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Hanford Site End State Vision

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

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Summary

The purpose of this document is to present the site-specific end state cleanup vision for the U.S. Department of Energy's (DOE) Hanford Site. This document responds to the requirements of DOE Policy 455.1, *Use of Risk-Based End States*, and was prepared following DOE's *Guidance for Developing a Site-Specific Risk-Based End State Vision*. The purpose of the policy is to focus DOE on conducting cleanup that protects human health and the environment for the planned future use of each defined area on the Hanford Site. In addition, the policy directs the consideration of future land use and risk in making cleanup decisions. The policy requires DOE to continue to comply with applicable federal, state, community and treaty requirements. It is not a license to do less, but rather to link decision making to a larger perspective.

Hanford's regulatory agencies, the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology), along with many other Hanford stakeholders were not in agreement with pursuing the DOE's Risk-Based End State Vision initiative. They pointed out that risk is only one of the nine criteria in the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) process and that focusing the decision solely on risk is unacceptable. However, they recognized that a more detailed end state definition is needed in the near-term to better focus remediation decisions and support the many key decisions that need to be made in the next several years. The Tri-Party agencies (DOE, EPA, and Ecology) along with several Hanford Advisory Board members formed a Hanford End States Interagency Management Integration Team (IAMIT) with the intent of building on the principles and outcomes of earlier public processes as well as adding detail and clarity for cleanup. This was a collaborative process requiring major participation and involvement from this team. Workshops planned by this IAMIT were held during June and August 2004 and May 2005 to obtain this input. Workshop participants, including regulatory agencies, stakeholders, Tribes and the public indicated the workshops were very informative and provided an opportunity for meaningful input to the Hanford cleanup decision process.

The DOE offices in Richland found the workshops valuable for obtaining input from the regulatory agencies, the public, stakeholders, and Tribal Nations on potential future uses of the Hanford Site and key cleanup strategies. This information will help DOE refine their vision of future land uses and develop sustainable cleanup decisions for Hanford. In addition, this clearer vision of Hanford's end states will enable DOE to write meaningful statements of work for the next generation of Central Plateau contracts and to reduce uncertainties and performance risks as those contracts are implemented.

The Hanford Site End State Vision describes a post-cleanup condition for the Hanford Site. The end state described in this document was originally based on an established land-use plan contained in the *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (CLUP; DOE 1999a). DOE recognizes that this document covers a 50-year planning window and that the contaminants that will remain at Hanford after cleanup will be hazardous for much longer periods of time. This led DOE to recognize that a broader set of potential future uses must be considered as cleanup decisions are finalized if those decisions are to be sustainable. Following the workshops, sections were added to the document describing the modified vision based on the workshop input.

This document provides a regional context for the end state vision and describes the hazards that must be mitigated as DOE moves toward an end state for the Hanford Site. Wherever possible, this document draws on existing documents and agreements already in place. A number of potential alternatives were considered during the creation of this document. DOE revised their original end state alternatives based on feedback from the end states workshops and follow-on consultation with the Tribes. DOE's stakeholders do not uniformly support each of these alternatives. Chapter 5 provides a description of the alternatives, and recommendations to support them, that exist between the end state vision and current cleanup plans.

The alternatives serve to identify tasks that DOE believes should be implemented in pursuit of the end state vision. These are tasks that DOE believes will help better quantify impact and address barriers and will also help focus ongoing planning and regulatory and community consultation on decision making tied to anticipated future land uses. Input received via the workshops will be considered in future CERCLA cleanup decisions. In addition, any alternatives that are pursued by DOE will be done through the existing decision-making processes that involve regulatory agencies, stakeholders, and Tribal Nations, as appropriate. The following are the revised end state vision alternatives:

1. Cleanup of the 100 Areas based on conservation and preservation land-use exposure scenarios for recreational, resident park ranger and tribal activities, including fishing for the next 50 years. Beyond 50 years unlimited use is anticipated.

   - Continue remediation of waste sites to the current Interim Action Record of Decisions (RODs).
   - No further degradation of groundwater above drinking water standards and restore groundwater to beneficial drinking water use when practicable. Follow process outlined in state and federal regulations to establish protective limits when applicable or relevant and appropriate requirements (ARARS) cannot be met.
   - Expedite final risk assessments and final RODs. Develop pathway analysis and exposure factors for the 100 Areas land-use scenarios identified in CLUP. In addition, analyze multiple scenarios considering input from the 100 Area End State Workshop.

2. Waste sites in the 300 Area should be cleaned up to achieve remedial action objectives that are based on industrial land-use exposure scenarios already identified in the CLUP.

   - Continue remediation of waste sites to industrial standards as required under the current Interim Action RODs. Remediated sites will be backfilled to support unlimited surface use (irrigation and groundwater use may be restricted, based on success of future groundwater cleanup activities) where practicable.
   - Re-evaluate the natural attenuation decision for the uranium plume at the 300 Area and develop a proposed plan/focused feasibility study to determine if other more effective groundwater remedial alternatives are available to meet cleanup goals. Work to meet the goals of no further degradation of groundwater above drinking water standards and restore groundwater to beneficial drinking water use when practicable. Follow process outlined in state and federal regulations to establish protective clean up goals if groundwater cannot be restored in a reasonable time frame.

3. A Central Plateau Core Zone will be a permanent waste management area and will remain under federal control for the next 150 years or longer. A buffer area (outside a Core Zone) will be maintained between a Core Zone and the remainder of the Central Plateau during cleanup operations. After cleanup is complete the buffer area will shrink and land use will be similar to the 100 Area. From the buffer area to the Columbia River, cleanup will be consistent with the 100 Area.

   - Address waste sites in a Core Zone through the CERCLA process consistent with *industrial exclusive and conservation/preservation land-use scenarios* identified in the CLUP and within the timeframe identified in the CLUP ROD (at least 50 years).
   - Remediate and monitor waste sites to achieve human health and environmental protection goals under CERCLA.
   - Remove and consolidate small waste sites to optimize placement and minimize the number of surface barriers.
   - Manage groundwater contamination across the site in accordance with the February 2004 *Hanford Site Groundwater Strategy* (DOE 2004a).
   - Retrievably stored suspect TRU waste will be retrieved, treated, and the TRU portion shipped to the Waste Isolation Pilot Plant (WIPP). The low-level portion of the retrieved waste will be treated and disposed of on-site. Wastes containing transuranic materials buried pre-1970 will be managed per CERCLA decisions.

4. Stabilize high-radioactivity material in a 200 Area Core Zone and allow for radioactive decay prior to final disposition.

   - Continue storage of cesium and strontium capsules in wet storage in the Waste Encapsulation and Storage Facility in the 200 Area in the near term (up to 5 years). Place cesium and strontium capsules in dry storage in the 200 Area until the cesium capsules can be sent to a geological repository and strontium capsules can be disposed of in the Central Plateau in accordance with waste acceptance criteria and CERCLA decision documents. There are regulatory issues and Ecology has serious concerns with this on-site disposal alternative.
   - Stabilize K-Basin sludge and dispose at WIPP or in a 200 Area Core Zone (if less than 100 nCi/g) in accordance with waste acceptance criteria and CERCLA decision documents. Grout remaining equipment and material in place and then cut up and move to a disposal facility in the 200 Area.

5. Remove-treat-dispose or stabilize in place contaminated materials within a Central Plateau Core Zone utilizing the CERCLA process.

   - Use canyon facilities that are robust as engineered waste disposal facilities.
   - Dispose small waste sites within or near the canyon/Plutonium Finishing Plant (PFP) facilities to optimize barriers and/or cap sizes.

- Grout in place the contaminated equipment in Plutonium-Uranium Extraction (PUREX) Plant tunnels.[1]
- Disposition buried pipelines in place in the Central Plateau using the Resource Conservation and Recovery Act (RCRA) and CERCLA processes, by remove-treat-dispose, or stabilize in place.[1]
- Demolish PFP to slab-on-grade. Remove equipment, debris, and plutonium hold-up material from PFP and dispose at WIPP or onsite in accordance with waste acceptance criteria and CERCLA decision documents.

6. Tank waste should be retrieved and the tank farms closed based on regulatory requirements (RCRA and CERCLA) and considering risk.

- Complete the tank closure environmental impact statement expeditiously with a ROD that allows the closure permitting process to begin.

7. The reactor pipelines in the Columbia River and the reactor cores revised end states are as follows:

- Cocoon eight of nine reactors and leave in place to decay for up to 75 years. DOE will make a final decision on whether to cut up and move reactor cores to Central Plateau after sufficient decay has occurred. The decision will be made prior to cleanup completion. This delay will require a commitment of future funds toward the final decision.
- Keep the B Reactor in its current configuration until funding is secured to support a museum. Should the support not materialize, B Reactor will follow the path described for the other reactors. Cocooning of B Reactor would be finished with the remainder of the 100 Area cleanup completions and no later than the end of the River Corridor Contract period.
- Leave the reactor pipelines in the Columbia River if risk levels are protective and ARARs are complied with and removal results in additional impact. Stabilize the pipelines if required. This evaluation will be part of the final ROD (2008) via the CERCLA process.

8. The strontium-90 groundwater plume at 100-N Area will attenuate through radioactive decay and efforts will be made to reduce the flux of strontium-90 to the Columbia River.

- Continue implementing the 100-NR 01/02 Interim Action ROD for soils and groundwater. Focus on implementing a groundwater remedial alternative that is more effective and efficient than pump-and-treat systems for reducing the flux of strontium-90 to the Columbia River. Utilize established CERCLA processes to modify the ROD for groundwater decisions.

[1] This was not discussed at the workshops and will require additional public involvement during regulatory decision process.

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Acronyms

ALE	Fitzner/Eberhardt Arid Lands Ecology Reserve
ARAR	applicable or relevant and appropriate requirement
BDAC	Biota Dose Assessment Committee
BCG	Biotic Concentration Guide
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLUP	Comprehensive Land-Use Plan
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy, Office of Environmental Management
DOE-HQ	U.S. Department of Energy, Headquarters
DOE-ORP	U.S. Department of Energy, Office of River Protection
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOI	U.S. Department of Interior
Ecology	Washington State Department of Ecology
EM	Office of Environmental Management
EPA	U.S. Environmental Protection Agency
ESD	explanation of significant difference
FFTF	Fast Flux Test Facility
FHI	Fluor Hanford, Inc.
FRG	Federal Republic of Germany
HAMMER	Hazardous Materials Management and Emergency Response
HQ	U.S. Department of Energy Headquarters
IAMIT	Interagency Management Integration Team
LTS	long-term stewardship
MCL	maximum contaminant level
NEPA	National Environmental Policy Act
NPL	National Priorities List
OFM	Office of Financial Management (Washington State)
ORP	Office of River Protection
PFP	Plutonium Finishing Plant

PUREX	Plutonium-Uranium Extraction (Plant)
RCRA	Resource Conservation and Recovery Act
RL	Richland Operations Office
RME	reasonably maximally exposed
ROD	record of decision
Tri-Party Agreement	*Hanford Federal Facilities Agreement and Consent Order*
WAC	Washington Administrative Code
WIPP	Waste Isolation Pilot Plant
WNP	Washington Nuclear Plant (Energy Northwest)
WTP	Waste Treatment Plant

1.0 Introduction

The purpose of this document is to present the site-specific end state cleanup vision for the U.S. Department of Energy's (DOE) Hanford Site. This document is the primary tool for communicating Hanford's end state vision to DOE, the site contractors, the regulatory agencies, Tribal Nations, and public stakeholders. This document responds to the requirements of DOE Policy 455.1, *Use of Risk-Based End States*, and was prepared following DOE's *Guidance for Developing a Site-Specific Risk-Based End State Vision*. The purpose of the policy is to focus DOE on conducting cleanup that protects human health and the environment for the planned future use of each defined area on each site. In addition the policy directs DOE sites to consider future land use and risk in making cleanup decisions. The policy requires DOE to continue to comply with applicable federal, state, community and treaty requirements. It is not a license to do less, but rather to link decision making to a larger perspective.

A draft Hanford end state vision was prepared in the fall of 2003 in response to the DOE policy. The draft was reviewed by the public in December 2003 and by DOE Headquarters (HQ) beginning in February 2004. In response to comments, the document was extensively revised by April 2004 and provided to regulatory agencies, the public, other stakeholders, Tribal Nations and DOE-HQ for review. Following this review, regulatory agencies pointed out that risk is only one of the nine criteria in the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) process so focusing the decision solely on risk is unacceptable. The public and regulatory agency response to the revised document led The Tri-Party agencies (U.S. Department of Energy at Hanford, U.S. Environmental Protection Agency [EPA], and Washington State Department of Ecology [Ecology]) along with several Hanford Advisory Board members to form a working group called an Interagency Management Integration Team (IAMIT) to assist in developing a clear understanding of what the Hanford Site will look like when cleanup is complete. The intent was to include the three dimensions of surface, soil, and groundwater; structures, operations or waste left on site, as well as contamination sources, pathways, expectations for land use; and institutional controls at the conclusion of cleanup at Hanford.

The IAMIT planned three workshops to obtain public input to assist in developing this picture. A workshop on the 100 Areas was held on June 23 and 24, 2004. A workshop on the 200 Areas was held on August 11 and 12, 2004. A workshop on the 300 Area originally scheduled for September 14 and 15, was postponed until May 19, 2005. This allowed DOE to complete the first phase of its re-evaluation of the 300 Area groundwater remedy and the city of Richland to complete a study of the redevelopment potential for the 300 Area. Information from both studies was useful to stakeholders for the 300 Area end states dialogue. Background information on the workshops and outcomes can be viewed at http://www.hanford.gov/docs/rbes. The original draft of Section 3.5 and Chapter 5 of this document have been extensively revised to reflect the information received during the workshops. Planning and carrying out the workshops was a collaborative process requiring major participation and involvement from this team. Workshop participants, including regulatory agencies, stakeholders, Tribes and the public indicated the workshops were very informative and provided an opportunity for meaningful input to the Hanford cleanup decision process.

In addition to the meetings in Richland during June and August 2004 and May 2005, representatives from DOE, regulatory agencies, Tribal Nations and stakeholders from across the DOE complex met in Chicago, Illinois, on October 6 and 7, 2004. The objective of the meeting was to explain the end state vision process so that dialogue between all parties about the process could improve. By helping stakeholders, regulatory agencies, elected officials, and tribal representatives understand that the end state vision is not the process DOE's Office of Environmental Management (EM) is going to use to make final decisions, but is a process EM can use to make better decisions, DOE anticipated that the process could become a powerful tool for moving cleanup forward (Golan 2004).

The development of this document and the discussions held in the workshops have highlighted a number of values and ideals held by DOE:

- Key milestones and project commitments will be met in a timely manner.
- Changes to key milestones and project commitments will be negotiated openly and transparently.
- Environmental rules and regulations will be adhered to, including pursuing waivers as appropriate.
- Public involvement will remain an important hallmark of project success.
- Groundwater will be restored to its highest beneficial use whenever possible.
- Technologies to address Hanford's groundwater plumes will continue to be pursued.
- Long-term stewardship will require perpetual support and commitment.
- Monitoring will be required whenever wastes are left in place to verify the robustness of the remedial action.

1.1 Background

In 2002, DOE-EM established a set of corporate projects to lead its response to the top-to-bottom review (DOE 2002a). The corporate projects are intended to change the way DOE-EM and, in some cases, DOE does business. One of these corporate projects, *A Cleanup Program Driven by Risk-Based End States Project*, resulted in DOE Policy 455.1 being issued in 2003 along with guidance and implementation documents. This policy is consistent with the CERCLA, the *Resource Conservation and Recovery Act* (RCRA), and the *Atomic Energy Act*, which either explicitly or implicitly direct the consideration of future land use and risk in making cleanup decisions. This approach attempts to gain a common acceptance of the post-remediation future for Hanford prior to implementing final remediation measures.

In September 1999, DOE issued the *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (CLUP) (DOE 1999a). The guidance for preparing an end state vision for Hanford called for the use of current land-use plans as the basis for the risk scenarios considered and initial end state planning relied heavily on the CLUP (DOE 1999a). The plan evaluated the potential environmental impact associated with implementing a 50-year comprehensive land-use plan for the Hanford Site. DOE's selected 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, expanding the Saddle Mountain National Wildlife Refuge to include all of the Wahluke Slope, and the management of the Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE) by the U.S. Fish and Wildlife Service. Anticipated future uses for Hanford land discussed in the end state vision have been extensively supplemented with information obtained in the public workshops mentioned above.

1.2 Organization of the Report

Information in this document has been taken wherever possible from existing documents. This report is organized into three main sections. Chapter 2 provides a regional context for the end state vision using several regional maps.

Chapter 3 was drawn extensively from the CLUP (DOE 1999a). The chapter describes the end state on a Hanford Site scale. The chapter includes current state and end state vision.

Chapter 4 relies heavily on the numerous documents developed to reach decisions on cleanup of the Hanford Site including CERCLA interim action records of decision (RODs). The chapter contains the hazard-specific descriptions. The chapter is organized by major areas of the Hanford Site (100 Area, 200 Area, 300 Area, 400 Area, 600 Area, and 1100 Area) and the specific types of hazards that exist in each area on the surface, in the subsurface, and in groundwater. Current state and end state vision conceptual site models are included.

The end-state conceptual site model narrative also includes a description of the mechanisms assumed in the end state vision that will ensure sustainable protection or safety for at-risk receptors and the uncertainties or risks of failure that could adversely affect these assumptions.

Chapter 5 provides a description of the alternatives between the end state vision and current cleanup plans for the DOE Hanford Site.

1.3 Site Mission

From its creation in 1943 until the late 1980s, the Hanford Site was dedicated first to the production of plutonium for national defense and later to management of the resulting waste. The plutonium production activities produced about 2,600 waste sites on the Hanford Site. The severity of contamination at individual waste sites ranges from contaminated tumbleweeds to radioactive and chemical waste in underground tanks. The waste and nuclear material inventory remaining from the plutonium production mission contains about 390 million curies of radioactivity and 362,874 to 544,311 metric tons (400,000 to 600,000 tons) of chemicals (Gephart 2003), as shown in Table 1.1. There are significant unknowns in this inventory, especially for specific radionuclides and their chemical forms.

Table 1.1. Hanford Site Waste and Nuclear Material Inventory

Waste Source	Radioactivity (million curies)	Chemicals	Volume
Tank Waste	195	217, 724 metric tons (240,000 tons)	2E+008 liters (>53 million gallons)
Solid Waste	6	63,503 metric tons (70,000 tons)	707,921 cubic meters (25 million cubic feet)
Soil and Groundwater	2	90,718 to 272,155 metric tons (100,000 to 300,000 tons)	9.9E+008 cubic meters (35 billion cubic feet)
Facilities	1	--	5,663,369 cubic meters (200 million cubic feet)
Nuclear Material (includes Cs/Sr capsules, spent nuclear fuel)	185	--	708 cubic meters (25,000 cubic feet)

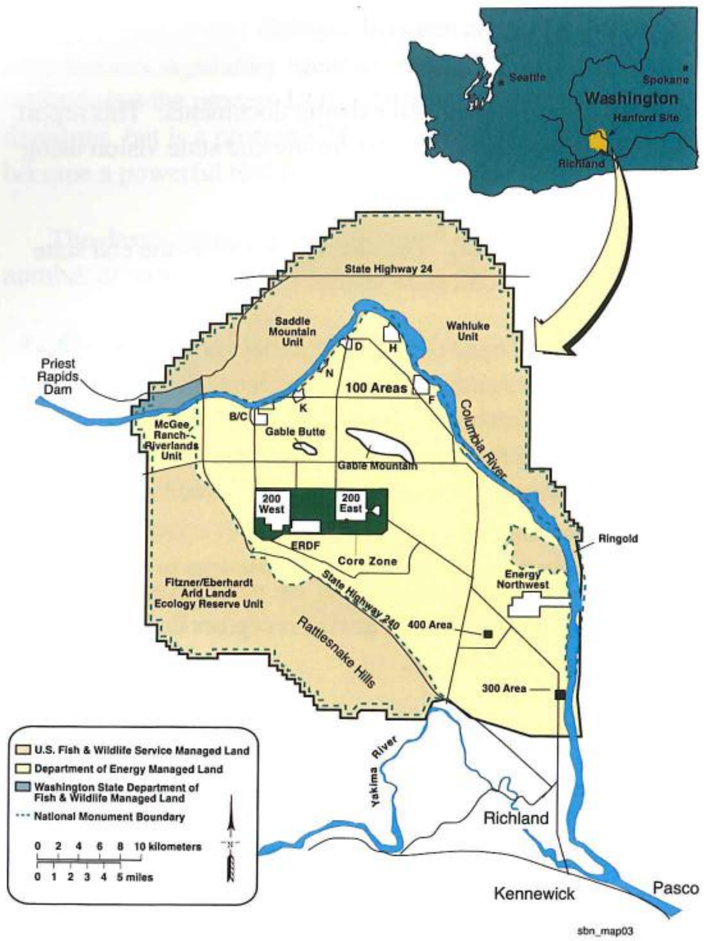

Figure 1.1. The Hanford Site (586 square miles) in Southeastern Washington State

Major operational areas (Figure 1.1) were created at the Hanford Site to carry out this mission:

- The 100 Areas (on the south shore of the Columbia River) are the sites of nine retired plutonium production reactors, including the dual-purpose N Reactor. The 100 Areas occupy ~11 square kilometers (~4 square miles).
- The 200 West and 200 East Areas are located within the Central Plateau, ~8 and 11 kilometers (~5 and 7 miles), respectively, south of the Columbia River. Historically, these areas have been dedicated to fuel reprocessing and to waste management and disposal activities. The 200 Areas cover ~16 square kilometers (~6 square miles).
- The 300 Area, located just north of the city of Richland, once contained fuel fabrication facilities and is currently the site of nuclear research and development and biological sciences laboratory. This area covers 1.5 square kilometers (0.6 square mile).
- The 400 Area is ~8 kilometers (~5 miles) northwest of the 300 Area. The 400 Area contains the Fast Flux Test Facility (FFTF), which was used to test breeder reactor systems. Also included in this area is the Fuels and Materials Examination Facility.
- The 600 Area includes all of the Hanford Site not occupied by the 100, 200, 300, and 400 Areas.
- The former 1100 Area (now called Richland North) is located south of the Hanford Site in the northern portion of the city of Richland. This is a support area that included general stores, transportation maintenance, and the DOE and contractor facilities. The 1100 Area has been remediated and removed from EPA's National Priorities List (NPL). Title of ~324 hectares (~800 acres) has been transferred to the Port of Benton for industrial development.

Non-DOE activities on Hanford Site leased land include commercial power production on the land occupied by the Energy Northwest Washington Nuclear Plant (WNP)-2 plant, as well as the partially completed WNP-1 and WNP-4 plants, and operation of a commercial low-level waste burial site by

US Ecology, Inc. Immediately adjacent to the southern boundary of the Hanford Site, AREVA operates a commercial nuclear fuel fabrication facility, and Pacific EcoSolutions operates a low-level waste decontamination, super compaction, and packaging disposal facility. The Laser Interferometer Gravitational-Wave Observatory is located between the 200 and 400 Areas.

Since the closeout of the plutonium production mission, the Hanford Site has transitioned to an environmental restoration and waste management mission. During the past 14 years, efforts have shifted to the development of new waste treatment and disposal technologies, and to characterization and cleanup of nuclear materials and contamination left from historical operations.

Currently, the primary mission includes cleaning up and shrinking the site footprint from ~1,517 to ~194 square kilometers (~586 to ~75 square miles) by 2012. The report *Hanford 2012: Accelerating Cleanup and Shrinking the Site* (DOE 2000) states that the cleanup mission includes three strategies:

1. Restore the Columbia River Corridor by continuing to clean up Hanford Site sources of radiological and chemical contamination that threaten the air, groundwater, or Columbia River. It is expected that most River Corridor projects will be completed by 2012.
2. Transition the Central Plateau (200 East and 200 West Areas) from primarily waste storage areas to waste characterization, treatment, storage, and disposal operations that are expected to take another 30 years.
3. Prepare the Hanford Site for future activities such as long-term stewardship, other DOE and non-DOE federal missions, and other public and private use.

On May 15, 1989, DOE, EPA, and Ecology signed a comprehensive agreement for cleaning up the Hanford Site. The *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989), or Tri-Party Agreement, is an agreement for achieving compliance with the CERCLA remedial action provisions and the RCRA treatment, storage, and disposal unit regulations and corrective action provisions. The Tri-Party Agreement (1) defines and ranks CERCLA and RCRA cleanup commitments, (2) establishes responsibilities, (3) provides a basis for budgeting, and (4) reflects aggressive goals for site remediation, with enforceable milestones to ensure compliance.

1.4 Status of Cleanup Program

This section presents the evolution of Hanford's thinking on risk-based strategies for cleaning up the Hanford Site, from a 1995 study commissioned by Mr. Grumbly to the present day status of the cleanup program.

A Risk-Based Approach to Cleanup. In June 1995, the existing Hanford Site contractors (Pacific Northwest Laboratory, Westinghouse Hanford Company, and Bechtel Hanford, Inc.) produced a document titled *Development of a Risk-Based Approach to Hanford Site Cleanup* (Hesser et al. 1995) in response to a request from Mr. Grumbly, then Assistant Secretary for Environmental Management. Mr. Grumbly asked Hanford to develop a conceptual set of risk-based cleanup strategies that (1) protected the public, workers, and environment from unacceptable risks, (2) were technically executable, and (3) fit within an expected annual funding profile of $1.05 billion. A systems engineering approach was used to develop mortgage-based, risk-based, and land-based cleanup strategies that differed in terms of the work to be performed, its sequence, and the resulting end states. The report recommended adoption of a risk-based cleanup strategy. The report examined these major decisions:

- Retrieval and treatment versus in-place disposal of tank waste
- Retrieval and treatment versus in-place disposal of post-1970 transuranic waste
- Treatment and confinement versus restriction of the contaminated groundwater
- Demolition and removal versus entombment of major facilities

Risk Framework Agreement

The basic assumptions agreed to by DOE, EPA, and Ecology in October 2001 include the following items:

- "The Core Zone (200 Areas including B Pond [main pond] and S Ponds) will have an industrial scenario for the foreseeable future (Figure 1.2).
- The Core Zone will be remediated and closed allowing for other uses consistent with an industrial scenario (environmental industries) that will maintain active human presence in this area, which in turn will enhance the ability to maintain the institutional knowledge of the waste left in place for future generations. Exposure scenarios used for this zone should include a reasonable maximum exposure to a worker/day user, to possible Native American users, and to intruders. An assumption of industrial land use will be used to set cleanup levels.
- DOE will follow the required regulatory processes for groundwater remediation (including public participation) to establish the points of compliance and remedial action objectives. It is anticipated that groundwater contamination under the Core Zone will preclude beneficial use for the foreseeable future, which is at least the period of waste management and institutional controls (150 years). It is assumed that the tritium and iodine-129 plumes beyond the Core Zone boundary to the Columbia River will exceed the drinking water standards for the period of the next 150 to 300 years (less for the tritium plume). It is expected that other groundwater contaminants will remain below or will be restored to drinking water levels outside the Core Zone.
- Drilling for water use would be limited in the Core Zone. An intruder scenario will be calculated for assessing the risk to human health and the environment.
- Waste sites outside the Core Zone but within the Central Plateau (200-N, Gable Mountain Pond, B/C cribs located south of 200 East Area) will be remediated and closed based on an evaluation of multiple land-use scenarios to optimize land use, institutional control cost, and long-term stewardship.
- Other land-use scenarios (e.g., residential, recreational) may be used for comparison purposes to support decision-making, especially for
  - the post-active institutional controls period (>150 years)
  - sites near the Core Zone perimeter to analyze opportunities to 'shrink the site'
  - early (precedent-setting) closure/remediation decisions"

(Note: This framework does not deal with the tank retrieval decision.)

Central Plateau Risk Framework. DOE, EPA, and Ecology initiated the development of a Central Plateau Risk Framework in October 2001 (see textbox on page 1.6). The product of this effort provides a basis for making cleanup decisions in the Central Plateau (Figure 1.2) and will be considered as future Tri-Party Agreement milestones are developed. Through a series of technical workshops attended by all the Central Plateau programs, initial agreements were made on the basic assumptions for the risk framework. This framework was then taken to the Hanford Advisory Board, Tribal Nations, Oregon Hanford Waste Board, and Hanford Site Board of Trustees.

The risk framework was developed subsequent to the CLUP (DOE 1999a) and is not completely consistent with the land uses envisioned in CLUP and the likely allowable land uses included in the comprehensive conservation plan being developed for the Hanford Reach National Monument. Tank farms will be closed under the permitting process for the state of Washington integrated with other waste sites.

In the future, activities at Hanford will be concentrated at the Central Plateau. The associated buffer zone (required for safety purposes) that presently extends to the Columbia River should shrink to the Central Plateau boundary over time. One hundred and fifty years has been identified as the reasonable time period to switch from active control to passive control outside the Central Plateau. This time period was chosen because the tritium and iodine plumes that currently exist in this region are expected to decay or disperse to below the drinking water standard within 150 years.

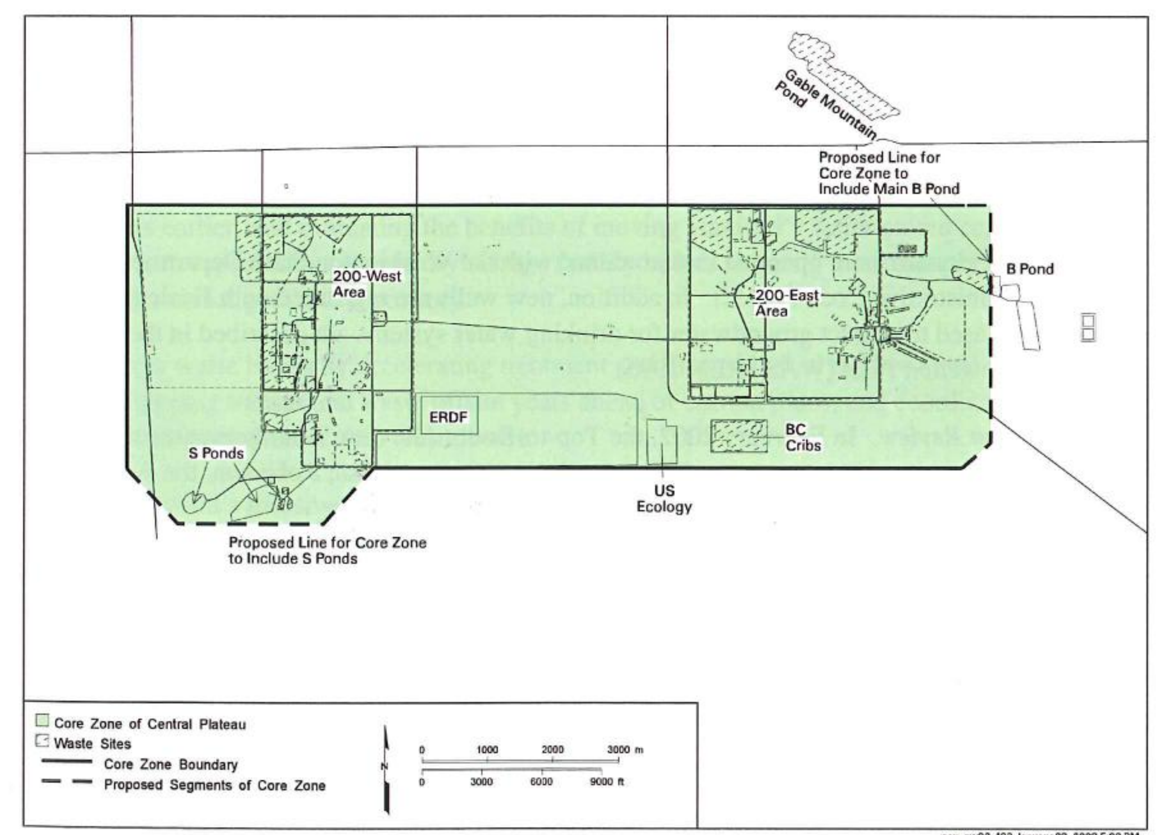

Figure 1.2. Central Plateau Core Zone Map

Groundwater Institutional Controls. The requirements for engineered barriers and institutional controls are found in the Hanford cleanup decision documents such as existing and future RODs. CERCLA RODs (e.g., ROD 1996a) stipulate the selected cleanup remedy or the closeout process once cleanup is completed for a particular site, which may include the implementation of engineered barriers and institutional controls. The requirements for institutional controls under CERCLA response actions are listed in *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions* (FHI 2002), along with descriptions of their implementation and maintenance.

Institutional controls are used to augment the engineered components associated with the cleanup of waste to minimize the potential for human exposure to contamination and are primarily administrative in nature. Approximately 259 square kilometers (100 square miles) of Hanford groundwater has been affected (e.g., drinking water standards are exceeded) because of past waste management practices. A significant portion of the remainder of the site continues to serve as a buffer zone for safety and emergency response purposes, and to protect human health and the environment from remaining hazards. DOE will control access and use of the Core Zone and the buffer zone for the duration of the cleanup, including restrictions on the drilling of new groundwater wells in the existing plumes or their paths. It is expected that institutional controls will be enforced until the remedial action objectives have been obtained. In the event that DOE transfers property with groundwater use restrictions to another entity, the appropriate use restrictions are attached to the real estate transaction to ensure that specific institutional controls will remain in place.

Groundwater use on the Hanford Site is generally restricted, except for the purposes of monitoring and treatment, as approved by EPA or Ecology. Groundwater use is also controlled through excavation permits and the land-use process. A limited number of wells are currently in operation for purposes other than research or testing, including those that supply drinking water at the FFTF in the 400 Area, the Hanford Patrol Training Center, the Yakima Barricade, and Energy Northwest. Other wells provide backup fire protection, emergency cooling water, and aquatic studies (FHI 2002).

Drinking water systems are operated in accordance with the Washington State Department of Health Washington Administrative Code (WAC). In addition, new wells are registered with Ecology. The control measures used to protect groundwater for drinking water systems are described in the *Hanford Site Wellhead Protection Plan* (WASTREN 1995).

Top-to-Bottom Review. In February 2002, the Top-to-Bottom Review Team presented their report, *A Review of the Environmental Management Program* (DOE 2002a) to Jessie Roberson, the Assistant Secretary for DOE-EM at that time. The review issued four major findings:

- The manner in which DOE-EM developed, solicited, selected, and managed many contracts did not focus on accelerating risk reduction and applying innovative approaches to doing the work.
- DOE-EM's cleanup strategy was not based on comprehensive, coherent, technically supported risk prioritization.
- DOE-EM's internal business processes were not structured to support accelerated risk reduction or to address its current challenges of uncontrolled cost and schedule growth.

- The scope of the DOE-EM program included activities that did not focus on or support an accelerated, risk-based cleanup and closure mission.

To address these weaknesses, the team recommended an aggressive course of action to change DOE-EM's approach to its cleanup and closure mandate. All the recommended changes were designed to focus the program on one result – reducing risk to public health, workers, and the environment on an accelerated basis.

Hanford Performance Management Plan. In August 2002, DOE, Richland Operations Office (RL) submitted the *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (Hanford Performance Management Plan) to DOE-HQ (DOE 2002b) in response to the Top-To-Bottom Review. The plan lays out DOE-RL and DOE-ORP goals for accelerated completion of the DOE-EM mission at Hanford and for high-quality, comprehensive cleanup that protects public health and the environment. The six strategic initiatives outlined in the plan call for DOE to:

1. Restore the Columbia River Corridor by 2012, completing remediation of 50 burial grounds, 551 waste sites, 261 excess facilities, and 7 plutonium production reactors, thereby reducing risk to the river and shrinking the Hanford Site by about 85%.

2. Take several near-term actions to ensure the tank waste program ends by 2035, including increasing the capacity of the planned Waste Treatment Plant; demonstrating tank closure and starting to close tanks within 5 years; and demonstrating alternative treatment and immobilization solutions for lower-risk tank waste.

3. Accelerate the stabilization and shipment offsite of nuclear materials, including cleaning up K Basins spent nuclear fuel, sludge, debris, and water 10 months early; stabilizing and securely storing remaining plutonium nine years sooner; demolishing the Plutonium Finishing Plant (PFP) 7 years earlier; and evaluating the benefits of moving Hanford's water-stored cesium and strontium capsules to a secure dry storage facility before shipping them directly (non-vitrified) to the national geologic repository.

4. Address waste issues by accelerating treatment and disposal of mixed low-level waste, retrieving and shipping transuranic waste offsite years ahead of current plans, and coordinating remaining waste site remediation with tank closure.

5. Use Hanford's massive decommissioned chemical separations buildings as waste disposal facilities, and accelerate the disposition of the Central Plateau's 900 excess facilities and more than 800 non-tank-farm waste sites by using regional and other grouping strategies.

6. Protect groundwater resources by removing or isolating contaminant sources on the Central Plateau, remediating other contamination sources, dramatically reducing the conditions that have the potential to drive contaminants into the groundwater, treating groundwater, and integrating monitoring requirements.

Hanford's Long-Term Stewardship Program. DOE is committed to protecting human health and the environment and to meeting its long-term, post-cleanup obligations in a safe and cost-effective manner. Hanford's long-term stewardship (LTS) vision statement is

> *"The vitality of human, biological, natural, and cultural resources is sustained over multiple generations."*

The LTS mission statement serves as the charter for the program:

> *"The mission of the LTS Program is to provide for continuous human and environmental protection, and the conservation and consideration of use of the biological, natural, and cultural resources, following the completion of the cleanup mission. This will be accomplished through the following functions:*
>
> 1. *Managing post-cleanup residual risks*
> 2. *Managing Site resources*
> 3. *Managing stewardship information*
> 4. *Using science and technology*
> 5. *Providing post-cleanup infrastructure*
> 6. *Integrating long-term stewardship responsibilities"*

Cleanup Progress to Date. DOE, Ecology, and EPA have worked hard to bring a well-defined and manageable focus to Hanford cleanup: restoring the lands along the Columbia River Corridor and transitioning the Central Plateau to a modern waste management operation. Substantial progress has been made toward reducing risk and achieving the cleanup outcomes identified in the Tri-Party Agreement documents. Substantive integration between the DOE Office of River Protection (ORP) and DOE-RL of performance and risk assessment methods, information and results has been noticeably improved. Arrangements to coordinate individual project performance assessments with the DOE Order 435.1 required Composite Analysis have been facilitated by the co-location of key contractor personnel and joint direction by DOE-ORP and DOE-RL staff.

Major underground radioactive tank waste safety issues have been resolved and all tanks have been removed from the Congressional watch list. Also, 98% of the remaining pumpable liquid (over 11.4 million liters [3 million gallons]) has been removed from the single-shell tanks per the *Interim Stabilization Consent Decree* (U.S. District Court 1999). The Plutonium-Uranium Extraction (PUREX) Plant and B Plant were the first chemical processing plants in the DOE complex to be deactivated to a low-cost maintenance state. Spent nuclear fuel has been taken out of wet storage and moved away from the Columbia River to safe, dry storage on the Central Plateau. Plutonium has been stabilized and packaged for safe, secure, long-term storage and disposition. Construction of the Waste Treatment Plant for tank waste treatment and immobilization is 36 percent complete as of June 2005. Additionally, work is progressing on the demonstration of bulk vitrification as a supplemental treatment method to support completion of Tri-Party Agreement milestones that accelerate the pace of retrieval and disposal of tank waste.

DOE-ORP has aggressively pursued a tank farm corrective action program to quantify the extent and risk-based impacts of past leaks in the tank farms. This soil-leak characterization program is the basis for

long-term predictions of tank residual performance that will be used for risk-based closure of the tank farms. Risk has been incorporated into the selection of tank retrieval sequences and communicated to Ecology.

DOE is actively addressing contaminated groundwater plumes. Reactor complexes are being dismantled and reactor cores cocooned for interim safe storage. All unpermitted discharges to the soil have stopped. As of April 2005, more than 4.2 million metric tons (4.7 million tons) of contaminated soil have been moved away from the Columbia River shoreline and into the Environmental Restoration Disposal Facility near the center of the Hanford Site. Over 1 million curies of radioactivity have been removed from contaminated facilities near the city of Richland, and the removal of 1,000 metric tons (1,102 tons) of enriched uranium was completed in May 2005. Over 4,500 drums of transuranic waste had been sent to the Waste Isolation Pilot Plant (WIPP) for disposal as of April 2005. All of this progress has been made while transforming the site safety environment to be among the best in the DOE complex.

As cleanup actions are completed, DOE has begun to transfer land to other entities for ownership or management. The 1100 Area has been transferred to the Port of Benton for development.

DOE and the U.S. Fish and Wildlife Service manages the majority of the Hanford Reach National Monument (Figure 1.1) for DOE consistent with the Presidential Proclamation. The U.S. Fish and Wildlife Service administers three major management units of the monument totaling about 66,775 hectares (165,000 acres):

1. Fitzner/Eberhardt Arid Land Ecology Reserve – a 312-square-kilometer (120-square-mile) tract of land in the southwestern portion of the Hanford Site

2. Saddle Mountain Unit – a 130-square-kilometer (50-square-mile) tract of land on the north-northwest side of the Columbia River, generally south and east of State Highway 24

3. Wahluke Unit – a 225-square-kilometer (87-square-mile) tract of land located north and east of both the Columbia River and the Saddle Mountain Unit.

The portion of the monument administered by DOE includes the McGee Ranch/Riverlands Unit (north and west of State Highway 240 and south of the Columbia River), the Columbia River islands in Benton County, the Columbia River Corridor (0.4 kilometer [0.25 mile]) inland from the Hanford Reach shoreline) on the Benton County side of the river, and the sand dunes area located along the Hanford side of the Columbia River north of the Columbia Generating Station. Approximately 162 hectares (400 acres) along the north side of the Columbia River, west of the Vernita Bridge and south of State Highway 243, were managed by the Washington Department of Fish and Wildlife under a permit from DOE.

In total, these land areas, which encompass 67,178 hectares (166,000 acres) and are now part of the Hanford Reach National Monument, have served as a safety and security buffer zone for Hanford Site operations since 1943. This has resulted in an ecosystem that has been relatively untouched for nearly 60 years.

2.0 Regional Context End State Description

This chapter provides information on the physical features and land use for the region surrounding the Hanford Site. Maps (Figures 2.1a, 2.1b, 2.1c, 2.2a, and 2.2b) showing the current conditions and the end state vision conditions are included in each section.

2.1 Physical and Surface Interface

The Hanford Site lies within the semi-arid Pasco Basin of the Columbia Plateau in southeast Washington State. The Columbia Plateau is a broad plain situated between the Cascade Range to the west and the Rocky Mountains to the east. This plateau was formed by a thick sequence of Miocene-Age tholeiitic basalt flows, called the Columbia River Basalt Group, which emanated from fissures in north central and northeastern Oregon, eastern Washington, and western Idaho (Swanson et al. 1979). In the central and western sections of the Columbia Plateau, where the Hanford Site is located, the Columbia River Basalt Group is underlain by continental sedimentary rocks from earlier in the Tertiary Period.

Four major geologic processes, occurring over millions of years, formed the soil, rocks, and geologic features of the area. The area was flooded with numerous basaltic lava flows between 17 and 6 million years ago, followed by tectonic forces that folded the basalt. In this landscape, the ancestral Columbia River meandered across the area leaving behind layers of sediment called the Ringold Formation. About 12,000 years ago the area was inundated by a series of Ice Age floods (including the Missoula Floods), which deposited more sediment in what is referred to informally as the Hanford formation. Major manmade and natural features of the region for the current and end state vision are shown on Figures 2.1a and 2.1b. Few regional changes are expected to affect these features between now and completion of cleanup with the exception of the footprint of the Hanford Site.

Hanford is a dry area, known for its sandy soil, basalt ridges, and shrub-steppe vegetation. Precipitation in the area averages less than 15.8 centimeters (6.2 inches) per year. Surface water enters the Pasco Basin from several other basins that include the Yakima River Basin, Horse Heaven Basin, Walla Walla River Basin, Palouse/Snake Basin, and the Big Bend Basin. The major rivers in the area are the Columbia, Snake, Yakima, and Walla Walla Rivers. Figure 2.1c shows the major drainage basins in the region contributing to the Columbia River.

2.2 Human and Ecological Land Use

Historically, Native Americans used the Columbia River extensively for fishing, hunting, gathering, and pasturing of livestock. By the turn of the century, settlers had moved into the region and developed irrigated farms. Grand Coulee Dam was built on the Columbia River in the 1940s. The Columbia Irrigation Project brought more water for farming and the population increased in Franklin County, across the Columbia River from Hanford.

Currently, land use within the vicinity of the Hanford Site includes urban and industrial development, wildlife protection areas, recreation, irrigated and dryland farming, and grazing. According to the 1992 Census of Agriculture, Benton, Franklin, and Grant counties had a total of 9,586 square kilometers (3,745 square miles) of land in farms, of which 6,670 square kilometers (2,606 square miles) were in cropland. Approximately 46% of cropland was irrigated in 1992, and ~40% of cropland 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 975 square kilometers (376 square miles) and 120 square kilometers (46.4 square miles) 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. In 1994, the Conservation Reserve Program of the U.S. Department of Agriculture[1] included 102.8 square kilometers (39.7 square miles) in Benton County, 93.6 square kilometers (36.1 square miles) in Franklin County, and 101.1 square kilometers (39 square miles) in Grant County.[2]

In 1992, the Columbia Basin Project, a major irrigation project north of the Tri-Cities, produced gross crop returns of $552 million, representing 12.5% 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% of irrigated acres), wheat (20.2%), and feed-grain corn (5.8%).

Land use in the region surrounding the Hanford Site is not expected to change drastically during the upcoming decades. It is assumed that the region will continue to be dedicated to agricultural and that populations may increase mainly around the current urban areas. Current and end state regional human and ecological land use are shown in Figures 2.2a and b.

[1] Agricultural lands at risk for soil erosion set aside to enhance wildlife.
[2] Personal communication from R Hamilton, Conservation Program Specialist with the U.S. Department of Agriculture, Farm Service Agency, in Spokane, Washington, October 1997.

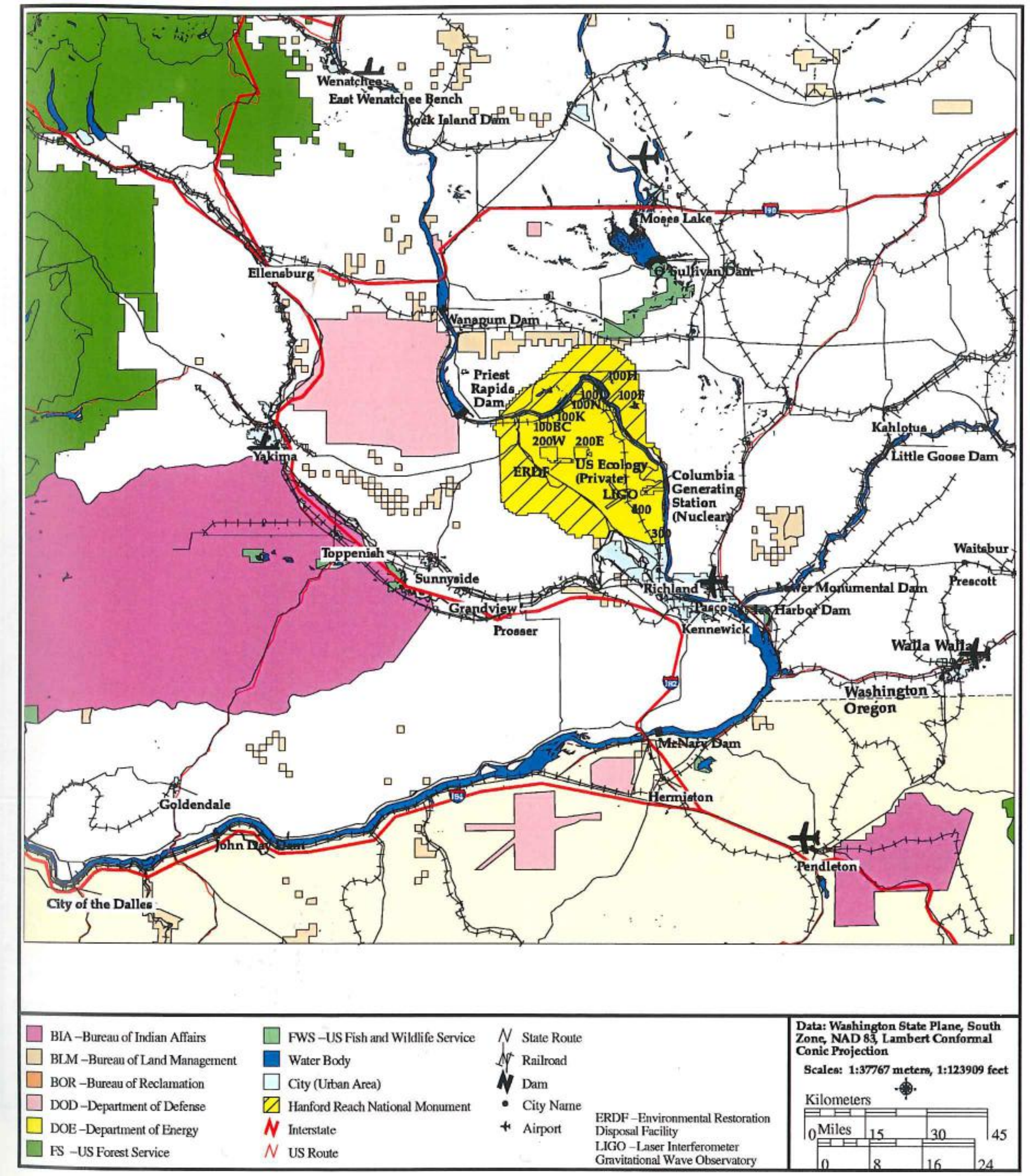

Figure 2.1a. Regional Physical and Surface Interface – Current State

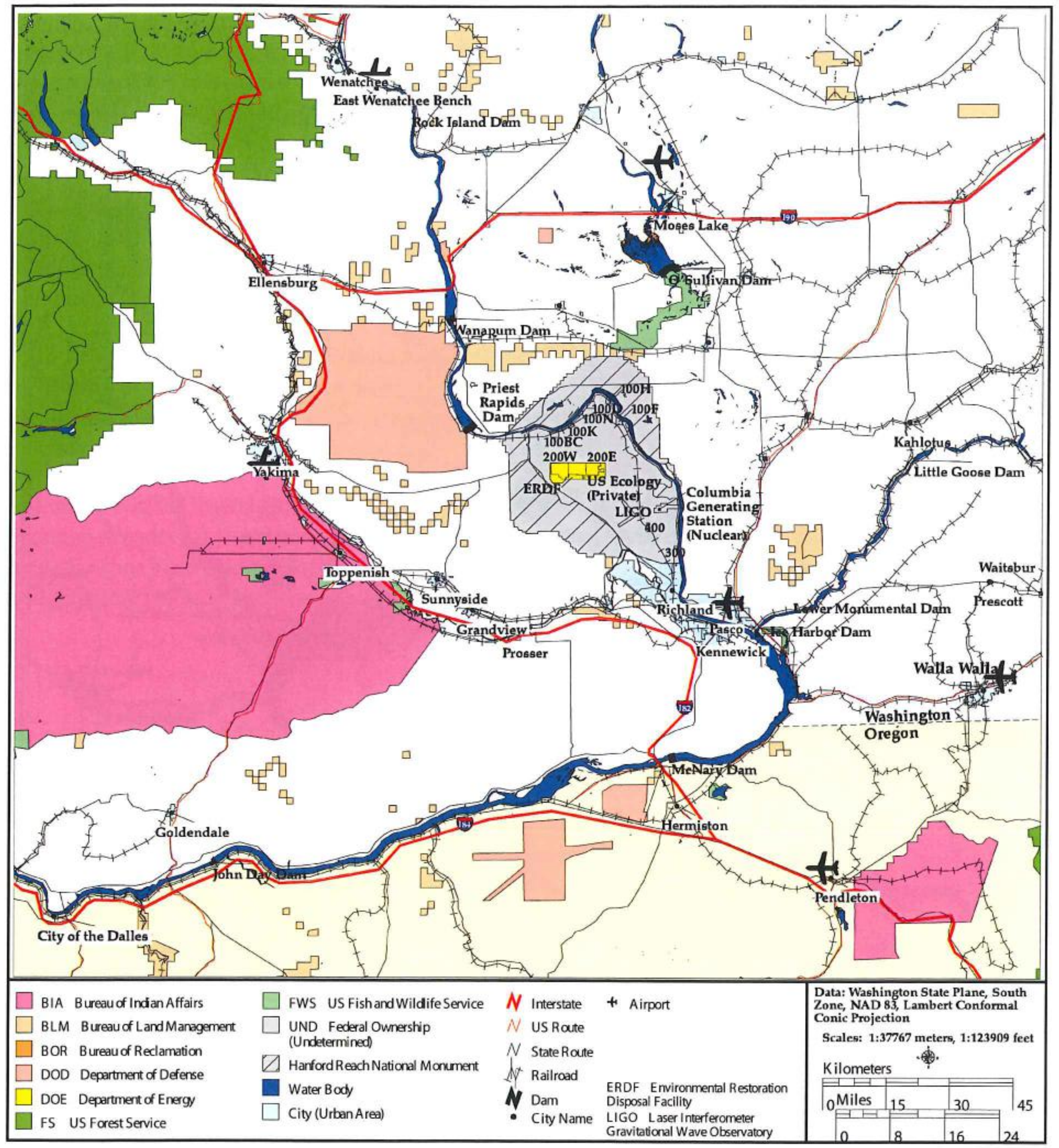

Figure 2.1b. Regional Physical and Surface Interface – End State Vision

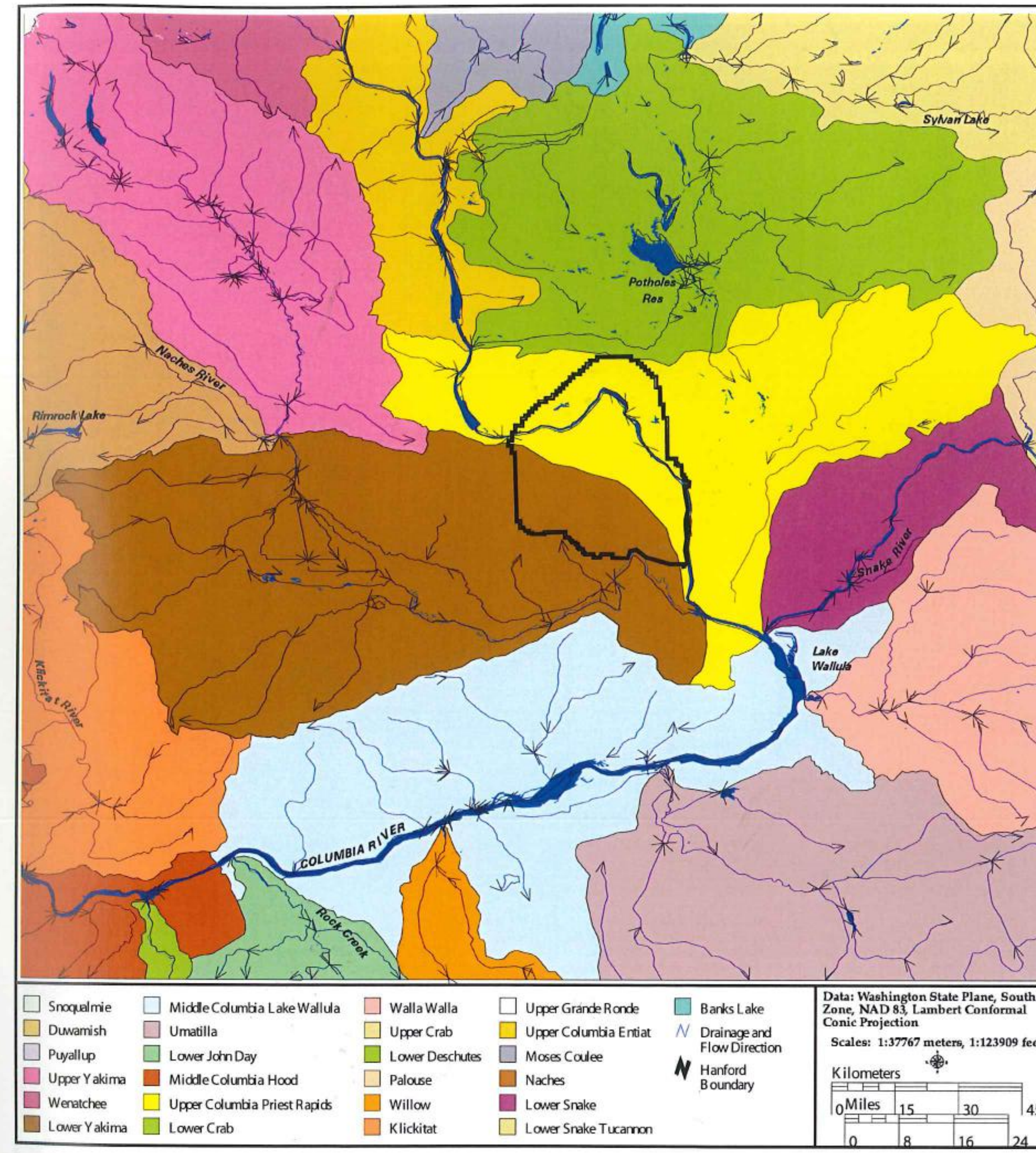

Figure 2.1c. Columbia River Watershed

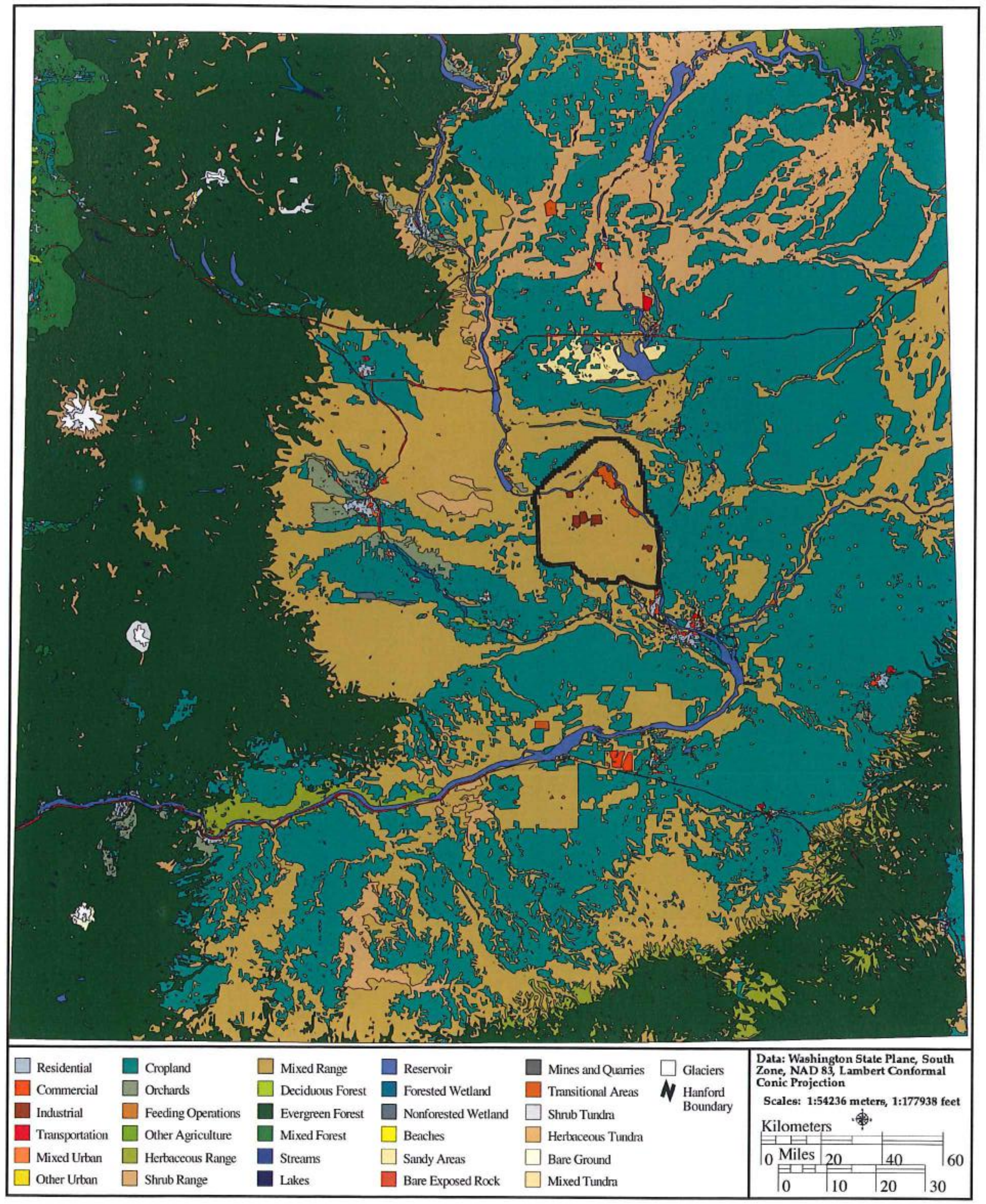

Figure 2.2a. Regional Human and Ecological Land Use – Current State

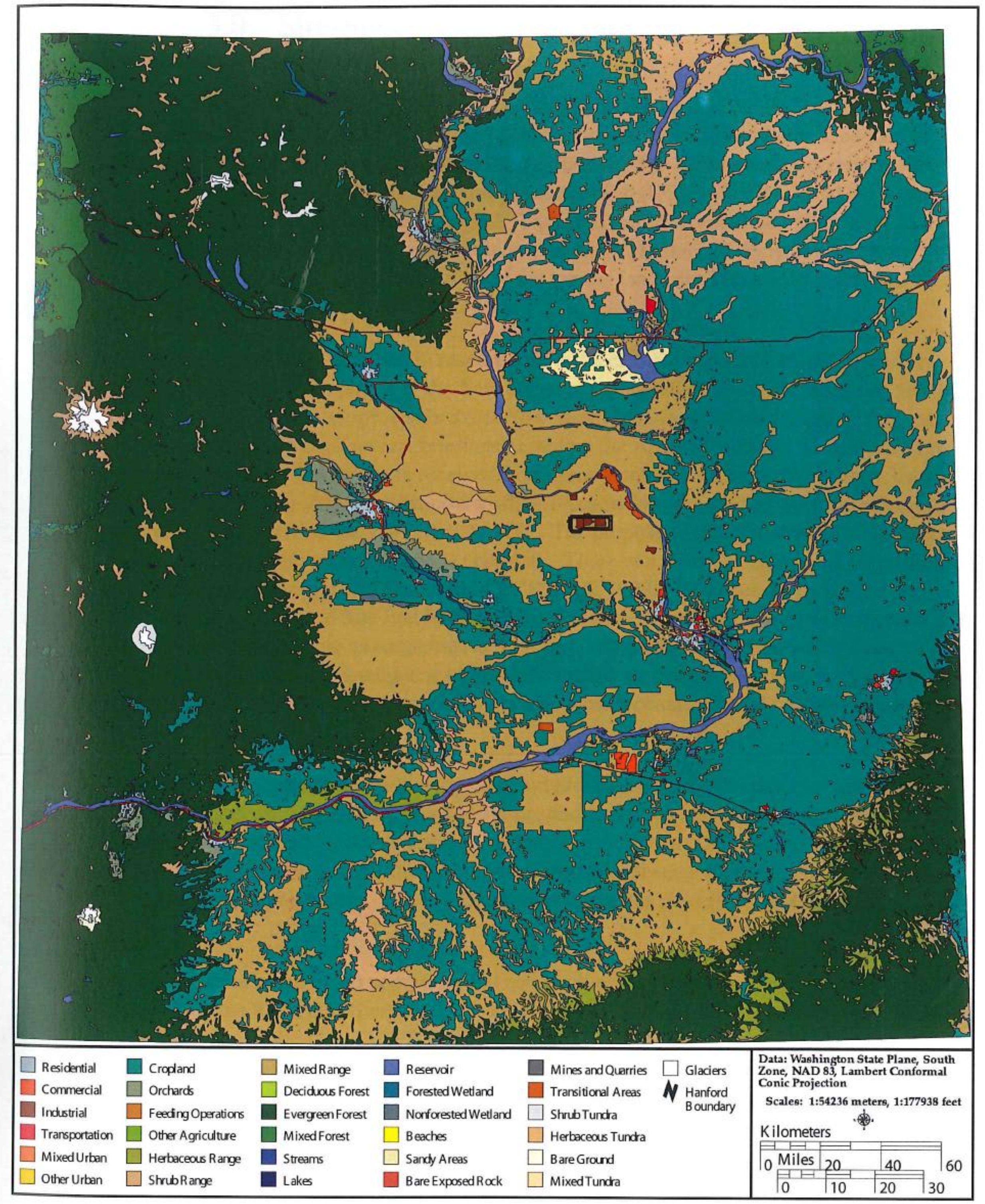

Figure 2.2b. Regional Human and Ecological Land Use – End State Vision