quality, and closer to existing infrastructure.

Under Alternative Four, a portion of the All Other Areas geographic area and a small portion of the ALE Reserve would be managed under the Conservation (Mining) land-use designation. Lands within the ALE Reserve under this land-use designation are classified as BRMaP Levels I and II. The portion of the All Other Areas geographic area available for mining includes BRMaP Levels II and III resources. Basalt and sand and gravel quarries developed in these areas could impact rare plants and sensitive plant communities, depending on their location. Because basalt and sand and gravel quarries are typically limited in size and would be permitted by DOE, it is unlikely that habitat losses would be large enough to affect biodiversity.

Alternative Four would increase recreational access to the Columbia River by adding two new access points to the river at White Bluffs and Vernita Bridge, which would be associated with tribal fishing villages and support facilities. The increased access could have impacts to biological resources such as those described for the Preferred Alternative, although impacts under Alternative Four may be less extensive because it would not provide access to as many areas.

Alternative Four would assign the Preservation land-use designation to approximately 76 percent (112,321 ha [277,551 ac]) of Hanford Site, including the Wahluke Slope, the Columbia River Corridor, most of the ALE Reserve, the basalt outcrops and active sand dunes, and other portions of the All Other Areas geographic area. The Preservation land-use designation would protect approximately 85 percent (56,842 ha [140,460 ac]) of BRMaP Level III and 100 percent (9,260 ha [22,882 ac]) of BRMaP Level IV resources on the Hanford Site.

5.2.3.7 Mitigation Measures. With the exception of the No-Action Alternative, the CLUP policies and implementing procedures described in Chapter 6 would be used to screen development proposals for Hanford Site lands. All proposals, including the No-Action Alternative, potentially affecting sensitive biological resources would be required to comply with applicable statutes, such as the *Endangered Species Act of 1973*, the *Bald and Golden Eagle Protection Act of 1972*, the *Migratory Bird Treaty Act of 1918*, and other statutes, Executive Orders, and policies discussed in Chapter 7. Some activities with the potential to impact habitats of concern would not be permitted by DOE and others would be modified or required by CLUP policies and implementing procedures to incorporate mitigation measures to reduce impacts. Mitigation measures that could reduce impacts to biological resources include the following:

- Minimize disturbance of wetlands and replace disturbed wetlands through purchase, construction, or restoration of wetlands.

- Mitigation for remedial actions should occur near the site of the disturbance as a first priority or, if that is not feasible, be performed as compensatory mitigation on areas designated for Conservation or Preservation.

- Revegetate disturbed areas using native vegetation.

- Schedule activities to avoid critical nesting, roosting, leking, breeding, and fawning times.

5.2.4 Cultural Resources

Impacts to cultural resources may include damage or destruction of archaeological and historic sites and artifacts, as well as disruption of religious and traditional uses of the Hanford Site by American Indians. Impacts of the alternatives on Hanford Site cultural resources are summarized in Table 5-10.

5.2.4.1 No-Action Alternative. The No-Action Alternative would allow quarrying from basalt outcrops that have traditional, cultural, and religious importance to American Indians. The No-Action Alternative also would allow sand and gravel mining and industrial development in most of the All Other Areas geographic area, which would alter the viewsheds associated with religious sites. These activities and cultivated agriculture (which could be allowed under the No-Action Alternative) could also displace natural resources traditionally gathered by American Indians and disturb archaeological and historic sites. Ground-disturbing activities adjacent to the Columbia River could also increase sediment loading to the Columbia River, which could damage salmonid spawning areas and potentially affect American Indian fishing as a cultural activity. Although the No-Action Alternative would not increase recreational access to the Columbia River, archaeological sites would remain at risk to unauthorized artifact collection and riverbank erosion from boat wakes.

5.2.4.2 Preferred Alternative. Although the Preferred Alternative would preclude quarrying of basalt outcrops such as Gable Mountain and Gable Butte, mining of other areas could damage or destroy archaeological and historic sites and displace natural resources traditionally gathered by American Indians. Mining and industrial development could also affect viewsheds associated with American Indian religious sites.

The Preferred Alternative would allow industrial development in the Central Plateau and in the southeastern portion of the Hanford Site. Although these areas already include developed sites (e.g., 200 Areas, Energy Northwest [formerly known as WPPSS], FFTF, and 300 Area), large land areas remain that have not been disturbed. Development of these areas could result in damage to or destruction of archaeological and historic sites and displacement of natural resources traditionally gathered by American Indians.

The Preferred Alternative would increase recreational access to the Columbia River by allowing additional boat launch facilities to be constructed. The Low-Intensity Recreation land-use designation would also allow increased recreational use of the Vernita Terrace. Increased recreational uses along the Columbia River could result in damage to natural resources traditionally gathered by American Indians and impacts to archaeological and historic sites from unauthorized artifact collection, vandalism, and erosion of riverbanks from boat wakes.

Table 5-10. Potential Impacts of Land-use Alternatives on Cultural Resources.

Alternative	Impacting Activity	Impacts to Key Cultural Resource Areas (T = impact)[a]				
		Religious Sites	Viewsheds	Natural Resource Gathering Areas	Archaeological and Burial Sites	Historic Sites
No-Action	Mining	T	T	T	T	T
	Livestock grazing	T		T	T	
	Cultivated agriculture		T	T	T	T
	Development		T	T	T	T
	Recreation				T	
Preferred Alternative	Mining		T	T	T	T
	Livestock grazing					
	Cultivated agriculture					
	Development		T	T	T	T
	Recreation			T	T	T
Alternative One	Mining		T	T	T	T
	Livestock grazing					
	Cultivated agriculture					
	Development				T	T
	Recreation			T	T	T
Alternative Two	Mining					
	Livestock grazing					
	Cultivated agriculture					
	Development				T	T
	Recreation					
Alternative Three	Mining	T	T	T	T	T
	Livestock grazing	T		T	T	
	Cultivated agriculture		T	T	T	T
	Development		T	T	T	T
	Recreation			T	T	T
Alternative Four	Mining		T	T	T	T
	Livestock grazing					
	Cultivated agriculture					
	Development			T	T	T
	Recreation				T	T

[a] Checkmarks do not represent adverse impacts of comparable significance; refer to accompany text for significance of impacts.

5.2.4.3 Alternative One. Under Alternative One, mining to support remediation would be allowed in scattered locations in the All Other Areas geographic area. Although some archaeological sites in these areas were previously disturbed by pre-Hanford farming or by construction of Hanford Site facilities, cultural artifacts may remain that could be impacted by mining. Mining in these areas could affect native plant communities and animals of importance to American Indians. However, this impact is less likely to occur under Alternative One than under the Preferred Alternative, because less land would be available for mining and much of it has been previously disturbed.

Alternative One would limit the Industrial and Research and Development land-use designations to the Central Plateau, Energy Northwest (formerly known as WPPSS) site, 300 Area, and the City of Richland UGA, where some archaeological and historic sites have already been identified and mitigated. The Industrial land-use designation also includes an area located south of the Energy Northwest (formerly known as WPPSS) site where cheatgrass dominates the vegetation cover. Future industrial development in this area could disturb archaeological or historic sites. Archaeological sites could also be disturbed by future development under the Industrial-Exclusive land-use designation on the Central Plateau, although Alternative One would protect more of these resources in the Central Plateau than would the Preferred Alternative.

Alternative One would increase recreational access to the Columbia River by allowing an additional boat launch facility to be constructed. Increased recreational uses along the Columbia River could result in damage to natural resources traditionally gathered by American Indians and impacts to archaeological and historic sites from unauthorized artifact collection, vandalism, and riverbank erosion from boat wakes. These impacts would be less extensive under Alternative One than under the Preferred Alternative, which would allow higher levels of recreational use.

5.2.4.4 Alternative Two. Industrial development under Alternative Two would be limited to the Central Plateau, Energy Northwest (formerly known as WPPSS) site, 300 Area, and areas adjacent to the City of Richland. Archaeological and historic resources in most of these areas have already been identified and mitigated. New development in areas of the Central Plateau could disturb additional sites, although Alternative Two would protect more of these resources in the Central Plateau than would the Preferred Alternative. Alternative Two would designate most of the Hanford Site for Preservation, which would minimize future impacts to cultural resources.

5.2.4.5 Alternative Three. Under Alternative Three, areas with known cultural resources, including the ALE Reserve, could be affected by mining if permitted by CLUP policies and implementing procedures. However, this alternative would not allow mining or other development within 400 m (0.25 mi) of the Columbia River Corridor, where cultural resources are concentrated. Mining, cultivated agriculture, and industrial development under this alternative could alter viewsheds associated with religious sites used by American Indians.

Alternative Three would allow industrial and R&D in the Central Plateau and in the eastern and southern portions of the Hanford Site. Although these areas already include developed sites, such as the 200 Areas, Energy Northwest site, FFTF, and 300 Area, there remain large land areas that have not been disturbed. Development of these areas could result in damage to or destruction of archaeological and historic sites and displacement of natural resources traditionally gathered by American Indians.

Alternative Three would allow conversion of much of the Wahluke Slope to croplands under the Agricultural land-use designation. Conversion to croplands would involve removal of native vegetation important to American Indians. Tillage of croplands would damage or destroy archaeological and historic sites. Irrigated agriculture would increase slumping of the White Bluffs, which have cultural significance to American Indians. Increased slumping could also impact American Indian cultural fishing and other fishing and could alter the river channel, causing losses of cultural resources to riverbank and island erosion.

Agricultural development and commercial grazing on the Wahluke Slope would also alter native plant communities and displace animals of importance to American Indians. Archaeological and burial sites could be damaged where livestock gather, such as at water sources.

Alternative Three would increase recreational access to the Columbia River by designating a large portion of the 100 Areas for Low-Intensity Recreation, as well as designating the Vernita Terrace and the B Reactor area for High-Intensity Recreation. Development of recreational facilities could damage archaeological and historic sites in these areas. Increased recreational uses along the Columbia River could also result in damage to natural resources traditionally gathered by American Indians and impacts to archaeological and historic sites from unauthorized artifact collection, vandalism, and riverbank erosion from boat wakes. An area near Horn Rapids on the Yakima River designated for High-Intensity Recreation could have similar impacts to cultural resources and the culturally important viewshed.

5.2.4.6 Alternative Four. Alternative Four would allow mining that followed the CLUP's policies and implementing procedures in support of remediation in the southern portion of the All Other Areas geographic area. Mining in this area could alter viewsheds associated with religious sites used by American Indians.

Alternative Four would designate southeastern portions of the Hanford Site for Industrial and Research and Development uses. Although these areas already include developed sites (e.g., Energy Northwest [formerly known as WPPSS], FFTF, and the 300 Area), other areas under these designations have not previously been disturbed. Development of these areas could result in damage to or destruction of archaeological and historic sites and displacement of natural resources traditionally gathered by American Indians. These impacts would be less extensive under this alternative than under the Preferred Alternative or Alternative Three because less land would be available for development.

Alternative Four would increase recreational access to the Columbia River by allowing additional boat launch facilities to be constructed. Increased recreational uses along the Columbia River could result in impacts to archaeological and historic sites from unauthorized artifact collection, vandalism, and riverbank erosion from boat wakes. These impacts may be less extensive under Alternative Four than under the Preferred Alternative because this alternative would not provide access to as many areas.

5.2.4.7 Mitigation Measures. With the exception of the No-Action Alternative, the CLUP policies and implementing procedures described in Chapter 6 would be used by DOE to screen development proposals for Hanford Site lands. Impacts of specific proposed projects would be evaluated through the NEPA process including potential impacts on tribal member's treaty rights and known archaeological and historic sites. Some projects may not be permitted and others may be required to incorporate mitigation measures to reduce the impacts. Mitigation measures that could reduce impacts to cultural resources include the following:

- Restrict irrigated agriculture on the Wahluke Slope, requiring hydrogeologic studies, or requiring efficient irrigation methods to minimize the potential for increased slumping of the White Bluffs.

- Continue to conduct cultural resource surveys of proposed project locations in accordance with Neitzel et al. 1997.

- Continue to schedule activities to avoid conflicts with American Indian traditional and religious uses.

- Continue to conduct consultations with the RL Cultural Resources Program Manager, the State Historic Preservation Office, affected Tribal governments, and Wanapum Band representatives to identify additional mitigation measures or project alternatives.

5.2.5 Aesthetic Resources

In this document, key aesthetic resources include viewing locations, viewsheds, visibility (ambient air quality), odors, and ambient noise levels. Adoption of any particular alternative would not directly impact aesthetic resources; however, activities allowed under the various alternatives could have different affects on these resources.

Impacts of the alternatives on aesthetic resources are described in the following sections and are summarized in Table 5-11. The primary impacts to aesthetic resources would occur as a result of altering viewsheds through mining or development, visibility or odor impacts from release of atmospheric pollutants from industrial activities, visibility impacts from releases of fugitive dust from construction sites and seasonally from agricultural activities, and new noise impacts as a result of development, mining, or recreation in areas that are typically quiet.

Under all alternatives, new development projects would be subject to a New Source Review in accordance with the requirements of *Washington Administrative Code* (WAC) 173-400. The New Source Review would identify probable air emissions and air emission control technology would be required, if necessary, to comply with Washington State air-quality thresholds.

5.2.5.1 No-Action Alternative. Under the No-Action Alternative, a quarry operation could be developed on Gable Mountain or Gable Butte, affecting access to these viewing locations. Mining and industrial development activities under this alternative could alter the viewsheds associated with the basalt outcrops. These activities could be widely dispersed under the No-Action Alternative and would stand out against the relatively undisturbed surrounding terrain.

Potential impacts to visibility under this alternative would occur as a result of temporary releases of fugitive dust from construction sites, seasonal releases of fugitive dust from agricultural fields, releases of fugitive dust during mining or quarrying operations, and from releases of pollutants from developed sites.

Potential noise impacts under the No-Action Alternative would include blasting associated with quarry operations, noise generated seasonally by agricultural machinery, and industrial noise around new industrial sites. Depending on the location of the activities, these noise impacts could detract from the recreation experience of recreationists on the Wahluke Slope and along the Columbia River.

Commercial grazing by domestic animals could destroy wetland vegetation, create mud holes, create obnoxious odors, create noise, and be a source of weed and insect pests. Grazing could detract from the recreation experience of recreationists, including hikers, hunters, fishers, and wildlife watchers using areas designated for Low-Intensity Recreation, Conservation, and Preservation; and could disrupt wildlife.

Table 5-11. Potential Impacts of Land-Use Alternatives on Aesthetic Resources.

Plan Map	Impacting Activity	Impacts to Aesthetic Resources (T = impact)		
		Viewsheds	Ambient Visibility	Ambient Noise Levels
No-Action Alternative	Mining	T	T	T
	Livestock grazing			
	Cultivated agriculture	T	T	T
	Development	T	T	T
	Recreation			T
Preferred Alternative	Mining	T	T	T
	Livestock grazing			
	Cultivated agriculture			
	Development	T	T	T
	Recreation			T
Alternative One	Mining	T	T	T
	Livestock grazing			
	Cultivated agriculture			
	Development		T	T
	Recreation			T
Alternative Two	Mining			
	Livestock grazing			
	Cultivated agriculture			
	Development		T	
	Recreation			
Alternative Three	Mining	T	T	T
	Livestock grazing			
	Cultivated agriculture	T	T	T
	Development	T	T	T
	Recreation	T		T
Alternative Four	Mining	T	T	T
	Livestock grazing			
	Cultivated agriculture			
	Development	T	T	T
	Recreation			T

Checkmarks do not represent adverse impacts of comparable significance; refer to accompany text for significance of impacts.

5.2.5.2 Preferred Alternative. Under the Preferred Alternative, viewing locations associated with basalt outcrops and the ALE Reserve would not be disturbed. Viewing locations associated with the Columbia River could be disrupted through development of a mining operation outside a quarter mile from the river. Mining operations would also be permitted within the viewsheds of basalt outcrops. An area designated for Industrial use is within the viewshed of Gable Mountain. Impacts to visibility could include releases of fugitive dust from construction sites and pollutants from new industrial sites.

Noise impacts under the Preferred Alternative could include blasting during quarry operation, increased noise in the vicinity of new industrial sites, and noise from increased motorized watercraft use on the Columbia River. The increased noise levels from these activities could detract from the recreation experience of recreationists, including hikers, hunters, fishers, and wildlife watchers using areas designated for Low-Intensity Recreation, Conservation, and Preservation; and could disrupt wildlife.

5.2.5.3 Alternative One. Under Alternative One, viewing locations associated with basalt outcrops, the Columbia River, and the ALE Reserve would be protected. Mining operations would be permitted within the viewshed of Gable Mountain, but with the exception of the 200 Areas, only limited industrial development would be permitted within the viewshed. Visibility impacts could include emissions of fugitive dust from mining operations and construction sites, along with potential emissions of pollutants from industrial activities.

Noise impacts under Alternative One could include blasting during quarry operation, increased noise in the vicinity of new industrial sites, and noise from increased motorized watercraft use on the Columbia River. Because areas designated for development are in close proximity to previously developed areas, new noise sources are not likely to affect previously quiet areas. Noise from blasting and from recreational activities along the Columbia River could affect some areas that are presently quiet, detracting from the recreation experience of recreationists and potentially disrupting wildlife.

5.2.5.4 Alternative Two. Alternative Two would allow minimal new development on the Hanford Site, protecting existing viewing locations and viewsheds. New industrial development could occur in the City of Richland UGA, but would have minimal visibility and noise impacts to recreationists.

5.2.5.5 Alternative Three. Alternative Three would allow quarrying operations on basalt outcrops and mining on the ALE Reserve, which could affect access to viewing locations. Viewing locations associated with the Columbia River would remain unaffected. The viewshed from the basalt outcrops and from points along the Columbia River could be altered by development of agriculture on the Wahluke Slope and mining and industrial development on other portions of the Hanford Site. Agricultural development of the Wahluke Slope would replace natural vegetation mosaics with ordered rectangular, linear, and circular patterns associated with irrigated cropland and orchards.

Visibility impacts could include fugitive dust from mining and quarrying operations, seasonal releases of particulates from farming activities, releases of fugitive dust from construction sites, and releases of pollutants from new industrial sites.

Noise impacts associated with this alternative could include blasting in support of quarry operations, noise from agricultural machinery, industrial noise in developed areas, and increased noise associated with motorized watercraft on the Columbia River. The new noise sources could affect some areas that are presently quiet, detracting from the recreation experience of recreationists and potentially disrupting wildlife.

Commercial grazing by domestic animals could destroy wetland vegetation, create mud holes, create obnoxious odors, create noise, and be a source of weed and insect pests. Grazing could detract from the recreation experience of recreationists, including hikers, hunters, fishers, and wildlife watchers using areas designated for Low-Intensity Recreation, Conservation, and Preservation; and could disrupt wildlife.

5.2.5.6 Alternative Four. Alternative Four would protect viewing locations at basalt outcrops, on the ALE Reserve, and along the Columbia River. Mining activities in the south-central portion of the Hanford Site could alter viewsheds associated with basalt outcrops. Impacts to visibility could include releases of fugitive dust from construction sites and pollutants from new industrial sites.

Noise impacts under Alternative Four could include blasting during quarry operation, increased noise in the vicinity of new industrial sites, and noise from increased motorized watercraft use on the Columbia River. The increased noise levels from these activities could detract from the recreation experience of recreationists and could disrupt wildlife.

5.2.5.7 Mitigation Measures. With the exception of the No-Action Alternative, the CLUP policies and implementing procedures described in Chapter 6 would be used to screen development proposals for Hanford Site lands. Proposed projects would be planned to be consistent with the CLUP policies requiring protection of natural and cultural resources. This planning effort would include consideration of aesthetic resources. Potential mitigation measures for aesthetic resources include:

- Implementing dust control measures, such as spraying water or other dust suppressants, on construction, excavation, and quarry sites to reduce emissions of fugitive dust.
- Covering loads when hauling materials away from construction or excavation sites.
- Siting development or mining activities in areas with the least impact on the viewshed from basalt outcrops with their talus slopes, such as Gable Butte and Gable Mountain.
- Minimizing noise impacts to wildlife by restricting activities that generate noise to seasons when sensitive wildlife would be disrupted the least.
- Limiting grazing timing, grazing rotation, and grazing areas to protect aesthetic resources.

5.3 Socioeconomic

5.3.1 Socioeconomic Impacts

The study area used for the purpose of socioeconomics analysis includes Benton, Franklin, and Grant counties.

5.3.1.1 No-Action Alternative. Under the No-Action Alternative, a land-use plan would not be implemented, and facility planning and siting would continue on a project-by-project basis. Because a land-use plan would not guide development, the potential socioeconomic impacts of the No-Action Alternative cannot be readily predicted. The lack of a land-use plan that provides a framework for DOE and local governments to work cooperatively may discourage multiple use and transfer of Hanford lands. In the absence of a land-use plan, it is also unlikely that new recreational opportunities would be developed that would generate economic benefits. However, it can be assumed that this alternative would allow industrial development and R&D activities to occur. Industrial development under the No-Action Alternative is likely to generate more employment than Alternatives One or Two, but probably less employment than would the Preferred Alternative or Alternative Three.

Under the No-Action Alternative, it is less likely facility siting would be coordinated to share utility corridors and conserve space. The lack of a land-use plan could result in inefficient use of existing infrastructure, with new infrastructure added on a project-by-project basis. In the absence of a land-use plan, prioritization of infrastructure maintenance and improvements would be more difficult and could result in higher costs to DOE and local governmental entities responsible for infrastructure.

5.3.1.2 Preferred Alternative. Implementation of the Preferred Alternative would allow industrial development, R&D initiatives, limited mining, and increased recreational uses on Hanford Site lands. A total of 15,335 ha (37,894 ac) would become available for industrial development, which would meet the estimated need forecasted by the Benton County Planning Department (1,639 ha [4,050 ac]), and would provide an additional 13,696 ha (33,844 ac) to support possible future DOE missions. This amount of land would allow the siting of several manufacturing facilities, with a total employment of 1,000 or more. Lands under the Research and Development land-use designation would total approximately 4,912 ha (12,138 ac), which could support at least 527,482 m^2 (5.9 million ft^2) of facility space (including buildings, parking lots, and support facilities) and total employment of up to 100 employees.

Future industrial development on Hanford Site lands would require additional support infrastructure, such as roads and utilities. The City of Richland, in its Comprehensive Plan (COR 1997), anticipates industrial development in its UGA[1], which includes Hanford's 300 Area, and a portion of the Hanford Site north of the city limits. The Comprehensive Plan was prepared with the assumption that all industrial development within the 20-year planning period would be accommodated by land already available within the UGA. The Comprehensive Plan describes the city's plans for addressing additional infrastructure needs anticipated in the UGA during the planning period.

The City of Richland's Comprehensive Plan (pp. 3-17, and 3-19 through 3-22) (COR 1997) indicates that growth exceeding the City's projections could result in reduced levels of service in the city's infrastructure, including the transportation system, waste water facilities, water supply, solid waste management, and electrical power supply. If industrial development under the Preferred Alternative expanded beyond the UGA, the development could exceed the City's capacity to provide supporting infrastructure. Existing Hanford Site infrastructure could meet at least some of the increased demand. Improvements to the existing infrastructure may have to be financed through other governmental or public entities, such as Benton County or the Port of Benton, to encourage industrial development on Hanford Site lands.

The Preferred Alternative would make some of the Hanford Site available for mining under the Conservation (Mining) land-use designation. The Preferred Alternative would allow the development of the existing natural gas claim held by the Big Bend Alberta Mining Company and the filing of new claims for sand and gravel and natural gas development. However, the Preservation land-use designation for the areas of the ALE Reserve surrounding those claims would preclude construction of an access road to the claims, and could make future development economically unfeasible. Mineral development on other areas of the Hanford Site would depend on the release of Hanford Site lands withdrawn from the public domain by DOE, the Bureau of Land Management (BLM), and the BoR. The BoR-held lands on the Wahluke Slope are not subject to mineral claims without the specific agreement of the BoR. The BoR does not anticipate giving permission for extraction of building materials such as sand and gravel from its lands on the Wahluke Slope. Because the restrictions placed on mineral development at the Hanford Site are likely to discourage investment in mining claims, future mineral development is unlikely to have impacts to the regional economy.

The Preferred Alternative would preclude basalt quarrying from basalt outcrops and soil mining from the McGee Ranch. These locations have been identified as the most cost-effective and technically feasible sources of geologic materials for remediation (see Appendix D). The Conservation (Mining) land-use designation under the Preferred Alternative designates an area in the ALE Reserve as an alternative basalt source. Alternative soil mining sites are also available under the Conservation (Mining) land-use designation. Increased haul distances from quarries to remediation sites would increase remediation costs under the Preferred Alternative, as compared to the No-Action Alternative and Alternative Three.

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[1] An urban growth area (UGA) is defined as an area designated by the county or city for the expansion of urban development and municipal jurisdiction.

Low-Intensity Recreation associated with the Vernita Terrace, and High-Intensity Recreation use associated with boat launches and the B Reactor Museum, along with limited recreational opportunities under the Conservation and Preservation land-use designations, could have impacts on the economy in the study area. Because current access to the Columbia River Corridor is effectively limited to the Wahluke Wildlife Recreation Area, increased access under the Preferred Alternative could greatly increase use for sport fishing, recreational boating, and other day uses. Assuming that increased access to the Columbia River Corridor would double the amount of day use over levels at the Wahluke Wildlife Recreation Area, an additional $1.4 million per year could be generated for the local economy in recreational tourism dollars. Increased recreational use could increase employment in retail sporting goods, boat dealers, recreational vehicle (RV) dealers, and hotels and motels in the study area. These service industry jobs typically benefit the economically disadvantaged worker by providing more job opportunities.

5.3.1.3 Alternative One. Implementation of Alternative One would expand the existing Saddle Mountain NWR. According to the Washington Department of Fish and Wildlife (WDFW), wildlife viewing is big business in Washington State. More than a third of the state's population participates in wildlife viewing and those wildlife watchers spent nearly $1.7 billion on the pursuit in Washington in 1996. A report issued by the WDFW entitled, *The Economic Benefits of Wildlife-Watching Activities in Washington*, found that wildlife watchers spent $1.1 billion on equipment purchases; $509 million on trip-related expenses including food and lodging; $106 million for land-use fees and rentals; and $59 million for items such as magazines, books, membership dues, and other items. Nationwide, Americans spent $29.2 billion on wildlife in 1996 and if wildlife-watching were a company, nationally it would have ranked 23rd among Fortune 500 corporations. In Washington alone, wildlife-viewing activities in 1996 translated to nearly 8,000 jobs, sales tax of $56.9 million, and destination tourism drawing about 270,000 out-of-state visitors who spent nearly 6 million visitor-days. How much income the expanded refuge would bring to the Hanford area is unknown at this time.

Alternative One would allow continued industrial development and limited recreational uses on Hanford Site lands. A total of 2,542ha (6,281 ac) would become available for industrial development, which would meet the estimated need forecasted by the Benton County Planning Department (1,639 ha [4,050 ac]), and would provide an additional area to support possible future DOE missions. This amount of land would allow the siting of several manufacturing facilities, with a total employment of 100 to 1,000. Research and Development land uses would be limited to the 300 Area and 400 Area, which are already developed. The economic impact of Research and Development land use under Alternative One would depend on possible future uses for the 300 and 400 Areas facilities.

Alternative One would allow efficient use of existing infrastructure located in the 300 Area and in the City of Richland UGA, but could require new infrastructure to develop the rectangular area located south of the Energy Northwest (formerly known as WPPSS) site designated for industrial use. This area is an "island" surrounded by lands designated Preservation, which could make extension of utilities to the area difficult. Construction of utility corridors through Preservation lands would require more project reviews and justification, resulting in increased costs and extended schedules. Because Alternative One would convert other areas containing existing infrastructure to the Preservation land-use designation, the existing infrastructure would not be maintained and would lose its remaining economic value.

Alternative One would expand an existing Federal wildlife refuge. Because a wildlife refuge would be expected to maintain high ecological values, there are various legal requirements attached by the Federal and state governments that could have socioeconomic impacts. A summary of possible socioeconomic impact drivers by resource area follows.

- **Air** -- For visibility protection, the *Clean Air Act of 1977* specifies that Federal wildlife refuges over 10,000 acres can only be designated as Federal Class I or Federal Class II air shed (CAA Section 162 and WAC 173-400).

- **Land** -- Any Dangerous Waste Management Unit boundary must be sited at least one-quarter mile from state or federally designated wildlife refuges (WAC 173-303-282); and, incinerator ash disposal facilities shall not be located in a state or federally designated wildlife refuge (WAC 173-306-350).

- **Surface water** -- No degradation of existing sediment quality shall be allowed of waters constituting an outstanding national resource, such as water of a wildlife refuge (WAC 173-204-120).

- **Groundwater** -- Degradation shall not be allowed of high quality ground waters constituting an outstanding national or state resource such as waters of a wildlife refuge (WAC 173- 200-030)

Alternative One would reduce the amount of land designated Industrial-Exclusive as compared to the No-Action Alternative, the Preferred Alternative, and Alternatives Three and Four. This could limit future development of lands under this designation for future DOE missions, and could have impacts on the future economic contribution of DOE activities. However, GIS data indicate that only 38 percent of lands under this designation are currently developed. Also, none of the reasonably foreseeable actions identified for the 200 Areas would require lands that would not be available under Alternative One, indicating that sufficient lands would remain available under the Industrial-Exclusive land-use designation to support future development without adverse socioeconomic impacts.

Alternative One would allow the development of the existing natural gas claim held by the Big Bend Alberta Mining Company, but would not allow the filing of new claims for sand and gravel and natural gas development. Mining on the Hanford Site would be limited to obtaining geologic materials to support remediation and maintaining existing sand and gravel quarries. These mining activities are unlikely to have economic impacts in the study area.

Alternative One would allow High-Intensity Recreational uses at the B Reactor and Vernita Bridge, where a new boat ramp would be constructed. Another unimproved boat ramp and other Low-Intensity Recreational uses would also be allowed. Recreation under this alternative is likely to have the greatest economic impact directly from ecotourism as a result of the expansion of the existing Saddle Mountain NWR.

5.3.1.4 Alternative Two. Implementation of Alternative Two would allow limited industrial development and limited recreational uses on Hanford Site lands. This alternative would have the least economic potential of the alternatives being considered. A total of 1,830 ha (4,522 ac) would become available for industrial development, which is 191 ha (472 ac) more than the estimated need forecasted by the Benton County Planning Department (1,639 ha [4,050 ac]). However, much of this land (which includes the Energy Northwest [formerly WPPSS], FFTF, and lands adjacent to the city of Richland), is already developed. According to the GIS database, 673 ha (1,662 ac) or 32 percent of the Industrial land-use designation under Alternative Two is already developed. Therefore, this alternative would not have sufficient vacant land to meet the estimated future need or provide for possible future DOE missions.

The relatively small amount of vacant land designated for Industrial development under this alternative would probably limit new industrial employment to less than 100. Research and Development land uses under this alternative would be limited to existing uses at LIGO (theoretical physics research), and the K Reactor Basins (aqua-culture). The number of employees that could be supported would depend on possible future uses of these facilities. As was described under Alternative One, Alternative Two would reduce the area available for development under the Industrial-Exclusive land-use designation but is unlikely to have adverse socioeconomic impacts.

As with the Preferred Alternative, Alternative Two would allow commercial development of the existing natural gas claim on the ALE Reserve, but the Preservation land-use designation would limit access. This alternative would preclude the development of any other geologic resources on the Hanford Site. Geologic resources required to support remediation activities would have to be obtained from locations off the Hanford Site, which could increase remediation costs (see Appendix D).

Alternative Two would allow High-Intensity Recreation associated with the B Reactor Museum, but would not increase recreational access to the river. Day use of the B Reactor area would generate some economic benefits, but they would be substantially less than those estimated for the recreational uses under the other alternatives.

As in Alternative One, an additional economic benefit may be realized from the Preservation land-use designation, which could increase interest in the Hanford Site in the ecotourism market. Interest in ecotourism, which focuses on pristine habitats and rare species, is increasing. The preserved habitats and associated species at the Hanford Site could draw additional visitors to the Site, and generate additional revenues. However, access would be limited under Alternative Two and the Preservation areas would lack the additional legal protection of being a NWR.

5.3.1.5 Alternative Three. Under Alternative Three, a total of 17,860 ha (44,133 ac) would become available for industrial development, which would meet the estimated need forecasted by the Benton County Planning Department (1,639 ha [4,050 ac]), and would provide an additional 16,221 ha (40,083 ac) to support possible future DOE missions. This amount of land would allow the siting of several manufacturing facilities, with a total employment of 1,000 or more. Industrial development on the Hanford Site could increase infrastructure demand, as described under the Preferred Alternative.

Lands under the Research and Development land-use designation would total approximately 8,177 ha (20,206 ac), of which approximately 20 percent would be occupied by infrastructure, such as roads and utility corridors. The remaining land base would support at least 878,000 m^2 (9.7 million ft^2) of facility space and total employment of 100 to 300 employees.

As with the Preferred Alternative, Alternative Three would allow the efficient use of existing infrastructure on the Hanford Site, but could generate increased demand that could exceed the capacity of the City of Richland. Improvements to the existing infrastructure may have to be financed through other governmental or public entities, such as Benton County or the Port of Benton, to encourage industrial development on Hanford Site lands.

Alternative Three would allow the development of the existing natural gas claim held by the Big Bend Alberta Mining Company, and the filing of new claims for sand and gravel and natural gas development. The Conservation (Mining) land-use designation on the ALE Reserve would allow access to develop the existing natural gas claim, pending review and issuance of a special-use permit, as described in Chapter 6. Alternative Three is more likely to result in development of the existing natural gas claim than would the other alternatives being considered, and could encourage further development of natural gas resources on and near the Hanford Site. Mineral development on other areas of the Hanford Site would depend on the release of Hanford Site lands withdrawn from the Public Domain, as described under the Preferred Alternative.

Alternative Three would not preclude basalt quarrying, if permitted by DOE, from basalt outcrops such as Gable Mountain and Gable Butte, and soil mining from the McGee Ranch.

These locations have been identified as the most cost-effective and technically feasible sources of geologic materials for remediation (see Appendix D). Alternative Three could reduce remediation costs compared to the Preferred Alternative and Alternatives One, Two, and Four.

Alternative Three would allow cultivated agriculture, industrial development, R&D initiatives, limited commercial grazing and mining, and High-Intensity Recreational uses within designated areas of the Hanford Site. This alternative would have the highest potential for economic development of the alternatives being considered. Under this alternative, lands on the Wahluke Slope could be developed for growing irrigated crops, including small grains, potatoes, hay, fruits, and vegetables, as well as livestock production. The economic impact of agricultural development on former Hanford Site lands would depend on how much land is converted to farmland, how much is irrigated, and what crops are grown. Table 5-12 summarizes the potential economic impacts of agricultural development under several scenarios. Under these scenarios, the total market value of agricultural products in the three counties could increase from 1.7 to 9.4 percent, corresponding to a range of $16 million to $88 million (using 1992 prices) in additional revenues. This potential increase does not take into account the affect of increasing production on the market for agricultural commodities. Alternative Three would allow livestock grazing on 6,476 ha (16,003 ac) of the Wahluke Slope, increasing the total pasture land base in the three counties by 2.5 percent. This acreage could support approximately 1,059 AUM, with a value of approximately $12,700.

High-Intensity Recreational development of the Vernita Terrace under Alternative Three may include a destination resort with golf course, a boat launch, Tribal fishing facilities, interpretive exhibits, and the B Reactor Museum. A destination resort and conference center featuring a 350-unit hotel, RV parking, and a golf course could employ 200 to 400 persons. By comparison, hotels and motels in the study area employed approximately 900 persons with a total payroll of approximately $9.4 million in 1995. A large destination resort located at Vernita Terrace could generate an additional $2 million to $4 million in payroll, in addition to other revenues. However, these possible benefits could have negative impacts on other hotels, motels, and resorts in the area. In addition, a destination resort development at Vernita Terrace could also require additional investment in infrastructure in the northwestern portion of the Hanford Site.

If future recreational developments under Alternative Three do not include a destination resort, other developments could contribute to the economy. An RV park containing 100 spaces and operating at 80 percent capacity for 200 days per year could generate approximately $1.3 million annually. A golf course serving 150 golfers per day and operating year-round could generate approximately $1.4 million annually. Increased access to the Columbia River Corridor under this alternative could also generate revenues from sport fishing and other day uses that would be similar to those estimated for the Preferred Alternative.

5.3.1.6 Alternative Four. Implementation of Alternative Four would allow continued industrial development, R&D initiatives, limited mining, and recreational uses on former Hanford Site lands. Alternative Four would increase the land base available for industrial and Research and Development land uses in Benton County. A total of 6,881 ha (17,003 ac) would become available for industrial development, which would meet the estimated need forecasted by the Benton County Planning Department (1,639 ha [4,050 ac]) and would provide an additional 5,242 ha (12,953 ac) to support possible future DOE missions. This amount of land would allow the siting of several manufacturing facilities, with a total employment of 100 to 1,000. Lands under the Research and Development land-use designation would total 4,388 ha (10,843 ac), which could support at least 522,000 m^2 (5.8 million ft^2) of facility space and total employment of up to 100 employees.

Table 5-12. Potential Economic Impacts of Agricultural Development.

Agricultural Economic Indicators for the Three-County Study Area	Scenario 1: Crop Mix with Grazing in Red Zone[a]	Scenario 2: Crop Mix Without Red Zone	Scenario 3: Specialty Crop Production with Grazing in Red Zone
	Percent Increase over Existing Conditions		
Agricultural land	2.5%	2.5%	2.5%
Cropland	2.1%	3.7%	2.1%
Irrigated land	4.5%	8.0%	4.5%
Land in vegetable crops	4.5%	8.0%	24%
Land in fruit orchards	4.5%	8.0%	24%
Pastureland	4.1%	0%	4.1%
Total market value of agricultural products	1.7%	3.0%	9.4%
Total market value of crops	2.1%	3.7%	12%
Total market value of livestock	4.1%	0%	4.1%
Total market value of specialty crops	4.5%	8.0%	24%

a Red Zone refers to areas on the Wahluke Slope that may contribute to sloughing of the White Bluffs if used for agricultural purposes.

As with the Preferred Alternative, Alternative Four would allow the efficient use of existing infrastructure on the Hanford Site, but could generate increased demand that could exceed the capacity of the City of Richland. Improvements to the existing infrastructure may have to be financed through other governmental or public entities, such as Benton County or the Port of Benton, to encourage industrial development on Hanford Site lands.

Alternative Four would allow the development of the existing natural gas claim held by the Big Bend Alberta Mining Company, but would not allow the filing of new claims for sand and gravel and natural gas development. As with the Preferred Alternative, Alternative Four would limit access to the existing natural gas claim on the ALE Reserve. Mining elsewhere on the Hanford Site would be limited to obtaining geologic materials to support remediation. These mining activities are unlikely to have economic impacts in the study area.

Alternative Four would provide increased boating access to the Columbia River by adding two new access points to the river at White Bluffs and Vernita Bridge. Recreation under this alternative is likely to have economic impacts such as increased revenues and employment, but these impacts would probably be less than those described for the Preferred Alternative.

5.4 Environmental Justice

The following discussion addresses environmental justice as related to the land-use alternatives being considered for the Hanford Site. Minority and low-income populations in the vicinity of the Hanford Site are identified, followed by a discussion of the impacts that the alternatives might have on these populations. Analysis of environmental justice concerns was based on a qualitative assessment of the impacts reported in other sections of Chapter 5. The analysis was performed to identify any disproportionately high and adverse human health or environmental impacts on minority or low-income populations within the zone of potential impact, and for tribal members that are beyond the 80 km (50 mi) radius from the 200 East Area but have reserved treaty rights on the Hanford Site. The evaluation considered potential impacts arising under each of the major impact categories evaluated in this EIS, including socioeconomics, water resources, air resources, ecology, health and safety, and cultural resources.

5.4.1 Demographic Analysis

Demographic information obtained from the U.S. Bureau of Census was used to identify minority populations and low-income communities within an 80-km (50-mi) radius surrounding the 200 East Area on the Hanford Site at the census block group level (Neitzel et al. 1997). For the evaluation of environmental justice impacts, the area defined by this 80-km (50-mi) radius was considered the zone of potential impact.

A total population of approximately 384,000 people reside within an 80-km (50-mi) radius of the Hanford Site. The minority population within the area of impact consists of approximately 95,000 people and represents approximately 25 percent of the population in the assessment area. The ethnic composition of the minority population is primarily Hispanic (approximately 80 percent) and American Indian (8 percent). Census block groups where the percentage of minority persons within the population exceeds 25 percent are primarily located to the southwest and northeast of the Hanford Site and within the City of Pasco, Washington (Neitzel et al. 1997). However, several large census block groups (i.e., areas with low population density) with populations consisting of between 25 and 50 percent minority persons border the Hanford Site on the west, north, and east.

The low-income population within the 80-km (50-mi) area of impact represents approximately 42 percent of households in the area of impact. Census block groups where the percentage of the population below the poverty level exceeds 20 percent are principally located to the southwest and north of the Hanford Site and within the City of Pasco, Washington (Neitzel et al. 1997).

5.4.2 American Indian Populations Near the Hanford Site

Substantial American Indian populations are located within the 80-km (50-mi) assessment area. Census block groups within the assessment area and composed primarily of American Indian populations are primarily located on the Yakama Indian Reservation in Yakima County, Washington. However, other American Indian populations located outside of the assessment area also have an interest in the Hanford Site based on treaty rights (see Appendix A). Treaty reserved Tribal fishing rights have been recognized as effective within the Hanford Reach. The Tribes also have an interest in renewing traditional uses, such as gathering of foods and medicines, hunting, and pasturing horses and cattle on Hanford Site lands (Yakama Nation, June 1, 1998, DOE CCN 059113).

Future opportunities of the tribal members to exercise reserved treaty rights are dependent upon the health of the ecosystems. The Tribes assert that a treaty right to hunt, fish, or gather plants is diminished (if not voided) if the fish, wildlife, or plants have vanished or are contaminated to the extent that they threaten human health. These resources, particularly the resources with cultural and religious connotations, do not have equivalent value for the general population.

5.4.3 Human Health Impacts

Although adoption of a land-use plan for the Hanford Site would not have any direct impacts on human health, each of the alternatives could indirectly affect human health, depending on the land uses that are implemented. The contamination left at depth poses a potential hazard to development.

Even facilities associated with Low-Intensity Recreation may increase human health risk by increasing infiltration of natural precipitation above the expected parameters used in the CERCLA risk estimation. Where vegetation is suppressed and ground covers are used (i.e., campgrounds), infiltration of precipitation could occur at a higher rate driving contaminants toward groundwater, unless the increase in activities also increases soil compaction. Soil compaction caused by camping activities could actually reduce the rate of infiltration in some areas by reducing the number and size of water infiltration pathways in the soil.

The recently completed *Screening Assessment and Requirements for a Comprehensive Assessment, Columbia River Comprehensive Impact Assessment* (CRCIA) (DOE 1998a) evaluated both chemical and radiological health risk potential for a variety of Hanford Site use scenarios. This assessment focused on the Columbia River and riparian zone and included several Native American subsistence scenarios (e.g., subsistence resident, upland hunter, river-focused hunter and fisher, gatherer of plant materials, and Columbia River island users). These Native American scenarios were developed by a Native American representative on the CRCIA team specifically for the CRCIA effort[1]. Environmental measurements used for the CRCIA analysis were based on data collected under DOE's environmental monitoring program from 1990 through 1996 and, as a consequence, would not necessarily reflect the future condition of the Hanford Site, as these scenarios do not assume cleanup.

Even these current monitoring program data do not indicate that adverse health risks would be associated with consumption of fish and game. The radiation dose received by a person who subsisted on wild game and fish would be higher than the 2.2×10^{-3} mrem reported as the "Sportsman Dose" in the *Hanford Site Annual Environmental Report* by Pacific Northwest National Laboratory (PNNL). However, this incremental dose to natural background of approximately 300 mrem would be unlikely to be sufficiently high to cause adverse health effects.

In the CRCIA Native American scenarios, people were assumed to live along the Columbia River, to eat substantial quantities of food grown in the riparian zone, to eat fish and wildlife from the river, and to drink seep water. These people who live a subsistence lifestyle linked to a specific location would have a much larger potential exposure and, thus, estimated health risk than other people who are more mobile and can trade for other food sources. Lifetime health risks greater than 1×10^{-4} [1 in 10,000] were found for many sections of the river for potential exposure to chromium, copper, strontium-90, uranium-238, lead, and tritium. However, the source of the nonradioactive heavy metals (particularly copper and lead) may be from historic mining operations upstream of Hanford (e.g., copper, silver, and gold mining in Idaho's Clearwater River drainage). According to these analyses, potentially increased health risk is possible if people were to move onto the Hanford Site and derive a large percentage of their daily food intake from crops and animals grown or taken in the river's riparian zone. In most cases, this higher risk is limited in extent to a few regions of highest contamination. Although many cultural differences exist in the relative percentages of food types between the general population and Native American populations, the common pathways of food and water consumption would affect both groups.

Land-use designations such as Preservation, Conservation, Low-Intensity Recreation, Industrial, and Research and Development are unlikely to contribute to increased health risk from residual contamination because the current CERCLA RODs are written to either industrial or residential exposure times and pathways. However, increased human health risk could be associated with Agriculture and High-Intensity Recreation uses if the CLUP policies and implementing procedures are not implemented with the land use designations.

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[1] These scenarios are not the same as scenarios commonly used for determining health impacts at Hanford.

Adoption of a land-use plan for the Hanford Site could have direct impacts on human health depending on the land uses that are implemented because of the associated changes in types and durations of activities associated with a land-use designation (Table 5-13). For example, currently the Hanford Site is used for Federal industrial activities. The Hanford Site has an average annual fatality rate of 2.8 per 100,000 workers. The national average annual fatality rate for private industry is 5.1 per 100,000 workers. The transfer jobs from the government to the private sector statistically doubles the fatality risk for the average worker. By race, white workers average annually 4.6 fatalities per 100,000 workers, black workers average annually 4.5 fatalities per 100,000 workers and hispanic workers average annually 5.3 fatalities per 100,000 workers (Table 5-13).

5.4.4 No-Action Alternative

Access restrictions would remain in effect under the No-Action Alternative and the potential for health risks would be comparable to existing risk. Use of the Columbia River for recreation would continue at levels comparable to current use. Minority or low-income individuals may be more prone to use this resource for subsistence than might members of the general population. Current uses of the Columbia River are not known to cause disproportionately high and adverse human health impacts in any population and no such impacts would be expected to occur as a result of the No-Action Alternative.

Development of Hanford Site lands would not be restricted by land-use designations under the No-Action Alternative. Cultural resources of importance to American Indians located on the Hanford Site, including Gable Butte and Gable Mountain, could be developed under this alternative. The availability of these resources for development represents a potential environmental justice impact to American Indians.

Prohibiting development of agriculture on the Wahluke Slope would also potentially impact low-income and minority populations located to the north of the Hanford Site by limiting the potential for new jobs in those areas. In general, lands on the Wahluke Slope are not presently available for agricultural development and many jobs associated with agricultural practices are not high wage opportunities. Consequently, the current management of the Wahluke Slope would be unlikely to result in disproportionately high and adverse impacts to low-income or minority populations.

5.4.5 Preferred Alternative

The Preferred Alternative would allow for increased access to Hanford Site lands and to the Columbia River for Tribal members by allowing a High-Intensity Recreation Tribal fishing camp at the White Bluffs boat launch on the Franklin County side (north) of the river and by allowing a High-Intensity Recreation Tribal fishing camp near B Reactor on the Grant County side (north) of the river. Private fishing, hunting and trapping activities have one of the highest fatal accident rates at 137.7 fatalities per 100,000 workers (Table 5-13).

As described in CRCIA (DOE 1998a), increased use and access to the Hanford Site would potentially increase exposure time to contaminated plants, air, soil, and water; and, therefore, could also potentially increase health risk. This access would also provide increased opportunity for subsistence consumption of fish taken from the Columbia River which could, in turn, increase

Table 5-13. Annual Occupational Fatality Rates for Selected Occupations (1996). (3 pages)

Number, percent, and rate of potential fatal occupational injuries by selected worker characteristics, industry, and occupation, 1996.

Characteristic	Fatalities		Employed[1] (thousands)	Fatalities per 100,000 workers[2]	Relative Standard error[3] (percent)
	Number	Percent			
TOTAL	**6,112**	**100**	**127,997**	**4.8**	**.2**
Employee Status					
Wage and salary workers	4,905	80	117,329	4.2	.2
Self-employed	1,207	20	10,668	11.1	1.1
Gender					
Men	5,605	92	69,329	8.1	.3
Women	507	8	58,668	0.9	.4
Age					
Under 16 years	27	--	--	--	--
16 to 17 years	43	1	2,648	1.6	2.2
18 to 19 years	124	2	3,941	3.1	1.8
20 to 24 years	440	7	12,532	3.5	1.0
25 to 34 years	1,336	22	32,579	4.1	.6
35 to 44 years	1,563	26	35,319	4.4	.5
45 to 54 years	1,226	20	25,550	4.8	.6
55 to 64 years	847	14	11,741	7.2	1.0
65 years and over	492	8	3,690	13.3	1.8
Not reported	14	--	--	--	–
Race					
White	5,047	83	108,805	4.6	.2
Black	617	10	13,789	4.5	.9
American Indian, Eskimo, and Aleut	35	1	--	--	--
Asian and Pacific Islander	163	3	--	--	--
Other	91	1	--	--	--
Not reported	159	3	--	--	–
Hispanic origin					
Hispanic	626	10	11,725	5.3	1.0
Industry					
PRIVATE INDUSTRY	**5,521**	**90**	**108,472**	**5.1**	**.2**
Agriculture, forestry, and fishing	798	13	3,505	22.2	1.9
Agricultural production, crops	335	5	1,025	31.3	3.5
Agricultural production, livestock	154	3	1,214	12.2	3.2
Agricultural services	171	3	1,189	14.3	3.2
Fishing, hunting and trapping	73	1	53	137.7	15.4
Mining	152	2	567	26.8	4.7
Coal mining	39	1	98	39.8	11.3
Oil and gas extraction	82	1	302	27.2	6.5
Construction	1,039	17	7,464	13.9	1.3
Manufacturing	715	12	20,434	3.5	.7
Food and kindred products	70	1	1,706	4.1	2.7
Lumber and wood products	203	3	794	25.6	4.0
Transportation and public utilities	947	15	7,248	13.1	1.3
Local and interurban passenger transit	78	1	503	15.5	5.0
Trucking and warehousing	511	8	2,451	20.8	2.3
Transportation by air	113	2	778	14.5	4.0
Electric, gas, and sanitary services	88	1	1,066	8.3	3.4

Table 5-13. Annual Occupational Fatality Rates for Selected Occupations (1996). (3 pages)

Number, percent, and rate of potential fatal occupational injuries by selected worker characteristics, industry, and occupation, 1996.

Characteristic	Fatalities		Employed[1] (thousands)	Fatalities per 100,000 workers[2]	Relative Standard error[3] (percent)
	Number	Percent			
Wholesale trade	267	4	4,942	5.4	1.6
Retail trade	672	11	21,443	3.1	.7
Food stores	173	3	3,507	4.9	1.9
Automotive dealers and service stations	98	2	2,165	4.5	2.4
Eating and drinking places	166	3	6,483	2.6	1.4
Finance, insurance, and real estate	114	2	7,862	1.5	1.2
Services	767	13	35,008	2.2	.5
Business services	168	3	5,680	3.0	1.5
Auto repair, services, and parking	103	2	1,618	6.4	2.8
Not reported	50	1	--	--	–
GOVERNMENT	**591**	**10**	**19,525**	**3.0**	**.8**
Federal	178	3	4,583	3.9	1.6
State	127	2	5,150	2.5	1.5
Local	284	5	9,791	2.9	1.1
Managerial and professional specialty occupations	711	12	36,497	1.9	.5
Executive, administrative, and managerial occupations	437	7	17,746	2.5	.8
Managers, food serving and lodging establishments	75	1	1,383	5.4	3.0
Professional specialty	274	4	18,752	1.5	.8
Technical, sales, and administrative support occupations	761	12	37,683	2.0	.5
Technicians and related support occupations	163	3	3,926	4.2	1.8
Airplane pilots and navigators	100	2	114	87.7	10.5
Sales occupations	503	8	15,404	3.3	.9
Supervisors and proprietors, sales occupations	225	4	4,501	5.0	1.7
Cashiers	94	2	2,856	3.3	2.1
Administrative support occupations, including clerical	95	2	18,353	0.5	.8
Messengers	8	--	175	4.6	8.5
Service occupations	492	8	17,177	2.9	.8
Protective service occupations	248	4	2,187	11.3	2.4
Fire fighting and fire prevention occupations[4]	37	1	270	13.7	6.8
Police and detectives	114	2	1,057	10.8	3.4
Guards	97	2	859	11.3	3.8
Farming, forestry, and fishing occupations	883	14	3,566	24.2	1.9
Farm occupations	569	9	2,212	24.8	2.4
Groundskeepers and gardeners, except farm	90	1	875	10.3	3.8
Forestry and logging occupations	134	2	108	124.1	10.8
Timber cutting and logging occupations	118	2	75	157.3	13.0
Fishers, hunters, and trappers	72	1	49	146.9	16.0
Fishers[5]	72	1	47	153.2	16.4
Precision production, craft, and repair occupations	1,072	18	13,587	7.9	.9
Mechanics and repairers	282	5	4,521	6.2	1.6
Automobile mechanics and apprentices	35	1	889	3.9	3.8
Heavy equipment mechanics	38	1	156	24.4	9.0
Construction trades	592	10	5,108	11.6	1.5
Carpenters and apprentices	87	1	1,220	7.1	3.2
Electricians and apprentices	98	2	763	12.8	4.1
Electrical power installers and repairers	38	1	126	30.2	10.0
Painters, construction and maintenance	45	1	504	8.9	5.0

Table 5-13. Annual Occupational Fatality Rates for Selected Occupations (1996). (3 pages)

Number, percent, and rate of potential fatal occupational injuries by selected worker characteristics, industry, and occupation, 1996.

Characteristic	Fatalities		Employed[1] (thousands)	Fatalities per 100,000 workers[2]	Relative Standard error[3] (percent)
	Number	Percent			
Plumbers, pipefitters, steamfitters, and apprentices	32	1	555	5.8	4.8
Roofers	61	1	197	31.0	8.0
Structural metal workers	52	1	61	85.2	14.4
Extractive occupations	87	1	130	66.9	9.8
Drillers, oil wells	22	--	22	100.0	23.9
Mining machine operators	28	--	39	71.8	18.0
Operators, fabricators, and laborers	2,006	33	18,197	11.0	.8
Machine operators, assemblers, and inspectors	218	4	7,874	2.8	1.2
Welders and cutters	62	1	605	10.2	4.6
Transportation and material moving occupations	1,154	19	5,302	21.8	1.5
Motor vehicle operators	913	15	4,025	22.7	1.7
Truck drivers	785	13	3,019	26.0	2.0
Drivers-sales workers	35	1	156	22.4	9.0
Taxicab drivers and chauffeurs	65	1	203	32.0	7.9
Water transportation occupations	42	1	69	60.9	13.5
Sailors and deckhands	33	1	25	132.0	22.5
Material moving equipment operators	177	3	1,093	16.2	3.4
Operating engineers	38	1	245	15.5	7.2
Excavating and loading machine operators	26	--	92	28.3	11.7
Industrial truck and tractor equipment operators	46	1	512	9.0	5.0
Handlers, equipment cleaners, helpers, and laborers	634	10	5,021	12.6	1.6
Construction laborers	291	5	809	35.7	3.9
Garbage collectors	21	--	43	48.8	17.1
Laborers, except construction	213	3	1,334	15.9	3.1
Military	123	2	1,289	9.5	--
Not reported	64	1	--	--	--

[1] The employment figures, except for military, are annual average estimates of employed civilians 16 years of age and older, from the Current Population Survey (CPS 1996). The resident military figure, derived from resident and civilian population data from the Bureau of the Census, was added to the CPS employment total.

[2] The rate represents the number of fatal occupational injuries per 100,000 employed workers and was calculated as follows: (N/W) x 100,000, where N = the number of fatal work injuries, and W = the number of employed workers, as described in the previous footnote. There were 27 fatally injured workers under the age of 16 years that were not included in the rate calculations to maintain consistency with the CPS employment.

[3] The relative standard errors of the CPS employment estimates can be used to approximate confidence ranges for the fatality rates. For example, a confidence range for the roofers rate can be approximated as follows: 31.0 x .08 x 1.6 = 4.0, where 31.0 = the rate, .08 = the relative standard error (8.0 percent), and 1.6 = the factor for a 90 percent confidence level. The confidence range for this rate is 27.0 to 35.0 (31.0 plus or minus 4.0).

[4] Includes supervisors.

[5] Includes captains and other officers.

NOTE: The rates are experimental measures using CPS employment. Selected rate categories had 20 or more reported work injury fatalities in 1996 and 20,000 or more employed workers. Dashes indicate data not available or less than .5 percent. Totals for major categories may include subcategories not shown separately. Figures may not add to totals because of rounding.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Census of Fatal Occupational Injuries, 1996.

the potential for adverse health effects from fish that have resided in contaminated water. As a percentage of their population, minority or low-income individuals may be more prone to adopt a subsistence lifestyle than might members of the general population and therefore any health impact would be disproportionate to the minority population. Avid sportsmen among the general population also could have an increased risk of health effects from increased exposure but would represent a smaller percentage of their population. Environmental measurements used for the CRCIA analysis were based on data collected from 1990 through 1996 and, as a consequence, would not necessarily reflect the future condition of the Hanford Site, as these scenarios do not assume cleanup. Therefore, although the CRCIA analyses used an increased access to and use of the Hanford Site as a basis for estimating health effects, the increased access due to this alternative is not expected to result in disproportionately high and adverse health effects in minority or low-income populations because of the institutional protections provided by the CLUP policies and implementing procedures.

The Preferred Alternative would designate Gable Mountain, Gable Butte, and other areas of cultural value to American Indians for Preservation. This designation would eliminate the potential for disproportionately high and adverse impacts due to development of culturally significant areas. The Preferred Alternative would allow development within the viewscape of these high promontories. Alteration of these viewscapes would represent a potential environmental justice impact to American Indians.

The Preferred Alternative would allow economic development of Hanford Site lands. Low-income populations in the vicinity of the Hanford Site would benefit from increased economic activity and growth in community services that could occur as a result of development. However, economic development could increase the demand for housing and tend to decrease the availability of low-income housing. In spite of these conflicting impacts, low-income populations in communities that are influenced by development at the Hanford Site would probably benefit from the development. Low-income communities located to the north and west of the Hanford Site historically have not been strongly influenced by Hanford Site activities and the affects of future development would probably be neutral in these communities.

Prohibiting development of agriculture on the Wahluke Slope would also potentially impact low-income and minority populations located to the north of the Hanford Site by limiting the potential for new jobs in those areas. In general, lands on the Wahluke Slope are not presently available for agricultural development and many jobs associated with agricultural practices are not high wage opportunities and have a higher average annual fatality rate of 31.3 fatalities per 100,000 workers (Table 5-13). Additionally, increased access to the Columbia River would allow more fishing which has a high average annual fatality rate of 153 fatalities annually per 100,000 workers. The Preferred Alternative would be unlikely to result in disproportionately high and adverse socioeconomic impacts to low-income or minority populations.

5.4.6 Alternative One

With the expansion of the existing Saddle Mountain NWR, more restrictions could be placed on the consumptive use of natural resources. These restrictions placed to preserve the natural resources could impact the exercise of treaty reserved rights that by their nature (e.g., hunting, fishing, pasturing of livestock etc.) consume the natural resources. Private fishing, hunting and trapping activities have one of the highest fatal accident rates at 137.7 fatalities per 100,000 workers (Table 5-13).

Alternative One would allow increased access to Hanford Site lands and to the Columbia River. As described in CRCIA (DOE 1998a), increased use and access to the Hanford Site would potentially increase exposure time to contaminated plants, air, soil, and water; and, therefore, could also potentially increase health risk. This access would also provide increased opportunity for subsistence consumption of fish taken from the Columbia River which could, in turn, increase the potential for adverse health effects from fish that have resided in contaminated water. As a percentage of their population, minority or low-income individuals may be more prone to adopt a subsistence lifestyle than might members of the general population and, therefore, any health impact would be disproportionate to the minority population. Avid sportsmen among the general population also could have an increased risk of health effects from increased exposure but would represent a smaller percentage of their population. Environmental measurements used for the CRCIA analysis were based on data collected from 1990 through 1996 and, as a consequence, would not necessarily reflect the future condition of the Hanford Site, as these scenarios do not assume cleanup. Therefore, although the CRCIA analyses used an increased access to and use of the Hanford Site as a basis for estimating health effects, the increased access due to this alternative is not expected to result in disproportionately high and adverse health effects in minority or low-income populations because of the institutional protections provided by the CLUP policies and implementing procedures.

Alternative One would limit development primarily to previously disturbed areas and to areas of low habitat quality (BRMaP Levels I and II). This limitation to development could constrain economic development in the vicinity of the Site, which would potentially affect low-income individuals and communities to a greater degree than it would potentially affect the general population. These impacts could include declining community services or increased taxes which could place an greater burden on low-income households and communities than on the population in general. This burden represents a potential disproportionately high socioeconomic impact; however, most low-income communities within the analysis area are not greatly influenced by development activities at the Site.

Prohibiting development of agriculture on the Wahluke Slope would also potentially impact low-income and minority populations located to the north of the Hanford Site by limiting the potential for new jobs in those areas. In general, lands on the Wahluke Slope are not presently available for agricultural development and many jobs associated with agricultural practices are not high wage opportunities. Consequently, Alternative One would be unlikely to result in disproportionately high and adverse impacts to low-income or minority populations.

5.4.7 Alternative Two

Alternative Two would designate the majority of the Hanford Site for Preservation, and would allow development in previously developed areas and in an area immediately north of the city of Richland. The major difference between Alternative Two and Alternative One is that Alternative Two would lack the Federal designation of wildlife refuge and therefore those natural resources would not be considered “taken” because they had Federal protection greater than normally found on Public Domain lands. Alternative Two would ensure that tribal treaty rights could be enjoyed under the limits of the Preservation designation. Alternative Two would protect cultural resources from Mining, and utilization of geologic resources on the Hanford Site would not be allowed under this alternative. Economic development of Hanford Site land and resources would be held to a minimum under this alternative.

Alternative Two would allow increased access to Hanford Site lands and to the Columbia River. As described in CRCIA (DOE 1998), increased use and access to the Hanford Site would potentially increase exposure time to contaminated plants, air, soil, and water; and, therefore, could also potentially increase health risk. This access would also provide increased opportunity for subsistence consumption of fish taken from the Columbia River which could, in turn, increase the potential for adverse health effects from fish that have resided in contaminated water. As a percentage of their population, minority or low-income individuals may be more prone to adopt a subsistence lifestyle than might members of the general population and, therefore, any health impact would be disproportionate to the minority population. Avid sportsmen among the general population also could have an increased risk of health effects from increased exposure but would represent a smaller percentage of their population. Environmental measurements used for the CRCIA analysis were based on data collected from 1990 through 1996 and, as a consequence, would not necessarily reflect the future condition of the Hanford Site, as these scenarios do not assume cleanup. Therefore, although the CRCIA analyses used an increased access to and use of the Hanford Site as a basis for estimating health effects, the increased access due to this alternative is not expected to result in disproportionately high and adverse health effects in minority or low-income populations because of the institutional protections provided by the CLUP policies and implementing procedures.

Alternative Two would also minimize access to the Hanford Site through the Preservation designation. This limited access would minimize the potential for environmental justice impacts to American Indians that could occur as a result of potential damage to cultural and biological resources under other alternatives.

Limitations to economic development under this alternative would potentially impact low-income populations in the vicinity of the Hanford Site. These impacts could include declining community services or increased taxes, which could in turn place an greater burden on low-income households and communities than on the population in general. This burden represents a potential disproportionately high socioeconomic impact; however, most low-income communities within the analysis area are not greatly influenced by development activities at the Site.

Prohibiting development of agriculture on the Wahluke Slope would also potentially impact low-income and minority populations located to the north of the Hanford Site by limiting the potential for new jobs in those areas. In general, lands on the Wahluke Slope are not presently available for agricultural development and many jobs associated with agricultural practices are not high wage opportunities. Consequently, the Preservation designation for the Wahluke Slope would be unlikely to result in disproportionately high and adverse impacts to low-income or minority populations.

5.4.8 Alternative Three

Alternative Three would allow increased access to Hanford Site lands and to the Columbia River. As described in CRCIA (DOE 1998), increased use and access to the Hanford Site would potentially increase exposure time to contaminated plants, air, soil, and water; and, therefore, could also potentially increase health risk. This access would also provide increased opportunity for subsistence consumption of fish taken from the Columbia River which could, in turn, increase the potential for adverse health effects from fish that have resided in contaminated water. As a percentage of their population, minority or low-income individuals may be more prone to adopt a subsistence lifestyle than might members of the general population and, therefore, any health impact would be disproportionate to the minority population. Avid sportsmen among the general population also could have an increased risk of health effects from increased exposure but would represent a smaller percentage of their population. Environmental measurements used for the CRCIA analysis were based on data collected from 1990 through 1996 and, as a consequence, would not necessarily reflect the future condition of the Hanford Site, as these scenarios do not assume cleanup. Therefore, although the CRCIA analyses used an increased access to and use of the Hanford Site as a basis for estimating health effects, the increased access due to this alternative is not expected to result in disproportionately high and adverse health effects in minority or low-income populations because of the institutional protections provided by the CLUP policies and implementing procedures. Independent of risk due to residual contamination, private fishing, hunting and trapping activities have one of the highest fatal accident rates at 137.7 fatalities per 100,000 workers (Table 5-13).

Activities associated with Alternative Three, such as agriculture, could result in damage to cultural and biological resources of value to American Indian Tribes. Furthermore, if permitted by DOE, Gable Butte and Gable Mountain could be available for development of quarries and mining activities could be undertaken within the viewsheds of these high promontories. Disturbance of the promontories or their viewsheds would be a disproportionately high and adverse environmental impact to American Indians.

Alternative Three would allow for the maximum potential for economic development of Hanford Site lands. Low-income populations in the vicinity of the Hanford Site would benefit from increased economic activity and growth in community services that could occur as a result of development. However, economic development could increase the demand for housing and tend to decrease the availability of low-income housing. In spite of these conflicting impacts, low-income populations in communities that are influenced by development at the Hanford Site would probably benefit from the development.

Allowing agriculture on the Wahluke Slope would potentially provide a benefit to low-income and minority populations located to the north of the Hanford Site by providing the potential for new jobs in those areas. Many jobs associated with current agricultural practices are not high wage opportunities and relatively dangerous with an average annual fatality rate of 31.3 fatalities per 100,000 workers (Table 5-13), but increases in economic opportunities could be expected to benefit local communities, including low-income and minority populations by increasing access to health care and educational opportunities. Infrastructure costs would increase in proportion to the number of low-wage jobs created and filled from outside the area. Disproportionately high and adverse socioeconomic impacts to low-income or minority populations would be unlikely under Alternative Three.

5.4.9 Alternative Four

Alternative Four would allow for increased access to Hanford Site lands and to the Columbia River for Tribal members by allowing a High-Intensity Recreation Tribal fishing camp at the White Bluffs boat launch on the Benton County side (south) of the river.

As described in CRCIA (DOE 1998), increased use and access to the Hanford Site would potentially increase exposure time to contaminated plants, air, soil, and water; and, therefore, could also potentially increase health risk. This access would also provide increased opportunity for subsistence consumption of fish taken from the Columbia River which could, in turn, increase the potential for adverse health effects from fish that have resided in contaminated water. As a percentage of their population, minority or low-income individuals may be more prone to adopt a subsistence lifestyle than might members of the general population and, therefore, any health impact would be disproportionate to the minority population. Avid sportsmen among the general population also could have an increased risk of health effects from increased exposure but would represent a smaller percentage of their population. Environmental measurements used for the CRCIA analysis were based on data collected from 1990 through 1996 and, as a consequence, would not necessarily reflect the future condition of the Hanford Site, as these scenarios do not assume cleanup. Therefore, although the CRCIA analyses used an increased access to and use of the Hanford Site as a basis for estimating health effects, the increased access due to this alternative is not expected to result in disproportionately high and adverse health effects in minority or low-income populations because of the institutional protections provided by the CLUP policies and implementing procedures. Independent of risk due to residual contamination, private fishing, hunting and trapping activities have one of the highest fatal accident rates at 137.7 fatalities per 100,000 workers (Table 5-13).

Alternative Four would designate most of the Hanford Site for Preservation and this designation would serve to protect cultural and biological resources of importance to American Indian Tribes. Alternative Four would also designate presently undisturbed lands to the north within the viewshed of Gable Butte and Gable Mountain for Preservation, leaving only the center portion of the Hanford Site with potential to cause disproportionate adverse impacts to American Indians.

Alternative Four would designate most of the Hanford Site for Preservation but would allow for Mining, Research and Development, and Industrial uses. Sufficient area is available to accommodate anticipated future development. Low-income populations in the vicinity of the Hanford Site would benefit from increased economic activity and growth in community services that could occur as a result of development. However, economic development could increase the demand for housing and tend to decrease the availability of low-income housing. In spite of these conflicting impacts, low-income populations in communities that are influenced by development at the Hanford Site would probably benefit from the development. Low-income communities located to the north and west of the Hanford Site historically have not been strongly influenced by Hanford Site activities and the effects of future development would probably be neutral in these communities.

Designating the Wahluke Slope for Preservation would potentially impact low-income and minority populations located to the north of the Hanford Site by limiting the potential for new jobs in those areas. In general, lands on the Wahluke Slope are not presently available for agricultural development and many jobs associated with agricultural practices are relatively dangerous and not high wage opportunities. Consequently, the Preservation designation for the Wahluke Slope would be unlikely to result in disproportionately high and adverse impacts to low-income or minority populations.

5.5 Human Health Risk

The alternatives being considered in this EIS were developed with the assumption that human health risk associated with contamination at the Hanford Site will continue to be addressed through the RCRA and CERCLA processes. These processes are expected to reduce human health risk to acceptable levels through remedial actions and administrative controls, such as deed restrictions, which are imposed by CERCLA Records of Decision (RODs). The DOE has also assumed that future land uses would not be allowed until remediation has reduced human health risk to levels acceptable for the intended land use.

Even though ongoing remedial actions at the Hanford Site are expected to reduce human health risks to acceptable levels, health risk from residual contamination could affect future land users at the Hanford Site. Continued migration of contaminant plumes in groundwater could increase future risk levels in down-gradient areas that had previously been remediated to acceptable risk levels. The Draft HRA-EIS (DOE 1996) addressed human health risk to future populations by evaluating four exposure scenarios: residential, agricultural, industrial, and recreational. The risk assessment evaluated the No-Action unrestricted-use alternative, which involved cleanup to annual risk levels less than 1 in 1,000,000 (10^{-6}), two restricted-use alternatives, and the exclusive-use alternative, which involved reducing annual risk levels to less than 1 in 10,000 (10^{-4}).

The Hanford Site has an average annual accident fatality rate that has ranged from 4.9 (1994) to 2.8 (1997) per 100,000 workers. The national average annual accident fatality rate for private industry in 1996 was 5.1 per 100,000 workers (Table 5-13) and Hanford was 4.3 per 100,000 workers. The transfer jobs from the government to the private sector statistically doubles the annual accident fatality risk for the average worker in 1997. Some comparisons can be made regarding occupational health risks among the land-use designations using statistics from the U.S. Bureau of Labor Statistics (Table 5-13). The data in Table 5-13 indicate that the riskiest occupation is logging with an annual fatality rate of 157.3 per 100,000 workers (equivalent to a 10^{-3} risk). Industrial activities associated with Industrial, Industrial Exclusive, and Research and Development have fatal accident annual rates that vary from administrative support operations at 0.5 fatalities per 100,000 workers to, 4.1 fatalities per 100,000 workers for food manufacturing workers, to 20.8 fatalities per 100,000 workers for trucking and warehousing workers. The land-use designations of Preservation, Conservation (Mining), Conservation (Mining and Grazing), Low-Intensity Recreation, High-Intensity Recreation have a different set of occupational hazards associated with recreational activities. Fishing, hunting and trapping are very risky occupations (second to logging) with an annual fatality rate of 137.7 fatalities per 100,000 workers. For sand and gravel mining operations, excavating and loading machine operators annually have 28.3 fatalities per 100,000 workers. The Agriculture land-use designation would expose workers to occupational fatality annual rates of 31.3 fatalities per 100,000 workers for crop production, 12.2 fatalities per 100,000 workers for livestock production and 14.3 fatalities per 100,000 workers for agricultural services (Table 5-13).

Increased recreational opportunities associated with the Preferred Alternative and Alternatives One, Three, and Four could increase accident risks associated with outdoor recreation activities. These would include risks from boating and swimming accidents, hunting and target shooting accidents, and bicycling accidents. Alternative Three would introduce the relatively risky occupation of agriculture onto the Hanford Site. The DOE Preferred Alternative and Alternative Three would best support the selection of some of the occupationally safer uses of the Hanford Site such as manufacturing, managerial and administrative support functions.

5.6 Cumulative Impacts

This section summarizes potential cumulative impacts associated with Hanford Site land-use designations for each alternative identified in Chapter 3. Cumulative impacts result

> *. . . from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).*

Reasonably foreseeable actions are identified and the relationship between these actions and the proposed land-use designations is discussed. The description of potential cumulative impacts couples impacts of each alternative with impacts from past and existing operations at the Hanford Site and impacts that may be associated with anticipated future actions. Section 5.6.1 discusses potential cumulative impacts to land use associated with present and reasonably foreseeable actions; Section 5.6.2 discusses potential cumulative impacts to trustee resources; and Sections 5.6.3 and 5.6.4 discuss potential cumulative socioeconomic impacts and cumulative human health risk, respectively.

5.6.1 Cumulative Impacts to Land Use

The alternatives analyzed in this document would establish acceptable uses for Hanford Site lands for at least the next 50 years. The alternative identified and selected for implementation in the ROD would allocate lands for use under the defined land-use designations. Other present and reasonably foreseeable actions at the Hanford Site that involve siting new facilities or using Site resources also would, in effect, allocate lands for certain uses. Those present and reasonably foreseeable actions that involve land uses that are compatible with the proposed land-use designations under all the alternatives would not have cumulative impacts for land use; these actions are listed in Table 5-14 and described further in Appendix E. However, those present and reasonably foreseeable actions that do not conform with the proposed land-use designations would change the land-use allocations and, in this sense, could be considered to have potential cumulative impacts. Those present and reasonably foreseeable actions involving nonconforming uses are listed in Table 5-15.

The five actions listed in Table 5-15 could involve land uses that conflict with land-use designations under some alternatives. The USFWS is initiating a Comprehensive Conservation Plan (CCP) for the ALE Reserve. Assuming that the USFWS management plan would call for maintaining the ALE Reserve in its present, Preservation and Conservation type of management, the management plan would not conflict with any of the proposed land-use designations. If the USFWS plan only addresses preservation, then the proposed mining alternative on ALE, in lieu of the McGee Ranch mining area, would be in conflict with alternatives, Preferred, Four and Three.

A similar situation exists with the alternative selected in the ROD for the Hanford Reach (NPS 1996), which calls for designating the Wahluke Slope as an overlay wildlife refuge and designating the Columbia River Corridor on the Hanford Site (i.e., the Hanford Reach) as a Wild and Scenic Recreational River. These designations could result in the management of the Wahluke Slope

Table 5-14. Present or Reasonably Foreseeable Future Actions Compatible with Land-Use Designations under All Alternatives.

Present or Reasonably Foreseeable Future Action	Location	Land Use
Wild and Scenic River Designation for Hanford Reach	Hanford Reach	Preservation
Decommissioning of Eight Surplus Production Reactors	200 Areas (disposal)	Industrial-Exclusive
Deactivation of the N Reactor	200 Areas (disposal)	Industrial-Exclusive
Safe Interim Storage of Hanford Tank Wastes	200 Areas	Industrial-Exclusive
Tank Waste Remediation System	200 Areas	Industrial-Exclusive
Plutonium Finishing Plant Stabilization	200 Areas	Industrial-Exclusive
Decommissioning of Building 232-Z and Building 233-S	200 Areas	Industrial-Exclusive
Environmental Restoration Disposal Facility Expansion	200 Areas	Industrial-Exclusive
Spent Nuclear Fuel Management (current and projected)	200 Areas	Industrial-Exclusive
200 Area Effluent Treatment Facility	200 Areas	Industrial-Exclusive
Operation of 200 Areas LLW Burial Grounds	200 Areas	Industrial-Exclusive
Operation of U.S. Ecology Commercial LLW Burial Ground	200 Areas	Industrial-Exclusive
Solid Waste Retrieval Complex, Enhanced Radioactive and Mixed Waste Storage Facility, and Central Waste Support Complex	200 Areas	Industrial-Exclusive
Tank 241-C-106 Sluicing and Waste Removal	200 Areas	Industrial-Exclusive
Special Case Waste Storage Facility	200 Areas	Industrial-Exclusive
Disposal of Decommissioned Naval Reactor Plants	200 Areas	Industrial-Exclusive
Environmental Molecular Sciences Laboratory	300 Area	Industrial, Research & Development (R&D)
Disposition of Sodium Test Loops	200 Areas, 300 Area	Industrial-Exclusive, Industrial, R&D
Fast Flux Test Facility	400 Area	Industrial, R&D
Disposal of S3G and D1G Prototype Reactor Plants	200 Areas	Industrial-Exclusive
Hanford Solid Waste EIS	200 Areas	Industrial-Exclusive
Offsite Thermal Treatment of Low-Level Mixed Waste	200 Areas, City of Richland	Industrial-Exclusive, Industrial, R&D
200 Area Emergency Facilities Campus	200 Areas	Industrial-Exclusive
300 Area Steam Replacement	300 Area	Industrial, R&D
Lead Test Assembly Irradiation and Analysis	200 Areas, 300 Area	Industrial-Exclusive, Industrial, R&D
Management of Hanford Site Non-Defense Production Reactor Spent Nuclear Fuel	200 Areas	Industrial-Exclusive
Relocation and Storage of Sealed Isotopic Heat Sources	200 Areas	Industrial-Exclusive
Trench 33 and 36 Widening in 218-W-5 LLW Burial Ground	200 Areas	Industrial-Exclusive
Idaho High Level Waste and Facility Disposition Environmental Impact Statement (DOE/EIS-0287)	200 Areas	Industrial-Exclusive
Implementation of Final Waste Management Programmatic EIS (DOE/EIS-0200) RODs	200 Areas	Industrial-Exclusive
Expansion of the Energy Northwest (formerly known as WPPSS) area industrial facilities (natural gas fired electric generator turbine or aluminum smelter)	600 Area	Industrial, R&D

Table 5-15. Present or Reasonably Foreseeable Future Actions with Nonconforming Land Uses.

Present or Reasonably Foreseeable Future Action	Nonconforming Land-Use Designations T = **nonconforming**					
	No-Action	**Preferred Alternative**	**Alternative One**	**Alternative Two**	**Alternative Three**	**Alternative Four**
Development of a Comprehensive Conservation Plan for the ALE Reserve by the USFWS **(Preservation)**	N/A	**T** **Conservation (Mining)**			**T** **Conservation (Mining)**	**T** **Conservation (Mining)**
Designation of the Wahluke Slope as a National Wildlife Refuge **(Preservation)**	N/A				**T** **Agriculture**	
Operation of the Laser Interferometer Gravitational Wave Observatory **(Research and Development)**	N/A	**T** **Conservation (Mining)**	**T** **Conservation (Mining)**		**T** **Conservation (Mining)**	**T** **Conservation (Mining)**
Inert/Demolition Waste Landfill (Pit 9) **(Industrial)**	N/A		**T** **Preservation**	**T** **Preservation**		**T** **Preservation**
B-Reactor Museum **(High-Intensity Recreation)**	N/A					**T** **Preservation**

and the Columbia River Corridor as Preservation, Conservation or Agriculture depending on the USFWS's CCP and intent for establishing the refuge. The management of the Wahluke Slope as an overlay wildlife refuge could conflict with the Agriculture land-use designation under Alternative Three unless a purpose of establishing the refuge as defined in the USFWS's CCP included sharecropping for wildlife. The need to link agriculture to furthering the purposes of wildlife is the reason agriculture appears as a conflict in Table 5-15. Of the 181 NWRs with farming programs in 1989, 612 km^2 (233 mi^2) of the129 refuges were farmed by permittees who retained a share of the crop in return for costs incurred to farm the land. On the remaining refuges, Service personnel conducted farming operations with government equipment.

The remaining nonconforming uses listed in Table 5-15 involve present or upcoming actions that would conflict with land-use designations. The operation of LIGO would be considered a pre-existing, nonconforming use under Alternative One and Alternative Four, which could require that the LIGO site be restored to the designated use at the end of the facility's life. Operation of LIGO conflicts with Conservation mining designations because of the facility's sensitivity to vibrations. The Inert/Demolition Waste Landfill proposed for Pit 9 involves using an existing gravel pit located north of the 300 Area for disposal of inert and demolition wastes from the 300 Area. This would be classified as an Industrial land use, and would be considered a pre-existing, nonconforming use under Alternative One, Alternative Two, and Alternative Four. The proposed salvage and demolition of the 300 Area Steam Plant calls for obtaining fill from Pit 9 for filling voids and constructing the final cover. The use of Pit 9 for quarrying materials would be a pre-existing, nonconforming use under Alternative One, Alternative Two, and Alternative Four. The B-Reactor Museum would be in conflict with the Preservation designation of Alternative Four. Management and mitigation of these nonconforming land uses would be accomplished through the CLUP policies and implementing procedures as explained in Chapter 6.

5.6.2 Cumulative Impacts by Trustee Resource

5.6.2.1 Geologic Resources. Geologic resources on the Hanford Site include unique features that have been preserved while similar features in the region have been damaged or destroyed by development. Mining of geologic materials would be allowed under all alternatives being considered, except Alternative Two, and could damage or destroy unique geologic features, such as Missoula Floods features and sand dunes. Mining under the No-Action Alternative and

Alternative Three, if permitted by DOE, could also impact basalt outcrops, such as Umtanum Ridge, Gable Mountain, and Gable Butte. Because these features are rare and susceptible to development elsewhere in the region, damage or destruction of these features on the Hanford Site would increase their aesthetic and ecological value offsite, and decrease their availability for scientific study.

Alternative Three would allow development of cultivated agriculture on the Wahluke Slope. Increasing irrigated lands in the vicinity of the White Bluffs would cumulatively increase groundwater recharge in the area and also could result in additional slumping of the White Bluffs. Additional slumping of the White Bluffs would further reduce their aesthetic, historic, and ecological value; would cumulatively increase sedimentation of the Columbia River; and could accelerate riverbank and island erosion. The No-Action Alternative would also allow the WDFW's current management practice of growing crops for wildlife management purposes on the Wahluke Slope as long as the practice is compatible with the USFS's CCP.

5.6.2.2 Water Resources. Water resources on the Hanford Site, including groundwater and surface water, have been impacted by past waste disposal practices at Hanford. Remediation strategies for cleaning up past contamination are designed for current and predicted future hydrologic conditions. Additional development on the Hanford Site could alter hydrologic conditions, disrupt CERCLA ROD conditions, and increase impacts to water quality from contamination.

Industrial development would be allowed under all alternatives being considered and would increase groundwater consumption and alter groundwater hydrology. Changes to groundwater hydrology as a result of aquifer drawdown and discharges to the soil column could alter the rate of the movement of contaminants toward the Columbia River or in any other direction. Groundwater recharge from industrial waste water discharges and collection and infiltration of runoff in quarries could mobilize contaminants in the vadose zone and cumulatively increase contaminant levels in groundwater.

The Preferred Alternative and Alternatives One, Three, and Four would increase recreational use of the Columbia River over existing levels, which would cumulatively increase levels of oil, gas, and engine exhaust discharged to the river; and increase riverbank and island erosion from boat wakes. Unregulated non-point sources associated with industrial development and mining could add to pollutants discharged to the river from upstream sources, resulting in further water quality degradation. Mining and grazing along the Columbia River Corridor, which would be allowed under the No-Action Alternative, would increase sedimentation in the river, with possible cumulative impacts on spawning areas in the Columbia River.

5.6.2.3 Biological Resources. Because the Hanford Site contains much of remaining undisturbed Columbia Basin shrub-steppe habitat, proposed developments of undisturbed areas would result in cumulative impacts to rare plants and animals, unique plant communities, and terrestrial and aquatic ecosystems. In addition, the Hanford Site contains the last unimpounded, nontidal segment of the Columbia River, and further development along the Reach could result in cumulative losses to species and habitats associated with the Hanford Reach. In some cases (e.g., Upper Columbia River spring run chinook salmon (Endangered listed -3/99), Middle Columbia River steelhead (Threatened listed -3/99) and Upper Columbia River steelhead [Endangered listed -8/97]), further losses of habitat could endanger remaining populations.

The Industrial, Research and Development, and Industrial-Exclusive land-use designations would allow industrial development to displace native plant communities and wildlife habitats where the habitats still exist. In addition, ongoing remediation activities, such as the decommissioning of surplus production reactors, would result in further habitat losses. Many of the actions listed in Table 5-14 for the 200 Areas would involve small losses of habitat, but expansion of the Environmental Restoration and Disposal Facility (ERDF) and other future actions in the 200 Areas could involve larger losses, with potential cumulative impacts to shrub-steppe habitat. Alternatives One and Two would limit potential cumulative impacts in the 200 Areas by reducing the size of the Industrial-Exclusive land-use designation.

The Conservation land-use designations could result in cumulative impacts by allowing commercial livestock grazing and mining. Cumulative impacts from grazing are most likely under the No-Action Alternative, which would allow grazing over the largest area and could result in further losses of regional biodiversity.

Although basalt and sand and gravel quarries are unlikely to have cumulative impacts because they would disturb relatively small areas, large-scale soil mining to support remediation could result in large habitat losses. If permitted by DOE, the potential for cumulative effects from mining are greatest under the No-Action Alternative and Alternative Three, which would allow development of quarry sites at the McGee Ranch. Losses of shrub-steppe habitat in this area could eliminate the remaining segments of the wildlife movement corridor between the Hanford Site and the Yakima Training Center; which are among the last remaining large tracts of shrub-steppe habitat in the region. Mining in the McGee Ranch area would add to habitat fragmentation that has previously taken place in the region as a result of agricultural, residential, and industrial development; and could further reduce regional biodiversity.

Increased recreational use associated with the Wild and Scenic River designation and High- or Low-Intensity Recreation land-use designations under the Preferred Alternative and Alternatives One, Three, and Four could result in cumulative impacts to wildlife and habitats that are not currently accessible by the public under the No-Action Alternative. Recreation designations would increase impacts from boating as well as foot traffic on sensitive plant communities and habitats.

The potential for cumulative impacts to biological resources may best be evaluated by determining the amount of BRMaP Level III and IV resources that could be affected. The BRMaP Level III and IV designations identify the resources that could be most adversely affected by further habitat losses. Alternative Three has the greatest potential to impact Level III and IV resources, primarily because it would allow conversion of native plant communities on the Wahluke Slope to cultivated agriculture. The Preferred Alternative and the No-Action Alternative would have less potential for impacts to BRMaP Level III and IV resources, but are more likely to impact those resources than Alternatives One, Two, or Four. Alternative Two is least likely to have cumulative effects on biological resources, based on the amounts of BRMaP Level III and IV resources that could be impacted by development.

5.6.2.4 Cultural Resources. Regionally, agricultural, industrial, and residential development have damaged or destroyed cultural resources. In addition, construction of dams along the Columbia River has inundated many cultural resources and sites of significance to American Indian Tribes. Cultural resources on the Hanford Site have been preserved by access restrictions for the past 55 years. Preservation of the Hanford Reach as the last free-flowing stretch of Columbia River would also preserve cultural resources associated with the river. Loss of these sites through development of Hanford Site lands could lead to potentially significant impacts on the remaining cultural resources in the region.

The biological resources on the Hanford Site are also important to American Indian Tribes for traditional subsistence uses. In addition, the Hanford Site includes religious sites important to American Indians. American Indian Tribes with ties to the Hanford Site have long advocated the protection of these resources in their efforts to maintain their cultures and traditional life ways. Further losses of these resources could impact American Indian cultures associated with the Hanford Site.

Potential cumulative impacts to cultural resources are most likely to occur along the Columbia River, where cultural resources and traditional American Indian uses are concentrated. The No-Action Alternative has the greatest potential to affect these resources by allowing mining, grazing, or industrial development in the Columbia River Corridor. The Preferred Alternative and Alternatives One, Three, and Four would increase recreational access to the corridor, which could result in impacts to cultural resources from unauthorized artifact collection, vandalism, and losses to riverbank and island erosion from boat wakes.

Industrial development under any of the alternatives has the potential to disturb archaeological and historic sites. Alternatives One and Two are least likely to result in cumulative impacts because these alternatives would minimize the amount of land designated for Industrial, Research and Development, and Industrial-Exclusive land uses. Ongoing remediation activities and some of the proposed projects listed in Table 5-15 could also have cumulative effects on cultural resources.

Other potential cumulative impacts to American Indian cultures could occur under the No-Action Alternative and Alternative Three which, if permitted by DOE, would allow quarrying on basalt outcrops that are important religious and cultural sites. Alternative Two would designate most of the Hanford Site for Preservation to protect cultural resources and would be least likely to have cumulative impacts.

5.6.2.5 Aesthetic Resources. The large, undeveloped portions of the Hanford Site and features such as the basalt outcrops, Rattlesnake Mountain, the White Bluffs, and the Columbia River Corridor have aesthetic values that are unique to the region. Industrial development associated with past Hanford operations has altered some viewsheds. Future development of Hanford Site lands could further alter viewsheds and reduce the aesthetic value by increasing airborne particulate, odors, or other pollutants.

The potential for cumulative impacts to viewsheds would be greatest under the No-Action Alternative, which would allow development of Hanford Site lands on a project-by-project basis. This alternative is more likely to result in the siting and construction of industrial developments in previously undisturbed viewsheds. Alternative Three could also have cumulative impacts to viewsheds by allowing, if permitted by DOE, quarrying on basalt outcrops, the conversion of native plant communities on the Wahluke Slope to crop land and orchards, and development of High-Intensity Recreational facilities adjacent to the Columbia River Corridor. Future industrial development under the Industrial-Exclusive land-use designation, along with proposed and planned actions listed in Table 5-14, would have cumulative effects on viewsheds that would be similar under the alternatives being considered.

Alternative Three also has the greatest potential for cumulative impacts on visibility associated with air quality. The conversion of much of the Wahluke Slope to agriculture would create a significant new source of fugitive dust from cultivated fields. Industrial development under this alternative as well as all other alternatives being considered could also result in new sources of industrial pollutants, which could further diminish visibility.

Future development could also increase ambient noise levels, which would detract from the recreational experience associated with the Columbia River Corridor and other natural areas on the Hanford Site. Cumulative increases in noise are most likely occur under the No-Action Alternative, which could allow industrial development along the Columbia River. Mining along the river corridor, which could occur under the No-Action Alternative, could also increase noise impacts. Increases in High-Intensity Recreational land-use activities such as Alternative Three’s proposed destination resort and RV camps or the Preferred Alternative’s and Alternative Four’s proposed Tribal fishing camps, could also increase the noise along the river and distract from the aesthetic experience.

5.6.3 Cumulative Socioeconomic Impacts

The economy of the area has in the past been strongly influenced by Hanford Site activities. Changes in the Site mission and reductions in Site activities have had negative impacts in the past. Recently, the area economy has become more diversified and less dependent on the Hanford Site. Future development of Hanford Site lands under multiple uses could accelerate the transition to a diversified economy. On the other hand, economic growth associated with future uses of the Hanford Site could cumulatively increase demand for infrastructure and services.

Alternative Three has the greatest potential to have cumulative impacts, both positive and negative, on socioeconomic conditions. On the positive side, Alternative Three would provide the most opportunities to develop alternate uses of Hanford Site lands, maximizing the economic return. Alternative Three could have negative impacts on socioeconomic conditions by increasing the demand for services, including schools, law enforcement, and health and human services. Alternative Two has the least potential to have cumulative socioeconomic impacts because it would minimize future Hanford Site development.

As was discussed in Section 5.3.1, future industrial development on Hanford Site lands could place increased demand on infrastructure beyond the City of Richland's capacity. This potentially cumulative impact could occur under the Preferred Alternative and Alternatives Three and Four because they have Industrial land-use designations larger than the City of Richland UGA. However, the impact would be the most under the No-Action Alternative, because no land-use plan would be available to assist government entities in anticipating and addressing increased demand.

5.6.4 Cumulative Human Health Risk

Risks due to exposure to residual contamination remaining after completion of CERCLA activities would be dependent on the level of access to any particular area where residual contamination remained. New wastes could be imported for disposal as specified in the RODs for the *Waste Management Programmatic Environmental Impact Statement* (DOE/EIS-0200, May 1997). Health risks from the new wastes would be principally to workers and could include physical hazards and latent cancer fatalities from waste management activities over the 20-year period of waste movements analyzed. Collective worker health risk estimates for the potential new wastes are one fatality for Low-Level Mixed Waste, three fatalities for High-Level Waste, and up to four fatalities for Low-Level Waste, depending on whether Hanford is selected as a Low-Level Waste disposal site. Less than one latent cancer fatality is estimated among the offsite population. These proposed waste management activities could greatly increase waste shipments entering or leaving the site.

Consequently, the cumulative health risk to humans would be expected to be greatest under Alternative Three because it would provide greater access to more areas and would provide more opportunities for development of Hanford Site lands than would the other alternatives. Conversely, Alternative Two would have the least potential for cumulative human health risks, because it would provide the least access to Hanford Site lands.

Significant occupational risk to workers could occur under some industrial uses, under both the Industrial-Exclusive and Industrial land-use designations. Agriculture is also traditionally a high risk occupation (Table 5-13). Cumulative occupational risk would likely be the greatest under Alternative Three because of the large area designated for Agriculture and the higher level of use associated with the entire Hanford Site. Conversely, occupational risk would be lowest for Alternative Two because industrial risk would be limited to workers in the 200 Areas (similar under all alternatives) and Alternative Two designates the smallest area for Industrial development.

5.7 Other NEPA Considerations

NEPA is used by the Executive Branch through Executive Orders to further the administration's goals in several policy areas. NEPA integration requires the presentation of many diverse subject areas to ensure that the Federal decision maker is fully informed.

5.7.1 Unavoidable Adverse Impacts

The potential unavoidable adverse impacts associated with implementation of future land uses on the Hanford Site are described in the following section. Unavoidable adverse impacts are impacts that would occur after implementation of all feasible mitigation measures. Although these impacts would not occur as a result of adoption of any particular land-use plan, unavoidable adverse impacts would occur as a result of development of undisturbed land for other uses. The greatest potential for unavoidable adverse impacts is associated with more intensive land uses and the areal extent of those uses in each alternative. These impacts would be associated with the degree of disturbance of sensitive habitats and loss of cultural resources.

Land-use designations with the greatest potential for unavoidable adverse impacts are Agriculture, Industrial, Industrial-Exclusive, and High-Intensity Recreation. Designations with less potential for unavoidable impacts (but that would likely include some unavoidable adverse effects on resources) include Research and Development, Low-Intensity Recreation, Conservation (Mining and Grazing), and Conservation (Mining). Unavoidable adverse impacts would be minimal or nonexistent under the Preservation designation.

The Hanford Site has an abundance of significant cultural resources and conversion of land from the relatively undisturbed condition could result in the loss of significant resources. These resources are considered irreplaceable. The extent of damage to these resources would depend on the extent of the land area converted to intensive uses and the distribution of the resources relative to the location of the disturbance. Some resource locations are more significant than others, and each location must be assessed individually. Mitigation measures, such as data collection, would be implemented but unavoidable adverse impacts associated with destruction of the actual location of resources would occur as a result of some land-use designations.

The Hanford Site also represents one of the last remaining large tracts of the shrub-steppe habitat that previously covered extensive areas in eastern Washington State. Intensive use of these lands could result in the loss of significant amounts of this habitat and could potentially lead to listing (as threatened or endangered) species that are dependent upon this habitat. Although lands converted to other uses potentially could revert to the original state, this reversion is unlikely to occur because the land would remain in the developed condition and reversion would require many years.

Physical impacts on terrestrial resources and sensitive habitats (e.g. aquatic habitat, wetlands, shrub-steppe habitat) would be unavoidable under some land-use designations. Permanent loss of habitat for some species of concern could occur and could result in population declines. Habitat loss within the 200 Areas would likely be unavoidable, but these losses are anticipated to be similar under all alternatives. The magnitude of potential physical impacts across other areas on the Hanford Site depends upon the land-use designations associated with particular alternatives.

The Agriculture land-use designation has the greatest potential for unavoidable adverse impacts. Destruction of cultural resource sites, both on the land converted to this use (and, potentially, as a result of increased slumping of the White Bluffs if uncontrolled irrigated agriculture occurs on the Wahluke Slope), would be unavoidable under this designation. Shrub-steppe habitat in areas converted to agricultural use would be lost. Depending on the area of land converted to agriculture, mitigation of habitat loss would not be feasible.

Industrial, Research and Development, and High-Intensity Recreation land-use designations could result in unavoidable adverse impacts to cultural resources and sensitive habitats. The degree of impact would depend on the extent of development. Siting of specific industrial facilities could be modified to minimize impacts. Nevertheless, if large portions of areas designated for Industrial use are ultimately used, cultural and biological resources within the areas would be lost. Similarly, development of High-Intensity Recreational facilities (e.g., golf courses) or R&D facilities could involve loss of or damage to resources.

Other potential unavoidable adverse impacts would be associated with grazing of livestock (resulting in damage to habitats that are sensitive to grazing or physical damage of cultural resources), inadvertent or deliberate damage to cultural resources due to increased exposure of resources to humans, and localized damage to resources due to mining activities.

Implementation of Alternative Three would involve the greatest potential for unavoidable adverse impacts. These impacts would be associated with loss of cultural and biological resources due to conversion of extensive areas on the Wahluke Slope to agriculture and with the area designated for Industrial use, and Research and Development. Alternative Three also includes the greatest extent of land designated for Recreational uses.

The Preferred Alternative also could potentially lead to unavoidable adverse impacts associated with lands designated for Industrial Use, Research and Development, and Conservation (Mining). Although impacts associated with other land-use designations could potentially be mitigated, Industrial and Research and Development uses would likely lead to unavoidable adverse impacts to some cultural and biological resources.

Implementation of Alternative Two would have the least potential for unavoidable adverse impacts. This alternative designates virtually the entire Hanford Site for Preservation. Areas designated for other uses occur largely in previously disturbed areas. Unavoidable adverse impacts under this alternative would be minimal and would be associated with Industrial-Exclusive use of the 200 Areas (similar under all alternatives) and with Industrial use in the UGA north of the City of Richland, which is smaller than the area designated for Industrial use under all other alternatives.

Alternatives One and Four represent intermediate conditions between Alternative Two and the Preferred Alternative. Potential unavoidable adverse impacts under the No-Action Alternative could involve development of any portion of the Hanford Site in the future, with the exception that this alternative assumes that management on the Wahluke Slope and ALE Reserve would continue to be similar to current management.

5.7.2 Irreversible and Irretrievable Commitments of Resources

The identification of irreversible and irretrievable (I&I) commitments of resources associated with actions proposed by Federal agencies is required by NEPA. On land-use projects, I&I commitments are related to the use of nonrenewable resources and the effects that consumption of those resources could have on future generations. For example, irreversible effects occur as a result of use or destruction of a resource (i.e., energy and minerals) that cannot be replaced within a reasonable time, while irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored (i.e., extinction of a species or disturbance of a cultural site).

The Final HCP EIS does not I&I commit resources to any specific project of the Hanford Site, but does I&I commit natural resources to the land-use designations as allocated by Table 3-1. After incorporating by reference the previous 1975 ERDA 1538 irreversible and irretrievable (I&I) commitments and other documented commitments into this EIS (see Section 1.3), future individual project land-use requirements would be I&I committed through the appropriate NEPA and CERCLA/RCRA/NEPA integrated processes, as described in Chapter 6. Table 3-3 summarizes the commitment of Hanford Site lands, by land-use designation, for each alternative.

5.7.3 Conflicts with Land-Use Plans of Other Federal, Regional, State, Local, and Tribal Agencies

The Draft HRA-EIS CLUP (DOE 1996) identified one vision for the future use of Hanford Site lands. Numerous comments were received by DOE from other agencies, Tribal governments, and stakeholders indicating that a land-use plan for the Hanford Site needed to be developed. These comments indicated that alternative land-use plans needed to be analyzed and compared to the plan presented in the Draft HRA-EIS CLUP, and that DOE needed to identify a Preferred Alternative for future land use at the Hanford Site. As a result of these comments and concerns regarding different visions for the future of Hanford Site lands, DOE initiated a process of coordination and consultation with other Federal, state, and local government agencies, and Tribal governments to develop and analyze potential impacts associated with alternative land-use scenarios for the Hanford Site. The DOE revised the August 1996 Draft HRA-EIS to reflect these concerns and is presenting the impact analysis in this Final HCP EIS.

Existing plans of other Federal, state, and local agencies, and Tribes have been incorporated as alternatives in the Final HCP EIS if those agencies or Tribes elected to provide DOE with a land-use map depicting a vision for the future of Hanford Site lands. The DOE cannot speculate with regard to land-use patterns that might be preferred by agencies or Tribes that did not provide a specific vision for the future of land use at the Hanford Site. Therefore, DOE knows of no existing land-use plans in conflict with the alternatives presented in this Final HCP EIS.

The DOE recognizes the interest of the BoR and the BLM in lands withdrawn from them at the Hanford Site, and acknowledges the U.S. Atomic Energy Commission's agreement to return lands no longer needed for safeguards and security purposes in the Wahluke Slope to the BoR for development as part of the Columbia Basin Project. The DOE also recognizes, as a co-preparing agency, the alternative selected in the ROD for the Hanford Reach EIS (NPS 1994). This alternative would designate the land within the Wahluke Slope as a NWR. The DOE and BLM have discussed consolidation of BLM lands within a specific area of the Hanford Site (Figure 4-3), or exchanging Hanford Public Domain lands for lands elsewhere with natural resources values. The BLM may consider selling land to private entities to allow Industrial, Research and Development, or High-Intensity Recreation uses to occur on BLM's scattered tracts of land if the economic return would fund appropriate environmental mitigation elsewhere. Public comment such as the anti-grazing response received on this EIS will help determine the path forward.

The BLM completes approximately 65 land exchanges per year, acquiring nearly 60,703 ha (150,000 ac) valued over $60,000,000. Current law restricts exchanges to lands located within the same state. In general, the lands must be of equal value, although limited cash equalization adjustments are allowed. Certain low value exchanges may proceed on the basis of "approximately equal" value.

The exchange of land is authorized under the *Federal Land Policy and Management Act of 1976*, (FLPMA), as amended, and the *Federal Land Exchange Facilitation Act of 1988* (FLEFA). The BLM's final rulemaking implementing FLEFA was published jointly with the U.S. Forest Service in 1993. A final Land Exchange Handbook was completed in 1997 replacing a draft that was in use for over two years.

Land exchange has been identified as a high priority within the DOI as well as BLM. Exchanges provide the opportunity for BLM to acquire lands with high recreational, wildlife habitat, scenic, and cultural resource values. They are also used to consolidate BLM lands into more manageable units and to meet community expansion needs.

Recent accomplishments in this program include the following:

- **Lake Tahoe, Zephyr Cove, Nevada** -- The Federal government acquired 14 ha (35 ac) along Lake Tahoe. The property has nearly 1.6 km (1 mi) of sandy beach, spectacular scenic views, and an opportunity to protect sensitive plant and animal species. The BLM traded approximately 546 ha (1,350 ac) of lands in the Las Vegas Valley for the property. The lands acquired will be managed by the U.S. Forest Service.

- **Lake Fork of the Gunnison River, Colorado** -- The BLM acquired 1,376 ha (3,400 ac) of Smock Ranch (formerly Gateview Ranch) along the Lake Fork of the Gunnison River. The BLM plans to acquire approximately 809 ha (2,000 ac) of the adjacent Thomas Ranch in a second phase. The exchange provides valuable fisheries and recreational resources, and reduces the BLM's management costs by placing 33 small isolated parcels into private ownership.

- **Santa Ana Pueblo, New Mexico** -- Approximately 6,070 ha (15,000 ac) of Federal and state lands were transferred to the Santa Ana Pueblo, resolving a 20-year commitment to eliminate the "checkerboard" land ownership pattern within the Pueblo's boundary. The BLM will receive state lands located in wilderness study areas and other special management areas throughout the state.

- **Clearwater - Phase II, Washington** -- The BLM acquired 364 ha (900 ac) of land including 3.2 km (2 mi) of river frontage adjacent to the Grande Ronde National Wild and Scenic River. The lands have important values for fish and wildlife as well as high recreational value for fishing, hunting, white water boating, hiking, and sightseeing.

5.7.4 Relationship Between Near-Term Use and Long-Term Productivity of the Environment

For the purposes of this Final HCP EIS, near-term use is defined to encompass the 50-year planning period associated with this EIS. Long-term productivity is defined to encompass the period following this planning window.

The DOE anticipates that considerable activity related to ongoing remedial actions will occur at the Hanford Site for the near-term. This activity would likely influence allowable land uses in the near-term. New near-term uses would be consistent with land-use designations adopted in the ROD for this Final HCP EIS, and remedial activities would be anticipated to support those uses and designations.

Although the land-use alternatives analyzed in this Final HCP EIS represent varied viewpoints of the best use of Hanford Site lands within the near-term, the objective of these plans is establishment of a framework for balancing overlapping long-term needs to meet the requirements of DOE missions, community development, recreational opportunities, and resource preservation. Long-term productivity can be enhanced through this process because conflicting viewpoints regarding the best use of Hanford Site land can be objectively analyzed, and the uses to satisfy the various real and perceived needs can be incorporated into long-term planning. Through this planning process, long-term productivity of Hanford Site lands can be enhanced by establishing areas that would be devoted in the short- and long-term for uses ranging from intensive development to preservation.

6.0 Implementation of the Comprehensive Land-Use Plan

This chapter provides an overview of the polices and implementing procedures that would be used by DOE, the cooperating agencies and the consulting Tribal governments to implement the Hanford Comprehensive Land-Use Plan (CLUP) following the Record of Decision (ROD) for the *Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (HCP EIS).

The DOE is expected to use this land-use plan in its decision-making process to establish what is the "highest and best use"[1] of the land (41 CFR 101-47, "Federal Property Management Regulations"). The final selection of a land-use map, land-use policies and implementing procedures, would create the working CLUP when they are adopted through the ROD for this EIS.

Once adopted, the CLUP would provide the framework within which future use of the Hanford Site's lands and resources occurs. In developing the CLUP DOE will have considered the visions, goals, and objectives articulated by participants in the land-use planning process. This framework consists of four basic elements:

1. A final ***Hanford CLUP Land-Use Map***, depicting land uses for the Site (see Chapter 3). The ROD for this EIS would select one of the alternative land-use maps presented in Chapter 3 or would select a land-use map such as the new Preferred Alternative that combines features of several alternatives.

2. ***Hanford CLUP Land-Use Definitions***, describing the purpose, intent, and principal use(s) of each of the land-use designations on the adopted CLUP map (see Chapter 3, Table 3-1, and Section 6.1 below).

3. ***Hanford CLUP Policies***, directing land-use actions. These policies will help to ensure that individual actions of successive managers collectively advance the adopted CLUP map, goals, and objectives over time (see policies in Section 6.3).

4. ***Hanford CLUP Implementing Procedures***, including:

   - Administrative procedures for reviewing and approving Use Requests for consistency with the CLUP

   - A Site Planning Advisory Board (SPAB) consisting of representatives from DOE, the cooperating agencies and the affected Tribal governments

   - Actions which, after plan adoption, shall be undertaken to align and coordinate existing and new "area" and "resource" management plans for the Site (e.g., The Comprehensive Conservation Plan for the Fitzner/Eberhardt Arid Lands Ecology Reserve [ALE Reserve]; fire; cultural and historical resources; and species management), with the policies and designations of the CLUP.

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[1] Section 101-47.4909 of the *Federal Property Management Regulations* defines the "highest and best use" as that use to which a property can be put that produces the highest monetary return from the property, promotes its maximum value, or serves a public or institutional purpose. The "highest and best use" determination must be based upon the property's economic potential, qualitative values inherent in the property, and utilization factors affecting land use such as zoning, physical characteristics, other private and public uses in the vicinity, neighboring improvements, utility services, access, roads, location, and environmental and historical considerations.

For all proposals and projects, the above procedures and actions would be integrated with existing DOE land-use review procedures (e.g., biological, cultural, and the *National Environmental Policy Act of 1969* [NEPA]), while DOE maintains control of the land. The DOE has the final determination and approval of all land-use decisions taking place on the Hanford Site land under DOE authority.

6.1 Definitions and Descriptions of Land-Use Map Designations

The land-use designations of each land-use map depict the categories of land use that would occur within specific geographic locations of the Site. Ideally, the designated use is suitable, based on a broad range of factors including natural and biological resources; existing uses; infrastructure; proximity to other development; economic objectives; and historical, prehistorical, and aesthetic resources and values.

The definitions of the various land-use designations are provided in Table 6-1. These land-use designations and their definitions were developed by the cooperating agencies and are discussed in greater detail in Chapter 3 of this Final HCP EIS.

Table 6-1. Hanford Site Land-Use Designations.

Land-Use Designation	Definition
Industrial-Exclusive	An area suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, and nonradioactive wastes. Includes related activities consistent with Industrial-Exclusive uses.
Industrial	An area suitable and desirable for activities, such as reactor operations, rail, barge transport facilities, mining, manufacturing, food processing, assembly, warehouse, and distribution operations. Includes related activities consistent with Industrial uses.
Agricultural	An area designated for the tilling of soil, raising of crops and livestock, and horticulture for commercial purposes along with all those activities normally and routinely involved in horticulture and the production of crops and livestock. Includes related activities consistent with Agricultural uses.
Research and Development	An area designated for conducting basic or applied research that requires the use of a large-scale or isolated facility or smaller scale time-limited research conducted in the field or in facilities that consume limited resources. Includes scientific, engineering, technology development, technology transfer, and technology deployment activities to meet regional and national needs. Includes related activities consistent with Research and Development.
High-Intensity Recreation	An area allocated for high-intensity, visitor-serving activities and facilities (commercial and governmental), such as golf courses, recreational vehicle parks, boat launching facilities, Tribal fishing facilities, destination resorts, cultural centers, and museums. Includes related activities consistent with High-Intensity Recreation.
Low-Intensity Recreation	An area allocated for low-intensity, visitor-serving activities and facilities, such as improved recreational trails, primitive boat launching facilities, and permitted campgrounds. Includes related activities consistent with Low-Intensity Recreation.
Conservation (Mining and Grazing)	An area reserved for the management and protection of archeological, cultural, ecological, and natural resources. Limited and managed mining (e.g., quarrying for sand, gravel, basalt, and topsoil for governmental purposes only) and grazing could occur as a special use (i.e., a permit would be required) within appropriate areas. Limited public access would be consistent with resource conservation. Includes activities related to Conservation (Mining and Grazing), consistent with the protection of archeological, cultural, ecological, and natural resources.
Conservation (Mining)	An area reserved for the management and protection of archeological, cultural, ecological, and natural resources. Limited and managed mining (e.g., quarrying for sand, gravel, basalt, and topsoil for governmental purposes only) could occur as a special use (i.e., a permit would be required) within appropriate areas. Limited public access would be consistent with resource conservation. Includes activities related to Conservation (Mining), consistent with the protection of archeological, cultural, ecological, and natural resources.
Preservation	An area managed for the preservation of archeological, cultural, ecological, and natural resources. No new consumptive uses (i.e., mining or extraction of non-renewable resources) would be allowed within this area. Limited public access would be consistent with resource preservation. Includes activities related to Preservation uses.

6.2 Definitions for Terms Relating to Plan Implementation

The following three definitions – Allowable Use, Special Use, and Amendments – relate the land-use policies to the land-use maps:

- ***Allowable Use*** -- Any reservation of land for a physical development or land-use activity that is consistent with the land-use designation and policies of the land-use map and CLUP, or a specifically identified part of an approved area management plan (AMP), except for "Amendments" or uses that are identified as "Special Use." Any new remediation project or support activity that is categorically excluded under DOE's NEPA regulations (10 CFR 1021) is an allowable use, except projects proposed in the Preservation designation.

- ***Special Use*** -- Activities requiring further review and approval prior to being allowed. The following are special uses.

  1. Any physical development or land-use activity in the Preservation designation
  2. Any physical development or land-use activity in the Conservation designation that is not categorically excluded under DOE's NEPA regulations (10 CFR 1021)
  3. AMPs outside of the 200, 300, and 400 Areas
  4. Any proposed new development that is inconsistent with the land-use designation of the adopted local counties' or cities' comprehensive plans for the Hanford Site
  5. Mining or grazing activities within areas designated for Conservation
  6. Any proposed new project that is located within an area that has a deed or covenant restriction as a result of the remediation process (e.g., institutional controls)
  7. Additions to or enlargements of pre-existing, nonconforming uses
  8. Any proposed new project that establishes an exclusive use zone (EUZ) over lands not currently under an EUZ (see Section 4.11.4).

- ***Amendments*** -- Amendments are required for the following:

  1. Any change to the map land-use designation of an area
  2. Any change to CLUP policy
  3. Any change in the use of land or an existing facility to a use that is inconsistent with the land-use designation.

Additionally, definitions are used to define the terms of the land-use policies. These definitions include the following:

- ***Area management plans (AMPs)*** – Management plans for specific geographic areas, which may include specific resource management plans, mitigation strategies, and various uses and facilities. An AMP shall be consistent with the CLUP's land-use designations and policies.

- ***Use Request*** -- A Use Request is a proposal to use land or a facility for an activity different from what is currently occurring. Use Requests can include site preparations, leasing, granting right-of-ways, or any other land-use related activities.

- ***Policy*** -- Policies are statements of intent which direct decisions toward the accomplishment of adopted goals and objectives. Policies are applied on a continuous basis and applied consistently over time.

- ***Pre-existing, Nonconforming Use*** -- Any existing lawfully established use that is neither allowed nor conditionally permitted within a land-use designation, but exists therein, having been established prior to the CLUP land-use designation.

- ***Resource management plan (RMP)*** – A RMP contains adopted management standards and strategies for a specific resource. Generally, resources subject to RMPs are not confined to geographically discrete areas and they are not static (i.e., their characteristics and conditions often vary in time and/or location across the Site). Examples of resources which have RMPs are biological resources (Draft *Biological Resources Management Plan* [BRMaP] [DOE-RL 1996c]), cultural resources (Draft *Cultural Resources Management Plan* [CRMP] [DOE-RL 1999]), and the *Bald Eagle Management Plan* (DOE-RL 1994b). The provisions of each RMP apply wherever its subject resource occurs on the Site, except for areas specifically exempted within the RMP itself.

  Several RMPs may apply within an AMP. A single RMP may extend across several AMPs. Where an RMP exists within an AMP, the provisions of both must be integrated toward achieving their common objectives, consistent with land-use designations within which they occur.

- ***RL Manager*** -- The RL Manager is the Manager of DOE's Richland Operations Office (RL).

- ***RL Site Management Board (SMB)*** – The SMB is chaired by the Site Deputy Manager and comprises selected members of RL senior management staff.

- ***Real Estate Officer (REO)*** – The REO, from the RL Site Services Division (SSD), is the single point of contact for reviewing, processing, and coordinating land-use activities on the Hanford Site.

- ***Shall*** -- For the purpose of Chapter 6 of this EIS, "shall" refers to activities that would be mandatory if adopted by the ROD.

- ***Should*** -- For the purpose of Chapter 6 of this EIS, "should" refers to activities that would be discretionary if adopted by the ROD.

- ***Site Planning Advisory Board (SPAB)* –** The SPAB is an advisory board to land-use matters on the Hanford Site. The SPAB consists of representatives from cooperating agencies with land-use authority, and affected Tribal governments. The SPAB reviews Use Requests that are not "allowable uses" and makes recommendations to DOE.

6.3 Hanford CLUP Policies

The Hanford CLUP policies connect all the CLUP elements. It is expected that the ROD for this EIS would set forth the following policies:

- Establish land-use mitigation procedures
- Establish hierarchies, priorities, and standards relating to land use, resource use, and values
- Integrate competing land and resource goals and objectives
- Provide reference points for addressing unanticipated circumstances and making actual Amendments to the CLUP when necessary
- Identify which RMPs or AMPs shall be considered for development or revision as part of the CLUP implementation.

Land-use and resource-related decisions, actions, and programs should neither conflict with, nor be inconsistent with the adopted CLUP map and policies. Actions related to policies should be feasible and practical, and policies should be consistently applied on a continuous basis.

The Hanford CLUP policies are described below. They are a synthesis of stated values and objectives from DOE, Future Site Uses Working Group, Hanford Advisory Board, August 1996 Draft HRA-EIS, April 1999 Revised Draft HRA-EIS written comments, public hearings and public meetings, cooperating agencies, consulting Tribal governments, and those associated with municipal and county land-use planning principles.

6.3.1 Overall Policy

The CLUP policy would accomplish the following for the Hanford Site:

1. Protect the Columbia River and associated natural and cultural resources and water quality.
2. Wherever possible, locate new development, including cleanup and remediation-related projects, in previously disturbed areas.
3. Protect and preserve the natural and cultural resources of the Site for the enjoyment, education, study, and use of future generations.
4. Honor treaties with American Indian Tribes as they relate to land uses and resource uses.
5. Reduce exclusive use zone (EUZ) areas to maximize the amount of land available for alternate uses while still protecting the public from inherently hazardous operations (see Section 4.11.4).
6. Allow access for other uses (e.g., recreation) outside of active waste management areas, consistent with the land-use designation.
7. Ensure that a public involvement process is used for amending the CLUP and land-use designations to respond to changing conditions.

8. As feasible and practical, remove pre-existing, nonconforming uses.

9. Facilitate cleanup and Waste Management.

6.3.2 Protection of Environmental Resources

The CLUP policy would accomplish the following for the Site:

1. Implement DOE's *Land- and Facility-Use Policy* (DOE P 430.1), which is to protect and sustain native species and their habitats on the Site. The Conservation and Preservation land-use designations are the primary land-use controls to accomplish this policy. Within the Conservation and Preservation designations, land uses shall be consistent with the purpose of the designation and significant impacts shall be mitigated. Implementation mechanisms such as the BRMaP (DOE-RL 1996c), the Draft *Hanford Site Biological Resources Mitigation Strategy Plan* (BRMiS) (DOE-RL 1996), the *Hanford Site Ground-Water Protection Management Plan* (DOE-RL 1995a) and cultural management plans augment these designations for development review and approval Site-wide. Developments for public access and recreation should be according to adopted AMPs depicting management of use, and siting of support facilities.

2. Within land-use designations other than Conservation and Preservation, mitigate significant unavoidable (residual) impacts at locations by enhancing habitats within the Conservation or Preservation designations. To accomplish this, undertake the following actions:

    a. Modify the BRMaP (DOE-RL 1996c) and BRMiS (DOE-RL 1996) to be consistent with this policy and with implementing procedures.

    b. Review habitat management plans to redirect their mitigation actions and strategies, where necessary and possible, to the established Conservation and Preservation areas.

    c. Consider provisions for the protection of "vulnerable aggregations," as defined by the Washington Department of Fish and Wildlife, for non-game species wherever they occur on the Site.

3. Require that projects have reasonable setbacks from the Preservation and Conservation features of importance.

    a. Within all land-use designations, require that land not be cleared until a specific project has been approved consistent with DOE's NEPA regulations (10 CFR 1021).

6.3.3 Protection of Cultural Resources

The CLUP policy would accomplish the following for the Site:

1. Implement DOE's *Land- and Facility-Use Policy* (DOE P 430.1), which is to protect and sustain cultural resources on the Site. The Conservation and Preservation land-use designations are the primary land-use controls to accomplish this policy. The CRMP addresses those actions where land-use controls are not the appropriate mitigation (i.e., if a cultural resource is found in an Industrial designation, provisions of the CRMP would be applied to mitigate impacts to the resource). Within the Conservation and Preservation designations, land uses shall be consistent with the

purpose of the designation and significant impacts mitigated. Implementation mechanisms such as the CRMP (DOE-RL 1999), and habitat management plans augment these designations for Site-wide reviewing and approving proposed development. Developments for public access and recreation should be according to adopted AMPs depicting management of use, and siting of support facilities.

2. Proposed developments within all areas should be reviewed consistent with the BRMaP (DOE-RL 1996c) and the CRMP (DOE-RL 1999), and reflected in the applicable AMP.

6.3.4 Siting New Development

The CLUP policy would accomplish the following for the Site:

1. Locate and approve new developments in areas consistent with the adopted Hanford CLUP.

2. Locate proposed projects, as feasible and practical, in those areas of the Hanford Site where the adopted CLUP and the local cities' and counties' land-use maps are consistent.

3. Within all land-use designations, previously disturbed areas (as identified by the BRMaP and CRMP) should be developed first, followed by the acreage with the least sensitive biological and cultural resources. Within the Hanford Site's plan of any proposed new development, the acreage with the most sensitive biological and cultural resources should be worked into natural open space for landscaping, buffers, natural drainage areas, etc.

4. Focus on using existing infrastructure and developed areas for new projects within a land-use designation.

   a. Locate new development in close proximity to existing infrastructure unless a project requires an isolated site away from incompatible uses.

   b. Concentrate development on or adjacent to existing infrastructure. Where extensions of infrastructure are necessary, minimize the extension of infrastructure into undeveloped areas.

   c. Site, plan, and design development to avoid significant impacts on resources. Mitigate unavoidable impacts through design to minimize impacts and mitigation costs associated with biological, cultural, air and groundwater resources.

6.3.5 Utility and Transportation Corridors

The CLUP policy would accomplish the following for the Site:

1. With to-be-identified exception(s), existing utility and transportation corridor right-of-ways are the preferred routes for expanded capacity and new infrastructure.

2. Existing utility corridors that are in actual service, clearly delineated, and of defined width, are not considered "nonconforming" uses in any land-use designation.

3. Utility corridors and systems without the characteristics of number 2 (above) are considered to be nonconforming uses and shall be identified in the applicable RMP or AMP.

4 Avoid the establishment of new utility corridors within the Conservation and Preservation designations unless the use of an existing corridor(s) is infeasible or impractical.

5. Avoid the location of new above-ground utility corridors and systems in the immediate viewshed of an American Indian sacred site. Prioritize for removal, as funding is available, existing nonconforming utility corridors and systems in such areas.

6.3.6 Economic Development

CLUP policy would promote the following for the Site:

1. Multiple land uses for both the private and public sector.

2. Protection and maintenance of existing functional infrastructure and utilities for use in economic development and Site transition.

3. Future Federal missions and programs, consistent with the provisions of the CLUP.

4. Protection of natural, historic, and cultural resources to assure continued biodiversity and cultural values as essential elements of a recreation and tourism economy.

5. Reduction or elimination of existing conditions which are impediments to the realization of the land-use designations (e.g., scattered withdrawn Public Domain land, contamination, and nonconforming and abandoned developments).

6.4 Organizational Structure and Procedure for Review and Approval of Use Requests

The existing organizational structure within RL would implement the Hanford CLUP, augmented with a SPAB consisting of representatives from the cooperating agencies and affected Tribal governments. The organizational structure for implementation of the Hanford CLUP is shown in Figure 6-1.

The REO receives notice (e.g., NEPA checklist, SEPA checklist, CERCLA RI/FS review request, CERCLA review request, RCRA permit request, etc.) from a proposed project or activity and initiates, with the NEPA Compliance Officer (NCO), a coordinated project review (Figure 6-2). As an initial step in the review process, the REO determines whether the project is an “Allowable Use,” “Special Use,” or “Amendment” to the CLUP. For projects that require Special Use Permits or Plan Amendments, the REO obtains comments and recommendations from the SPAB on the suitability of the proposed “Use” with respect to the existing CLUP map, land-use policies and implementing procedures. For CLUP Amendments, review includes a final RL Site Management Board (SMB) affirmation, or the SMB can refer a proposed Plan Amendment back to the REO for further review. Figure 6-2 depicts the route of review for proposed projects.

Figure 6-1. Organizational Structure for CLUP Implementation.

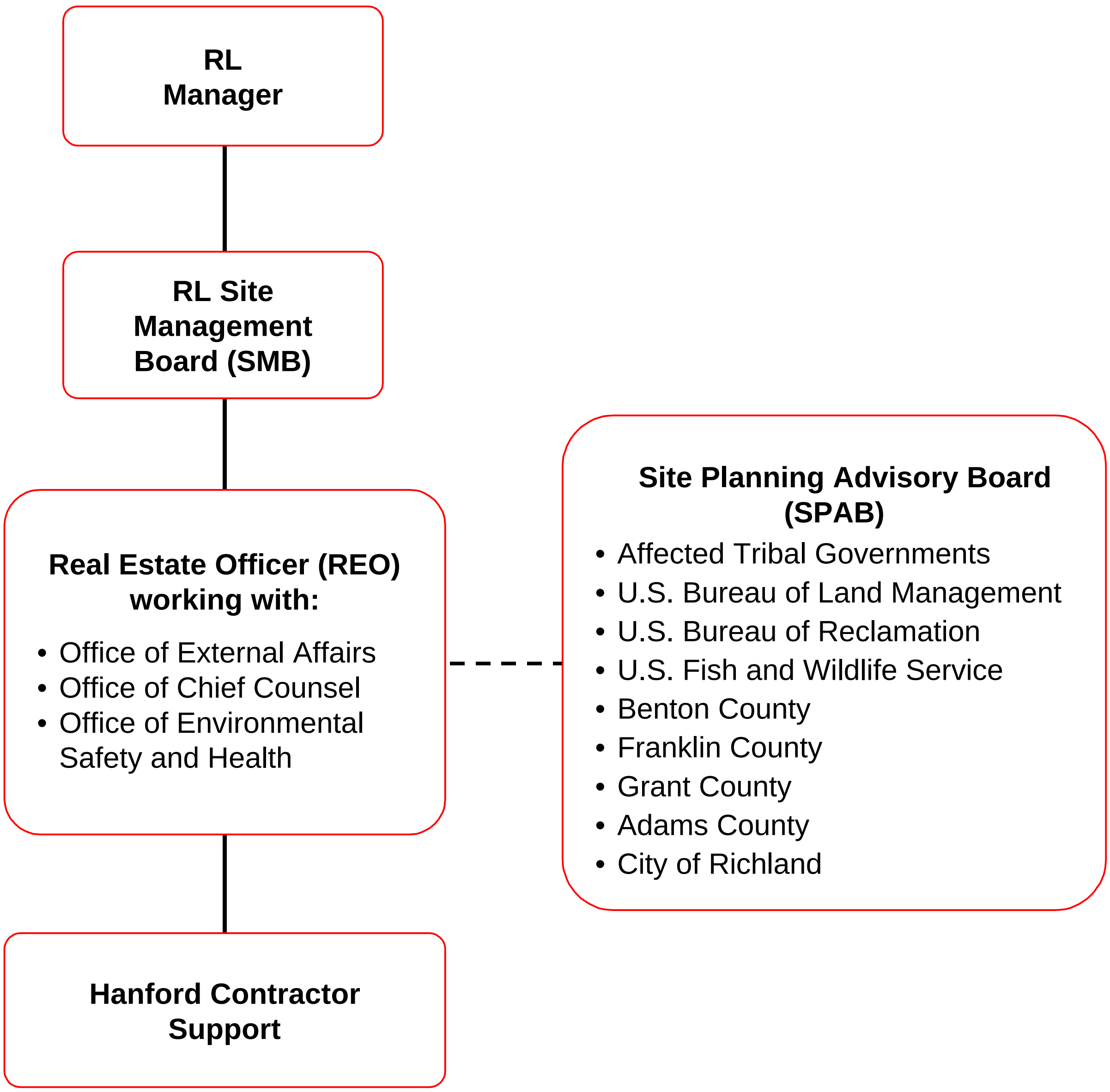
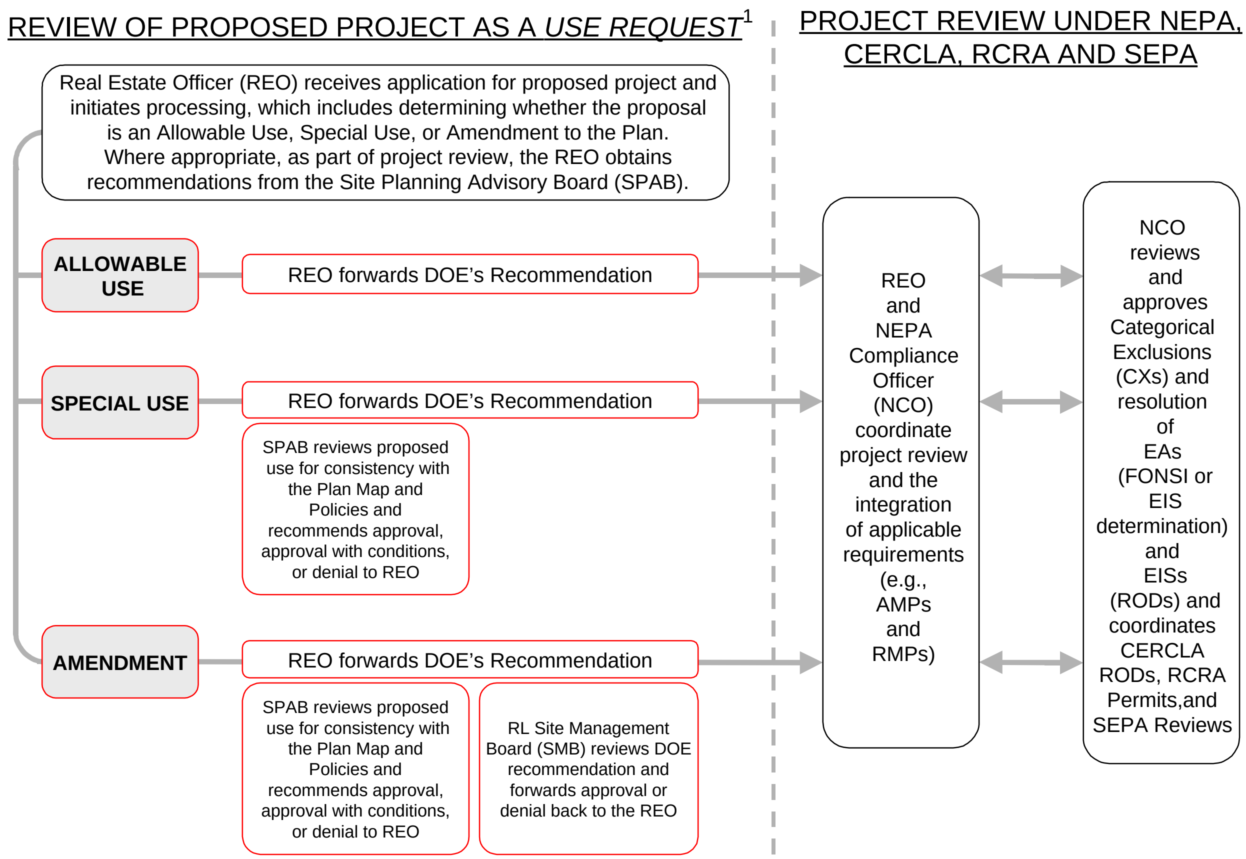


Figure 6-2. Review Process for Use Requests.



[1]The proposed land or facility use, and location are reviewed for consistency with the Plan Map and Policies.

AMP = area management plan
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CX = categorical exclusion
EA = environmental assessment
FONSI = finding of no significant impact
EIS = environmental impact statement
NEPA = *National Environmental Policy Act of 1969*
RCRA = *Resource Conservation and Recovery Act of 1976*
ROD = Record of Decision
SEPA = *State Environmental Policy Act of 1971*

6.4.1 Relationship Between the Site Planning Advisory Board and Real Estate Officer

The SPAB has been recommended by the cooperating agencies and consulting Tribal governments as an essential function, and by DOE as a desirable function, for the successful implementation of the CLUP. The SPAB would directly interface with the REO to advise DOE on land use and resource management issues. The SPAB would consist of representatives from the cooperating agencies with land-use authority, and affected Tribal governments.

The SPAB would support the REO by reviewing and providing advice for “area” and “resource” management plans, providing policy advice to RL in areas involving coordination of land and resource management, and advising during consideration of nonconforming proposals within the boundaries of the Hanford Site. The SPAB advice shall be provided in a timely manner to support the decision process.

6.5 Use Requests for Non-Federal Projects

Proponents and entities of non-Federal projects shall follow the approval process for Use Requests onsite (Section 6.4). The county, city or private entity would be invited to cooperate early in the Use Request and in the NEPA review process (Figure 6-2). Use Requests for non-Federal projects involving new construction shall be required to comply with applicable local county and/or city review and permitting requirements such as compliance with the Uniform Building Code (UBC), health district requirements, shoreline permits, and local air authority standards.

6.6 Plan Implementation Requirements

After the HCP EIS ROD is approved, the actions presented in this section would be undertaken to ensure that the plan is implemented. The objectives of these actions are as follows:

- To streamline and integrate procedures for project review, including ensuring project consistency with the plan, pre-planning for large areas, siting new developments, providing and using infrastructure and utilities, managing resources, notifying the public, and conducting environmental review.

- To make decisions on the use of lands and resources on the Site within the framework of existing DOE legal and administrative procedures, with an implementation process that parallels, and efficiently coordinates with local land-use regulatory processes, and provides similar accountability and tracking.

- To make adjustments in existing DOE administrative structures as necessary to efficiently implement the CLUP.

Achieving these objectives is essential to accomplishing DOE missions and working with Federal agencies, Tribes, and local cities and counties to jointly accomplish planning goals, economic transition, institutional controls, long-term Site stewardship, and multiple uses of the Site.

6.6.1 DOE Equivalent to a Municipal or County Planning Approach

Given the mutual objectives of RL and local governments to coordinate on privatization and transition, the management of uses of real estate at the Hanford Site would be done with procedures that are similar to, or compatible with, the administration of land use in the adjacent municipality or counties. Currently, there are similarities which are amenable to closer alignment. Table 6-2 shows the similarities between geographic segmentation (e.g., a city in the county is similar to an area on the Hanford Site). Table 6-3 shows the similarities between local land-use regulatory procedures and implementation processes on the Hanford Site which, if aligned and coordinated, would improve management of resources.

Table 6-2. Administration Parallels of RL and Local Jurisdictions.

Municipal and County-Land Use	.	DOE Equivalent
Region	.	Region
County	.	Hanford Site
City	.	Area (i.e., 100, 200, 300, and 400)
Neighborhood or Industrial Park	.	Complex (e.g., ORP)
Site, Lot, and Parcel	.	Site, Lot, and Parcel
Facility, Utility, and Infrastructure	.	Facility, Utility, and Infrastructure

Table 6-3. Example of Local Government Processes and RL Counterparts.

Existing Municipal or County Process	.	DOE Counterpart
<u>Administrator: Planning Department Director</u> C Reviews for consistency with Comprehensive Plan C Coordinates land-use review (e.g., Planning Commission, Board of Adjustment, and Board of County Commissioners) C Administrative/discretionary approval C Initiates *State Environmental Policy Act* (SEPA) <u>Administrator: Planning Department Director</u> C Administers SEPA	. . . .	<u>Administrator: Real Estate Officer (REO)</u> C Reviews for consistency with CLUP C Coordinates review of Use Requests for real estate (e.g., Site Planning Advisory Board, Site Management Board, and Site Manager) C Not applicable C Initiates NEPA <u>NEPA Compliance Officer (NCO)</u> C Administers NEPA
<u>Comprehensive Plan</u> C Map C Policies	. . .	<u>CLUP</u> C Map C Policies
<u>Regulatory Review</u> C Protocols for coordination of Department and agency review	. .	<u>CLUP RL Implementing Procedures</u> C Protocols for coordination of program and agency review
<u>Official Controls</u> C Zoning ordinances C Subdivision ordinances C Critical Resources Protection Ordinances C Shoreline management plan C SEPA C Uniform Building Codes C Approval of building permits C Occupancy permits by Building Department C Other controls	. . . .	<u>Implementation Controls</u> C Design standards C Location and development requirements C Resource management plans C Area management plans C NEPA C Uniform Building Codes C Approval of Use Requests C Occupancy permit by Fire Marshal C Other controls

6.6.2 CLUP Implementation Procedures and Implementation Controls

The CLUP implementation procedures and implementation controls should be made consistent and integrated with the CLUP, so that project activities are consistent with and carry out the CLUP over time. This would be instituted through a RL Implementing Directive for the CLUP, which would provide the mandatory requirements and procedures for RL and its contractors to follow. Integrated implementation procedures would be accomplished within 24 months of the issuance of the HCP EIS ROD, funding permitting, under the coordination of the RL Assistant Manager responsible for the Site Services Division.

Table 6-4 shows the implementing controls (RMPs and AMPs) required for implementation of the CLUP. These controls are tools to ensure that land-use actions are consistent with the CLUP. Prior to the adoption of the controls, each RMP and AMP would be reviewed for consistency and alignment with the CLUP, in accordance with the list of tasks that follows Table 6-4. Task One through Task Seven would be performed sequentially. Completion of these tasks would integrate the various RMPs, AMPs, and project-review activities currently in use on the Site with the CLUP implementation procedures.

Table 6-4. Current Status of CLUP Implementing Controls (RMPs and AMPs).

Resource Management Plans (RMPs)	To Be Prepared	Current Draft	Current Final	Revision Planned
Hanford Cultural Resources Management Plan		U		U
Hanford Biological Resources Management Plan		U		U
Hanford Bald Eagle Management Plan			U	U
Fire Management Plan			U	U
Noxious Weed Management Plan			U	U
Chinook Salmon - Upper Columbia River Spring run Hanford Management Plan	U			
Steelhead - Middle Columbia River run Hanford Management Plan	U			
Steelhead Upper Columbia River run Hanford Management Plan		U		
Aesthetic and Visual Resources Management Plan	U			
Facility and Infrastructure Assessment and Strategy		U		
Mineral Resources Management Plan (i.e., soils, sand, gravel, and basalt)	U			
Hanford Site Watershed Management Plan	U			
Hanford Site Ground-Water Protection Management Plan			U	
Groundwater Vadose Zone Integration Project Summary Description			U	
Hanford Institutional Control Plan (i.e., long-term stewardship plan)	U			
Area Management Plans (AMPs)	**To Be Prepared**	**Current Draft**	**Current Final**	**Revision Planned**
ALE Reserve Comprehensive Conservation Plan			U	U
Wahluke Slope Comprehensive Conservation Plan	U			
Columbia River Corridor Area Management Plan	U			
South 600 Area Management Plan (includes 300 Area)	U			

1. Identify all similar documents, policies, and procedures.

2. Review documents and associated policies and implementing procedures for consistency with the CLUP map and policies and implementing procedures.

3. Identify changes necessary to align documents and associated policies and implementing procedures with the provisions of the CLUP.

4. Prepare recommendations to amend existing documents and associated policies and implementing procedures so they are consistent with and carry out the CLUP.

5. Prepare new RMPs and AMPs.

6. Submit CLUP Amendments and new RMPs and AMPs to the REO for review as Special Use Requests so these changes may be integrated with the CLUP implementation procedures as standards for project review (see Figures 6-1 and 6-2).

7. Integrate the prescribed and coordinated process for applying the provisions of the documents into the RL Implementing Directive for the CLUP (Table 6-4).

6.6.3 Mission-Related Program and Contractor Integration

The CLUP map and policies would be integrated with and addressed at the threshold decision points of all authorizations, operational plans (e.g., the current Hanford Strategic Plan), and actions considered in RCRA, CERCLA, NEPA and SEPA reviews. This includes contracts and budget proposals that directly or indirectly affect land use on the Site.

6.6.4 Establishment of Site Planning Advisory Board

The establishment and seating of the SPAB (see Figures 6-1 and 6-2) shall be accomplished within two months from the issuance of the HCP EIS ROD. Prescribed SPAB charter and guidelines would need to be developed by this board and DOE.

6.6.5 Amendments to the Comprehensive Land-Use Plan

The CLUP is a living document designed to hold a chosen course over an extended period of development and management of resources, yet the plan is flexible enough to accommodate a wide spectrum of both anticipated and unforeseen mission conditions. A fundamentally good plan can do this for a relatively short period of time (five years), during which monitoring, data gathering, and analysis for the purposes of "fine tuning" and improving the plan by Amendment should be an ongoing program. It is recommended that a reassessment of the CLUP should occur every 5 years, in the form of a NEPA Supplemental Analysis per 10 CFR 1021.

7.0 Consultations, Laws, and Requirements

This chapter summarizes the major laws, regulations, Executive Orders, and U.S. Department of Energy (DOE) regulations, orders, and agreements that might apply to Hanford Site land uses. The Federal, Tribal, state, and local agencies that were consulted by DOE during the preparation of the HRA-EIS are also identified.

7.1 Federal Laws

Relevant laws of the United States that might apply to the implementation of the land-use alternatives at the Hanford Site are discussed in the sections that follow.

7.1.1 Treaties of the United States with American Indian Tribes of the Hanford Region

In May and June of 1855, at Wai-i-lat-pu (near present-day Walla Walla, Washington), leaders of various Columbia Plateau American Indian Tribes and Bands negotiated treaties with representatives of the United States. The negotiations resulted in 3 treaties, one with the 14 Tribes and bands of what would become the Confederated Tribes and Bands of the Yakama Nation, one with the 3 Tribes that would become the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and one with the Nez Perce Tribe. The treaties were ratified by the U.S. Senate in 1859. The negotiated treaties are as follows:

- *Treaty with the Walla Walla, Cayuse, etc.* (June 9, 1855; 12 Stat. 945)
- *Treaty with the Yakama* (June 9, 1855; 12 Stat. 951)
- *Treaty with the Nez Perce* (June 11, 1855; 12 Stat. 957).

The terms of all three treaties are essentially the same. Each of the three Tribal organizations agreed to cede large blocks of land to the United States. The Tribes retained certain lands for their exclusive use (the three reservations) and also retained the rights to continue traditional activities outside the reservations. These reserved rights include the right to fish (and erect fish-curing facilities) at usual and accustomed places. These rights also include rights to hunt, gather foods and medicines, and pasture livestock on open and unclaimed lands.

The act of treaty-making between the United States and an Indian Tribe has many legal consequences for both entities. The United States recognizes the existence of the Tribe as a sovereign and initiates a government-to-government relationship with the Tribe. At the same time, the Tribe loses some aspects of its sovereignty, such as the right to negotiate (independently of the United States) with other foreign powers. In return, the United States and the Tribe enter into a trust relationship, whereby the United States assumes the responsibility to preserve the rights and resources of the Tribe from incursions by private entities, states, or the Federal government itself. One aspect of this trust duty is the need to consult with the Tribes concerning decisions made by the Federal government that could affect Tribal rights or resources. In addition to these general legal consequences of treaty-making, the individual treaty itself defines particular new roles and responsibilities of the two governments, within the terms of the new legal relationship created by the treaty.

Every Federal agency that makes decisions potentially affecting the rights or resources of federally recognized American Indian Tribes shares in the trust responsibility duties of the Federal government. This trust responsibility includes the duty to consult with those Tribes concerning the potential impacts of agency decisions. As a result, DOE regularly consults with the CTUIR, the Confederated Tribes and Bands of the Yakama Nation, and the Nez Perce Tribe concerning decisions being made by DOE on the Hanford Site that might affect Tribal rights or resources. Land-use planning decisions are within the realm of such decisions. DOE invited all affected Tribes to participate in the drafting of the HRA-EIS. The U.S. Department of Energy, Richland Operations Office (RL) will continue to consult with these Tribes during the further development and implementation of this environmental impact statement (EIS). Copies of the Treaties are presented in Appendix A.

7.1.2 International Treaties of the United States

7.1.2.1 Migratory Bird Treaty Act of 1918. The *Migratory Bird Treaty Act of 1918*, as amended, is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. The law regulates the harvest of migratory birds by specifying factors such as the mode of harvest, hunting seasons, and bag limits. This Act stipulates that, except as permitted by regulations, it is unlawful at any time, by any means, or in any manner to “kill . . . any migratory bird.” The DOE is required to consult with the U.S. Fish and Wildlife Service (USFWS) regarding impacts to migratory birds and to evaluate ways to avoid or minimize impacts in accordance with the USFWS migration policy.

7.1.2.2 Pacific Salmon Treaty Act of 1985. The *Pacific Salmon Treaty Act of 1985* ratified a treaty between the United States and Canada concerning Pacific salmon. The law is intended to protect and maintain Pacific salmon fisheries by regulating the fishing season. The law establishes panels with jurisdiction over certain areas. Associated regulations close the panel area to sockeye and pink salmon fishing unless opened by panel regulations or by in season orders of the Secretary of Commerce that give the effect to panel orders.

7.1.3 Federal Natural Resource Management, Pollution Control, and Cultural Resource Laws

7.1.3.1 National Environmental Policy Act of 1969. The *National Environmental Policy Act of 1969* (NEPA), as amended, establishes a national policy that encourages awareness of the environmental consequences of human activities and promotes consideration of those environmental consequences during the planning and implementing stages of a project. Under NEPA, Federal agencies are required to prepare detailed statements to address the environmental effects of proposed major Federal actions that might significantly affect the quality of the human environment. The HRA-EIS has been prepared in accordance with NEPA requirements and policies, and presents reasonable alternatives and the potential environmental consequences of those alternatives.

7.1.3.2 Clean Air Act of 1970. The *Clean Air Act of 1970* (CAA), as amended, is intended to “protect and enhance the quality of the Nation’s air resources so as to promote the public health and welfare and the productive capacity of its population.” Section 118 of the CAA requires each Federal agency, with jurisdiction over properties or facilities engaged in any activity that might result in the discharge of air pollutants, to comply with all Federal, state, interstate, and local requirements with regard to the control and abatement of air pollution.

Under Section 109 of the CAA, the U.S. Environmental Protection Agency (EPA) is required to establish national ambient air quality standards (NAAQS) that protect public health from known or anticipated adverse effects of a regulated pollutant. Section 111 of the CAA requires establishment of national performance standards for new or modified stationary sources of atmospheric pollutants. Specific emission increases must be evaluated in order to prevent significant deterioration of air quality. Hazardous air pollutants, including radionuclides, are regulated separately. Emissions of air pollutants are regulated by the EPA in 40 CFR 50-99. Radionuclide emissions and hazardous air pollutants are regulated under the National Emissions Standards for Hazardous Air Pollutants Program (40 CFR 61 and 40 CFR 63).

7.1.3.3 Safe Drinking Water Act of 1974. The primary objective of the *Safe Drinking Water Act of 1974* (SDWA), as amended, is to protect the quality of the public water supply and sources of drinking water. In the State of Washington, the EPA has the authority to implement regulations to establish standards applicable to public water systems. These regulations further establish the maximum contaminant levels, including maximum levels of radioactivity, that are allowed in public drinking water systems. The EPA has promulgated the SDWA requirements in 40 CFR 140-149. Current regulations (40 CFR 141) specify that the average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 mrem/yr. Revisions to the limits regulating radionuclides have been proposed by the EPA.

Other programs established by the SDWA include the Sole Source Aquifer Program, the Wellhead Protection Program, and the Underground Injection Control Program.

7.1.3.4 Clean Water Act of 1977. The *Clean Water Act of 1977* (CWA), as amended, was enacted to "restore and maintain the chemical, physical and biological integrity of the Nation's water." The CWA prohibits "discharge of toxic pollutants in toxic amounts" to navigable waters of the United States. Section 313 of the CWA requires all branches of the Federal government with jurisdiction over properties or facilities engaged in any activity that might result in a discharge or runoff of pollutants to surface waters, to comply with Federal, state, interstate, and local requirements.

In addition to setting water quality standards for waterways, the CWA provides guidelines and limitations for effluent discharges from point sources and gives authority for the EPA to implement the National Pollutant Discharge Elimination System (NPDES) Permitting Program. The NPDES Program is administered by the Water Management Division of the EPA (40 CFR 122).

In 1987, the CWA was amended and EPA was required to establish regulations for issuing permits for stormwater discharges associated with industrial activity. Stormwater discharges are permitted through the NPDES Program, and general permit requirements are published in 40 CFR 122.

7.1.3.5 Resource Conservation and Recovery Act of 1976. Treatment, storage, and/or disposal of hazardous and nonhazardous waste is regulated under the *Solid Waste Disposal Act of 1965,* which was amended by the *Resource Conservation and Recovery Act of 1976* (RCRA), and the *Hazardous and Solid Waste Amendments of 1984*. Any state that seeks to administer and enforce a hazardous waste program pursuant to RCRA may apply for EPA authorization of the state program. The Washington State Department of Ecology (Ecology) has been delegated the authority for implementing the Federal RCRA program in the State of Washington. The EPA regulations implementing RCRA define hazardous wastes and specify the transportation, handling, and waste management requirements of these wastes (40 CFR 260-280).

The *Federal Facilities Compliance Act of 1992* (FFCA) amends RCRA and waives sovereign immunity for fines and penalties for RCRA violations at Federal facilities. A provision of the FFCA postpones fines and penalties for three years for mixed waste storage prohibition violations at DOE sites and requires DOE to prepare plans for developing the required treatment capacity for mixed waste stored or generated at each facility. Each plan must be approved by the host state or the EPA, after consultation with other affected states, and a consent order requiring compliance with the plan must be issued by the regulator. The FFCA also states that DOE will not be subject to fines and penalties for land disposal restriction storage prohibition violations for mixed waste as long as DOE is in compliance with an approved plan and consent order and meets all other applicable regulations.

7.1.3.6 Comprehensive Environmental Response, Compensation, and Liability Act of 1980. The *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) provides a statutory framework for the remediation of waste sites containing hazardous substances and, as amended by the *Superfund Amendments and Reauthorization Act of 1986* (SARA), an emergency response program in the event a release (or threat of a release) of a hazardous substance to the environment occurs. Using a hazard ranking system, Federal and private contaminated sites are ranked and may be included on the National Priorities List. CERCLA requires Federal facilities with contaminated sites to undertake investigations, remediation, and natural resource restoration, as necessary.

7.1.3.7 Emergency Planning and Community Right-to-Know Act of 1986. Under Subtitle A of the *Emergency Planning and Community Right-to-Know Act of 1986*, also known as the *Superfund Amendments and Reauthorization Act of 1986* (SARA Title III), Federal facilities are required to provide information regarding the inventories of chemicals used or stored at a site and releases from that site to the State Emergency Response Commission and the Local Emergency Planning Committee. This requirement ensures that emergency plans are sufficient to respond to unplanned releases of hazardous substances. Implementation of provisions in the *Emergency Planning and Community Right-to-Know Act of 1986* began voluntarily in 1987; inventory and emissions reporting began in 1988 based on 1987 activities and information. The requirements of the *Emergency Planning and Community Right-to-Know Act of 1986* are promulgated by the EPA in 40 CFR 350-372. The DOE requires compliance with SARA Title III.

7.1.3.8 Toxic Substances Control Act of 1976. The *Toxic Substances Control Act of 1976* (TSCA) provides the EPA with the authority to require testing of chemical substances (both new and old) entering the environment and, where necessary, to regulate those chemicals. The law complements and expands other toxic substance laws such as Section 112 of the CAA and Section 307 of the CWA. The TSCA was enacted because there were no Federal regulations requiring evaluation of potential environmental or health effects from the thousands of chemicals being developed and released to the public or commerce annually. The TSCA also regulates the treatment, storage, and disposal of certain toxic substances (e.g., polychlorinated biphenyls, chlorofluorocarbons, asbestos, dioxins, certain metal-working fluids, and hexavalent chromium).

7.1.3.9 Pollution Prevention Act of 1990. The *Pollution Prevention Act of 1990* establishes a national policy for waste management and pollution control. This Act focuses first on source reduction, followed sequentially by environmentally safe recycling and treatment and, as a last resort, disposal or other release into the environment. The DOE has committed to participation in Section 313 of SARA, the EPA 33/50 Pollution Prevention Program. The goal for facilities involved in Section 313 compliance is a 33 percent reduction in releases of 17 priority chemicals by 1997 (based on a 1993 baseline). On August 3, 1993, Executive Order 12856 was issued. This Executive Order expands the 33/50 Pollution Prevention Program and requires DOE to reduce total releases of all toxic chemicals by 50 percent by December 31, 1999. Each DOE site is, therefore, establishing site-specific goals to reduce generation of all waste types.

7.1.3.10 National Historic Preservation Act of 1966. The *National Historic Preservation Act of 1966*, as amended, requires nomination for placement of sites with significant national historic value on the National Register of Historic Places (NPS 1988). Permits and certifications are not required under this Act; however, consultation with the Advisory Council on Historic Preservation is required if a Federal undertaking might impact a historic property resource. This consultation generally results in a Memorandum of Agreement (MOA) that includes stipulations to minimize adverse impacts to the historic resource. Coordination with the State Historic Preservation Office is undertaken to ensure that potentially significant sites are properly identified and appropriate mitigation measures are implemented.

7.1.3.11 Archaeological Resources Protection Act of 1979. The *Archaeological Resources Protection Act of 1979*, as amended, requires a permit for any excavation or removal of archaeological resources from Federal or Indian lands. Excavations must be undertaken for the purpose of furthering archaeological knowledge in the public interest, and resources removed are to remain the property of the United States. Consent must be obtained from the Indian Tribe or the Federal agency having authority over the land on which a resource is located before issuance of a permit; the permit must contain terms and conditions requested by the Tribe or Federal agency.

7.1.3.12 Native American Graves Protection and Repatriation Act of 1990. The *Native American Graves Protection and Repatriation Act of 1990* directs the Secretary of the Interior to guide Federal agencies in the repatriation of Federal archaeological collections and collections affiliated culturally to American Indian Tribes, which are currently held by museums receiving Federal funding. This Act established statutory provisions for the treatment of inadvertent discoveries of American Indians' remains and cultural objects. Specifically, when discoveries are made during ground disturbing activities, the following must take place: (1) activity in the area of the discovery must cease immediately, (2) reasonable efforts must be made to protect the items discovered, (3) notice of discovery must be given to the agency head (DOE) and the appropriate Tribes, and (4) a period of 30 days must be set aside following notification for negotiations regarding the appropriate disposition of these items.

7.1.3.13 American Indian Religious Freedom Act of 1978. The *American Indian Religious Freedom Act of 1978* reaffirms American Indians' religious freedom under the First Amendment and sets United States policy to protect and preserve the inherent and constitutional right of American Indian Tribes to believe, express, and exercise traditional religions. This Act also requires that Federal agencies avoid interfering with access to sacred locations and traditional resources that are integral to the practice of religion.

7.1.3.14 Endangered Species Act of 1973. The *Endangered Species Act of 1973*, as amended, is intended to prevent further decline of endangered and threatened species and to restore those species and their habitats. This Act is jointly administered by the Departments of Commerce and Interior. Section 7 of this Act requires agencies to consult with the USFWS or the National Marine Fisheries Service. This consultation determines whether endangered and threatened species or critical habitats are known to be in the vicinity of a proposed action, and whether an action will adversely affect listed species or designated critical habitats.

7.1.3.15 Bald and Golden Eagle Protection Act of 1972. The *Bald and Golden Eagle Protection Act of 1972*, as amended, makes it unlawful to take, pursue, molest, or disturb bald and golden eagles, their nests, or their eggs anywhere in the United States. A permit must be obtained from the U.S. Department of the Interior (DOI) to relocate a nest that interferes with resource development or recovery operations.

7.1.3.16 Wild and Scenic Rivers Act of 1968. The *Wild and Scenic Rivers Act of 1968*, as amended, protects selected national rivers possessing outstanding scenic, recreational, geological, fish and wildlife, historical, cultural, or other similar values. These rivers are to be preserved in a free-flowing condition to protect water quality and for other vital national conservation purposes. This Act also instituted a National Wild and Scenic Rivers system, designated the initial rivers within the system, and developed standards for the addition of new rivers in the future.

7.1.3.17 Nuclear Waste Policy Act of 1982. The *Nuclear Waste Policy Act of 1982*, as amended, authorizes Federal agencies to develop a geologic repository for the permanent disposal of spent nuclear fuel and high-level radioactive waste. This Act specifies the process for selecting a repository site and constructing, operating, closing, and decommissioning the repository, and also establishes programmatic guidance for these activities.

7.1.3.18 Atomic Energy Act of 1954. The *Atomic Energy Act of 1954 (*AEA), as amended, authorizes DOE to establish standards to protect health or minimize dangers to life or property with respect to activities under DOE jurisdiction. The DOE has used a series of departmental orders to establish an extensive system of standards and requirements to ensure safe operation of DOE facilities.

The AEA and related statutes give EPA the responsibility and authority for developing applicable environmental standards for protection of the general environment from radioactive materials. The EPA has promulgated several regulations under this authority.

7.1.3.19 Occupational Safety and Health Act of 1970. The *Occupational Safety and Health Act of 1970*, as amended, establishes standards to enhance safe and healthy working conditions in places of employment throughout the United States. The *Occupational Safety and Health Act of 1970* is administered and enforced by the Occupational Safety and Health Administration (OSHA), a U.S. Department of Labor agency. Although the OSHA and the EPA both have a mandate to limit exposures to toxic substances, the jurisdiction of the OSHA is limited to safety and health conditions in the workplace. In general, each employer is required to furnish a place of employment free of recognized hazards likely to cause death or serious physical harm to all employees. The OSHA regulations establish specific standards telling employers what must be done to achieve a safe and healthy working environment. Employees have a duty to comply with these standards and with all rules, regulations, and orders issued by OSHA.

The DOE places emphasis on compliance with OSHA regulations at DOE facilities. Through DOE orders, DOE prescribes that contractors shall meet OSHA standards applicable to work at government-owned, contractor-operated facilities. The DOE maintains and makes available the various records of minor illnesses, injuries, and work-related deaths, as required by OSHA regulations.

7.1.3.20 Comprehensive Conservation Study of the Hanford Reach of the Columbia River, Public Law 100-605. Public Law 100-605, passed by Congress on November 4, 1988, authorizes a comprehensive study of the Hanford Reach of the Columbia River to identify the outstanding features of the Hanford Reach and its immediate environment (including fish and wildlife, geologic, scenic, recreational, natural, historical, and cultural values), and to examine alternatives for their preservation. The Secretary of the Interior has affirmed the addition of the Hanford Reach to the National Wild and Scenic Rivers System and is waiting for Congressional action to implement the decision.

The Secretary of the Interior is charged with reviewing proposed actions within the study corridor to determine if there will be a direct and adverse effect on the values for which the Hanford Reach is under study and, if so, to provide recommendations for mitigation. In 1996, Public Law 104-333, *Omnibus Parks and Public Lands Management Act of 1996*, was enacted. Section 404 of this Act amended Public Law 100-605 to extend the Secretary's environmental review responsibility indefinitely and permanently prohibited any damming, dredging, or navigation project within the Hanford Reach.

7.1.3.21 Mining Law of 1872, as amended. *The Mining Law of 1872*, as amended, permits prospecting and mining on the unappropriated public domain for hardrock minerals (the Hanford Site is not considered unappropriated public domain). Congress declared that it is the continuing policy of the Federal government to foster and encourage private enterprise in (1) the development of economically sound and stable domestic mining, minerals, metals and mineral reclamation industries; (2) the economic development of domestic mineral resources, reserves, and reclamation of metals and minerals; (3) mining, mineral, and metallurgical research, including the use and recycling of scrap to promote the efficient use of natural and reclaimable resources; and (4) the study and development of methods for the disposal, control, and reclamation of mineral waste products and the reclamation of mined land, to lessen the adverse impact of mineral extraction and processing on the physical environment.

7.1.3.22 Archeological and Historic Preservation Act of 1974. The *Archaeological and Historic Preservation Act of 1974*, as amended, protects sites that have historic and prehistoric importance.

7.1.3.23 Fish and Wildlife Conservation Act of 1980. The *Fish and Wildlife Conservation Act of 1980*, as amended, encourages all Federal entities (in cooperation with the public) to protect and conserve the nation's fish and wildlife.

7.1.3.24 Fish and Wildlife Coordination Act of 1934. *The Fish and Wildlife Coordination Act of 1934*, as amended, promotes more effectual planning and cooperation between Federal, state, public, and private agencies for the conservation and rehabilitation of the nation's fish and wildlife and authorizes the DOI to provide assistance.

7.1.3.25 National Wildlife Refuge System Administration Act of 1966 (as amended by the National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57). The *National Wildlife Refuge System Administration Act of 1966*, as amended, provides guidelines and directives for the administration and management of all lands within the system, including "wildlife refuges, areas for the protection and conservation of fish and wildlife that are threatened with extinction, wildlife ranges, game ranges, wildlife management areas, or waterfowl production areas." The Secretary of the Interior is authorized to permit by regulations the use of any area within the system provided "such uses are compatible with the major purposes for which such areas were established."

7.1.3.26 Noise Control Act of 1972. The *Noise Control Act of 1972*, as amended, directs all Federal agencies to carry out, to the fullest extent within agency authority, programs within agency jurisdiction in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare.

7.1.3.27 American Antiquities Preservation Act of 1906. The *American Antiquities Preservation Act of 1906*, as amended, protects historic and prehistoric ruins, monuments, and antiquities, including paleontological resources, on federally controlled lands.

7.1.3.28 Federal Insecticide, Fungicide, and Rodenticide Act of 1972. The *Federal Insecticide, Fungicide, and Rodenticide Act of 1972*, as amended, governs the storage, use, and disposal of pesticides through product labeling, registration, and user certification.

7.1.3.29 Federal Land Policy and Management Act of 1976. The *Federal Land Policy and Management Act of 1976*, as amended, governs the use of Federal lands which may be overseen by several agencies and establishes the procedure for applying to the U.S. Bureau of Land Management (BLM) for land withdrawals and right-of-ways.

7.1.3.30 Federal Water Pollution Control Act Amendments of 1972. The *Federal Water Pollution Control Act Amendments of 1972* is the predecessor Federal statute to the *Clean Water Act of 1977*.

7.1.3.31 Historic Sites, Buildings, and Antiquities Act of 1965. The *Historic Sites, Buildings, and Antiquities Act of 1965* sets national policy to preserve historic sites, buildings, and antiquities for the inspiration and benefit of the people of the United States.

7.1.3.32 Materials Act of 1947. The *Materials Act of 1947* provides for the management of minerals, timber, and other construction resource materials on public lands.

7.1.3.33 Federal Urban Land-Use Act of 1949. The *Federal Urban Land-Use Act of 1949* was enacted to promote harmonious intergovernmental relations. The Act also encourages sound planning, zoning, and land-use practices by prescribing uniform policies and implementing procedures in order that land transactions entered into for the General Services Administration or on behalf of other Federal agencies be consistent with zoning and land-use practices and be made in accordance with planning and development objectives of local governments and local planning agencies concerned.

7.1.3.34 National Defense Authorization Act, Public Law 104-201. Section 3153 of the National Defense Authorization Act requires DOE to develop a future-use plan for defense nuclear facilities, including the Hanford Site. The future-use plans required under this section must address a planning period of at least the next 50 years. The DOE prepared an overview report, *Planning for the Future, An Overview of Future Use Plans at Department of Energy Site*s, which provided a summary of the future land-use planning processes at the Hanford Site, the Idaho National Engineering and Environmental Laboratory, the Rocky Flats Environmental Technology Site, and the Savannah River Site. This overview report was delivered to Congress on October 7, 1998. In addition, DOE submitted the current future-use plans for three of the above four sites, excluding Hanford. Hanford's CLUP will be delivered to members of Congress with the distribution of this Final HCP EIS.

7.2 State Laws

State and local statutes also apply to activities at the Hanford Site when Federal law delegates enforcement or implementation authority to state or local agencies. In general, state laws do not apply to the Federal government based on the National Supremacy Clause that reads, "This constitution, and the laws of the United States which shall be made in pursuance thereof; and all treaties made, or which shall be made, under the authority of the United States, shall be the supreme law of the land; and the judges in every state shall be bound thereby, any thing in the constitution or laws of any state to the contrary notwithstanding" (Article 4, U.S. Constitution).

7.2.1 State Environmental Policy Act of 1971

The Washington State legislature enacted the *State Environmental Policy Act of 1971* (SEPA). The statute was amended in 1983, and new implementing regulations (the SEPA rules) were adopted and codified by Ecology in 1984 as *Washington Administrative Code* (WAC) 197-11. The purpose and policy sections of the statute are extremely broad, including recognition by the legislature that "each person has a fundamental and inalienable right to a healthful environment. . . ." SEPA contains a substantive mandate that "policies, regulations, and laws of the State of Washington shall be interpreted and administered in accordance with the policies set forth in [SEPA]."

SEPA applies to all branches of state government, including state agencies, municipal and public corporations, and counties. It requires each agency to develop procedures implementing and supplementing SEPA requirements and rules. Although the SEPA does not apply directly to Federal actions, the term "government action" with respect to state agencies is defined to include the issuance of licenses, permits, and approvals. Thus, as in NEPA, proposals (Federal, state, or private) are evaluated, and may be conditioned or denied through the permit process, based on environmental considerations. SEPA does not create an independent permit requirement, but overlays all existing agency permitting activities.

7.2.2 Hazardous Waste Management Act of 1976

The Federal RCRA program allows state enforcement if the state program is consistent with the Federal program and is at least as stringent. Through the *Hazardous Waste Management Act of 1976*, Ecology has enacted hazardous waste regulations that are consistent with and as stringent as (or more stringent than) the Federal program. Washington has been delegated authority to implement RCRA and *Hazardous and Solid Waste Amendments of 1984* programs. Regulated parties must comply with the requirements of both the Federal program, pursuant to regulations in 40 CFR 260-280, and the state program, pursuant to the requirements of the *Hazardous Waste Management Act of 1976* and WAC 173-303, "Dangerous Waste Regulations."

7.2.3 Model Toxics Control Act of 1989

The State of Washington has adopted a statutory "Superfund" scheme for identifying and responding to releases of hazardous substances. Known as the *Model Toxics Control Act of 1989* (MTCA), the State of Washington law supplements CERCLA. Under this Act, Ecology must investigate and prioritize hazardous waste release sites, provide technical assistance to "potentially liable parties" desiring to perform cleanups, set cleanup standards for hazardous substances, undertake cleanups where appropriate, require and assist in or perform cleanups, provide opportunities for public involvement, establish a scientific advisory board, and regularly report to the legislature. The statute empowers Ecology to gain access to property, enter into settlements (either through administrative orders or consent decrees), file actions or issue orders to compel cleanups, and impose civil penalties and seek recovery of state cleanup costs.

7.2.4 Water Pollution Control Act of 1945

The *Water Pollution Control of 1945*, as amended, establishes a permit system to license and control the discharge of pollutants into waters of the state. Under the permit system, dischargers must reduce releases to a level determined to be technologically and economically achievable, regardless of the condition of the receiving water. Dischargers also must maintain or improve the condition of the receiving water. The state has a general policy prohibiting degradation of existing water quality, and a variety of approaches are used to address the problem of toxic pollutants. Permits are required for both point-source and nonpoint-source discharges.

7.2.5 Growth Management Act of 1989

Most planning by local governments falls under the *State of Washington Growth Management Act* (GMA), which established a state-wide planning framework and created roles and responsibilities for planning at the local, regional, and state levels. The GMA required the largest and fastest growing counties (counties with more than 50,000 people or with a population growth of more than 20 percent in the past 10 years) and cities within those counties to develop new comprehensive plans. Counties not required to plan may elect to do so. Benton, Franklin, and Grant counties, along with the City of Richland, have elected to plan under the GMA requirements. Jurisdictions under GMA must prepare comprehensive plans that project growth for a minimum of 20 years.

7.2.6 Air Quality Regulations

Most of the provisions of the *Washington Clean Air Act of 1991* (WCAA) mirror the requirements of the *Federal Clean Air Act Amendments of 1990* (Federal CAAA). The Federal CAAA establishes a minimum or "floor" for Washington air quality programs. The WCAA authorizes Ecology and local air pollution control authorities to implement programs consistent with the Federal CAAA. For example, the WCAA authorizes an operating permit program, enhanced civil penalties, new administrative enforcement provisions, motor vehicle inspections, and provisions addressing ozone and acid rain.

Washington State also has an extensive set of regulations governing toxic air pollutants (TAPs) (WAC 173-460). These regulations are similar to the programs for regulating hazardous air pollutants (HAP) required by the Federal CAAA. In contrast to the Federal CAAA HAPs program, which applies to new and existing emission sources, the TAP rules apply only to new sources of TAPs, including any modification of an existing source where the modification will increase TAP emissions. Furthermore, Ecology refers to a list of more than 450 individual chemicals that are deemed to be TAPs. The list overlaps with the Federal CAAA list of HAPs, but is considerably longer. The TAP rules are implemented under the New Source Review Program, and the regulatory standard for TAPs is "best available control technology."

The Washington State Department of Health regulations, "Radiation Protection—Air Emissions" (WAC 246-247), contain standards and permit requirements for the emission of radionuclides to the atmosphere from DOE facilities based on Ecology standards, "Ambient Air Quality Standards and Emission Limits for Radionuclides" (WAC 173-480).

The local air authority, Benton County Clean Air Authority, enforces regulations pertaining to detrimental effects, fugitive dust, incineration products, odor, opacity, asbestos, and sulfur oxide emissions. The Benton County Clean Air Authority also has been delegated authority to enforce the EPA asbestos regulations.

7.2.7 The Shoreline Management Act of 1971

The *Shoreline Management Act of 1971* (RCW 90.58) uses authority passed to the state by the Federal *Rivers and Harbors Act of 1899* (33 U.S.C. 401-413; Section 407, referred to as the *Refuse Act*). Section 10 of the *Rivers and Harbors Act of 1899* prohibits the unauthorized obstruction or alteration of any navigable waters of the United States. Examples of activities requiring a U.S. Army Corps of Engineers permit (33 CFR 322) include constructing a structure in or over any waters of the United States, excavation or deposit of material in such waters, and various types of work performed in such waters, including fill and stream channelization. The state is considered the owner of all navigatible waterways within its boundaries.

The state has passed regulatory responsibility for the *Shoreline Management Act of 1971* to the affected county. Counties in Washington State regulate the shoreline (i.e., from the high-water mark to the low-water mark) through each county's Shoreline Management Master Plan and a shoreline permit system consistent with Ecology guidelines (WAC 173-16).

7.3 Executive Orders

This section identifies Presidential Executive Orders that clarify issues of national policy and provide guidelines relevant to Hanford Site land-use planning.

7.3.1 Executive Order 11593, Protection and Enhancement of the Cultural Environment

Executive Order 11593 requires Federal agencies to direct their policies, plans, and programs in a way that preserves, restores, and maintains federally owned sites, structures, and objects of historical or archaeological significance.

7.3.2 Executive Order 11988, Floodplain Management

Executive Order 11988 directs Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for actions undertaken in a floodplain. The Order further directs that floodplain impacts are to be avoided to the extent practicable.

7.3.3 Executive Order 11990, Protection of Wetlands

Governmental agencies are directed by Executive Order 11990 to avoid, to the extent practicable, any short- and long-term adverse impacts on wetlands wherever there is a practicable alternative. The DOE has issued regulations for compliance with this Order and Executive Order 11988 (10 CFR 1022).

7.3.4 Executive Order 12088, Federal Compliance with Pollution Control Standards

Executive Order 12088 was issued on October 13, 1978. This Order directs Federal agencies to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the CWA, the CAA, the SDWA, TSCA, and RCRA. This Order was amended by Executive Order 12580, issued on January 23, 1987.

7.3.5 Executive Order 12372, Intergovernmental Review of Federal Programs

Executive Order 12372 applies to state review of NEPA documents and to the coordination of state and Federal NEPA processes. The goal of this Executive Order is to foster an intergovernmental partnership and a strengthened coordination and consultation process.

7.3.6 Executive Order 12411, Government Work Space Management Reforms

Executive Order 12411 requires the heads of all Federal executive agencies to establish programs to reduce the amount of work space, used or held, to that amount which is essential for known agency missions; to produce and maintain a total inventory of work space and related furnishings and declare excess to the Administrator of General Services all such holdings that are not necessary to satisfy existing or known and verified planned programs; and to ensure that the amount of office space used by each employee of the agency, or others using agency-controlled space, is held to the minimum necessary to accomplish the task that must be performed.

7.3.7 Executive Order 12512, Federal Real Property Management

Executive Order 12512 authorizes the Administrator of General Services to provide government-wide policy oversight and guidance for Federal real property management. This Executive Order requires all executive departments and agencies to establish internal policies and systems of accountability that ensure effective use of real property in support of mission-related activities, consistent with Federal policies regarding the acquisition, management, and disposal of such assets. All such agencies shall also develop annual real property management improvement plans that include clear and concise goals and objectives related to all aspects of real property management; and identify sales, work space management, productivity, and excess property targets.

7.3.8 Executive Order 12580, Superfund Implementation

Executive Order 12580 delegates to the heads of executive departments and agencies the responsibility (1) for undertaking remedial actions for releases, or threatened releases, that are not on the National Priorities List; and (2) for removal actions where the release is from a facility under the jurisdiction or control of executive departments and agencies.

7.3.9 Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements

Executive Order 12856 directs Federal agencies to reduce and report toxic chemicals entering any waste stream; improve emergency planning, response, and accident notification; and encourage clean technologies and testing of innovative prevention technologies. The Executive Order also provides that Federal agencies are persons for purposes of the *Emergency Planning and Community Right-to-Know Act of 1986* (SARA Title III), which obliges agencies to meet the requirements of that Act.

7.3.10 Executive Order 12866, Regulatory Planning and Review

Executive Order 12866 requires Federal agencies to promulgate only regulations that are required by law, necessary to interpret the law, or necessary by compelling public need. Agencies are further required to assess costs and benefits associated with available regulatory alternatives in deciding how, and whether, to regulate. This Executive Order also outlines principles that agencies are to follow in the regulatory process, including avoidance of regulations that are inconsistent, incompatible, or duplicative with other regulations and tailoring regulations to impose the least burden on society. The Order also addresses the regulatory planning and review process, including coordination of regulations and maximizing consultation and resolution of conflicts at an early stage in the process. Agencies are also directed to review existing regulations to determine if those regulations should be modified of eliminated. Procedures for centralized review of regulations and resolution of conflicts are also identified in this Executive Order. This Order revokes Executive Orders 12291 and 12498.

7.3.11 Executive Order 12875, Enhancing the Intergovernmental Partnership

Executive Order 12875 addresses the imposition of unfunded mandates upon State, local and Tribal governments by Federal agencies. The Order directs agencies to avoid promulgating regulations that create an unfunded mandate that is not required by statute unless funding is available to pay costs incurred by State, local, or Tribal governments, and to develop an effective process for representatives of these governments to provide meaningful and timely input into the development of regulatory proposals that contain significant unfunded mandates. The Order further directs agencies to increase flexibility for State and local waivers. Executive Order 12875 supplements, but does not supercede, Executive Order 12866.

7.3.12 Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 12898 directs all Federal agencies, to the greatest extent practicable and permitted by law, to achieve environmental justice by identifying and addressing disproportionately high and adverse human health or environmental effects of agency programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions. The Executive Order creates an Interagency Working Group on Environmental Justice and directs each Federal agency, to the extent permitted by existing law, to develop strategies to identify and address environmental justice concerns. The Order further directs each Federal agency, to the extent permitted by existing law, to collect, maintain, analyze, and make available information on the race, national origin, income level, and other readily accessible and appropriate information for areas surrounding facilities or sites expected to have a substantial environmental, human health, or economic effect on the surrounding populations. This action is required when these facilities or sites become the subject of a substantial Federal environmental administrative or judicial action. The accompanying

Presidential letter to heads of agencies identifies documents prepared under NEPA as the vehicle for complying with the Order.

7.3.13 Executive Order 13007, Indian Sacred Sites

Executive Order 13007 directs Federal agencies to take measures to protect and preserve American Indian Tribes' religious practices. Federal agencies shall, to the extent practicable and permitted by law, and when consistent with essential agency functions, accommodate access to and ceremonial uses of sacred sites by American Indian Tribes' religious practitioners. Further, the Executive Order states that Federal agencies will comply with presidential direction to maintain government-to-government relations with Tribal governments.

7.3.14 Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks

Because a growing body of scientific knowledge demonstrates that children may suffer disproportionately from environmental health and safety risks, Executive Order 13045 directs each Federal agency to make it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children. Each Federal agency will, to the extent permitted by law and appropriate, and consistent with the agency mission, ensure that its policies, programs, activities, and standards address potential disproportionate risks to children.

7.3.15 Executive Order, Invasive Species

Issued on February 11, 1999, Executive Order 13112, *Invasive Species*, is intended to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. The Executive Order establishes an Invasive Species Council, whose members include the Secretaries of numerous Federal agencies (not including DOE), and a stakeholders' Advisory Committee to provide information and advice to the Council. Within 18 months after issuance of this Executive Order, the Council is to have prepared and issued a National Invasive Species Management Plan detailing and recommending performance-oriented goals and objectives and specific measures of success for Federal agencies concerned about invasive species. The Management Plan, which will be updated biennially, is to be developed through a public process and in consultation with Federal agencies and stakeholders.

7.4 Presidential and Executive Branch Policies

President Clinton issued a memorandum to the heads of executive departments and agencies regarding government-to-government relations with Tribal governments on April 29, 1994. This memorandum directed executive departments and agencies to implement activities that affect Tribal rights in a "knowledgeable, sensitive manner respectful of tribal sovereignty." The memorandum outlined principles for executive departments and agencies to follow in their interactions with Tribal governments and clarify the responsibility of the Federal government to operate within a government-to-government relationship with federally recognized American Indian Tribes.

The U.S. Department of Justice recently reaffirmed a long-standing policy regarding the relationship between the Federal government and American Indian Tribes (61 FR 29424). The policy states that the United States recognizes the sovereign status of Indian Tribes as "domestic dependent nations" from its earliest days. The Constitution recognizes Indian sovereignty by classifying Indian treaties among the "supreme Law of the Land," and establishes

Indian affairs as a unique area of Federal concern.

The DOE American Indian policy commits DOE to working with Tribal governments on a government-to-government basis, recognizes the Federal trust relationship with Tribes and Tribal members' treaty rights, and commits the department to consultation with Tribes regarding agency activities that could potentially affect the Tribes.

7.5 U.S. Department of Energy Regulations, Orders, and Other Agreements and Requirements

This section identifies DOE regulations implementing statutory environmental, health, and safety protection responsibilities and requirements that must be met by operating contractors.

The DOE is responsible for establishing a comprehensive health, safety, and environmental program for its facilities, as authorized by the *Atomic Energy Act of 1954* (AEA). The regulatory mechanisms used by DOE to manage its facilities are the promulgation of regulations and issuance of DOE orders.

DOE regulations are found in Title 10 of the CFR. These regulations address such areas as energy conservation, administrative requirements and procedures, nuclear safety, and classified information. For purposes of this EIS, relevant regulations include the following:

- 10 CFR 820, "Procedural Rules for U.S. Department of Energy Nuclear Activities"
- 10 CFR 830.120, "Quality Assurance Requirements"
- 10 CFR 834, "Radiation Protection of the Public and the Environment"
- 10 CFR 835, "Occupational Radiation Protection"
- 10 CFR 1021, "*National Environmental Policy Act* Implementing Procedures"
- 10 CFR 1022, "Compliance with Floodplain/Wetlands Environmental Review Requirements."

The DOE orders generally set forth policies and identify the need for programs and internal procedures to implement those policies.

The DOE, represented by the Bonneville Power Administration, entered into the *Vernita Bar Settlement Agreement* with several Public Utility Districts, the National Marine Fisheries Service, the States of Washington and Oregon, the Confederated Tribes of the Yakama Nation, the CTUIR, and the Confederated Tribes of the Colville Indian Reservation in June 1988. The Agreement established the obligation of the parties to protect mid Columbia summer/fall Chinook Salmon run at Vernita Bar by requiring maintenance of a sufficient amount of water flowing over Vernita Bar (protection-level flow) to provide protection to salmon redds. The Agreement was approved by the Federal Energy Regulatory Commission as a condition of license for the Priest Rapids Dam. Flows are to be maintained through the spawning period, pre-hatch period, post-hatch period, and emergence period, from approximately December 15 through May 31 each year. The Agreement limits river flow in the fall to 1,960 cubic meters per second (70,000 cubic feet per second), with post-spawning flows determined annually based on field surveys that identify when, where, and to what extent spawning has occurred (NPS 1994). Parties to the agreement may request reopening of the agreement and the imposition by the Federal Energy

Regulatory Commission of different, additional, or modified fall Chinook salmon protection measures at Vernita Bar.

The Office of Management and Budget Circular A-95 provides guidance to Federal agencies for cooperation with state and local agencies in the evaluation, review, and coordination of Federal and federally assisted programs and projects.

7.6 Consultations

The NEPA and the Council on Environmental Quality (CEQ) regulations require consultation with Federal, Tribal, state, and local agencies with jurisdiction or special expertise regarding any environmental impact. Agencies involved include those with authority to issue applicable permits, licenses, and other regulatory approvals; as well as those agencies responsible for protecting significant resources (e.g., endangered species, critical habitats, or historic resources). Federal and state agencies and Tribal governments have been, and will continue to be, consulted during the development of the Final HCP EIS. Representatives of Federal, Tribal, state, and local agencies were involved in scoping for the HRA-EIS through involvement in the Hanford Future Site Uses Working Group and will be consulted in the preparation of the Final HCP EIS. Copies of letters from DOE inviting the participation of cooperating agencies and consulting Tribal governments are presented in Appendix B. Copies of response letters received by DOE are also included.

7.6.1 Consultation with Other Federal Agencies

In accordance with CEQ guidance encouraging lead agencies to consult with other agencies during the NEPA process, DOE invited other Federal agencies to participate in scoping and development of the Final HCP EIS. The DOI (USFWS and the National Park Service [NPS]) and the EPA were represented on the Hanford Future Site Uses Working Group and assisted in developing the group's report (FSUWG 1992), which was adopted as a scoping comment for the HRA-EIS. The emphasis of the HRA-EIS on future land use led to the development of a comprehensive land-use plan for the Hanford Site, which was issued as Appendix M to the August 1996 Draft HRA-EIS. Other Federal agencies were invited to participate in a series of meetings geared to identify values associated with Hanford Site resources. The DOI (USFWS, BLM, and the Bureau of Indian Affairs [BIA]), EPA, and Department of Commerce (National Marine Fisheries Service) were invited to participate in these meetings. Subsequent to identification of values, DOE developed a comprehensive land-use plan that incorporated values identified by the participants in the meetings.

The DOE received numerous comments on the August 1996 Draft HRA-EIS that emphasized the need for more extensive agency participation in land-use planning at the Hanford Site and the need to consider alternatives to the single plan presented in the Comprehensive Land-Use Plan. The DOI, in particular, requested formal involvement in the land-use planning process for the Hanford Site. As a result of these comments, DOE cut the scope of the HRA-EIS to emphasize future land use at the Hanford Site and formally invited other Federal agencies to cooperate in preparation of the downsized Revised Draft and the Final HCP EIS.

The DOE also initiated a series of meetings through which alternative land-use plans were developed and analyzed. Representatives of the DOI (USFWS, BLM, and Bureau of Reclamation [BoR]) have participated in these meetings and have assisted in the development of the Final HCP EIS.

In addition to consultation on the land-use planning process, DOE has formally requested updated lists of endangered species from the USFWS and the National Marine Fisheries Service. The DOE has also requested that the BoR provide information regarding the availability of water for potential development of irrigated agriculture on the Wahluke Slope. The DOE also consulted with the Natural Resources Conservation Service (formerly known as the Soil Conservation Service) regarding "prime and unique farmlands" on the Hanford Site (Jason Associates 1996).

7.6.2 Consultation with Affected Tribal Governments

The policy of the Federal government for relations with Tribal governments is clearly stated. The Department of Justice recently reaffirmed a long-standing policy regarding the relationship between the Federal government and American Indian Tribes (61 FR 29424). The policy emphasizes the Federal trust responsibility in government-to-government relations with Indian Tribes. Furthermore, the policy of the present Presidential Administration recognizes the sovereignty of Tribal governments, supports the Tribal Governments' rights of self-government and self-determination, and to commit to government-to-government relationships with Tribal governments. The official policy also emphasizes the responsibility of Federal agencies to remove impediments to working directly with Tribal governments on activities that effect the trust property and/or governmental rights of the Tribes. The DOE American Indian policy commits DOE to working with American Indian Tribal governments on a government-to-government basis, recognizes that some Tribes have treaty-protected interests in resources outside reservation boundaries, recognizes the Federal trust relationship to American Indian Tribes imposes duties on DOE, commits to consult with American Indian Tribal governments concerning DOE activities that potentially affect Tribes, and commits to remove impediments to working directly and effectively with Tribal governments in accordance with the Presidential policy. Consultations with Tribal governments have been, and will continue to be, carried out in accordance with these policies.

The DOE invited Tribal Governments to participate in the scoping of the August 1996 Draft HRA-EIS through the Hanford Future Site Uses Working Group, in development of the Comprehensive Land-Use Plan through the meeting held by DOE to identify values associated with Hanford Site resources, and in development of the Final HCP EIS as consulting Tribal governments. Representatives of the CTUIR, Yakama Nation, and Nez Perce Tribe were participants on the Working Group. The Wanapum Band, CTUIR, Yakama Nation, and Nez Perce Tribe all participated in meetings on comprehensive land-use planning prior to issuance of the August 1996 Draft HRA-EIS. Nevertheless, Tribal governments expressed concern that the August 1996 Draft HRA-EIS presented only one alternative for land use at the Hanford Site and indicated a desire to have a greater role in the planning process. As a result of these concerns, and the concerns of other entities regarding land-use planning at the Hanford Site, DOE invited the affected Tribes to participate in the land-use planning process. Representatives of the CTUIR, Nez Perce Tribe, and Yakama Nation have been consulted with in the process. The CTUIR and Nez Perce Tribe representatives have provided alternatives for analysis in the Final HCP EIS.

7.6.3 Consultation with State and Local Governments

The DOE has invited state and local government agencies to participate in all phases of the Final HCP EIS. State and local governments were invited, through their participation in the Hanford Future Site Uses Working Group, to participate in the scoping of the August 1996 Draft HRA-EIS. They participated in the development of the Comprehensive Land-Use Plan through a meeting held by DOE to identify values associated with Hanford Site resources, and, as cooperating agencies, they helped develop the Final HCP EIS. Representatives from the states of Washington and Oregon; Benton, Franklin, and Grant counties; and the Port of Benton participated on the Working Group. Representatives from Ecology and the Washington Department of Fish and Wildlife; Benton, Adams, Franklin, and Grant County Commissioners' offices; Benton County and City of Richland Planning Departments; and the Port of Benton were invited to participate in meetings on comprehensive land-use planning prior to development of the August 1996 Draft HRA-EIS. Upon issuance of the August 1996 Draft HRA-EIS, these government entities expressed concern that the Comprehensive Land-Use Plan presented only one alternative for land use at the Hanford Site. Several local agencies expressed an interest in working with DOE in the planning process. As a result of these concerns, and concerns of other entities regarding land-use planning at the Hanford Site, DOE invited state and local governments to cooperate in development of this Final HCP EIS. Representatives of these entities have either participated in the planning process or been consulted during the process of developing this Final HCP EIS.

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8.0 List of Preparers

8.1 Environmental Impact Statement Preparers

U.S. Department of Energy, Richland Operations Office

Thomas W. Ferns, NEPA Document Manager
U.S. Department of Energy, Richland Operations Office
M.S., 1985, Land Rehabilitation, Montana State University
B.S., 1980, Interdisciplinary Science, Southern Oregon State College
B.S., 1980, Biology, Southern Oregon State College
Years of Experience: 15

Jason Associates Corporation

William J. Berry, Senior Scientist
Jason Associates Corporation
Ph.D., 1988, Entomology, Iowa State University
M.S., 1983, Biology, University of Notre Dame
B.S., 1981, Biology, University of Notre Dame
Years of Experience: 12

Elizabeth Bush Williams, Public Involvement
Jason Associates Corporation
B.S., 1979, Home Economics/Journalism Option, University of Idaho
Years of Experience: 9

Christine Chamberlain, Technical Writer
Jason Associates Corporation
B.A., 1974, History of Art, Skidmore College
Years of Experience: 18

Donald Thomas England, Scientific Specialist
Jason Associates Corporation
B.S., 1985, Biology/Chemistry, Radford University
Years of Experience: 11

Michelle R. Peterson, Technical Editor
Jason Associates Corporation
B.A., 1994, Psychology/Communication, Washington State University
A.A., 1992, Communications, Columbia Basin Community College
Years of Experience: 7

Regan S. Weeks, Senior Scientist
Pacific Northwest National Laboratory
B.S. 1986, Environmental Studies, Huxley College, Western Washington University
Years of Experience: 9

Portage Environmental, Inc.

Michael J. Spry, Senior Environmental Specialist
Portage Environmental, Inc.
M.S., 1986, Land Rehabilitation, Montana State University
B.S., 1983, Environmental Studies
Years of Experience: 12

Bechtel Hanford, Inc.

Rudy Prosser, Hanford Geographic Information System Database Administrator
Bechtel Hanford, Inc.
M.A., 1994, Geography, San Diego State University
B.A., 1982, Philosophy, University of California, San Diego
Years of Experience: 12

DynCorp Tri-Cities Services, Inc.

H. Boyd Hathaway, Senior Land Use Planner
DynCorp Tri-Cities Services, Inc.
B.A., 1979, Urban and Regional Planning, Eastern Washington University
Years of Experience: 16

8.2 Cooperating Agencies

Bureau of Land Management

Joel "Jake" Jakabosky, Environmental Specialist
Bureau of Land Management, Division of Sciences
B.S., 1970, Range Management, Oregon State University
B.S., 1969, Wildlife Science, Oregon State University
Years of Experience: 27

Bureau of Reclamation

Jim Blanchard, Special Projects Officer
Bureau of Reclamation, Ephrata District
B.S., 1973, Natural History, Evergreen State College
Years of Experience: 23

City of Richland

Dennis Rhodes, Comprehensive Planning Manager
City of Richland, Comprehensive Planning Division
B.S., 1986, Environmental Planning, Humboldt State University
Years of Experience: 10

Benton County

Darin K. Arrasmith, Associate Planner
Benton County Planning Department
B.A., 1991, Urban and Regional Planning, Eastern Washington University
Years of Experience: 7

Phil Mees, Senior Long Range Planner
Benton County Planning Department
Years of Experience: 22

Franklin County

Richard German, Director of Planning and Development
Franklin County Planning Department
B.A., 1966, Geography, Eastern Washington State College
Years of Experience: 30

Grant County

Larry Angel, Planning Director
Grant County Planning Department
B.A., 1972, History, Washington State University
Years of Experience: 17

U.S. Fish and Wildlife Service

Dave Goeke, Project Leader
U.S. Fish and Wildlife Service, Columbia National Wildlife Refuge Complex
B.S., 1964, Wildlife Management, Western Illinois University
Years of Experience: 30

8.3 Consulting Tribal Governments

Confederated Tribes of the Umatilla Indian Reservation

Christopher L. Burford, Policy Analyst
CTUIR Special Sciences and Resources Program
J.D., 1992, University of Oregon School of Law
B.A., 1986, History, Western Kentucky University
Years of Experience: 5

Nez Perce Department of Environmental Restoration and Waste Management

Stan Sobcyzk, Environmental Specialist
Nez Perce Tribe Department of Environmental Restoration and Waste Management
Ph.D., 1994, Geology, Washington State University
M.S., 1977, Geophysics, University of Utah
B.S., 1975, Geology/Mathematics, University of Southern California

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9.0 References and Bibliography

10 CFR 820, 1993, "Procedural Rules for U.S. Department of Energy Nuclear Activities," *Code of Federal Regulations*, as amended.

10 CFR 830.120, 1994, "Quality Assurance Requirements," *Code of Federal Regulations*, as amended.

10 CFR 834, 1993, "Radiation Protection of the Public and the Environment," *Code of Federal Regulations*, as amended.

10 CFR 835, 1993, "Occupational Radiation Protection," *Code of Federal Regulations*, as amended.

10 CFR 1021, 1992, "*National Environmental Policy Act* Implementing Procedures," *Code of Federal Regulations*, as amended.

10 CFR 1022, 1979, "Compliance with Floodplain/Wetlands Environmental Review Requirements," *Code of Federal Regulations*, as amended.

29 CFR 1910, 1974, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

36 CFR 800.9, 1986, "Criteria of Effect and Adverse Effect," *Code of Federal Regulations*, as amended.

40 CFR 50-99, 1970, "National Primary and Secondary Ambient Air Quality Standards," *Code of Federal Regulations*, as amended.

40 CFR 50.9, 1979, "National Primary and Secondary Ambient Air Quality Standards," *Code of Federal Regulations*, as amended.

40 CFR 52.21, 1972, "Prevention of Significant Deterioration of Air Quality," *Code of Federal Regulations*, as amended.

40 CFR 60, 1971, "Standards of Performance for New Stationary Sources: Applicability," *Code of Federal Regulations*, as amended.

40 CFR 61, 1973, "National Emissions Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, as amended.

40 CFR 63, 1994, "National Emissions Standards for Hazardous Air Pollutants for Source Categories," *Code of Federal Regulations,* as amended.

40 CFR 122, 1990, "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System," *Code of Federal Regulations,* as amended.

40 CFR 140-149, 1975, "Chapter 1 - Environmental Protection Agency Subchapter D - Water Programs," *Code of Federal Regulations,* as amended.

40 CFR 260-280, 1978, "Federal Regulations for Implementing the *Resource Conservation and Recovery Act*," *Code of Federal Regulations*, as amended.

40 CFR 350-372, 1991, "Federal Regulations for Implementing the Emergency Planning and

Community Right-to-Know Act," *Code of Federal Regulations*, as amended.

40 CFR 1500-1508, 1978, "Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act," *Code of Federal Regulations*, as amended.

50 CFR 17, 1975, "Endangered and Threatened Wildlife and Plants," *Code of Federal Regulations*, as amended.

40 FR 18026, 1981, "Memorandum to Agencies: Forty Most Asked Questions Concerning the Council on Environmental Quality's National Environmental Policy Act Regulation," *Federal Register*, Vol. 46, p. 18026 (March 23).

57 FR 37959, 1992, "Intent to Prepare the Hanford Remedial Action Environmental Impact Statement, Richland, Washington," *Federal Register*, Vol. 57, p. 37959 (August 21).

58 FR 48509, 1993, "Record of Decision: Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington, Environmental Impact Statement," *Federal Register*, Vol. 58, p. 48509 (September 16).

60 FR 28680, 1995, "Record of Decision: Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs," *Federal Register,* Vol. 60, p. 28680 (June 1).

60 FR 61687, 1995, "Record of Decision: Safe Interim Storage of Hanford Tank Wastes, Hanford Site, Richland, WA," *Federal Register,* Vol. 60, p. 61687 (December 1).

60 FR 63878, 1995, "Record of Decision: Tritium Supply and Recycling Programmatic Environmental Impact Statement," *Federal Register,* Vol. 60, p. 63878 (December 5).

61 FR 9441, 1996, "Amendment to the Record of Decision for the Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs," *Federal Register,* Vol. 61, p. 9441 (March 8).

61 FR 10736, 1996, "Record of Decision: Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, Richland, Washington," *Federal Register,* Vol. 61, p. 10736 (March 15).

61 FR 29424-29426, 1996, "Department of Justice Policy on Indian Sovereignty and Government-to-Government Relations with Indian Tribes," *Federal Register*, Vol. 61, pp. 29424-29426 (June 10).

61 FR 29719, 1996, "National Ambient Air Quality Standards for Ozone and Particulate Matter," *Federal Register*, Vol. 61, pp. 29719 (June).

61 FR 36352, 1996, "Record of Decision: Plutonium Finishing Plant Stabilization Final Environmental Impact Statement," *Federal Register*, Vol. 61, p. 36352 (July 10).

61 FR 41596, 1996, "National Environmental Policy Act Record of Decision for the Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants," *Federal Register*, Vol. 61, p. 41596 (August 9).

61 FR 45949, 199, "Final Environmental Impact Statement: Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes, Hanford Site, Richland, Washington," *Federal*

Register, Vol. 61, p. 45949 (August 30).

62 FR 3014, 1997, “Record of Decision: Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Impact Statement,” *Federal Register,* Vol. 62, p. 3014 (January 21).

62 FR 8693, 1997, “Record of Decision: Final Environmental Impact Statement: Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes, Hanford Site, Richland, WA,” *Federal Register,* Vol. 62, p. 8693 (February 26).

62 FR 10830, 1997, “Notice of Availability of Record of Decision: Columbia River System Operation Review on Selecting an Operating Strategy for the Federal Columbia River Power System,” *Federal Register,* Vol. 62, p. 10830 (March 10).

62 FR 32076, 1997, “Interior Columbia Basin Ecosystem Management Project, Notice of Availability of Draft Environmental Impact Statements,” *Federal Register,* Vol. 62, p. 32076 (June 12).

American Antiquities Preservation Act of 1906, 16 U.S.C. 431, et seq.

American Indian Religious Freedom Act of 1978, 42 U.S.C. 1996, et seq.

Anadromous Fish Conservation Act of 1965, Public Law 89-304, as amended.

Archeological and Historic Preservation Act of 1974, 16 U.S.C. 469, et seq.

Archaeological Resources Protection Act of 1979, 16 U.S.C. 470aa-47011, et seq.

Atomic Energy Act of 1954, 42 U.S.C. 2011, et seq.

Bald and Golden Eagle Protection Act of 1972, 16 U.S.C. 668-668d, et seq.

Backman, G. E., 1962, Dispersion of 300 Area Liquid Effluent in the Columbia River, HW-73672, General Electric Company, Hanford Atomic Products Operation, Richland, Washington.

BCPD, 1997, *Draft Benton County Comprehensive Plan, Environmental Impact Statement Addendum*, Board of County Commissioners Hearing Draft, Benton County Planning Department, Prosser, Washington.

BHI, 1995a, *105-B Reactor Facility Museum Phase I Feasibility Study Report*, BHI-00076, Rev. 1, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995b, *Miocene- to Pliocene-Aged Suprabasalt Sediments of the Hanford Site, South-Central Washington*, K. A. Lindsey, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995c, *Site Evaluation Report for Candidate Basalt Quarry (DOE/RL-93-83)*, BHI-00005, Rev. 00, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1996, *The Hanford Site N Reactor Buildings Task Identification and Evaluation of Historic Properties*, BHI-00627, Rev. 0, Bechtel Hanford, Inc., Richland, Washington (January).

BHI, 1997, *Class 1 Permit Modification Request for 183-H Solar Evaporation Basins*, Chron #054377, letter from G. C. Henckel, III, Bechtel Hanford, Inc., to K. M. Thompson, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

BLM, 1992, *Proposed Spokane Resource Management Plan Amendment and Final Environmental Impact Statement*, Spokane District of the Bureau of Land Management, Spokane, Washington.

COR, 1997, *City of Richland Comprehensive Plan*, City of Richland, Richland, Washington (September).

CEQ, 1993, *Incorporating Biodiversity Considerations into Environmental Impact Analysis Under the National Environmental Policy Act*, Council on Environmental Quality, Washington, D.C. (January).

Clean Air Act of 1970, 42 U.S.C. 7401, et seq.

Clean Water Act of 1977, 33 U.S.C. 1251, et seq.

Comprehensive Conservation Study of the Hanford Reach of the Columbia River, Public Law 100-605, et seq.

Comprehensive River Conservation Study, 1988, Public Law 100-605 (November 5).

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

Cooper, A. T., 1995, *Measurements of Environmental Radiation Exposure Rates from Vernita, Hanford Reach, and Richland Area Shores*, PNL-8789, Addendum 1, Pacific Northwest Laboratory, Richland, Washington (February).

Cushing, C. E., 1992, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNL-6415, Rev. 5, Pacific Northwest Laboratory, Richland, Washington.

Cushing, C. E., 1995, *Hanford Site National Environmental Policy Act* (NEPA) *Characterization*, PNL-6415, Rev. 7, Pacific Northwest Laboratory, Richland, Washington.

DART (See Data Acquisition in Real Time).

Data Acquisition in Real Time, 1998, Columbia Basin Research Project, Department of Fisheries, University of Washington, Seattle, Washington (web site: **http://www.cqs.washington.edu/index.html)**.

Dirkes, R. L., 1993, *Columbia River Monitoring: Distribution of Tritium in Columbia River Water at the Richland Pumphouse.* PNL-8531, Pacific Northwest Laboratory, Richland, Washington.

Dirkes, R. L., and R. W. Hanf, 1995, *Hanford Site Environmental Report for Calendar Year 1994*, PNL-10574, Pacific Northwest Laboratory, Richland, Washington.

Dirkes, R. L., and R. W. Hanf, 1996, *Hanford Site Environmental Report for Calendar Year 1995*, PNL-11139, Pacific Northwest National Laboratory, Richland, Washington.

Dirkes, R. L., and R. W. Hanf, 1997, *Hanford Site Environmental Report for Calendar Year 1996*, PNL-11472, Pacific Northwest National Laboratory, Richland, Washington.

DOE, 1987, *Final Environmental Impact Statement: Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes, Hanford Site, Richland, Washington*, DOE/EIS-0113, U.S. Department of Energy, Washington, D.C. (December).

DOE, 1988, *Radioactive Waste Management*, DOE Order 5820.2A, U.S. Department of Energy, Washington, D.C.

DOE, 1988a, *Consultation Draft Site Characterization Plan*, Volumes 1 through 9, DOE/RW-0164, Office of Civilian Radioactive Waste Management, U.S. Department of Energy, Washington, D.C.

DOE, 1989, *Draft Environmental Impact Statement: Decommissioning of Eight Surplus Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119D, U.S. Department of Energy, Washington, D.C. (March).

DOE, 1990a, *General Environmental Protection Program*, DOE Order 5400.1, U.S. Department of Energy, Washington, D.C. (June).

DOE, 1990b, *Environmental Assessment for the Environmental and Molecular Sciences Laboratory at the Hanford Site, Richland, Washington*, DOE/EA-0429, U.S. Department of Energy, Washington, D.C. (September).

DOE, 1992a, *Addendum (Final Environmental Impact Statement): Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119F, U.S. Department of Energy, Washington, D.C. (December).

DOE, 1992b, *Environmental Assessment: Hanford Environmental Compliance Project, Hanford Site, Richland, Washington*, DOE/EA-0383, U.S. Department of Energy, Washington, D.C. (March).

DOE, 1993a, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, U.S. Department of Energy, Washington, D.C. (January).

DOE, 1993b, *Environmental Protection, Safety and Health Protection Standards*, DOE Order 5480.4, U.S. Department of Energy, Washington, D.C. (January).

DOE, 1994a, *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Draft Environmental Impact Statement*, DOE/EIS-0203-D, U.S. Department of Energy, Idaho Operations Office (June).

DOE, 1994b, *Land- and Facility-Use Policy*, Stewards of a National Resource, U.S. Department of Energy, Washington, D.C.

DOE, 1994c, *Environmental Assessment for the Resiting, Construction and Operation of the Environmental and Molecular Sciences Laboratory at the Hanford Site, Richland, Washington*, DOE/EA-0959, U.S. Department of Energy, Washington, D.C. (July).

DOE, 1994d, *Tank 241-C-106 Past-Practice Sluicing Waste Retrieval, Hanford Site, Richland, Washington,* DOE/EA-0933, U.S. Department of Energy, Washington, D.C. (February).

DOE, 1995a, *U.S. Department of Energy Environmental Justice Strategy, Executive Order 12898*, U.S. Department of Energy, Washington, D.C. (April).

DOE, 1995b, *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, DOE/EIS-0203-F, U.S. Department of Energy, Idaho Operations Office (April).

DOE, 1995c, *Life-Cycle Asset Management,* DOE Order 430.1, U.S. Department of Energy, Washington, D.C. (August).

DOE, 1995d, *Final Environmental Impact Statement: Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, Richland, Washington*, DOE/EIS-0245D, U.S. Department of Energy, Richland, Washington (October).

DOE, 1995e, *Environmental Assessment for the Deactivation of the N Reactor Facilities*, DOE/EA-0984, U.S. Department of Energy, Richland, Washington (May).

DOE, 1995f, *222-S Radioactive Liquid Waste Line Replacement and 219-S Secondary Containment Upgrade, Hanford Site, Richland, Washington*, DOE/EA-0944, U.S. Department of Energy, Richland, Washington (January).

DOE, 1995g, *Environmental Assessment: Inert/Demolition Waste Landfill (Pit 9) Hanford Site, Richland, Washington*, DOE/EA-0983, U.S. Department of Energy, Washington, D.C. (May).

DOE, 1995h, *Environmental Assessment: Disposition of Alkali Metal Test Loops, Hanford Site, Richland, Washington*, DOE/EA-0987, U.S. Department of Energy, Washington, D.C. (May).

DOE, 1995i, *Environmental Assessment: 300 Area Process Sewer Piping Upgrade and 300 Area Treated Effluent Disposal Facility Discharge to the City of Richland Sewer System, Hanford Site, Richland, Washington*, DOE/EA-0980, U.S. Department of Energy, Washington, D.C. (May).

DOE, 1995j, *Environmental Assessment: Shutdown of the Fast Flux Test Facility, 400 Area, Hanford Site, Richland, Washington*, DOE/EA-0993, U.S. Department of Energy, Washington, D.C. (May).

DOE, 1995k, *Environmental Assessment: Relocation and Storage of TRIGA Reactor Irradiated Fuel, Hanford Site, Richland, Washington*, DOE/EA-0985, U.S. Department of Energy, Washington, D.C. (August).

DOE, 1995l, *Environmental Assessment: Transfer of Plutonium-Uranium Extraction Plant and N Reactor Irradiated Fuel for Storage at the 105-KE and 105-KW Fuel Storage Basins, Hanford Site, Richland, Washington,* DOE/EA-0988, U.S. Department of Energy, Washington, D.C. (July).

DOE, 1996, *Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land-Use Plan*, DOE/EIS-0222D, U.S. Department of Energy, Washington, D.C. (June).

DOE, 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement*, DOE/EIS-0229D, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, D.C. (February).

DOE, 1996b, *Addendum (Final Environmental Impact Statement): Management of Spent*

Nuclear Fuel from the K Basins at the Hanford Site, Richland, Washington, DOE/EIS-0245F, U.S. Department of Energy, Washington, D.C. (January).

DOE, 1996c, *Baseline Environmental Management Report*, DOE/EM-0290, U.S. Department of Energy, Washington, D.C. (May).

DOE, 1996d, *Biodiversity Inventory and Analysis of the Hanford Site: 1995 Annual Report*, Grant #DE-FG06-94RL12858, prepared by The Nature Conservancy of Washington for the U.S. Department of Energy, Washington, D.C.

DOE, 1996e, *Comprehensive Land-Use Planning Process Guide*, GPG-FM-033, U.S. Department of Energy, Washington, D.C. (March).

DOE, 1996f, *Comprehensive Emergency Management System*, DOE Order 151.1, U.S. Department of Energy, Washington, D.C. (August).

DOE, 1997a, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-D, U.S. Department of Energy, Washington, D.C. (May).

DOE, 1997b, *Cross-Cut Guidance on Environmental Requirements for DOE Real Property Transfers*, DOE/EH-413/9712, U.S. Department of Energy, Office of Environmental Policy and Assistance; RCRA/CERCLA Division (EH-413), Washington, D.C. (October).

DOE, 1997c, *Report on "Audit of the U.S. Department of Energy's Identification and Disposal of Nonessential Land,"* Internal Memorandum from Office of Inspector General to the Secretary, U.S. Department of Energy, Washington, D.C. (January).

DOE, 1998, *Accelerating Cleanup: Paths to Closure,* DOE/EM-0342, U.S. Department of Energy, Office of Environmental Management, Washington, D.C. (February 1998).

DOE, 1998a, *Screening Assessment and Requirements for a Comprehensive Assessment, Columbia River Comprehensive Impact Assessment*, DOE/RL-96-16, Rev 1, UC-630. Prepared by the Pacific Northwest National Laboratory and CRCIA Management Team, Richland, Washington, and Washington, D.C. (March).

DOE, DOA, and DOI, 1995, *Columbia River System Operation Review Final Environmental Impact Statement*, DOE/EIS-0170, U.S. Department of Energy, U.S. Department of the Army, and the U.S. Department of the Interior, Portland, Oregon (November).

DOE and Ecology, 1996, *Final Environmental Impact Statement for the Tank Waste Remediation System*, DOE/EIS-0189, U.S. Department of Energy and Washington State Department of Ecology, Richland, Washington (August).

DOE and Ecology, 1997, *Environmental Impact Statement for the Tank Waste Remediation System - Record of Decision*, DOE/EIS-0189, U.S. Department of Energy and Washington State Department of Ecology, Richland, Washington (February).

DOE-RL, 1990a, *Hanford Site Development Plan*, DOE/RL-89-15, U.S. Department of Energy, Richland Operations Office, Richland, Washington (January).

DOE-RL, 1990b, *Hanford Site Infrastructure Plan*, DOE/RL-89-31, U.S. Department of Energy, Richland Operations Office, Richland, Washington (January).

DOE-RL, 1991a, *Hanford Site Environmental Monitoring Plan*, DOE/RL-91-50, U.S. Department of Energy, Richland Field Office, Richland, Washington (November).

DOE-RL, 1994a, *Hanford Site Development Plan*, DOE/RL-94-13, U.S. Department of Energy, Richland Operations Office, Richland, Washington (May).

DOE-RL, 1994b, *Bald Eagle Site Management Plan for the Hanford Site, South-Central Washington,* DOE/RL-94-150, U.S. Department of Energy, Richland Operations Office, Richland, Washington (May).

DOE-RL, 1994c, *Fiscal Year 1995 Hanford Mission Plan, Volume 1, Site Guidance*, DOE/RL-93-102, U.S. Department of Energy, Richland Operations Office, Richland, Washington (September).

DOE-RL, 1995a, *Ecological Compliance Assessment Management Plan*, DOE/RL-95-11, Rev. 1, U. S. Department of Energy, Richland Operations Office, Richland, Washington (April).

DOE-RL, 1995b, *Solid Waste Retrieval Complex, Enhanced Radioactive and Mixed Waste Storage Facility, Infrastructure Upgrades, and Central Waste Support Complex, Hanford Site, Richland, Washington*, DOE/EA-0981, U.S. Department of Energy, Richland Operations Office, Richland, Washington (June).

DOE-RL, 1995c, *Hanford Site Ground-Water Protection Management Plan*, DOE/RL-89-12, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1996, *Hanford Site Biological Resources Mitigation Strategy Plan* (BRMiS), DOE/RL-96-88, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1996a, *Plutonium Finishing Plant Stabilization Final Environmental Impact Statement, Hanford Site, Richland, Washington*, DOE/EIS-0244-F, U.S. Department of Energy, Richland Operations Office, Richland, Washington (May).

DOE-RL, 1996b, *Hanford Strategic Plan*, RL-D-96-92 U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1996c, *Hanford Biological Resources Management Plan* (BRMaP), DOE/RL-96-32, U.S. Department of Energy, Richland Operations Office, Richland, Washington (September).

DOE-RL, 1998, *Management and Integration of Hanford Site Groundwater and Vadose Zone Activities*, U.S. Department of Energy, Richland Operations Office, Richland, Washington (April).

DOE-RL, 1999, *Hanford Cultural Resources Management Plan*; *Preservation and Protection Guidance*, U.S. Department of Energy, Richland Operations Office, Richland, Washington (May).

DOI, 1995, *Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation*, U.S. Department of the Interior, National Biological Service, Washington, D.C. (February).

DOI, 1995a, *Treaties, Spirituality, and Ecosystems: American Indian Interests in the Northern*

Intermontane Region of Western North America, U.S. Department of the Interior, Bureau of Land Management, Eugene, Oregon (August).

DOI, 1996, *United States Department of the Interior Record of Decision -- Hanford Reach of the Columbia River: Final Environmental Impact Statement for Comprehensive River Conservation Studies*, U.S. Department of the Interior, Washington, D.C. (July).

Ecology, 1993, *Hanford Land Transfer: A Report Prepared by the Washington State Department of Ecology*, Washington State Department of Ecology, Olympia, Washington (March).

Ecology, 1994, *Air Quality Program Annual Report 1994*, #95-200, Washington State Department of Ecology, Olympia, Washington.

Ecology and DOE-RL, 1995, *Final Environmental Impact Statement: Safe Interim Storage of Hanford Tank Wastes*, DOE/EIS-0212, Washington State Department of Ecology and U.S. Department of Energy, Richland Operations Office, Richland, Washington (October).

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, Document No. 89-10, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. 11001, et seq.

Endangered Species Act of 1973, 16 U.S.C. 1531, et seq.

EPA et. al, 1989, *Federal Manual for Identifying and Delineating Jurisdictional Wetlands: An Interagency Cooperative Publication*, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and Soil Conservation Service, Washington, D.C.

EPA, 1995a, *Declaration of the Record of Decision: USDOE Hanford 100 Area, 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units, Hanford Site, Benton County, Washington*, #023681, U.S. Environmental Protection Agency, Washington, D.C. (September).

EPA, 1995b, *Declaration of the Record of Decision: USDOE Hanford Environmental Restoration Disposal Facility, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Washington, D.C. (January).

EPA, 1997, *Brownfields Economic Development Initiative*, EPA 500-F-97-158, U.S. Environmental Protection Agency, Washington, D.C. (September).

ERDA, 1975, *Waste Management Operations, Hanford Reservation, Richland Washington: Final Environmental Impact Statement*, ERDA-1538, Vol. 1, U.S. Energy Research & Development Administration, Washington, D.C.

Executive Order 11988, *Floodplain Management*, issued May 24, 1977.

Executive Order 11990, *Protection of Wetlands*, issued May 24, 1977.

Executive Order 12088, *Federal Compliance with Pollution Control Standards*, issued October 13, 1978.

Executive Order 12372, *Intergovernmental Review of Federal Programs*, issued July 14, 1982.

Executive Order 12580, *Superfund Implementation*, issued January 23, 1987.

Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements*, issued August 3, 1993.

Executive Order 12866, *Regulatory Planning and Review*, issued September 30, 1993.

Executive Order 12875, *Enhancing the Intergovernmental Partnership*, issued October 26, 1993.

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, issued February 11, 1994.

Executive Order 13007, *Indian Sacred Sites*, issued May 24, 1996.

Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks,* issued April 21, 1997.

Executive Order 13112, *Invasive Species*, issued February 11, 1999.

Farmland Protection Policy Act of 1981, 7 U.S.C. 4201-4209, et seq.

Federal Clean Air Act Amendments of 1990, 42 U.S.C. PRAC. 7512, 75129(a), et seq.

Federal Facilities Compliance Act of 1992, 42 U.S.C. 6901, et seq.

Federal Insecticide, Fungicide, and Rodenticide Act of 1972, 7 U.S.C. 136, et seq.

Federal Land Policy and Management Act of 1976, 43 U.S.C. 1701, 11761-1771, et seq.

Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. 1251-1376, et seq.

Fish and Wildlife Coordination Act of 1934, 16 U.S.C. 661, et seq.

Fish and Wildlife Conservation Act of 1980, 16 U.S.C. 2901, et seq.

Fitzner, R. E., and R. H. Gray, 1991, "The Status, Distribution, and Ecology of Wildlife on the U.S. DOE Hanford Site: A Historical Overview of Research Activities," *Environmental Monitoring and Assessment*, 18 (3): 173-202.

Franklin, J. F., and C. T. Dyrness, 1973, *Natural Vegetation of Oregon and Washington*, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oregon.

FSUWG, 1992, *The Future for Hanford: Uses And Cleanup, The Final Report of the Hanford Future Site Uses Working Group*, Hanford Future Site Uses Working Group, Westinghouse Hanford Company, Richland, Washington.

Gerber, M. S., 1992, *Legend and Legacy: Fifty Years of Defense Production at the Hanford Site*, WHC-MR-0293, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Gerber, M. S., 1997, *Gerber's History Homepage*, **http://www.hanford.gov/history/index.htm,** U. S. Department of Energy, Richland, Washington.

Growth Management Act of 1990, *Revised Code of Washington* 36.70A, as amended.

Hanford Reach, 1996, "Trimming the Workforce," *Hanford Reach*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, p. 12 (April 8).

Hanford Tank Waste Tank Force, 1993, *Hanford Tank Waste Task Force: Final Report to Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy*, The Hanford Tank Waste Task Force, Richland, Washington.

Hazardous and Solid Waste Amendments of 1984, 42 U.S.C. 6901, et seq.

Hazardous Waste Management Act of 1976, *Revised Code of Washington* 70.105, as amended.

Historic Sites, Buildings, and Antiquities Act of 1965, 16 U.S.C. 1461, et seq.

Jason Associates, 1996, Personal communication with E. Brincken, Natural Resources Conservation Service, U.S. Department of Agriculture, Pasco, Washington, dated March 19, 1996, Jason Associates, Richland, Washington.

Jones, V. C., 1985, *United States Army in World War II, Special Studies -- Manhattan: The Army and the Atomic Bomb*, Center of Military History, United States Army, Washington, D.C.

Lindberg, J.W., 1994, *Geology of the McGee Ranch Site, Area B: Phase II*, WHC-SD-EN-TI-206, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Materials Act of 1947, 30 U.S.C. 601-603, et seq.

McGavock, E. H., W. D. Wiggens, R. L. Blazs, P. R. Boucher, L. L. Reed, and M. C. Smith, 1987, *Water Resources Data Washington Water Year 1985*, U.S. Geological Survey, Tacoma, Washington.

Metric Conversion Act o 1975, Public Law 94-168, as amended by Public Law 100-148.

Migratory Bird Treaty Act of 1918, 16 U.S.C. 703, et seq.

Mining Law of 1872, 30 U.S.C. 22, et seq.

Model Toxics Control Act of 1989, *Revised Code of Washington* 70.105D, et seq.

National Defense Authorization Act of 1994, Public Law 104-201, 42 U.S.C. 7274k, et seq.

National Environmental Policy Act of 1969, 42 U.S.C. 4321, et seq.

National Historic Preservation Act of 1966, 16 U.S.C. 470, et seq.

National Wildlife Refuge System Administration Act of 1966, 42 U.S.C. 668dd-ee, et seq.

Native American Graves Protection and Repatriation Act of 1990, 25 U.S.C. 3001, et seq.

Navy, 1996, *Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants,* DOE/EIS-0259, U.S. Department of the Navy, Washington, D.C. (April).

Neitzel, D. A., C. J. Formire, D. W. Harvey, D. J. Hoitink, P. D. Thorne, B. N. Bjornstad, R. A. Fowler, P. L. Hendrickson, D. J. Hostick, T. M. Poston, and M. K. Wright, 1997, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNNL-6415, Rev. 9 (UC-600), Pacific Northwest National Laboratory, Richland, Washington (August).

Neitzel, D.A. et al. 1998, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNNL-6415, Rev. 10 (UC-600), Pacific Northwest National Laboratory, Richland, Washington (August).

Noise Control Act of 1972, 42 U.S.C. 4901 to 4918, et seq.

Noise Pollution and Abatement Act of 1970, 42 U.S.C. 1858, et seq.

Northwest Power Act, 16 U.S.C. 839-839h, et seq.

NPS, 1988, *National Register of Historic Places,* National Park Service, U.S. Department of the Interior, Washington, D.C.

NPS, 1994, *Hanford Reach of the Columbia River, Comprehensive River Conservation Study and Environmental Impact Statement, Final -- June 1994*, National Park Service, Pacific Northwest Regional Office, Seattle, Washington (June).

NSF, 1993, *Environmental Assessment for Construction and Operation of a Laser Interferometer Gravitational-Wave Observatory on the Hanford Site*, National Science Foundation, Richland, Washington (October).

Nuclear Waste Policy Act of 1982, 42 U.S.C. 10101-10270, et seq.

Occupational Safety and Health Act of 1970, 29 U.S.C. 651, et seq.

Omnibus Parks and Public Lands Management Act of 1996, Public Law 104-333, November 12, 1996.

OTA, 1993, *Preparing for an Uncertain Climate, Volume II,* ATA-0-568, U.S. Congress, Office of Technology Assessment, U.S. Government Printing Office, Washington, D.C.

Pacific Salmon Treaty Act of 1985, 16 U.S.C. 3631, et seq.

Parker, P. L., and T. F. King, 1990, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, National Register Bulletin No. 38, U.S. Department of the Interior, National Park Service, Interagency Resources Division, Washington, D.C.

PNL, 1966, *Soil Survey Hanford Project in Benton County Washington*, BNWL-243, Pacific Northwest Laboratory, Richland, Washington (April).

PNL, 1977, *Ecology of the 200 Area Plateau Waste Management Environs: A Status Report*, PNL-2253, Pacific Northwest Laboratory, Richland, Washington (October).

PNL, 1981, *Raptors of the Hanford Site and Nearby Areas of Southcentral Washington*, PNL-3212, Pacific Northwest Laboratory, Richland, Washington (May).

PNL, 1984, *Environmental Characterization of Two Potential Locations at Hanford for a New*

Production Reactor, PNL-5275, Pacific Northwest Laboratory, Richland, Washington (September).

PNL, 1987, *The Economic and Community Impacts of Closing Hanford's N Reactor and Nuclear Materials Production Facilities*, PNL-6295, Pacific Northwest Laboratory, Richland, Washington (August).

PNL, 1990a, *Spawning and Abundance of Fall Chinook Salmon (Oncorhynchus tshawytscha) in the Hanford Reach of the Columbia River, 1948-1988*, PNL-7289, Pacific Northwest Laboratory, Richland, Washington (March).

PNL, 1990b, *Archaeological Survey of the 200 East and 200 West Areas, Hanford Site, Washington*, PNL-7264, Pacific Northwest Laboratory, Richland, Washington (March).

PNL, 1991a, *A Study Plan for Determining Recharge Rates at the Hanford Site Using Environmental Tracers*, PNL-7626, Pacific Northwest Laboratory, Richland, Washington (February).

PNL, 1991b, *An Evaluation of the Chemical, Radiological, and Ecological Conditions of West Lake on the Hanford Site*, PNL-7662, Pacific Northwest Laboratory, Richland, Washington (March).

PNL, 1992, *Archaeological Survey of the McGee Ranch Vicinity, Hanford Site, Washington*, PNL-8186, Pacific Northwest Laboratory, Richland, Washington.

PNL, 1993a, *Hanford Site Environmental Report for Calendar Year 1992*, PNL-8682, Pacific Northwest Laboratory, Richland, Washington (June).

PNL, 1993b, *Arid Lands Ecology Reserve Facility Management Plan*, PNL-8506, Pacific Northwest Laboratory, Richland, Washington (February).

PNL, 1993c, *Habitat Types on the Hanford Site: Wildlife and Plant Species of Concern*, PNL-8942, Pacific Northwest Laboratory, Richland, Washington (December).

PNL, 1993d, *A Preliminary Survey of Selected Structures on the Hanford Site for Townsend's Big-Eared Bat (Plecotus townsendii)*, PNL-8916, Pacific Northwest Laboratory, Richland, Washington (October).

PNL, 1994a, *Public Values Related to Decisions in the Tank Waste Remediation System Program*, PNL-10107, Pacific Northwest Laboratory, Richland, Washington (August).

PNL, 1994b, *Climatological Data Summary 1993 with Historical Data*, PNL-9809, Pacific Northwest Laboratory, Richland, Washington (June).

PNL, 1995, *Hanford Site Environmental Report for Calendar Year 1994*, PNNL-10574, Pacific Northwest National Laboratory, Richland, Washington.

PNNL, 1996a, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNL-6415, Rev. 8, Pacific Northwest National Laboratory, Richland, Washington (August).

PNNL, 1996b, *Hanford Site Environmental Report for Calendar Year 1995*, PNNL-11339, Pacific Northwest National Laboratory, Richland, Washington (June).

PNNL, 1996c, *Hanford Site Ground-Water Monitoring for 1995,* PNNL-11141, Pacific Northwest National Laboratory, Richland, Washington (August).

PNNL, 1997a, *Hanford Site Environmental Report for Calendar Year 1996*, Pacific Northwest National Laboratory, Richland, Washington.

PNNL, 1997b, *Hanford Site Groundwater Monitoring for Fiscal Year 1997*, Pacific Northwest National Laboratory, Richland, Washington.

Pollution Prevention Act of 1990, 42 U.S.C. 13101, et seq.

Relander, C., 1956, *Drummers and Dreamers*, Caxton Printers, Caldwell, Idaho.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq.

Rickard, W. H., and L. D. Poole, 1989, "Terrestrial Wildlife of the Hanford Site: Past and Future," *Northwest Science*, 63 (4): 183-193.

Rivers and Harbors Act of 1899, 33 U.S.C. 401-415, et seq.

Safe Drinking Water Act of 1974, 42 U.S.C. 300(f), et seq.

Sackschewsky, M. R. et. al, 1992, *Vascular Plants of the Hanford Site*, WHC-EPO-554, Westinghouse Hanford Company, Richland, Washington.

Schuller, C. A., W. H. Rickard, and G. A. Sargeant, 1993, "Conservation of Habitats for Shrub-Steppe Birds," *Environmental Conservation*, 20 (1): 57-64.

Shuster, R. L., A. F. Chleborad, and W. H. Hays, 1987, *Irrigation Induced Landslides in Fluviallacustrine Sediments, Southcentral Washington State*, AnzSlide 87, Fifth International Conference and Field Workshop on Landslides.

Shoreline Management Act of 1971, *Revised Code of Washington* 90.58, as amended.

Skaggs, R. L., and W. H. Walters, 1981, *Flood Risk Analysis of Cold Creek Near the Hanford Site*, RHO-BWI-120, PNL-4219, Pacific Northwest Laboratory, Richland, Washington.

Skelly, W. A., 1992, *Characterization Plan for Fine-Textured Soils in the McGee Ranch Site Vicinity*, WHC-SD-EN-AP-051, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Solid Waste Disposal Act of 1965, 42 U.S.C. 3251 to 3259, et seq.

Sonnichsen, J. C., 1991, *Biotic Surveys of Prospective Fine Soil Borrow Site*, written communication to J. G. Woolard, July 12, Westinghouse Hanford Company, Richland, Washington.

State Environmental Policy Act of 1971,*Revised Code of Washington* 43.21C, as amended.

State of Washington, 1979, *Easement Deed for Section 1, Township 11 North, Range 26 East, Willamette Meridian, Benton County, Washington*, Vol. 396, Page 957, No. 822547, State of Washington, County of Benton, Washington (October 4).

State of Washington, 1980, *Quit Claim Deed for Section 1, Township 11 North, Range 26 East,* *Willamette Meridian, Benton County, Washington*, Vol. 395, Page 956, No. 822546, State of Washington, King County, Washington (June 30).

Sula, M. J. 1980. *Radiological Survey of Exposed Shorelines and Islands of the Columbia River Between Vernita and the Snake River Confluence*, PNL-3127, Pacific Northwest Laboratory, Richland, Washington.

Superfund Amendments and Reauthorization Act of 1986, 42 U.S.C. 9671, et seq.

Takaro, T. K., 1995, *A Brief Summary of Stakeholder Values Pertaining to Remediation Activities at Hanford*, Hanford Advisory Board, Richland, Washington.

TCH, 1996a, “Apartment Vacancy Rates Rising in Tri-Cities,” page C1, (Carrie Schafer, Herald Staff Writer), *Tri-City Herald*, Kennewick, Washington (March 7).

TCH, 1996b, “State Seeks Increase in Radioactive Waste Limit,” page A12, (John Stang, Herald Staff Writer), *Tri-City Herald*, Kennewick, Washington (May 30).

TCH, 1998a, “Huge Plan for Basin Land on the Rocks,” page A1, (Mike Lee, Herald Staff Writer), *Tri-City Herald*, Kennewick, Washington (June 23).

TCH, 1998b, “Large Apple Harvest has Only Pricey Solutions,” (Mike Lee, Herald Staff Writer), *Tri-City Herald*, Kennewick, Washington (July 8).

TNC and R. J. Pabst, 1995, *Biodiversity Inventory and Analysis of the Hanford Site, 1994 Annual Report*, prepared by The Nature Conservancy for the U.S. Department of Energy, Richland Operations Office, Richland, Washington (May).

TNC, 1998, *Biodiversity Inventory and Analysis of the Hanford Site, 1997 Annual Report*, prepared by The Nature Conservancy for the U.S. Department of Energy, Richland Operations Office, Richland, Washington (May).

Toxic Substances Control Act of 1976, 15 U.S.C. 2601-2671, et seq.

Treaty with the Nez Perce, June 11, 1855, 12 Stat. 957.

Treaty with the Walla Walla, Cayuse, etc., June 9, 1855, 12 Stat. 945.

Treaty with the Yakama, June 9, 1855, 12 Stat. 951.

USACE, 1970, *Columbia River Washington, Water Surface Profiles*, RM323 to RM395, U.S. Army Engineer District, U.S. Army Corps of Engineers, Seattle, Washington.

USACE, 1995, *Columbia River Treaty Access Fishing Sites Final Phase Two Evaluation Report and Finding of No Significant Impact/Environmental Assessment*, U.S. Army Corps of Engineers.

USBC, 1992, *1990 Census of Population and Housing*, Summary Tape File 3 (on CD-ROM), U.S. Department of Commerce, U.S. Bureau of Census, Washington, D.C.

USDA-NASS, 1992, *Census of Agriculture*, U.S. Department of Agriculture, Washington, D.C.

USDA, 1998, *Conservation Reserve Enhancement Program (CREP)*, Farm Service Agency Web Site, **http://www.fsa.usda.gov/dafp/cepd/16CRP/wa.htm**

USFWS, 1976, National Wetlands Inventory (Maps). The NWI is available on 7.5 min. U.S. Geological Survey topographic maps. (The following 7.5 min. maps were consulted during the preparation of this assessment: Taunton, Corfu, Wahatis Peak, Smyrna, Hanford NE, Eagle Lakes, Locke Island, Coyote Rapids, Vernita Bridge, Priest Rapids NE, Basin City, Savage Island, Hanford, Gable Butte, Riverland, Emerson Nipple, Matthews Corner, Wooded Island, Horn Rapids Dam, Iowa Flats, Snively Basin, Maiden Spring, Columbia Point, Richland, Benton City, Corral Canyon; U.S. Fish and Wildlife Service, St. Petersburg, Florida.)

WAC 173-216, 1995, "State Waste Water Discharge Permit Program," *Washington Administrative Code*, as amended.

WAC 173-303, 1995, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 173-460, 1991, "Controls for New Sources of Toxic Air Pollutants," *Washington Administrative Code*, as amended.

WAC 173-480, 1986, "Ambient Air Quality Standards and Emission Limits for Radionuclides," *Washington Administrative Code*, as amended.

WAC 197-11, 1984, "State Environmental Policy Act," *Washington Administrative Code*, as amended.

WAC 232-12-011, 1993, "Wildlife Classified as Protected Shall Not Be Hunted or Fished," *Washington Administrative Code*, as amended.

WAC 232-12-014, 1993, "Wildlife Classified as Endangered Species," *Washington Administrative Code*, as amended.

WAC 246-247, 1994, "Radiation Protection--Air Emissions," *Washington Administrative Code*, as amended.

WAC 365-190-080, 1991, "Critical Areas," *Washington Administrative Code*, as amended.

Washington Clean Air Act of 1991,*Revised Code of Washington* 70.94, as amended.

Washington Department of Ecology (Ecology), 1998, *1996 Air Quality Data Summary*, #98-208, Washington State Department of Ecology Olympia, Washington.

Washington Department of Fish and Wildlife Agricultural Lease #R-01.

Washington Department of Fish and Wildlife Agricultural Lease #WB-01.

Washington Department of Fish and Wildlife Agricultural Lease #WB-02.

Washington Department of Fish and Wildlife Grazing Permit #W5-01.

WDFW, 1993, *Priority Habitats & Species and Natural Heritage Data (Maps)*, Washington Department of Fish and Wildlife, Olympia, Washington.

WDOH, 1996, *100-D Island Radiological Survey Report*, WDOH/ERS-96-1101, Washington State Department of Health, Olympia, Washington (November).

Water Pollution Control Act of 1945, *Revised Code of Washington* 90.48, as amended.

Water Resources Planning Act of 1965, 42 U.S.C. 1962, et seq.

Watson, J., et. al, 1991, Benton County Agricultural Extension Office, Prosser, Washington.

WDFW, 1996, *Status of Washington's Shrub-Steppe Ecosystem: Extent, Ownership, and Wildlife/Vegetation Relationships*, Washington Department of Fish and Wildlife, Wildlife Management Program, Olympia, Washington (August).

WHC, 1991a, *Geologic Setting of the 200-West Area: An Update*, WHC-SD-EN-TI-008, Rev. 0, Westinghouse Hanford Company, Richland, Washington (January).

WHC, 1992, *Hanford Groundwater Cleanup and Restoration Conceptual Study*, WHC-EP-0458, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992a, *Fiscal Year 1991 100 Areas CERCLA Ecological Investigations*, WHC-EP-0448, Westinghouse Hanford Company, Richland, Washington (April).

WHC, 1992b, *Status of Birds at the Hanford Site in Southeastern Washington*, WHC-EP-0402, Rev. 1, Westinghouse Hanford Company, Richland, Washington (June).

WHC, 1992c, *A Synthesis of Ecological Data from the 100 Areas of the Hanford Site*, WHC-EP-0601, Westinghouse Hanford Company, Richland, Washington (October).

WHC, 1992d, *Biological Assessment for Rare and Endangered Plant Species, Related to CERCLA Characterization Activities*, WHC-EP-0526, Westinghouse Hanford Company, Richland, Washington (April).

WHC, 1992e, *Biological Assessment for State Candidate and Monitor Wildlife Species Related to CERCLA*, WHC-SD-EN-EE-009, Rev. 0, Westinghouse Hanford Company, Richland, Washington (August).

WHC, 1992f, *Vascular Plants of the Hanford Site*, WHC-EP-0554, Westinghouse Hanford Company, Richland, Washington (July).

WHC, 1993, *Biological Resources of the 300-FF-5 Operable Unit*, WHC-SD-EN-TI-121, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994, *Vegetation Communities Associated with the 100-Area and 200-Area Facilities on the Hanford Site*, WHC-SD-EN-TI-216, Rev. 0, Westinghouse Hanford Company, Richland, Washington (January).

Wild and Scenic Rivers Act of 1968, 16 U.S.C. 1271, et seq.