Odessa Subarea Special Study

Final Environmental Impact Statement
Volume 1

Columbia Basin Project, Washington

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Columbia-Cascades Area Office
Yakima, Washington

State of Washington
Office of Columbia River
Department of Ecology
Wenatchee, Washington

Ecology Publication No. 12-12-014

August 2012

Mission Statements

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

The mission of the Department of Ecology is to protect, preserve and enhance Washington's environment, and promote the wise management of our air, land and water for the benefit of current and future generations.

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Final Environmental Impact Statement Odessa Subarea Special Study
Adams, Lincoln, Franklin, and Grant Counties, Washington

Co-Lead Agencies:	For further information contact:
U.S. Department of the Interior Bureau of Reclamation	Ms. Candace McKinley Columbia-Cascades Area Office 1917 Marsh Road Yakima, Washington 98901-2058 509-575-5848 ext. 603
State of Washington Department of Ecology	Mr. Derek I. Sandison Office of Columbia River 303 South Mission Street, Suite 200 Wenatchee, Washington 98801 509-575-2490

Cooperating Agency:

Bonneville Power Administration

This Final Environmental Impact Statement (Final EIS) examines the feasibility, acceptability, and environmental consequences of alternatives to replace groundwater currently used for irrigation on approximately 102,600 acres of land in the Odessa Ground Water Management Subarea (Odessa Subarea) with Columbia Basin Project (CBP) surface water. A No Action Alternative, two partial replacement alternatives, two full replacement alternatives, and two modified partial replacement alternative are evaluated.

This Final EIS was prepared in compliance with the National Environmental Policy Act (NEPA) and the State of Washington Environmental Policy Act (SEPA): Chapter 43.21C RCW and the SEPA Rules (Chapter 197-11 WAC). It also provides the public review required under Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands) and the National Historic Preservation Act. Results of compliance with the Fish and Wildlife Coordination Act, the Endangered Species Act of 1973, as amended, and the Clean Water Act are included in the evaluations contained in this Final EIS.

SEPA FACT SHEET

Project Title: Odessa Subarea Special Study

Brief Description of Proposal:

The Bureau of Reclamation and Washington State Department of Ecology are studying the potential to replace groundwater currently used for irrigation in the Odessa Subarea Special Study Area (Study Area) with CBP surface water. The alternatives being considered include the No Action Alternative as required by NEPA and SEPA, and six action alternatives that address the Purpose and Need. The six action alternatives fall within three categories:

- **Full Replacement:** This group of delivery alternatives would provide CBP surface water to most groundwater-irrigated acreage in the Study Area (102,600 acres), both north and south of I-90. Lands south of I-90 would be served by enlarging and extending the East Low Canal. Lands north of I-90 would be served by constructing an East High Canal system.
- **Partial Replacement:** This group of delivery alternatives focuses on enlarging and extending the existing East Low Canal and providing CBP surface water to approximately 57,000 acres in the Study Area currently irrigated with groundwater. The acreage served would be south of I-90. No surface water replacement would be provided to most of the remaining groundwater-irrigated acres in the Study Area (north of I-90).
- **Modified Partial Replacement:** This group of delivery alternatives focuses on enlarging the existing East Low Canal and providing CBP surface water to approximately 70,000 acres in the Study Area currently irrigated with groundwater. The acreage served would be both north and south of I-90.

The six alternatives within each of the three replacement alternative categories consist of variations in the water supply options that would be used. **Two supply options are being considered** that would use storage from Banks Lake or Banks Lake and Lake Roosevelt, as follows: **Option A—Banks Lake**, would use storage in and additional drawdowns from Banks Lake, exclusively; **Option B—Banks Lake and Lake Roosevelt (FDR)**, would use storage in Banks Lake and Lake Roosevelt, resulting in drawdowns from both reservoirs.

Location: The Project is located in eastern Washington State and includes portions of Grant, Adams, Lincoln, and Franklin Counties, as well as Lake Roosevelt and Banks Lake. A location map follows this fact sheet.

Proponents and Lead Agencies:

Washington State Department of Ecology
Office of Columbia River
303 South Mission Street, Suite 200
Wenatchee, Washington 98801
509-575-2490

U.S. Department of the Interior
Bureau of Reclamation
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, Washington 98901-2058

Schedule: Anticipated that construction would commence in 2014 (earlier if funding becomes available) and continue in a phased manner for about 10 years.

Agency Contacts:

Derek I. Sandison
SEPA Responsible Official

Department of Ecology
Office of Columbia River
303 South Mission Street, Suite 200
Wenatchee, Washington 98801
509-575-2490

Candace McKinley
Environmental Program Manager

Bureau of Reclamation
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, Washington 98901-2058
509-575-5848, ext. 603

Permits, Licenses, and Approvals Required for Proposal:

The most common types of permits, licenses, and approvals associated with water resources and habitat that may be required for the proposed Odessa Subarea Special Study alternatives are listed below by the jurisdictional agency:

Federal Permits, Licenses, and Approvals

- Section 404 Permit, Clean Water Act
- Endangered Species Act
- National Historic Preservation Act
- Executive Order 11988: Floodplain Management
- Executive Order 11990: Protection of Wetlands
- Executive Order 12898: Environmental Justice
- Executive Order 13007: Indian Sacred Sites

State Permits, Licenses, and Approvals

- Water use permits/certificate of water right – Department of Ecology
- Reservoir permits – Department of Ecology
- Construction Stormwater Permit (Section 402) – Department of Ecology
- Section 401 water quality certification – Department of Ecology
- Shoreline conditional use permit, or variance – Department of Ecology
- Hydraulic project approval – Department of Fish and Wildlife

Local Permits, Licenses, and Approvals

- Critical areas permit or approval – Appropriate local jurisdictional agency
- Floodplain development permit – Appropriate local jurisdictional agency
- Shoreline substantial development permit, conditional use permit, or variance – Appropriate local jurisdictional agency
- Building permit – Appropriate local jurisdictional agency
- Clearing and grading permit – Appropriate local jurisdictional agency

Authors and Contributors:

A list of authors and contributors is provided following Chapter 5.

Date of Issue:

August 31, 2012

Document Availability:

The FEIS for the Odessa Subarea Special Study can be viewed online at: http://www.usbr.gov/pn/programs/ucao misc/odessa/index.html. The document may be obtained in hard copy or CD by written request to the SEPA Responsible Official listed above, or by calling 509-454-4239. To ask about the availability of this document in a format for the visually impaired, call the Office of Columbia River at 509-454-4241. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Location of Background Materials:

Background materials used in the preparation of this Final EIS are available online at the following links.

Columbia River Basin Water Management Program – Odessa Subarea Special Study
http://www.ecy.wa.gov/programs/wr/cwp/crwmp.html

Odessa Subarea Special Study, Columbia-Cascades Area Office
http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html

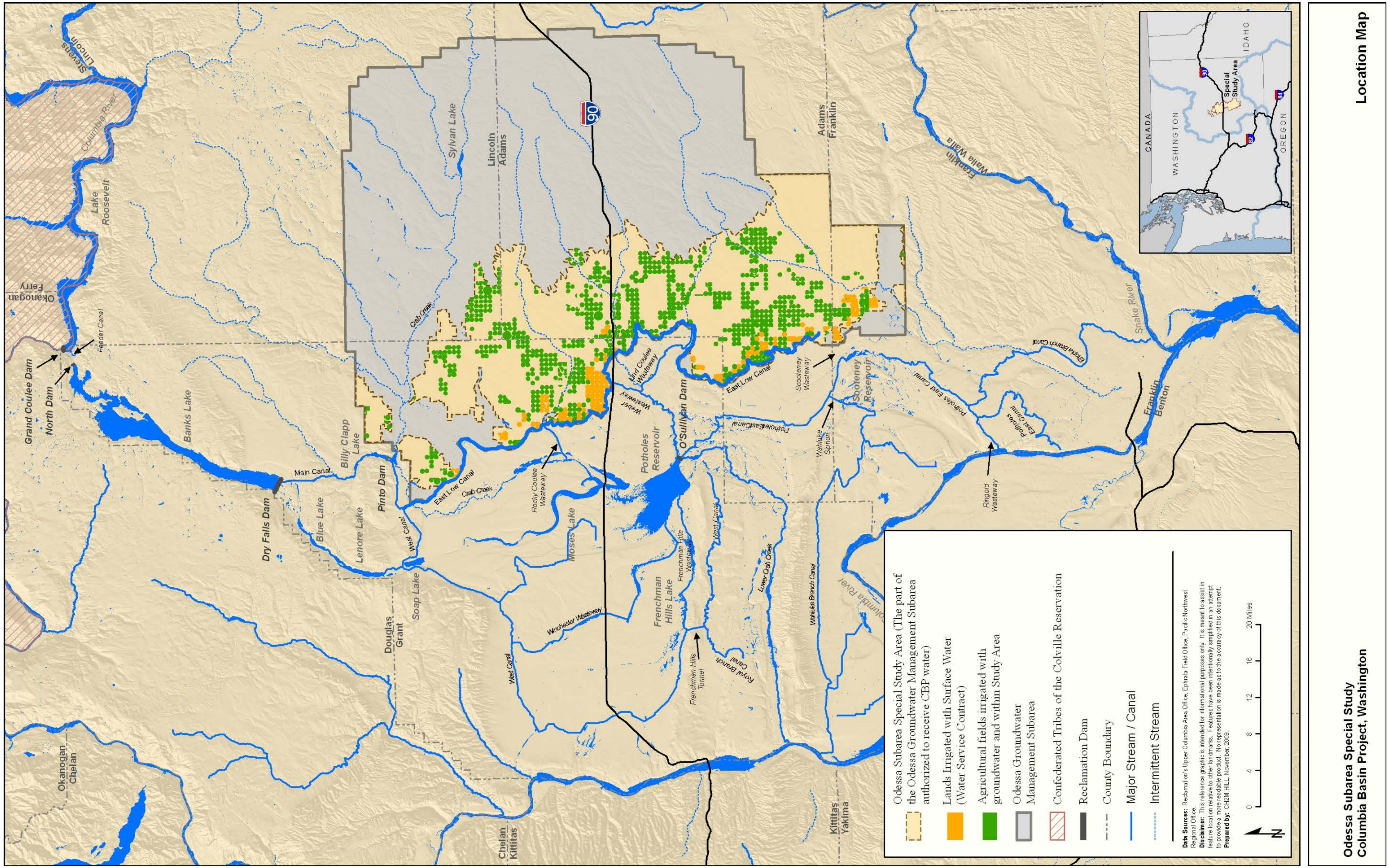

Figure 1. Location map.

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Odessa Subarea Special Study Final EIS

EXECUTIVE SUMMARY

ODESSA SUBAREA SPECIAL STUDY
FINAL ENVIRONMENTAL IMPACT STATEMENT

EXECUTIVE SUMMARY

Introduction

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and Washington Department of Ecology (Ecology) have jointly prepared this Final Environmental Impact Statement (Final EIS) for the Odessa Subarea Special Study (Study). The purpose of the Study is to evaluate alternatives that would deliver surface water from the Columbia Basin Project (CBP) to irrigated lands that currently rely on a declining groundwater supply in the Odessa Ground Water Management Subarea (Odessa Subarea). The CBP is a multipurpose water development project in the central part of the State of Washington (State), east of the Cascade Range. The Odessa Subarea Special Study Area (Study Area) is shown on Figure 1, as a smaller portion of the overall Odessa Subarea. The relationship of these three areas is also shown in Figure 1. The area of the Study is within the boundaries of the CBP, and includes portions of Lincoln, Adams, Grant, and Franklin counties (Figure 2).

The Study fulfills an agreement by Reclamation, the State, and the three CBP irrigation districts—the East Columbia, South Columbia, and Quincy Columbia Basin Irrigation Districts—to cooperatively conduct the Study as stated in the Columbia River Initiative Memorandum of Understanding (MOU) in December 2004 (Appendix A).

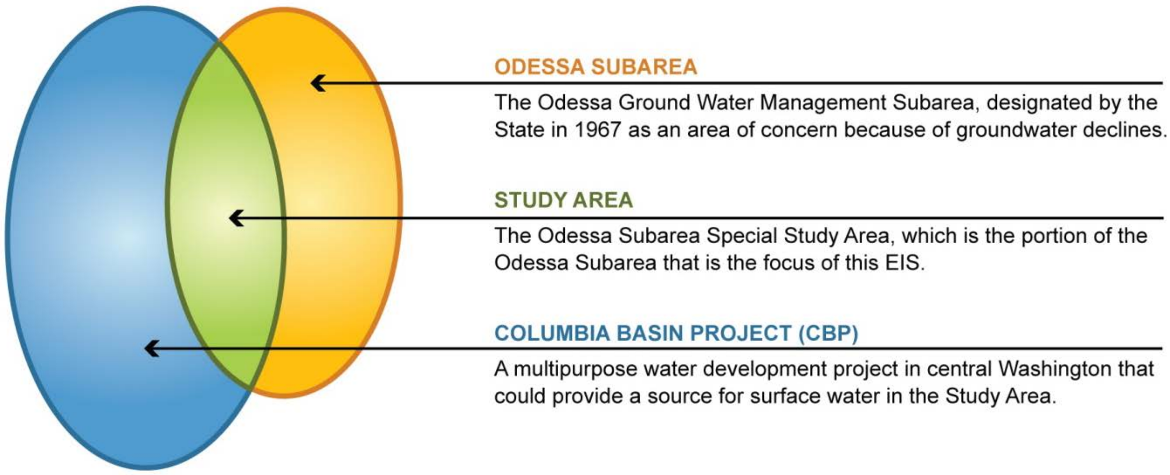

Figure 1. Illustration showing the common terms used in this EIS and the relationships of the three areas.

Drilling groundwater wells to provide irrigation within the Odessa Subarea (including the Study Area) began in the early 1960s, but drilling new wells essentially ended in the late 1980s. Groundwater levels in wells of the Odessa Subarea have declined steadily since pumping began in the 1960s. In 1967, the Washington State Legislature designated the Odessa Subarea as a groundwater management area because of groundwater level declines resulting from pumping (Washington Administrative Code [WAC] 173-128A, Odessa Ground Water Management Subarea).

Since the early 1980s, groundwater levels have progressively dropped by 100 to 200 feet in nearly half of the production wells as shown on Figure 3. For the Final EIS, a review of the groundwater analysis was conducted and information from a USGS 2010 report was used to verify information that was used for the Draft EIS for pumping depths and rate of decline between 1984 and 2009 (Reclamation 2012 Groundwater). As a result of the current conditions of groundwater decline in the Odessa Subarea including the Study Area, as shown on Figure 1, the ability of farmers to irrigate their crops is at risk. Domestic, commercial, municipal, and industrial uses and water quality are also affected. The Study is a cooperative process undertaken by Reclamation, Ecology, and CBP irrigation districts to respond to these risks.

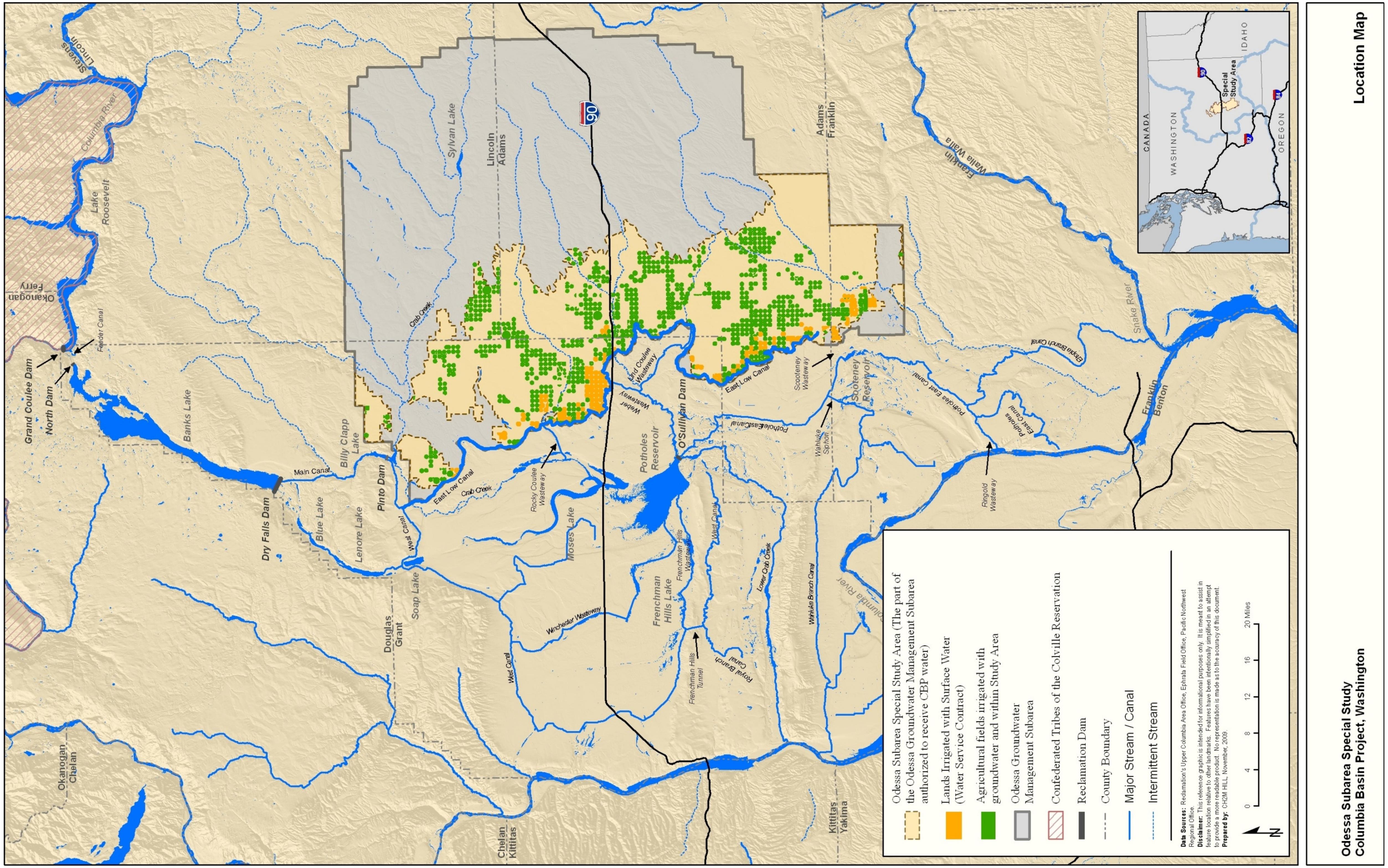

Figure 2. Location map.

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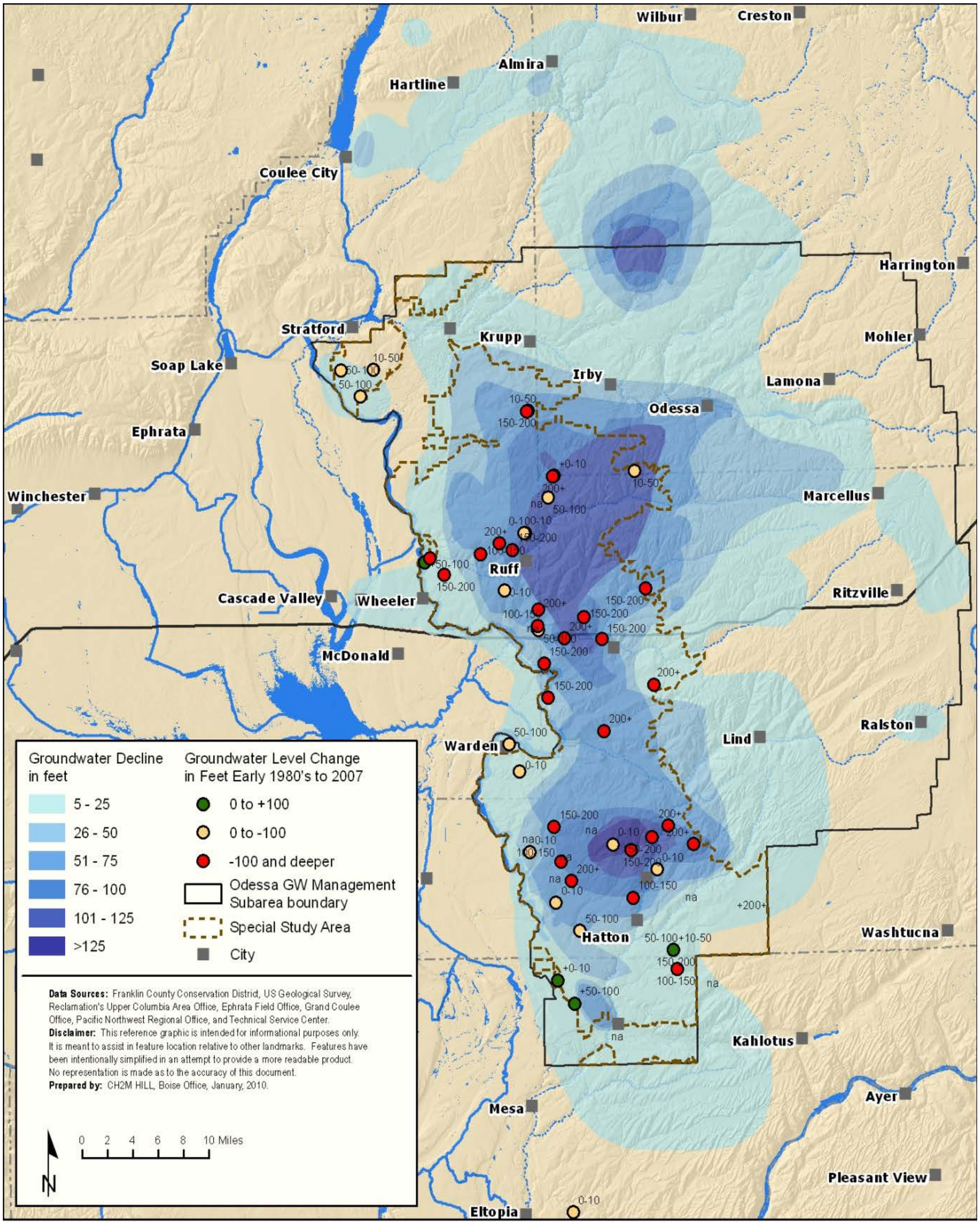

Figure 3. Groundwater level decline in aquifers of the Odessa Subarea, 1981 to 2007.

Photograph 1. Crops currently irrigation by groundwater in the Study Area. This is representative of land that would be eligible for replacement with surface water.

The Proposed Action

Reclamation and Ecology are proposing to replace groundwater currently used for irrigation in the Study Area with surface water by constructing or modifying distribution systems and appurtenant structures (Photograph 1). There are approximately 102,600 acres of currently groundwater-irrigated lands within the Study Area that are eligible to receive CBP water as part of the continued phased development of the CBP. The surface water would be provided by further developing existing CBP water rights which are held by the U.S. for diversion and storage of water from the Columbia River system.

This Final EIS evaluates six action alternatives for delivering CBP water to partially or fully replace groundwater used to irrigate eligible acres in the Study Area. The partial replacement alternatives (described later as 2A and 2B) would deliver approximately 138,000 acre-feet of water annually to irrigate 57,000 acres. The partial replacement alternatives focus on surface water replacement for acreage located primarily south of Interstate Highway 90 (I-90) that can be served by expanding and extending the existing East Low Canal (Figure 1-1).

The full replacement alternatives (described later as 3A and 3B) would deliver approximately 273,000 acre-feet of water to serve all or most of the approximately 102,600 eligible acres in the Study Area. Full replacement would include surface water replacement to both the acreage located south of I-90 and the remaining lands in the Study Area north of I-90. Water provided to acreage south of I-90 would be conveyed via an expanded and extended East Low Canal while lands north of I-90 would be served by constructing a new East High Canal system.

The modified partial replacement alternatives (described later as 4A and 4B) have been developed in response to a number of concerns raised in comments regarding the Draft EIS. The modified partial replacement alternatives would divert approximately 164,000 acre-feet of water and provide surface water replacement for approximately 70,000 acres of currently groundwater-irrigated lands both north and south of I-90.

If an action alternative is selected during the Record of Decision process, there would likely be a variety of Federal and State actions occurring in order to implement the alternative. Construction of new and modification of existing structures, such as pumping plants, conveyance facilities, and appurtenances, would be required, as well as possible construction of a new reregulation reservoir. Land acquisition, permitting, and other activities would also need to be conducted. The duration of construction for a partial, full, or modified partial alternative is estimated to span a period of about 10 years and could begin as early as 2014. Construction would be conducted in phases for all action alternatives to allow the delivery system to be brought online as early and efficiently as possible. For more detail, Chapter 2 – Alternatives provides a description of these alternatives and associated actions that would be taken if an action alternative is selected for implementation.

Overview of the Final EIS

This Final EIS closely follows the format recommended by the Council of Environmental Quality and is a companion volume to the Final Odessa Subarea Special Study Report (Special Study Report) (Reclamation 2012 Study) that Reclamation completed.[1] The Final EIS is organized into two volumes.

Volume 1:

- Chapter 1 identifies the Proposed Action, the purpose and the need for action; provides background information; and summarizes public involvement activities, and applicable laws and regulations.

[1] The report is available on the web at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html. The Special Study Report fulfills the requirements of the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&Gs). The Special Study Report presents the alternatives and the results of the P&G-specific analyses (the National Economic Development, the Regional Economic Development, the Other Social Effects, and the Environmental Quality accounts).

- Chapter 2 presents a No Action Alternative and six action alternatives and summarizes the process of formulating the proposed action alternatives. A table presenting a summary comparison of the alternatives is also included.
- Chapter 3 presents the affected environment and relevant resource components that make up the baseline environment.
- Chapter 4 describes the environmental impacts of the alternatives considered in detail in addition to identifying mitigation measures, cumulative impacts, and Reclamation's environmental commitments.
- Chapter 5 summarizes consultation and coordination activities, including public involvement efforts relevant to the Final EIS, and applicable laws and regulations.
- In addition, the following have been included:
    - Acronyms
    - Bibliography
    - List of Preparers
    - Glossary
    - Index
    - Contact and Distribution List
    - Appendices A – F

Volume 2:

- Public comments on the Draft EIS and Reclamation’s responses.

Purpose and Need for Action

The purpose of the Proposed Action is to maintain economic viability by providing surface water from the CBP to replace groundwater from declining wells currently used for irrigation in the Odessa Subarea. This purpose is consistent with the intent of the Columbia Basin Project Act by encouraging “settlement and development of the project, and for other purposes.” The CBP is currently authorized for construction and development. Surface water would be provided as part of the continued phased development of the CBP and would come from existing CBP diversion and storage rights for water from the Columbia River.

Need

The Proposed Action is needed to address declining groundwater supply in the Study Area and avoid economic loss to the region's agricultural sector.

Authorization and History

The Study is being conducted under the authority of the Reclamation Act of 1939 and the Columbia Basin Project Act of 1943, as amended. Section 9(a) of the Reclamation Project Act of 1939 gave authority to the Secretary of the Interior (Secretary) to approve a finding of feasibility and thereby authorize construction of a project upon submitting a report to the President and the Congress. The Secretary approved a plan of development for the CBP, known as House Document No. 172 in 1945. House Document No. 172 anticipated that development of the CBP would occur in phases over a 70-year period.

The Proposed Action would be implemented pursuant to these authorities. This Act, authorized by Congress, led to the implementation of the CBP to irrigate a total of 1,029,000 acres, of which about 671,000 acres are currently irrigated. The Acts gave authority to the Secretary of the Interior (Secretary) to assess feasibility, approve plans, and implement construction of the CBP. Construction of the CBP was anticipated to occur in phases over a 70-year period.

The State issued irrigation groundwater permits in the 1960s and 1970s in the Odessa Subarea as a temporary measure to provide water to these lands until the CBP was further developed. Acting for the Secretary, Reclamation is authorized to implement additional development phases of the CBP as long as the Secretary finds each phase to be economically justified and financially feasible. In response to the public's concern about the declining groundwater supply in areas of the CBP and associated economic and other environmental effects, Congress funded Reclamation to investigate the problem. The State partnered with Reclamation by providing funding and collaborating on various technical studies.

With increasing concern over the groundwater supply, the State, Reclamation, and CBP irrigation districts entered into the Columbia River Initiative MOU in December 2004 to engage in a cooperative process for implementing water management improvements within the CBP (Appendix A). The State provided a cost-share through an Intergovernmental Agreement between Ecology and Reclamation in December 2005 to fund this Study.

Subsequent to the signing of the 2004 Columbia River Initiative MOU, the State Legislature passed the Columbia River Basin Water Resource Management Act in February 2006 (RCW 90.90). The Act directs Ecology to aggressively pursue development of water benefiting both instream and out-of-stream uses. Among the activities identified in the legislation, Ecology is directed to focus on "development of alternatives to groundwater for agricultural users in the Odessa subarea aquifer."

Changes to Draft EIS

The changes identified here are not a comprehensive listing of all changes in the Final EIS and include only the more substantive additions or revisions. Many other changes and corrections have been made throughout the Final EIS to update discussions of existing and anticipated future conditions, as well as to improve descriptions of the effects of the alternatives.

Tiered Review Process

Reclamation and Ecology have clarified that this Final EIS is the initial environmental analysis within a tiered review process under NEPA and SEPA. "Tiering" refers to the process of addressing a broad, general program, policy, or proposal in an initial analyses followed by analyses of a more precisely defined site-specific proposal related to the initial program, policy, or proposal when that proposal is ready to be carried forward (see 40 CFR §§ 1502.20 and 1508.28). Tiering may also be used when an EIS is prepared on a specific action, such as the Proposed Action here, but at an early stage to consider broad issues such as general location, scope, and site selection (40 CFR § 1508.28[b]). In such cases, subsequent NEPA at a later stage in the action may be necessary. The use of tiering is encouraged in large and complex projects such as this, and allows the agencies to focus on the issues ripe for decision.

Reclamation and Ecology expect that some projects or actions advanced out of this first tier EIS may be subject to subsequent second tier, project-level environmental analysis under NEPA and SEPA before being approved for implementation. Any subsequent NEPA project-level analysis could include a combination of EIS(s), supplemental EIS(s), environmental assessments(s), and/or categorical exclusion(s) along with corresponding SEPA reviews, as appropriate, depending on the proposed action, phasing of implementation, and potential for adverse impacts. Actions described in this Final EIS that are analyzed in full will not undergo a second tier NEPA/SEPA review. Decisions relative to the general scope of the action alternative which include acreage, water supply, and general site locations would also not be subject to additional review.

An example of how the tiering process may work, the East Low Canal widening is an example of a project feature that is analyzed under this Final EIS. Locations of pumping plants are an example of projects that may require subsequent NEPA project-level reviews due to the uncertainty associated with the location of the pumping plants at this time.

Modified Partial Replacement Alternatives Developed and Analyzed

In response to public comments and in consultation with the ECBID, Reclamation and Ecology developed the modified partial groundwater irrigation replacement alternatives for the Final EIS in response to a number of concerns regarding the partial and full groundwater replacement alternatives presented in the Odessa Subarea Special Study Draft EIS. The modified partial replacement alternatives are similar to the Alternative C option described in the Appraisal-Level Investigation Summary of Findings (Appraisal Study). Alternative C was considered but eliminated in the Draft EIS because it precluded deliveries to some lands within the SCBID and was not an economically viable option as configured. The Modified Partial Replacement Alternatives 4A and 4B incorporate modifications to Alternative C, which makes them “reasonable” alternatives for the Proposed Action in this Final EIS.

Further review of the PASS Analysis and Appraisal Study indicated that the modified replacement alternatives would not preclude full development. Alternatives 4A and 4B would in fact provide service to some of the SCBID lands. Reclamation and Ecology developed Alternatives 4A and 4B for the Final EIS to address expressed concerns. These alternatives were configured in such a way as to economically serve lands both north and south of I-90 while increasing the number of acres that would no longer pump from the Odessa aquifer (Reclamation 2012 Economics).

The modified partial replacement alternatives (Alternative 4A: Modified Partial – Banks and Alternative 4B: Modified Partial – Banks + FDR) would serve lands north and south of I-90 from the East Low Canal. Alternative 4A has been identified by Reclamation and Ecology as the preferred alternative.

The modified partial replacement alternatives have been fully analyzed in this Final EIS and are within the range of the partial and full groundwater replacement alternatives evaluated in the Draft EIS. The amount of water proposed for diversion is within the range of diversions previously evaluated for action alternatives in the Draft EIS. Similarly the number of acres to be served is within the range covered by the action alternatives in the Draft EIS. The lands proposed to be served south of I-90 were included within partial replacement alternatives in the Draft EIS. The lands proposed to be served north of I-90 are a portion of the lands that would be served by the new East High Canal system under the full replacement alternatives, but instead would be served from the East Low Canal in the modified partial replacement alternatives. The modified partial replacement alternatives involve facilities, diversions, operations, and lands that were either evaluated in the Draft EIS or are within the range of alternatives considered in that document; therefore, the potential impacts associated with the modified partial replacement alternatives are of an equal or lesser magnitude as the effects presented in the Draft EIS and no additional impacts are anticipated.

Other Changes

- As described in Chapter 2, Section 2.8.3.5, the proposed Rocky Coulee Reservoir and action alternatives utilizing this water supply source was eliminated from further consideration.
- In the Draft EIS, the annual diversion requirement from the Columbia River was incorrectly reported as the on-farm delivery amount. On the CBP, because of recapture and reuse on-farm, deliveries are more than river diversions. This error has been corrected in this Final EIS.
- The hydrologic modeling was updated to reflect the changes in diversions discussed above and the updated HYDSIM model (Chapter 4, Section 4.2). Also, the additional diversions available from the Columbia River were modified in fall and winter and eliminated in September.
- Based on informal ESA consultation with NMFS, an additional diversion scenario was analyzed.
- BMPs and environmental impact mitigations are more clearly identified in the Final EIS (Chapter 4, Section 4.31).
- A cumulative impact section has been added in response to comments that requested a unified section for cumulative impact analysis and discussion (Chapter 4, Section 4.27).
- Further refinements to project design resulted in reduced rights-of-way and easements for various proposed facilities for all action alternatives as shown in Table 1.

Table 1. Revised right-of-way and easement acquisition assumptions since the Draft EIS.

Facility Component	Draft EIS Assumption	Final EIS Assumption
Canal-side pumping plants and re-lift stations	7.0 acres	3.0 acres
Distribution pipelines greater than 24 inches in diameter	400 feet	200 feet
Distribution pipelines less than 24 inches in diameter	200 feet	100 feet
East High Canal	600 feet	200 feet

Alternatives

Reclamation and Ecology considered a No Action Alternative, as required by NEPA and SEPA implementing regulations, and a reasonable range of action alternatives to meet the purpose and need. The No Action Alternative and six action alternatives analyzed in this Final EIS are described in Chapter 2 - Alternatives.

The six action alternatives fall into three groups: two partial replacement alternatives, which would replace groundwater supplies south of I-90; two full replacement alternatives, which would replace groundwater supplies throughout the Study Area, both north and south of I-90; and two modified partial replacement alternatives, which would replace groundwater supplies in the western portion of the Study Area both north and south of I-90 (Figure 4). Three of the alternatives evaluate combinations of water supply sources from Banks Lake and Lake Roosevelt (FDR):

1. No Action Alternative
2. Partial replacement alternatives:

   2A: Partial-Banks

   2B: Partial-Banks + FDR
3. Full replacement alternatives:

   3A: Full-Banks

   3B: Full-Banks + FDR
4. Modified Partial replacement alternatives:

   4A: Modified Partial-Banks

   4B: Modified Partial - Banks + FDR

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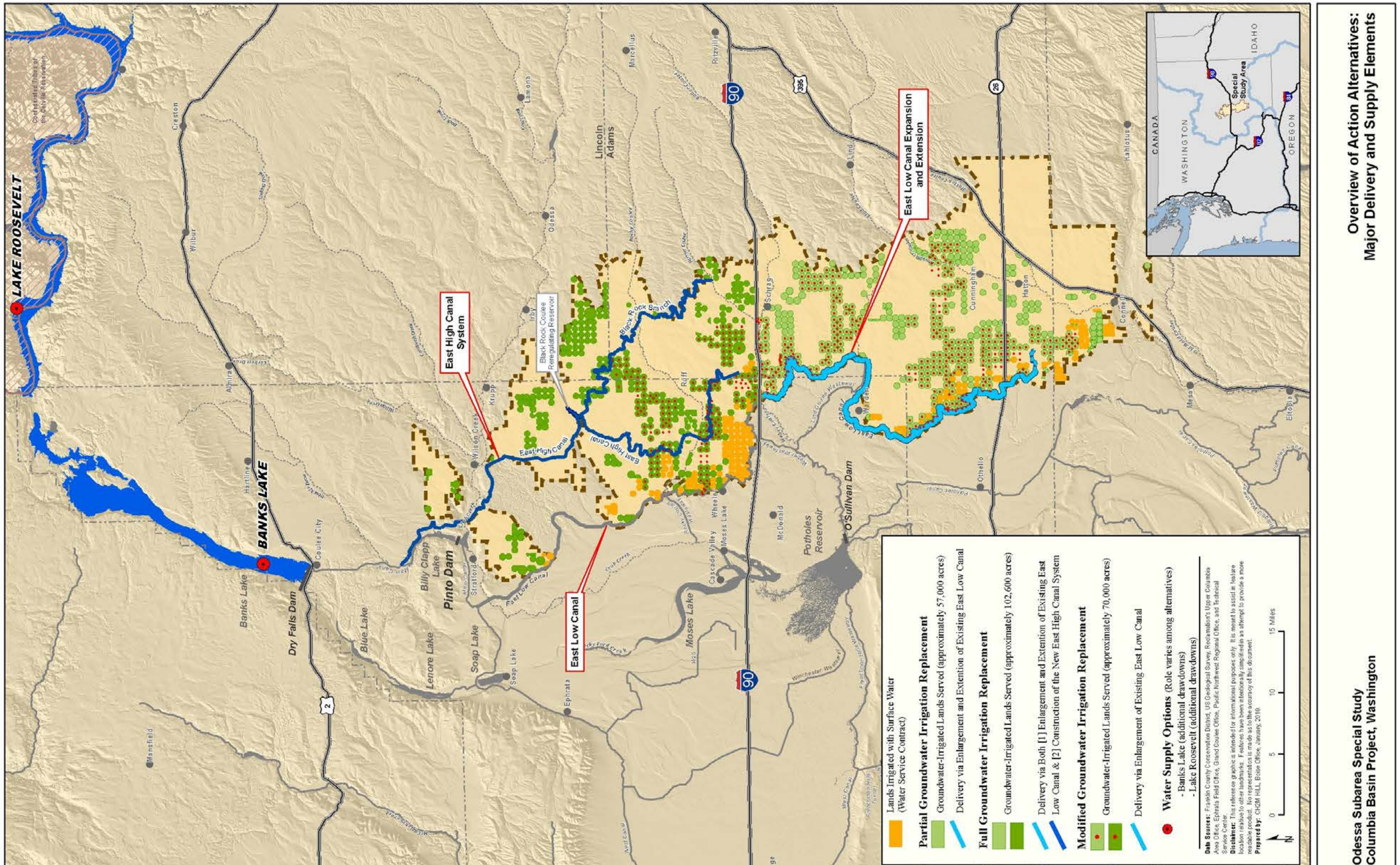

Figure 4. Overview of Action Alternatives: Major Delivery and Supply Elements.

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The six action alternatives within the two delivery categories vary in the water supply options that would be used. Table 2 presents an overview of the water supply and delivery options of the action alternatives.

Table 2. Alternatives overview (see Figure 4).

Alternative – Water Supply	Delivery Options
1 – No Action	
No Action	• Current and ongoing Columbia River and CBP programs, commitments, and operations continue • No CBP surface water provided to any additional groundwater-irrigated lands in the Odessa Subarea • No additional drawdowns at either reservoir • No facility construction required
2 – Partial Groundwater Irrigation Replacement	
2A – Banks Lake **2B – Banks + FDR**	• Current and ongoing Columbia River and CBP programs, commitments, and operations continue • Additional drawdown of Banks Lake (2A and 2B) and FDR (2B) • Approximately 57,000 acres of eligible groundwater-irrigated lands south of I-90 supplied with CBP surface water • Water delivered by enlargement and extension of the existing East Low Canal and construction of a distribution system
3 – Full Groundwater Irrigation Replacement	
3A – Banks Lake **3B – Banks + FDR**	• Current and ongoing Columbia River and CBP programs, commitments, and operations continue • Additional drawdown of Banks Lake (3A and 3B) and FDR (3B) • Approximately 102,600 acres of eligible groundwater-irrigated lands supplied with CBP surface water • Water delivered south of I-90 by enlargement and extension of the existing East Low Canal and construction of a distribution system • Water delivered north of I-90 by construction of a new East High Canal system, with an associated distribution system

Alternative – Water Supply	Delivery Options
4 – Modified Partial Irrigation Replacement	
4A – Banks Lake (Preferred Alternative) **4B – Banks + FDR**	• Current and ongoing Columbia River and CBP programs, commitments, and operations continue. • Additional drawdown of Banks Lake (4A and 4B) and FDR (4B) • Approximately 70,000 acres of eligible groundwater-irrigated lands provided with CBP surface water • Lands supplied with surface water replacement would be both north and south of I-90 • Water delivered by enlargement of the existing East Low Canal and construction of a distribution system

How Would the Columbia River System be Changed by the Alternatives?

None of the six action alternatives in the Final EIS would result in a significant change in Columbia River flows. Water management programs and constraints are in place (i.e., the FCRPS BiOp) for the Columbia River to protect the resource values associated with the mainstem of the Columbia River, including ESA-listed fish species in the river. These would continue to be met as a first priority in all hydrologic conditions.

Providing CBP surface water to lands in the Study Area would require changing reservoir operations during and immediately after the irrigation season at Banks Lake for all action alternatives and at Lake Roosevelt for Alternatives 2B, 3B, and 4B. At both reservoirs, these changes would mean increased drawdowns and therefore, lower pool levels when compared with the No Action Alternative. In all cases, the pool levels would reach their minimum elevations at the end of August.

Supply Options for Action Alternatives

All surface water supplies for the action alternatives would be through diversion from the Columbia River using Reclamation's existing water rights for the CBP and existing storage in Lake Roosevelt and Banks Lake (Figure 4):

- Alternatives 2A, 3A, and 4A would use existing storage in Banks Lake, exclusively.
- Alternative 2B, 3B, and 4B would use existing storage in both Banks Lake and Lake Roosevelt.[2]

The surface water supplies would allow stored water to be used from the reservoirs during the irrigation season. The reservoirs would be refilled during the fall and winter. Spring diversions, when possible (April through June), would be used for direct delivery to the Study Area and refill storage at Banks Lake.

Quantity and Timing of Diversions

Two potential scenarios for diverting water from the Columbia River into the Study Area via Banks Lake are evaluated in this Final EIS for each action alternative:

Spring Diversion Scenario: This scenario is similar to that assumed in the Draft EIS except that the diversion in October through March could take place every year even when the water management objectives are not met in the Columbia River. The maximum amount of diversion in October was increased to 2,700 cfs and additional diversions up to 350 cfs could occur during November through March to refill Banks Lake and Lake Roosevelt. Diversion in April through June would be allowed from the Columbia River when flows exceed 135,000 cfs at Priest Rapids Dam, 260,000 cfs at McNary Dam, and there is adequate pump capacity to pump water from Lake Roosevelt to Banks Lake. This spring limitation is consistent with the previous analysis performed for the Draft EIS.

Limited Spring Diversion Scenario: During informal ESA consultation (June 2012), it was suggested that Reclamation limit diversions in the spring (April through June) for direct delivery to the Study Area to periods when the Columbia River flow immediately downstream of Grand Coulee Dam exceeds 200,000 cfs and there is adequate pump capacity to pump water from Lake Roosevelt to Banks Lake. Diversions in October of up to 2,700 cfs would be allowed and additional diversions up to 350 cfs could occur November through March to refill Banks Lake and Lake Roosevelt. This is within the range of drawdown scenarios for Bank Lake and Lake Roosevelt presented in the Draft EIS.

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[2] The State of Washington has committed through agreements with the Confederated Tribes of the Colville Reservation and the Spokane Tribes of Indians to not seek further drawdown of Lake Roosevelt. Therefore, the State does not support Alternatives 2B, 3B, or 4B.

The flows for the Spring and Limited Spring diversion scenarios are summarized in Table 3.

Table 3. Diversion scenario summary.

Diversion Scenario	Spring (April through June)	October	November through March
Spring	Diversions from Columbia River allowed when outflows exceed 135,000 cfs at Priest Rapids Dam, 260,000 cfs at McNary Dam and there is adequate pump capacity at Lake Roosevelt	Diversions up to 2,700 cfs	Up to 350 cfs each month
Limited Spring	Diversions from Columbia River allowed when outflows from Grand Coulee Dam exceed 200,000* cfs and there is adequate pump capacity at Lake Roosevelt	Diversions up to 2,700 cfs	Up to 350 cfs each month
* This flow was not modeled for the Final EIS; however, this occurs in less than 10 percent of the years.			

No Action Alternative (Alternative 1)

In this EIS, no action means that the proposed Federal action would not take place and the resulting conditions from taking no action are compared with the action alternatives. Under the No Action Alternative, Reclamation and Ecology would not replace existing groundwater supplies with CBP surface water. Currently, farmers use groundwater to irrigate about 102,600 farmland acres in the Study Area, as shown in Figure 2.

The No Action Alterative represents the foreseeable future if an action alternative is not implemented and groundwater levels continue to decline in the Study Area aquifers. Under the No Action Alternative, irrigated agriculture in the Study Area that currently relies on groundwater would continue using that source of water. With continued dependence on groundwater, aquifers would further decline in quantity and quality. As groundwater declines, well yield and irrigation capability would progressively diminish in the Study Area, resulting in a reduction of groundwater-irrigated acreage and crop yield.

Consequences of the No Action Alternative

The consequences of the No Action Alternative to various environmental and socioeconomic resources are discussed further in Chapter 4 - Environmental Consequences.

t The consequences of the No Action Alternative over the next 10 years[3] (approximately 2020) (see Chapter 4.3.2.2 *Groundwater Resources*) would include:

- Only 15 percent of the production wells in the Study Area would continue to support irrigation for valuable high-water crops, such as potatoes.
- About 55 percent of the production wells in the Study Area would cease groundwater output and use of these wells would be permanently discontinued.
- The remaining 30 percent of the production wells in the Study Area would no longer support high water use crops, even on reduced acreage.

Under the No Action Alternative, the following would occur related to other water management programs:

- Operations at Lake Roosevelt and Banks Lake would continue as they do currently, providing water supply to meet authorized CBP purposes, including water delivery for irrigation, fish management, municipal and industrial uses, and recreation.
- Actions by the Columbia River Management Program to pursue the development of water supply alternatives to groundwater for agricultural users in the Odessa Subarea would not proceed further under the No Action Alternative since this Study is the direct response to this specific provision of Chapter 90.90 RCW - Columbia River Water Management Act.
- The No Action Alternative would not address existing East Low Canal system constraints that affect ECBID's ability to meet delivery commitments to existing water service contract holders in the Study Area (as described in Section 2.2.3).
- The Coordinated Conservation Program (as described in Section 2.2.3) would continue to implement conservation efforts to create water savings in the Study Area to reduce the use of groundwater for existing irrigation.
- The Lake Roosevelt Incremental Storage Releases Program (as described in Section 2.2.3) would continue to implement additional incremental storage releases from Lake Roosevelt to supplement water supplies for instream flows, existing agricultural lands in the Study Area, and municipal and industrial needs.

[3] Based on information provided by GWMA, as well as others, Reclamation interpreted the rate at which wells would go out of production to be approximately 26 years (Reclamation 2012 Groundwater).

Partial Replacement Action Alternatives (Alternatives 2A and 2B)

The partial replacement alternatives, Alternatives 2A and 2B, would provide CBP surface water supplies to approximately 57,000 acres of lands in the Study Area south of I-90 (Figure 9). The total volume of water diverted from the Columbia River with partial groundwater replacement is estimated at 138,000 acre-feet. A small portion of currently groundwater-irrigated lands north of I-90 nearest the East Low Canal may also be included in the partial replacement alternatives. As the surface water supply system is brought online and this water becomes available to eligible lands, the intent would be to cease operation of associated irrigation wells. Under current State regulations, the irrigation wells would not be decommissioned or abandoned. Instead, superseding state water rights would be issued and the wells would be placed in standby status, remaining operational for use in an emergency (such as an interruption of the Federal surface water delivery system). Any different scenario or mandatory decommissioning would require that the statute to be modified. Alternatives 2A and 2B would involve the same water delivery system facilities and the same quantity of water. The delivery system would involve enlarging and extending the East Low Canal and constructing a distribution system. The alternatives vary only in the option used to store and supply CBP water.

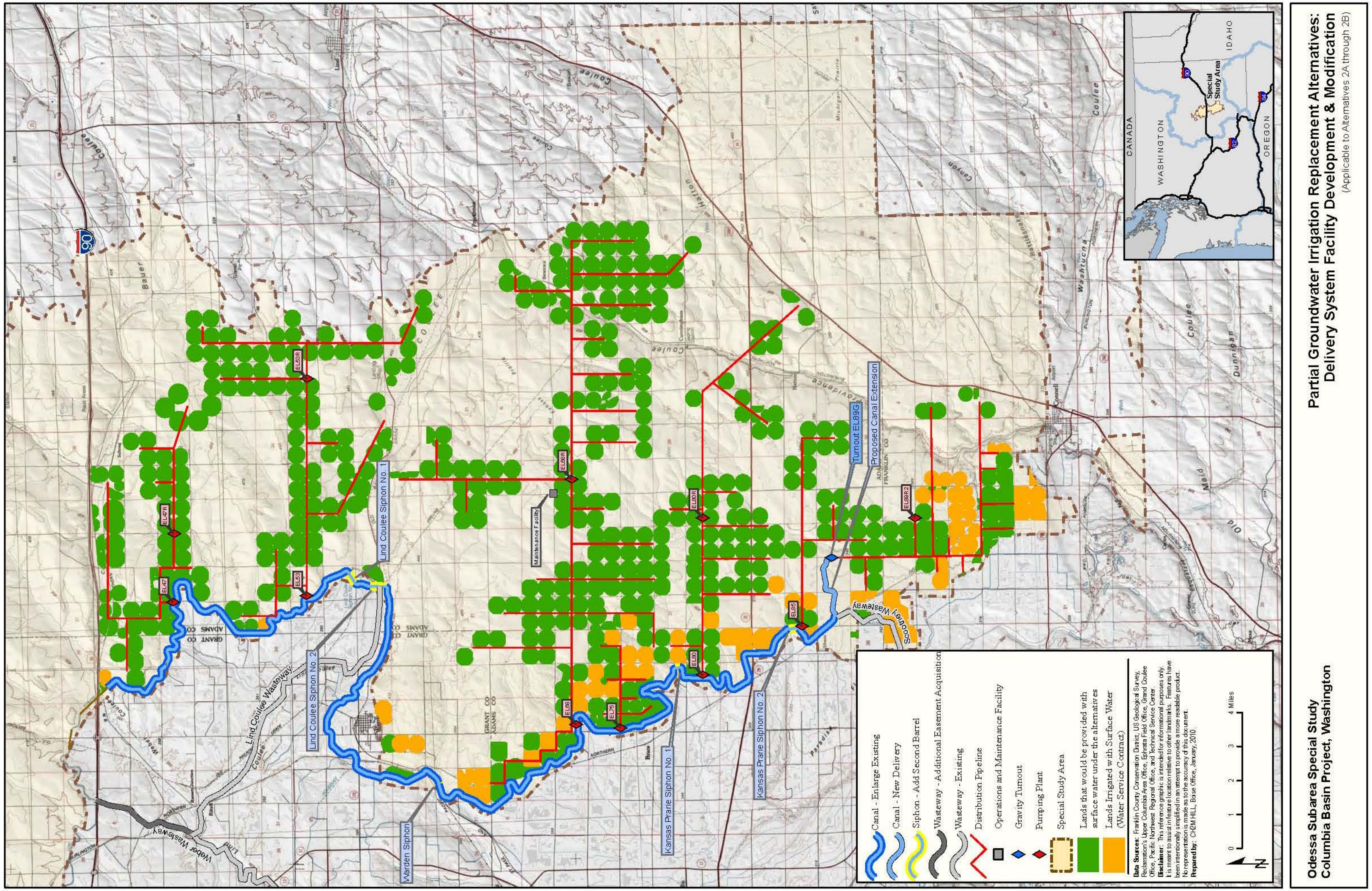

Figure 5. Partial groundwater irrigation replacement alternatives: delivery system facility development and modification.

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Partial Replacement Delivery System Facility Requirements

The water delivery system necessary for Alternative 2A: Partial-Banks and 2B: Partial - Banks + FDR is shown on Figure 9. Facility development would include the following:

- Enlarging the capacity of the 43.3 miles of the East Low Canal south of I-90, including adding a second barrel to all five existing siphons.
- Extending the East Low Canal about 2.1 miles at its southern end.
- Constructing a pipeline distribution system fed by pumping plants along the canal and a gravity-feed turnout at mile 89. This system would require numerous meter and equipment stations along the pipeline routes, primarily at farm delivery points.

Partial Replacement River and Reservoir Operational Changes

Table 4 provides a summary the additional drawdowns that would occur in average years at Banks Lake and Lake Roosevelt with the two partial replacement alternatives in context with the No Action Alternative. In all cases, the additional drawdowns at both of these reservoirs as a result of the alternatives would reach their maximums at the end of August each year. The reservoirs would be refilled outside the juvenile migration season in the fall and winter as flows are available.

Table 4. Partial Replacement Alternatives 2A and 2B – reservoir drawdown changes in a representative average year (1995).

Alternative	End-of-August Drawdowns*	
	Total	Beyond No Action
Banks Lake with Spring diversion scenario		
2A: Partial Replacement —Banks	7.3	2.3
2B: Partial Replacement —Banks + FDR	7.3	2.3
Lake Roosevelt with Spring diversion scenario		
2B: Partial Replacement —Banks + FDR	11.0	0.0
Banks Lake with limited Spring diversion scenario		
2A: Partial Replacement —Banks	9.6	4.6
2B: Partial Replacement —Banks + FDR	8.0	3.0

Alternative	End-of-August Drawdowns*	
	Total	**Beyond No Action**
Lake Roosevelt with limited Spring diversion scenario		
2B: Partial Replacement —Banks + FDR	11.5	0.5
*Feet in average years		

Full Replacement Action Alternatives (Alternatives 3A and 3B)

Full replacement alternatives would provide CBP surface water supply to replace existing groundwater supply for most lands in the Study Area now irrigated with groundwater (approximately 102,600 acres) both north and south of I-90. The total volume of water diverted from the Columbia River is approximately 273,000 acre-feet. As the surface water supply system is brought online and this water becomes available to eligible lands, operation of associated irrigation wells would cease. Under current State regulations, the irrigation wells would not be decommissioned or abandoned, but instead, superseding state water rights would be issued and the wells would be placed in standby status, remaining operational for use in an emergency (such as an interruption of the Federal surface water delivery system). Any different scenario or mandatory decommissioning would require that the statute to be modified.

Each of the two full replacement alternatives would involve the same water delivery system facilities and the same quantity of water. Delivery would require all facilities described for the partial replacement alternatives, plus development of the East High Canal System north of I-90 and construction of a distribution system (Figure 10). Each of the full replacement alternatives vary only in the option used to store and supply CBP water.

The two full replacement alternatives include the following:

- Alternative 3A: Full-Banks consisting of full replacement using the Banks Lake supply.

- Alternative 3B: Full-Banks + FDR consisting of full replacement using the Banks Lake and Lake Roosevelt supply.

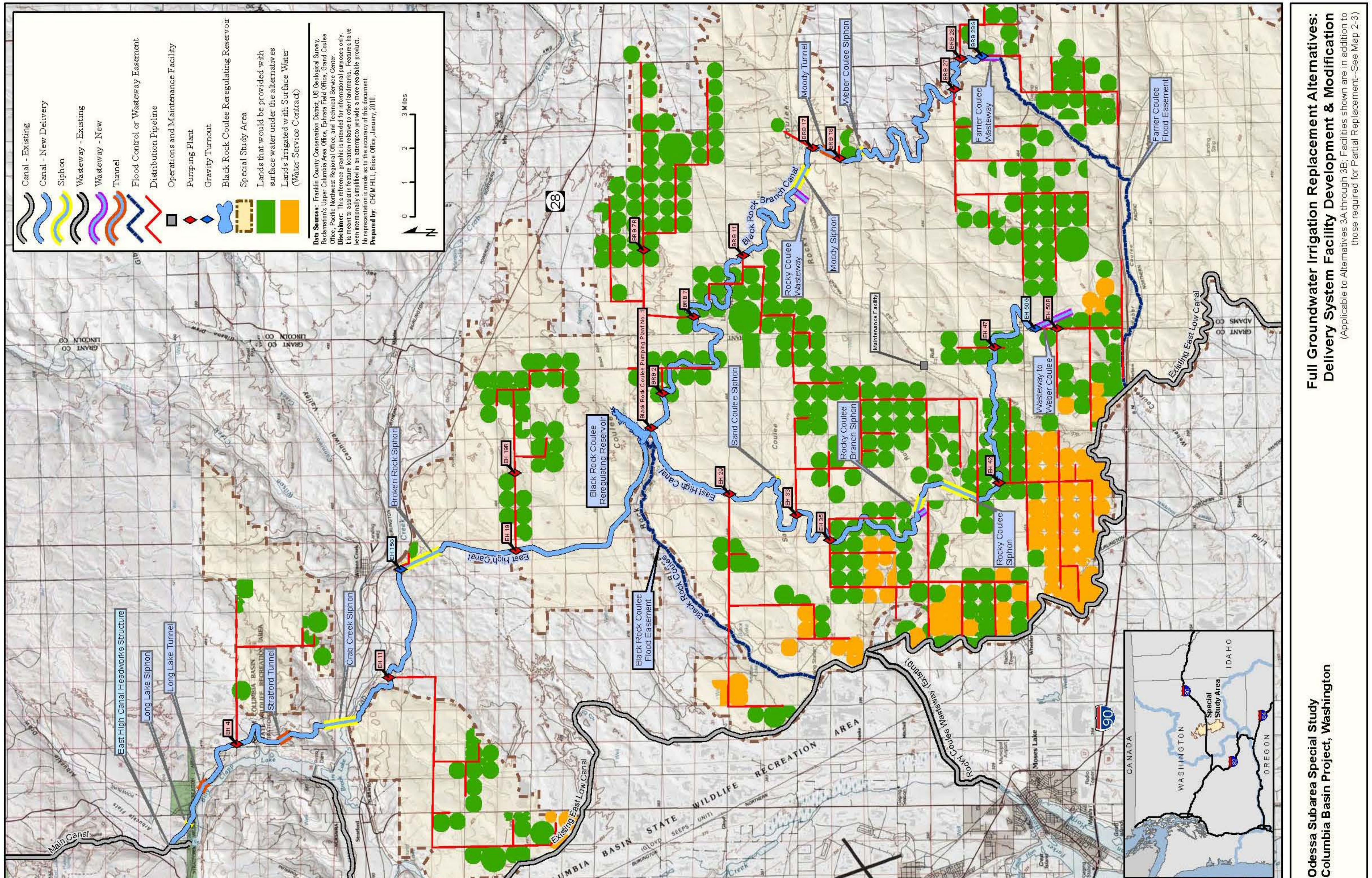

Figure 6. Full groundwater irrigation replacement alternatives: delivery system facility development and modification.

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Full Replacement Delivery System Facility Requirements

The water delivery system for Alternative 3A: Full-Banks would require development of all facilities described for the partial replacement alternatives under Alternative 2A: Partial-Banks (Section 2.5.1) to serve acreage south of I-90. To serve acreage north of I-90, the following additional facilities would be developed (Figure 10).

- 78.4 miles of new canal (including associated siphons and tunnels), comprised of the 44.8 mile East High Canal and the 26.8 mile Black Rock Branch Canal.
- Four new wasteway channels, 2.8 miles long, to manage canal flow.
- A reregulating reservoir in Black Rock Coulee (Black Rock Coulee Reregulating Reservoir), including a pumping plant to lift water from the reservoir to the Black Rock Branch Canal.
- A pipeline distribution system involving 187.3 miles of pipeline fed by 15 pumping plants and 3 gravity turnout facilities along the East High and Black Rock Branch Canals, and 3 re-lift pumping plants (2 associated with the East High Canal and 1 associated with the Black Rock Branch Canal).

Full Replacement River and Reservoir Operational Changes

Table 5 provides a summary of the additional drawdowns that would occur in an average year at Banks Lake and Lake Roosevelt with the two full replacement alternatives in context with the No Action Alternative. In all cases, the additional drawdowns at both of these reservoirs as a result of the alternatives would reach their maximums at the end of August each year.

Table 5. Full Replacement Alternatives 3A and 3B – reservoir drawdown changes in a representative average year (1995).

Alternative	End-of-August Drawdowns*	
	Total	Beyond No Action
Banks Lake with Spring diversion scenario		
3A: Full—Banks	10.6	5.6
3B: Full—Banks + FDR	8.0	3.0
Lake Roosevelt with Spring diversion scenario		
3B: Full—Banks + FDR	11.9	0.9
Banks Lake with limited Spring diversion scenario		
3A: Full—Banks	14.8	9.8
3B: Full—Banks + FDR	8.0	3.0
Lake Roosevelt with limited Spring diversion scenario		
3B: Full—Banks + FDR	11.9	0.9
*Feet in average years		

Modified Partial Replacement Action Alternatives (Alternatives 4A and 4B)

The action alternatives 4A: Modified Partial—Banks (Preferred Alternative) and 4B: Modified Partial — Banks + FDR would provide a CBP surface water supply to approximately 70,000 acres of lands in the Study Area north and south of I-90 (Figure 11). The total volume of water diverted from the Columbia River with the modified partial groundwater replacement alternatives is estimated at 164,000 acre-feet. As the surface water supply system is brought online and this water becomes available to eligible lands, the intent would be to cease operation of associated irrigation wells. Under current State regulations, the irrigation wells would not be decommissioned or abandoned. Instead, superseding state water rights would be issued and the wells would be placed in standby status, remaining operational for use in an emergency (such as an interruption of the Federal surface water delivery system). Any different scenario or mandatory decommissioning would require that the statute to be modified.

As part of these alternatives, the 16,864 acres of existing water service contracts that pump out of the East Low Canal at 34 locations would not be incorporated into the delivery system. This action would have no effect on current system operations or ECBID's ability to meet scheduled deliveries.

Alternatives 4A: Modified Partial—Banks (Preferred) and 4B: Modified Partial — Banks + FDR would involve the same water delivery system facilities and the same quantity of water. The delivery system would involve enlarging the East Low Canal and constructing a distribution system. The alternatives vary in the option used to store and supply CBP water.

A component of the modified partial alternatives would include an "infill" option to allow some groundwater irrigators in areas distant from the East Low Canal to move their operations to previously disturbed lands closer to the canal. It is anticipated that as much as 15 percent of the lands served under the Preferred Alternative would involve relocation of current operations. Relocation would be limited to an acre-per-acre exchange; that is, one acre of currently groundwater-irrigated land would be retired for each acre of relocated irrigated land served with replacement water.

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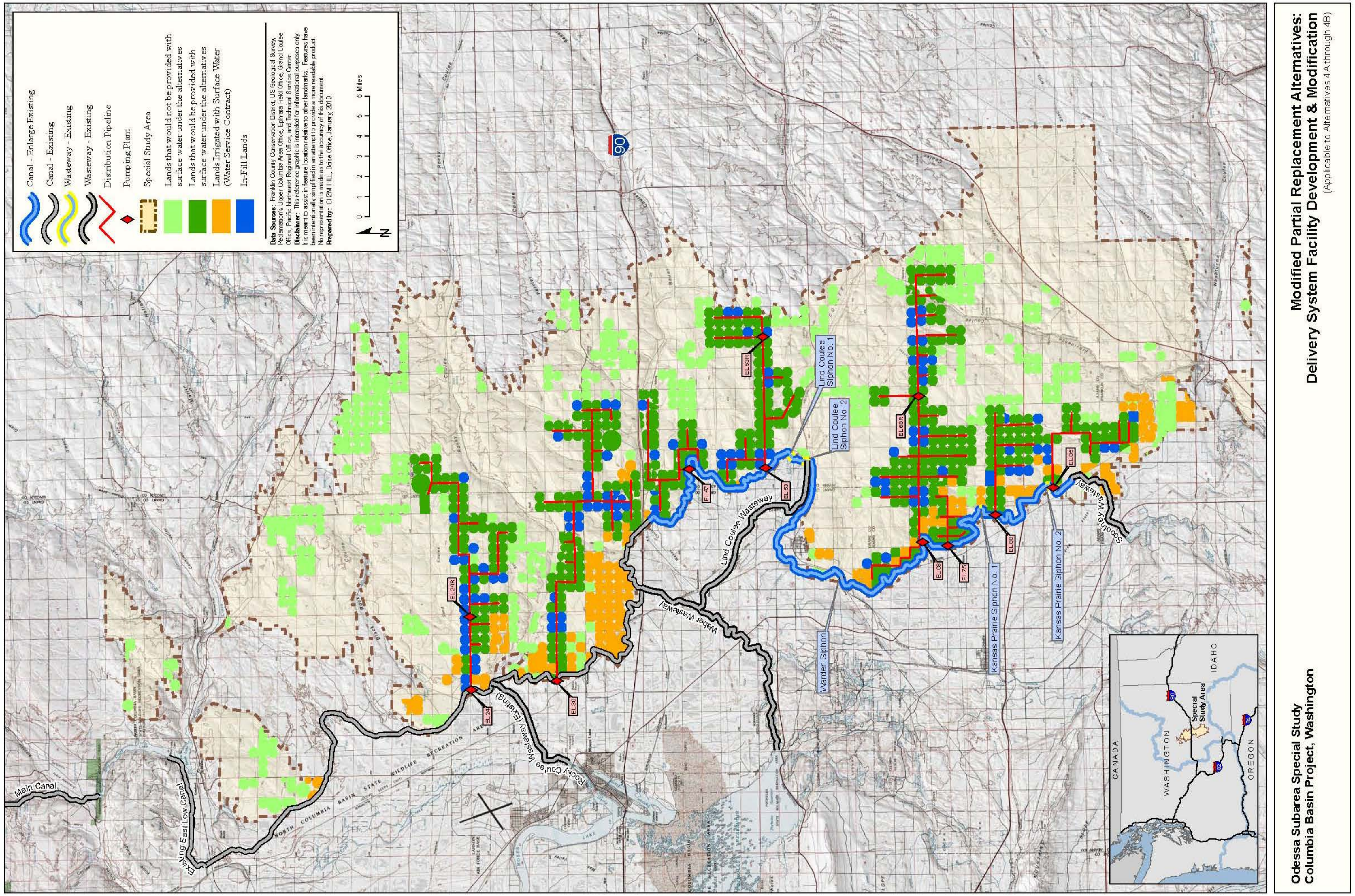

Figure 7. Modified partial replacement alternatives: delivery system facility development and modifications.

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Modified Partial Replacement Delivery System Facility Requirements

Major facility development would be necessary to deliver CBP water for the two modified partial replacement alternatives. These facilities are shown on Figure 11 and include the following:

- Enlarging the East Low Canal south of I-90, including adding a second barrel to all five existing siphons, with all work occurring within the existing East Low Canal easement.
- Creating a pressurized pipeline distribution system to get the water to farmlands, consisting of buried pipelines, pumping plants, and transmission lines.
- Acquiring additional easement width along the constructed portion of the existing Weber Wasteway south of I-90 and constructing a gravity turnout at the southern end of the East Low Canal.

Alternatives 4A and 4B would involve enlarging the East Low Canal south of I-90 and constructing canal-side pumping plants, re-lift pumping plants, and pressurized pipeline systems both north and south of I-90. Alternative 4A: Modified Partial—Banks (Preferred Alternative), Limited Spring Diversion has been identified as the Preferred Alternative by the co-lead agencies for the Final EIS. The modified partial groundwater replacement Alternative 4A meets the Purpose and Need of the project and was selected as the Preferred Alternative because it:

- Provides the most benefits to the aquifer with the least impacts to other environmental resources as compared to the partial and full replacement alternatives.
- Delivers water to the most acreage as possible with existing infrastructure.
- Has the highest Benefit - Cost Ratio of all the replacement alternatives.
- It is the environmentally preferred alternative.
- Requires no additional drawdown of Lake Roosevelt.

As shown on Figure 11, the main aspects of Alternative 4A include providing water supply from Banks Lake, via the East Low Canal, to currently groundwater-irrigated lands north and south of I-90. Major facility development associated with this alternative would be limited to enlargement of the East Low Canal south of I-90 and installation of a distribution system to deliver the water from the canal to farmlands. Neither modified partial replacement alternative involves extension (lengthening) of the East Low Canal.

Modified Partial Replacement River and Reservoir Operational Changes

Table 6 provides a summary the additional drawdowns that would occur in an average year at Banks Lake and Lake Roosevelt with the two modified partial replacement alternatives in context with the No Action Alternative. In all cases, the additional drawdowns at both of these reservoirs as a result of the alternatives would reach their maximums at the end of August each year. Reservoirs will be refilled outside the juvenile migration as flows are available.

Table 6. Modified Partial Replacement Alternatives 4A and 4B – reservoir drawdown changes in a representative average year (1995).

Alternative	End-of-August Drawdowns*	
	Total	Beyond No Action
Banks Lake with Spring diversion scenario		
4A: Modified Partial—Banks	8.1	3.1
4B: Modified Partial —Banks + FDR	8.0	3.0
Lake Roosevelt with Spring diversion scenario		
4B: Modified Partial l—Banks + FDR	11.0	0
Banks Lake with limited Spring diversion scenario		
4A: Modified Partial —Banks	11.0	6.0
4B: Modified Partial—Banks + FDR	8.0	3.0
Lake Roosevelt with limited Spring diversion scenario		
4B: Modified Partial —Banks + FDR	12	1.0
*Feet in average years		

Alternatives Costs

Table 7 provides a summary of the estimated costs for the alternatives. These cost estimates should only be used to compare alternatives. All the alternatives used the same assumptions and unit prices so these are directly comparable from a cost standpoint.

Table 7. Summary of alternative cost estimates (millions of dollars).

Alternative	Construction & Land Acquisition Costs	IDC Costs	Total	Maximum Annual OMR&P Costs (Year 2025+)*
1: No Action	--	--	--	$3.3
2A: Partial—Banks	$691.3	$89.1	$780.5	$6.6
2B: Partial—Banks + FDR	$691.3	$89.1	$780.5	$6.6
3A: Full—Banks	$2,457.7	$327.8	$2,785.6	$15.0
3B: Full—Banks + FDR	$2,457.7	$327.8	$2,785.6	$15.0
4A: Modified Partial—Banks (Preferred)	$736.5	$91.0	$827.5	$7.9
4B: Modified Partial—Banks + FDR	$736.5	$91.0	$827.5	$7.9

* Since the construction periods vary by phase, this maximum annual OMR&P cost does not occur until year 2025 after all construction phases are completed.

Benefit-Cost Analysis

This section summarizes the results of a benefit-cost analysis (BCA) of the Proposed Action alternatives. For a more detailed discussion of the BCA, see the Odessa Special Study Report (Reclamation 2012 Study).

A BCA compares the benefits of a proposed project to its costs. The total costs of the project are subtracted from the total benefits to measure net benefits. If the net benefits are positive, implying that benefits exceed costs, the project would be considered economically justified. In studies where multiple alternatives are being considered, the alternative with the greatest positive net benefit would be preferred strictly from an economics perspective. Another way of displaying this benefit-cost comparison involves dividing total project benefits by total project costs—resulting in the benefit-cost ratio (BCR). A BCR greater than one is analogous to a positive net benefit.

The benefit-cost results were developed by alternative and estimated using two hydrologic scenarios and two municipal benefit estimates. The hydrologic scenarios include a “With Spring Diversion” option and a “Limited Spring Diversion” option. The municipal benefit options vary based on the water supply transition path assumed for each town. Option 1 assumes towns ultimately move to either a deep well system or a combined deep well and surface water system. Option 2 assumes all towns move to a deep well system. Since these different scenarios result in four benefit-cost estimates for each alternative, the decision was made to present only the high and low results in the tables below. For the entire range of benefit-cost results for each alternative, see the Economics Technical Report (Reclamation 2012 Economics).

Table 8. Results of BCA based on original CBP planning rate of 4.0 percent, millions of dollars.

	Partial Replacement Alternatives (2A/2B)		Full Replacement Alternatives (3A/3B)		Modified Partial Replacement Alternatives (4A/4B)	
	High Estimate (With Spring Diversion & Municipal Benefit Option 1)	Low Estimate (Limited Spring Diversion & Municipal Benefit Option 2)	High Estimate (With Spring Diversion & Municipal Benefit Option 1)	Low Estimate (Limited Spring Diversion & Municipal Benefit Option 2)	High Estimate (With Spring Diversion & Municipal Benefit Option 1)	Low Estimate (Limited Spring Diversion & Municipal Benefit Option 2)
1) Total Benefits:	1,109.3	1,102.4	2,006.0	1,982.5	1,378.9	1,366.9
a) Agriculture	1,070.0	1,070.0	1,884.9	1,884.9	1,315.4	1,315.4
b) Municipal	34.1	27.2	116.2	92.7	58.6	46.6
c) Industrial	5.2	5.2	4.9	4.9	4.9	4.9
2) Total Costs (including Lost Benefits):	1,250.0	1,271.9	3,920.8	3,952.4	1,367.9	1,399.6
a) Canal & Reservoir Construction & IDC Costs	886.0	886.0	3,169.3	3,169.3	942.0	942.0
b) Canal & Reservoir OMR&P Costs	192.5	192.5	428.1	428.1	228.7	228.7
	3.2	3.2	3.9	3.9	2.5	2.5
e) Reduced Hydropower Benefits	168.3	190.2	319.5	351.1	194.7	226.4
3) Net Benefits (row 1 minus row 2)	(140.7)	(169.5)	(1,914.8)	(1,969.9)	11.0	(32.7)
4) Benefit-Cost Ratio (row 1 divided by row 2)	.887	.867	.512	.502	1.008	.977

Summary of Environmental Consequences

The environmental consequences of the alternatives, including the No Action Alternative, are fully described in Chapter 4 of the Final EIS. Table 9 provides a summary of impacts and benefits associated with the No Action, Partial Replacement, Full Replacement, and Modified Partial Replacement alternatives for specific areas within affected resource topics. In addition, Table 9 details the relative magnitude of benefits and adverse impacts expected under each of the seven alternatives.

Resources that would have potential benefits or minimal to significant impacts include, but are not limited to, groundwater resources; vegetation and wetlands, wildlife and wildlife habitat; fisheries and aquatic habitat; land and shoreline use, recreation; energy; visual resources; and cultural resources.

Resource areas that would have no notable beneficial effects or negative impacts include, but are not limited to, surface water quantity; water rights; geology; soils; threatened and endangered species; air quality; public services and utilities; public health; Indian trust assets; and environmental justice.

Table 9. Summary of the benefits and impacts associated with the No Action, Partial Replacement, Full Replacement, and Modified Partial Replacement alternatives.

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Surface Water Quantity							
Instream flow requirements	No impact	Minimal Impact with both diversion scenarios.	Minimal Impact with both diversion scenarios.	Minimal Impact with both diversion scenarios.	Minimal Impact with both diversion scenarios.	Minimal Impact with both diversion scenarios.	Minimal Impact with both diversion scenarios.
Reduction of surface water elevations in Lake Roosevelt	No impact	No impact with both diversion scenarios	Minimal additional drawdown in late August and September with both diversion scenarios. Minimal hydrologic impact.	No impact with both diversion scenarios	Minimal additional drawdown in late August and September with both diversion scenarios. Minimal hydrologic impact.	No impact with both diversion scenarios	Additional drawdown in August and September with both diversion scenarios. Minimal hydrologic impact.
Reduction of surface water elevations in Banks Lake	No impact	Drawdown starting April through late September with both diversion scenarios. Minimal hydrologic impact.	Drawdown starting April through late September with both diversion scenarios. Minimal hydrologic impact.	Drawdown starting April through late September with both diversion scenarios. Minimal hydrologic impact.	Drawdown starting April through late September with both diversion scenarios. Minimal hydrologic impact.	Drawdown starting April through late September with both diversion scenarios. Minimal hydrologic impact.	Drawdown starting April through late September with both diversion scenarios. Minimal hydrologic impact.
Changes to flows, geomorphology, or connectivity from inundation under a planned reservoir or spillway flow from a reservoir	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	Inundation by Black Rock Coulee Reregulating Reservoir. Minimal impact with both diversion scenarios.	Inundation by Black Rock Coulee Reregulating Reservoir. Minimal impact with both diversion scenarios.	Minimal impact with both diversion scenarios.	Minimal impact with both diversion scenarios.
Changes to areas that receive water from the wasteways	No impact	Minimal impact with both diversion scenarios.	Minimal impact with both diversion scenarios.	Minimal impact in Black Rock Coulee with both diversion scenarios	Minimal impact in Black Rock Coulee with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Groundwater Resources							
Groundwater level declines	Continued decline in levels and high level of discontinued use in next 10-20 years. Adverse impact.	Conservation of about 138,000 ac-ft/year of groundwater; level declines continue, but at slower rate with both diversion scenarios. Beneficial impact.	Conservation of about 138,000 ac-ft/year of groundwater; level declines continue, but at slower rate with both diversion scenarios. Beneficial impact.	Conservation of about 273,000 ac-ft/year of groundwater; level declines continue and may rise slightly with both diversion scenarios. Beneficial impact.	Conservation of about 273,000 ac-ft/year of groundwater; level declines continue and may rise slightly with both diversion scenarios. Beneficial impact.	Conservation of about 164,000 ac-ft/year of groundwater; level declines continue, but at slower rate with both diversion scenarios. Beneficial impact.	Conservation of about 164,000 ac-ft/year of groundwater; level declines continue, but at slower rate with both diversion scenarios. Beneficial impact.
Recharge or seepage in Black Rock Coulee	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	Local recharge to shallow groundwater from reservoir with both diversion scenarios	Local recharge to shallow groundwater from reservoir with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Municipal and industrial users	Continued decline in levels. Adverse impact.	Reduced rate of declining groundwater levels. Beneficial effect south of I-90. Continued decline in levels north of I-90 with both diversion scenarios. Adverse impact.	Reduced rate of declining groundwater levels. Beneficial effect south of I-90. Continued decline in levels north of I-90 with both diversion scenarios. Adverse impact.	Reduced rate of declining groundwater levels as shallow aquifer seeps into deep aquifer with both diversion scenarios. Beneficial impact.	Reduced rate of declining groundwater levels as shallow aquifer seeps into deep aquifer with both diversion scenarios. Beneficial effect.	Reduced rate of declining groundwater levels with both diversion scenarios. Beneficial effect.	Reduced rate of declining groundwater levels with both diversion scenarios. Beneficial effect.

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Water Quality							
Temperature (FDR)	No impact	No impact with both diversion scenarios	Minimal impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios
Dissolved oxygen (FDR)	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Heavy metals (FDR)	No impact	No impact with both diversion scenarios	Minimal impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios
Temperature (Banks)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact, but greater than 2A with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact, but greater than 2A with both diversion scenarios	Minimal impact with both diversion scenarios
Dissolved oxygen (Banks)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact, but greater than 2A with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact, but greater than 2A with both diversion scenarios	Minimal impact with both diversion scenarios
Turbidity (Banks)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Temperature (Columbia)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Total dissolved gas (Columbia)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Temperature (CBP)	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
pH (CBP)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Salinity (CBP)	No impact	Minor beneficial effect with both diversion scenarios	Minor beneficial effect with both diversion scenarios	Minor beneficial effect with both diversion scenarios	Minor beneficial effect with both diversion scenarios	Minor beneficial effect with both diversion scenarios	Minor beneficial effect with both diversion scenarios
Nutrients (CBP)	Potential minor beneficial effect	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Water Rights							
Loss or curtailment of groundwater rights	No impact	Minor impacts with both diversion scenarios	Minor impacts with both diversion scenarios	Minor impacts with both diversion scenarios	Minor impacts with both diversion scenarios	Minor impacts with both diversion scenarios	Minor impacts with both diversion scenarios
Columbia River and Lake Roosevelt Tribal water rights	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Geology							
Commitment of geologic resources	No impact	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios
Geologic hazards	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Unique geologic features	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Soils							
Farmland Protection Policy Act	No impact	No impacts with both diversion scenarios with implementation of legal requirements, BMPs, and mitigation measures	No impacts with both diversion scenarios with implementation of legal requirements, BMPs, and mitigation measures	No impacts with both diversion scenarios with implementation of legal requirements, BMPs, and mitigation measures	No impacts with both diversion scenarios with implementation of legal requirements, BMPs, and mitigation measures	No impacts with both diversion scenarios with implementation of legal requirements, BMPs, and mitigation measures	No impacts with both diversion scenarios with implementation of legal requirements, BMPs, and mitigation measures
Vegetation and Wetlands							
Impact on native plant communities	No impact	Adverse impact on native plant communities with both diversion scenarios	Adverse impact on native plant communities with both diversion scenarios	Significant impact with both diversion scenarios, including Black Rock Coulee Reregulating Reservoir	Significant impact with both diversion scenarios, including Black Rock Coulee Reregulating Reservoir	Adverse impact on native plant communities with both diversion scenarios	Adverse impact on native plant communities with both diversion scenarios
Fragmentation of native plant communities	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Adverse impact with both diversion scenarios with construction of new canals	Adverse impact with both diversion scenarios with construction of new canals	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Impact on special status plants	No impact	Potential impacts with both diversion scenarios; not yet quantified	Potential impacts with both diversion scenarios; not yet quantified	Potential impacts with both diversion scenarios; not yet quantified, but approximately an order of magnitude greater than 2A	Potential impacts with both diversion scenarios; not yet quantified, but approximately an order of magnitude greater than 2A	Potential impacts with both diversion scenarios; not yet quantified	Potential impacts with both diversion scenarios; not yet quantified
Habitat restoration	No impact	Long time periods for restoration of disturbed habitat with both diversion scenarios	Significant requirement for restoration of disturbed habitat with both diversion scenarios	Long time periods for restoration of disturbed habitat over larger areas than 2A with both diversion scenarios	Significant requirement for restoration of disturbed habitat over larger areas than 2A with both diversion scenarios	Long time periods for restoration of disturbed habitat with both diversion scenarios	Significant requirement for restoration of disturbed habitat with both diversion scenarios
Long-term loss of wetland area	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Adverse impact at Banks Lake with both diversion scenarios	Adverse impact at Banks Lake with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Long-term loss or degradation of wetland function	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal to adverse impact at Banks Lake depending on water year with both diversion scenarios	Minimal to adverse impact at Banks Lake depending on water year with both diversion scenarios	Minimal impact at Banks Lake depending on water year with both diversion scenarios	Minimal impact at Banks Lake depending on water year with both diversion scenarios

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Wildlife and Wildlife Habitat							
Impact on intact shrub-steppe habitat	Minimal impact on wildlife that use farm lands because wheat fields would be fallowed every other year	Adverse impact with both diversion scenarios with removal of shrub-steppe habitat	Adverse impact with both diversion scenarios with removal of shrub-steppe habitat	Significant impact with both diversion scenarios over substantially larger area than with Alternative 2A	Significant impact over substantially larger area than with Alternative 2A	Adverse impact over slightly larger area than with Alternative 2A	Adverse impact over slightly larger area than with Alternative 2A
Barriers to unrestricted movement by wildlife	No impact	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios	Significant impact with both diversion scenarios from extended canal system	Significant impact with both diversion scenarios from extended canal system	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios
Impact on special status species, including migratory birds	No impact	Significant impact on multiple species with both diversion scenarios. Impacts to grebes would be more pronounced with the limited spring diversion scenario.	Significant impact on multiple species with both diversion scenarios. Impacts to grebes would be more pronounced with the limited spring diversion scenario.	Significant impact on multiple species with both diversion scenarios, involving substantially larger area and a number of species than with Alternative 2A	Significant impact on multiple species with both diversion scenarios, involving substantially larger area and a number of species than with Alternative 2A	Significant impact on multiple species with both diversion scenarios, involving slightly larger area and a number of species than with Alternative 2A	Significant impact on multiple species with both diversion scenarios, involving slightly larger area and a number of species than with Alternative 2A
Habitat fragmentation and population viability	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	Significant impact from extended canal system	Significant impact from extended canal system	No impact with both diversion scenarios	No impact with both diversion scenarios
Fisheries and Aquatic Resources							
Columbia River: Downstream migration of salmonid smolts (mid-April to August)	No impact	No to minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	No to minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	No to minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	No to minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	No to minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	No to minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario
Columbia River: Upstream migration of adult salmon and steelhead (September to October for Fall Chinook, Steelhead)	No impact	No to minimal impact under both diversion scenarios	No to minimal impact under both diversion scenarios	No to minimal impact under both diversion scenarios	No to minimal impact under both diversion scenarios	No to minimal impact under both diversion scenarios	No to minimal impact under both diversion scenarios
Columbia River: Chum salmon spawning below Bonneville Dam (November to mid-April)	No impact	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios
FDR: Zooplankton production	No impact	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios
FDR: Rainbow trout net pen program	No impact	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios
FDR: Kokanee salmon spawner access to San Poil River	No impact	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Banks Lake: Fish and zooplankton entrainment	No impact	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal to adverse impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal to adverse impact under both diversion scenarios	Minimal impact under both diversion scenarios
Surface areas of littoral habitat temporarily exposed during drawdowns	No impact	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	Significant impact from greater drawdown under both diversion scenarios.	Minimal impact under both diversion scenarios	Minimal to adverse impact under both diversion scenarios	Minimal impact under both diversion scenarios
Banks Lake: Overall condition of the fishery	No impact	Minimal under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal to adverse impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal to adverse impact under both diversion scenarios	Minimal impact under both diversion scenarios
Threatened and Endangered Species							
Pygmy rabbits	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Downstream migration of salmonid smolts	No impact	Minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	Minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	Minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	Minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	Minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	Minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario
Upstream migration of adult salmon, steelhead, and bull trout	No impact	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios
Chum salmon spawning below Bonneville Dam	No impact	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios
Air Quality							
Primary air quality standards	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Secondary air quality standards	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Attainment area classification	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Land Use and Shoreline Resources							
Changes in land ownership and land status	Potential for consolidation of farms	About 5,150 acres acquired (easements and fee title) with both diversion scenarios. Adverse impact	About 5,150 acres acquired (easements and fee title) with both diversion scenarios. Adverse impact	About 17,360 acres acquired (easements and fee title) with both diversion scenarios. Adverse impact	About 17,360 acres acquired (easements and fee title) with both diversion scenarios. Adverse impact	About 4,740 acres acquired (easements and fee title) with both diversion scenarios. Adverse impact	About 4,740 acres acquired (easements and fee title) with both diversion scenarios. Adverse impact
Changes in land or shoreline uses: Protection of irrigated agriculture	Adverse impact with significant change from irrigated to dryland agriculture.	57,000 acres of irrigated agriculture preserved with both diversion scenarios. Beneficial effect.	57,000 acres of irrigated agriculture preserved with both diversion scenarios. Beneficial effect.	102,600 acres of irrigated agriculture preserved with both diversion scenarios. Beneficial effect.	102,600 acres of irrigated agriculture preserved with both diversion scenarios. Beneficial effect.	70,000 acres of irrigated agriculture preserved with both diversion scenarios. Beneficial effect.	70,000 acres of irrigated agriculture preserved with both diversion scenarios. Beneficial effect.

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Consistency with relevant plans, policies and programs	Adverse impact from inconsistent plans across 102,614 acres.	Supports county comprehensive plans across 57,000 acres with both diversion scenarios. Beneficial effect.	Supports county comprehensive plans across 57,000 acres with both diversion scenarios. Beneficial effect.	Supports county comprehensive plans across 102,600 acres with both diversion scenarios. Beneficial effect.	Supports county comprehensive plans across 102,600 acres with both diversion scenarios. Beneficial effect.	Supports county comprehensive plans across 70,000 acres with both diversion scenarios. Beneficial effect.	Supports county comprehensive plans across 70,000 acres with both diversion scenarios. Beneficial effect.
Recreation							
FDR: Loss of boating capacity	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	In dry years, 6 of 22 launches unavailable for 1-3 weeks. Slight increase in impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	No impact with both diversion scenarios	Minimal impact with both diversion scenarios
FDR: Exposure of boating hazards	No impact	No impact with both diversion scenarios	Minimal impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios
FDR: Loss of fishing opportunities	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
FDR: Loss of usability at developed swimming areas	No impact	No impact with both diversion scenarios	Increased distance to water's edge with both diversion scenarios. Minimal impact.	No impact with both diversion scenarios	Increased distance to water's edge with both diversion scenarios. Adverse impact.	No impact with both diversion scenarios	Increased distance to water's edge with both diversion scenarios. Minimal impact.
FDR: Decrease in usability or aesthetic quality at developed camping or day use facilities	No impact	No impact with both diversion scenarios	Increased distance to water's edge with both diversion scenarios. Minimal impact.	No impact with both diversion scenarios	Increased distance to water's edge with both diversion scenarios. Adverse impact.	No impact with both diversion scenarios	Increased distance to water's edge with both diversion scenarios. Minimal impact.
FDR: Dispersed recreation	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios
FDR: Loss of opportunity for hunting, wildlife viewing, hiking, etc. on lands surrounding the reservoirs	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Banks: Loss in boat launch capacity and related impacts on fishing access, camping, and day use	No impact	In dry years, two of five high-capacity launches unavailable for 3-4 weeks with both diversion scenarios. Adverse impact.	With both diversion scenarios, minimal impact at high-capacity ramps, but low-capacity ramps would be out of service for up to 5 weeks	All but one boat ramp unavailable for 6 weeks with both scenarios. Adverse impact.	With both diversion scenarios, minimal impact at high-capacity ramps, but low-capacity ramps would be out of service for up to 5 weeks	In dry years, high capacity ramps unavailable for 1-4 weeks. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	With both diversion scenarios, minimal impact at high-capacity ramps, but low-capacity ramps would be out of service for up to 5 weeks

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Banks: Exposure of boating hazards	Minimal impact	Drawdown exposure of hazards would last for about 3-6 weeks. Potential for increased hazard exposure with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Drawdown exposure of hazards would last for about 6-7 weeks. Potential for increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Drawdown exposure of hazards would last for about 10-13 weeks. Potential for increased hazard exposure with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Drawdown exposure of hazards would last for about 10-13 weeks. Potential for increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Drawdown exposure of hazards would last for about 4-7 weeks. Potential for increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Drawdown exposure of hazards would last for about 6-7 weeks. Potential for increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.
Banks: Loss of fishing opportunities (because of impact on fishery; impact on fishing access reflected in boating capacity indicator)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal Impact with both diversion scenarios.	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Banks: Loss of usability at developed swimming areas	No impact	Three of four swimming areas unusable for about 6 weeks. Slight increase in impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Three of four swimming areas unusable for about 5-6 weeks. Potential increased impact with limited spring diversion scenario than with spring diversion scenario Adverse impact.	All four swimming areas would be unusable for up to 12 weeks. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Three of four swimming areas unusable for about 5-6 weeks. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Three of four swimming areas unusable for about 6 weeks. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Three of four swimming areas unusable for about 5-6 weeks. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.
Banks: Decrease in usability or aesthetic quality at developed camping or day use facilities	Minimal impact	Distance to water's edge would be about 20-260 feet for dry years with both diversion scenarios. Adverse impact.	Distance to water's edge would be about 20-260 feet for dry years with both diversion scenarios. Adverse impact.	Distance to water's edge would be about 50-850 feet in dry years. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Distance to water's edge would be about 20-260 feet for dry years with both diversion scenarios. Adverse impact.	Distance to water's edge would be about 50-450 feet in dry years. Potential increased hazard exposure with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Distance to water's edge would be about 20-260 feet for dry years with both diversion scenarios. Adverse impact.
Banks: Decrease in usability of aesthetic quality at dispersed recreation sites	Minimal impact	Distance to water's edge would be about 20-445 feet for dry years with both diversion scenarios. Adverse impact.	Distance to water's edge would be about 20-420 feet for dry years with both diversion scenarios. Adverse impact.	Distance to water's edge would be over 50-890 feet for dry years. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Distance to water's edge would be about 20-420 feet for dry years. Adverse impact.	Distance to water's edge would be about 25-470 feet for dry years. Adverse impact.	Distance to water's edge would be about 20-420 feet for dry years. Adverse impact.
Banks: Loss of opportunity for hunting, wildlife viewing, hiking, etc. on lands surrounding the reservoirs	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Loss of hunting and/or wildlife viewing opportunities in Odessa Special Study Area	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Irrigated Agriculture							
Gross Farm Income 2025 Study Area Compared to Four-County Analysis Area	Adverse long-term impact: gross farm income drops from about $119.1 million to $54.5 million	Beneficial long-term effect: gross farm income increases from about $119.1 million to $156.8 million	Beneficial long-term effect: gross farm income increases from about $119.1 million to $156.8 million	Beneficial long-term effect: gross farm income increases from about $119.1 million to $243.5 million	Beneficial long-term effect: gross farm income increases from about $119.1 million to $243.5 million	Beneficial long-term effect: gross farm income increases from about $119.1 million to $182.6 million	Beneficial long-term effect: gross farm income increases from about $119.1 million to $182.6 million
Socioeconomics							
Change in regional employment (number of jobs) within the four-county analysis area	Minimal long–term impact: less than 1 percent decrease in jobs	Short–term beneficial effects: less than one percent increase in jobs. Net long–term beneficial effects: less than 1 percent increase in jobs. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 4 percent increase in jobs. Net long–term beneficial effects: less than 1 percent increase in jobs. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 4 percent increase in jobs. Net long–term beneficial effects. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 2 percent in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 2 percent increase in jobs.
Change in regional labor income within the four-county analysis area	Minimal long–term impact: less than 0.5 percent decrease in labor income	Short–term beneficial effects: less than 2 percent increase in labor income. Net long–term beneficial effects. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 2 percent increase in labor income. Net long–term beneficial effects: less than 1 percent increase in labor income. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 6 percent increase in labor income. Net long–term beneficial effects: less than 1 percent increase in labor income. Ag: less than 3 percent increase in jobs.	Short–term beneficial effects: less than 6 percent increase in labor income. Net long–term beneficial effects. Ag: less than 3 percent increase in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 2 percent in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 2 percent increase in jobs.
Change in regional sales within the four-county analysis area	Minimal long–term impact: less than 0.5 percent decrease in sales	Short–term beneficial effects: less than 1 percent increase in sales. Net long–term beneficial effects. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 1 percent increase in sales. Net long–term beneficial effects. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 4 percent increase in sales. Net long–term beneficial effects: less than 1 percent increase in sales. Ag: less than 4 percent increase in jobs.	Short–term beneficial effects: less than 4 percent increase in sales. Net long–term beneficial effects. Ag: less than 4 percent increase in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than one percent increase in jobs. Ag: less than 3 percent increase in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 3 percent increase in jobs.
Transportation							
Short- or long-term increases in traffic (general average daily and peak hour) on regional or local roads	No impact	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Increases in large and/or heavy-load vehicle traffic on regional or local roads	No impact	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios
Existing roads and railroads: crossings by new surface facilities or inundation by new reservoirs	No impact	Minimal impact given committed Transportation Management Plan (TMP)	Minimal impact given committed TMP	Minimal impact given committed TMP	Minimal impact given committed TMP	Minimal impact given committed TMP	Minimal impact given committed TMP
Energy							
Change in net energy available in region	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Keys PGP reserves, reliability and diurnal load shifting	No impact	Adverse to significant impact with both diversion scenarios	Adverse impact with both diversion scenarios	Significant impact with both diversion scenarios	Adverse impact with both diversion scenarios	Significant impact with both diversion scenarios	Adverse impact with both diversion scenarios
Public Services and Utilities							
Exceedance of service or utility capacity (long-term)	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Disruption of services or utilities for existing residents and landowners (short-term, construction-phase)	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Impact on emergency response times (short-term, construction-phase)	No impact	Minimal Impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Noise							
Short-term (construction) increases in noise levels	No impact	Localized adverse impact	Localized adverse impact	Localized adverse impact	Localized adverse impact	Localized adverse impact	Localized adverse impact
Long-term increases in noise levels	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Public Health (Hazardous Materials)							
Hazardous sites	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Mosquito habitat	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Visual Resources							
Landscape-level change: conversion from irrigated agriculture to dryland or fallow over approximately 30-year period	About 100,000 acres would convert to dryland or fallow. Adverse impact.	About 48,000 acres would convert to dryland or fallow. Adverse impact.	About 48,000 acres would convert to dryland or fallow. Adverse impact.	General landscape appearance does not change.	General landscape appearance does not change.	About 35,000 acres would convert to dryland or fallow. Adverse impact.	About 35,000 acres would convert to dryland or fallow. Adverse impact.

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Introduction of new developed facilities	No impact	Pumping plants and regulating tanks south of I-90 only. Adverse impact.	Pumping plants and regulating tanks south of I-90 only. Adverse impact.	Canal, laterals, pumping plants, and regulating tanks north and south of I-90. Adverse impact.	Canal, laterals, pumping plants, and regulating tanks north and south of I-90. Adverse impact.	Pumping plants and regulating tanks north and south of I-90. Adverse impact.	Pumping plants and regulating tanks north and south of I-90. Adverse impact.
Changes in reservoir drawdown patterns at Banks Lake and Lake Roosevelt	Minimal Impact	Adverse impact at Banks Lake generally related to depth of additional drawdown. Adverse impact with both diversion scenarios.	Adverse impact at Banks Lake generally related to depth of additional drawdown. Adverse impact with both diversion scenarios.	Adverse impact at Banks Lake generally related to depth of additional drawdown. Impacts would be slightly more pronounced with the limited spring diversion scenario.	Adverse impact at Banks Lake generally related to depth of additional drawdown. Impacts would be slightly more pronounced with the limited spring diversion scenario.	Adverse impact at Banks Lake generally related to depth of additional drawdown. Adverse impact with both diversion scenarios.	Adverse impact at Banks Lake generally related to depth of additional drawdown. Adverse impact with both diversion scenarios.
Cultural and Historic Resources *Potential for construction to encounter and impact significant cultural resources*							
Miles of new linear facilities with high potential	No impact	166 miles. Adverse impact.	166 miles. Adverse impact.	245 miles. Adverse impact.	245 miles. Adverse impact.	162 miles. Adverse impact.	162 miles. Adverse impact.
Acres of facility site acquisition with high potential	No impact	38 acres. Adverse impact.	38 acres. Adverse impact.	100 acres. Adverse impact.	100 acres. Adverse impact.	27 acres. Adverse impact.	27 acres. Adverse impact.
Additional acreage exposed by drawdowns at Banks Lake	No impact	About 560 acres exposed with spring diversion scenario and about 1,079 acres with limited spring diversion scenario. Adverse impact.	About 560 acres exposed with spring diversion scenario and about 700 acres with limited spring diversion scenario. Adverse impact.	About 1,395 acres exposed with spring diversion scenario and about 2,433 acres with limited spring diversion scenario. Adverse impact.	About 700 acres exposed with spring diversion scenario and about 700 acres with limited spring diversion scenario. Adverse impact.	About 790 acres exposed with spring diversion scenario and about 1,479 acres with limited spring diversion scenario. Adverse impact.	About 700 acres exposed with spring diversion scenario and about 700 acres with limited spring diversion scenario. Adverse impact.
Indian Sacred Sites							
Potential for facility development to impact known sacred sites	No impact	Potential impacts; not yet quantified	Potential impacts; not yet quantified	Potential impacts; not yet quantified	Potential impacts; not yet quantified	Potential impacts; not yet quantified	Potential impacts; not yet quantified
Indian Trust Assets							
Potential for facility development to impact known ITAs	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Environmental Justice							
Disproportionate impact to minority or low-Income populations	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios

Cumulative Impacts

Cumulative impacts are the sum of all effects that may result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what public agency or private party in responsible for such other actions (40 CFR 1508.7). Many of the potential cumulative effects associated with the Study Proposed Action are examined under the various environmental elements in Chapters 3 and 4 of this Final EIS. Those analyses discuss the effects of past processes and trends that have cumulatively influenced or led to the resource conditions that exist today. In addition, they examine ongoing or reasonably foreseeable actions that are considered to be part of the No Action Alternative and all action alternatives.

The cumulative impacts discussion presented in this section expands on the discussions of past processes, trends, and current actions by focusing on reasonably foreseeable future actions that are not considered part of the No Action Alternative or action alternatives.

The following cumulative actions have been identified for potential cumulative effects:

- Columbia River Basin Water Management Program and its anticipated component actions (considered as part of No Action Alternative).
- Lake Roosevelt Incremental Storage Releases (considered as part of No Action Alternative).
- Coordinated Conservation Program (considered as part of No Action Alternative).
- 2008 Federal Columbia River Power System (FCRPS) Biological Opinion (considered as part of No Action Alternative).
- Potholes Supplemental Feed Route Project (considered as part of No Action Alternative).
- Groundwater withdrawals of municipalities, communities, and irrigators (considered as part of No Action Alternative).
- John W. Keys III Pump-Generating Plant Modernization Project (a reasonably foreseeable future action)
- Assured Annual Flood Control provision of the Columbia River Treaty (a reasonably foreseeable future action).

- Yakima River Basin Integrated Water Resource Management Plan (a reasonable foreseeable future action).

- Umatilla Basin Aquifer Recovery (a reasonably foreseeable future action).

No other reasonably foreseeable future actions have been identified that would contribute to cumulative effects during the same time frame or in the same geographic area as the Study Proposed Action and alternatives.

Environmental Commitments

Reclamation and Ecology are required to follow a variety of State and Federal regulations and policies intended to protect people and the environment during construction and operation of any of the alternatives. These requirements would prevent some potential impacts from occurring or minimize the extent to which an impact would affect people or places. Reclamation and Ecology have also committed to implement BMPs intended to further avoid or minimize impacts. The analysis of impacts assumes that the legal requirements and BMPs would be successfully implemented. However, not all impacts would be avoided by following these measures.

Environmental commitments are measures or practices adopted by a project proponent to reduce or avoid adverse affects that could result from project operations. These commitments are “action” specific; therefore it is appropriate to include within an array of documents including but not limited to construction contracts, management agreements with resource agencies, water contracts, and management plans. In addition, Reclamation, Ecology, and WDFW have entered into a Memorandum of Understanding (Appendix C) that will facilitate coordination and communication concerning these mitigation measures and environmental commitments; Reclamation and Ecology share the responsibility to ensure obligations to protect natural resources are fulfilled.

The scale of which these mitigation measures and commitments would be implemented would likely occur in phases and would be dependent of what actions are being undertaken by Reclamation and Ecology. Reclamation and Ecology have also committed to implementing mitigation measures to compensate for some impacts that cannot be avoided or minimized through legal requirements and BMPs.

Consultation and Coordination

Concurrent with preparation of this document, agency consultation and coordination have been conducted in accordance with the Endangered Species Act (ESA) of 1973, as amended, the Fish and Wildlife Coordination Act (FWCA) as amended, the National Historic Preservation Act (NHPA) of 1966, and the Clean Water Act (CWA).

As explained in Chapter 5 of the Final EIS, Reclamation and Ecology established a public involvement program early in the process. The program was designed to provide the public and agencies with a variety of methods to learn about, participate in, and comment on the Study. The program included scoping notices, multiple public scoping meetings, Scoping Summary Report (Reclamation 2008 Scoping), and informal Public Hearings. Extensive coordination with agencies and organizations occurred prior to initiation of the NEPA/SEPA processes and during preparation of the Draft EIS and Final EIS. Bonneville Power Administration served as a cooperating agency throughout the process.

Commitment to Continued Coordination

Reclamation and Ecology have encouraged participation by Tribes and resource agencies as part of this environmental review process. Reclamation and Ecology remain committed to this ongoing coordination and welcome the continued opportunity to work with the Tribes, U.S. Fish and Wildlife Service (USFWS), NMFS, Washington Department of Fish and Wildlife (WDFW), State Historical Preservation Officer (SHPO), CBP irrigation districts, and other stakeholders to identify appropriate mitigation, monitoring, evaluation, and adaptive management programs. Both agencies have successfully collaborated on natural resource enhancements in the past with Tribes, resource agencies, and CBP Irrigation Districts and believe such collaboration is a critical element to future phased development of the CBP. In addition, this Final EIS is a tiered document where, in coordination with jurisdictional agencies and/or Tribal governments, additional NEPA/SEPA analysis would be conducted, as appropriate, prior to construction of each phase of the proposed project.

Public Dissemination of the Final EIS

The release of this Final EIS was announced on Reclamation's and Ecology's websites and in local and regional newspapers. These announcements include the dates and locations the document will be available for public review. The Final EIS is posted on the Odessa Study website at: http://www.usbr.gov/pn/programs/ucao_misc/Odessa/.

Preparation of the Final EIS

Reclamation and Ecology have carefully considered all comments received on the Draft EIS and responded to substantive comments in the Final EIS by adjusting alternatives, supplementing or improving the analysis, or making factual corrections. Two public hearings were held during the public review period for the Draft EIS, as described on the Fact Sheet. Participants were encouraged to provide comments through several mechanisms—written comment cards, letters, e-mails, and oral comments at the meetings. All comments received on the Draft EIS, regardless of how submitted, were given equal consideration. Volume 2 of this Final EIS displays the comment letters received on the Draft EIS as well as Reclamation and Ecology's responses to those comments.

Record of Decision

In accordance with Federal guidelines, a ROD is prepared after the Final EIS is completed and distributed to the public. It explains the decision and discusses the reasoning and rationale used in making the decision. The ROD cannot be issued until at least 30 days after the EPA publishes its notice of availability for the Final EIS in the Federal Register.

ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations

1939 Act	Reclamation Project Act of 1939
amsl	above mean sea level
aMw	average megawatts
APE	area of potential effect
ARPA	Archeological Resources Protection Act
ATV	all-terrain vehicle
BA	biological assessment
BCA	benefit-cost analysis
BCSD	Bias Correction Spatial Disaggregation
BCR	benefit-cost ratio
bgs	below ground surface
BIA	Bureau of Indian Affairs
BMPs	Best Management Practices
BiOp	Biological Opinion
BPA	Bonneville Power Administration
CAR	Coordination Act Report
CBP	Columbia Basin Project
CBWA	Columbia Basin Wildlife Area
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIG	Climate Impact Group
Corps	U.S. Army Corps of Engineers
CRI	Columbia River Initiative
CSRIA	Columbia Snake River Irrigator’s Association
CWU	Central Washington University
°C	degrees Celsius
DAHP	Washington Department of Archaeology and Historic Preservation

°F	degrees Fahrenheit
dB	decibels
dBA	A-weighted decibel
DO	dissolved oxygen
DOI	U.S. Department of the Interior
DPS	District Population Segment
EA	environmental assessment
EC	electrical conductivity
ECBID	East Columbia Basin Irrigation District
Ecology	Washington State Department of Ecology
EDR	Environmental Data Resources, Inc.
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act of 1973, as amended
ESHB	Engrossed Substitute House Bill
ESU	evolutionarily significant unit
EWWRS	Eastern Washington Wetland Rating System
FCRPS	Federal Columbia River Power System
FDR	Franklin D. Roosevelt Lake
FERC	Federal Energy Regulatory Commission
FLIR	forward-looking infrared
FONSI	Finding of No Significant Impact
FPPA	Farmland Protection Policy Act
FR	Federal Register
GAP	Gap Analysis Program
GCM	Global climate/circulation models
GHG	greenhouse gas
GIS	Geographic Information Systems
gpm	gallons per minute
GWMA	Columbia Basin Ground Water Management Area

HEP	Habitat Evaluation Procedures
HRFCPP	Hanford Reach Fall Chinook Protection Program
HSI	Habitat Suitability Index
HTI	Hydroacoustic Technology, Inc.
I-	interstate highway
IDC	interest during construction
IMPLAN	IMpact analysis for PLANning
ISAB	Independent Scientific Advisory Board
ITA	Indian trust asset
kcfs	thousand cubic feet per second
Keys PGP	John W. Keys III Pump-Generating Plant
kWh	kilowatthours
Lake Roosevelt	Franklin D. Roosevelt Lake
Land Classification	Irrigation Suitability Land Classification
Leq	equivalent sound pressure level
Lmax	maximum noise level
LRNRA	Lake Roosevelt National Recreation Area
LUST	leaking underground storage tank
LW/D	less warming and drier climate conditions
LW/W	less warming and wetter climate conditions
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
µS/cm	microsiemens per centimeter
MAF	million acre-feet
M&I	municipal and industrial
Management Act	Columbia River Water Resource Management Act
Management Program	Columbia River Basin Water Management Program
MCL	maximum contaminant level
mg/L	milligrams per liter
mm Hg	millimeters of mercury
MOA	Memorandum of Agreement

MOU	Memorandum of Understanding
MVP	minimum viable population
MW	Megawatts
MW/D	more warming and drier climate conditions
MW/W	more warming and wetter climate conditions
N/A	not applicable
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAIP	National Agricultural Imagery Program
NASS	National Agricultural Statistics Service
NED	National Economic Development
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act, as amended
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide or nitrite
NO_3	Nitrate
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NR	Not reported
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTU	nephelometric turbidity units
NWI	National Wetlands Inventory
O&M	operations and maintenance
Odessa Subarea	Odessa Ground Water Management Subarea
ODFW	Oregon Department of Fish and Wildlife
OM&R	operations, maintenance, and replacement
OMR&P	operating, maintenance, and replacement, and power
OWRD	Oregon Water Resources Department
P&Gs	Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies
PA	programmatic agreement

PASS	Project Alternative Solutions Study
PEM	palustrine emergent wetlands
PFO	palustrine forested wetlands
PGE	Portland General Electric
PHS	priority habitats and species
PM_{10}	particulate matter nominally 10 microns or less
$PM_{2.5}$	particulate matter nominally 2.5 microns or less
POS	Plan of Study
ppm	parts per million
psi	pounds per square inch
PSS	palustrine scrub-shrub wetlands
PSU	Portland State University
PUD	Public Utility District
PVA	population viability analysis
QAPP	Quality Assurance Project Plan
QCBID	Quincy-Columbia Basin Irrigation District
RCW	Revised Code of Washington
Reclamation	Bureau of Reclamation
RM	river mile
RMJOC	River Management Joint Operating Committee
RMP	Resource Management Plan
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
RV	recreational vehicle
SAR	sodium adsorption ratio
SCADA	supervisory control and data acquisition
SCBID	South Columbia Basin Irrigation District
SEPA	State Environmental Policy Act
Secretary	Secretary of the Interior
SHPO	State Historic Preservation Office
Special Study Report	Odessa Subarea Special Study Report

SR	State Route
SRSP	Steamboat Rock State Park
SSURGO	Soil Survey Geographic database
State	State of Washington
Study	Odessa Subarea Special Study
Study Area	Odessa Subarea Special Study area
SWPPP	Storm Water Pollution Prevention Plan
TCP	Traditional Cultural Property
TDG	total dissolved gas
TDS	Total Dissolved Solids
TERO	Tribal Employment Rights Ordinance
TMDL	total maximum daily load
QCBID	Quincy Columbia Basin Irrigation District
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
VIC	Variable Infiltration Capacity
VRA	voluntary regional agreements
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WNHP	Washington Natural Heritage Program
WSDOH	Washington State Department of Health
WSDOT	Washington State Department of Transportation
WSPRC	Washington State Parks and Recreation Commission

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CHAPTER 1
PURPOSE AND NEED

Chapter 1 PURPOSE AND NEED

1.1 Introduction

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and Washington Department of Ecology (Ecology) have jointly prepared this Final Environmental Impact Statement (Final EIS) for the Odessa Subarea Special Study (Study). The purpose of the Study is to evaluate alternatives that would deliver surface water from the Columbia Basin Project (CBP) to irrigated lands that currently rely on a declining groundwater supply from the Odessa Ground Water Management Subarea (Odessa Subarea). The CBP is a multipurpose water development project in the central part of the State of Washington (State), east of the Cascade Range. The area of the Study is within the boundaries of the CBP, and includes portions of Lincoln, Adams, Grant, and Franklin counties (Figure 1-1). The Odessa Subarea Special Study Area (Study Area) is shown on Figure 1-1, as a smaller portion of the overall Odessa Subarea. The relationship of these three areas is also shown on Figure 1-2.

The Study fulfills an agreement by Reclamation, the State, and the three CBP irrigation districts – East Columbia Basin Irrigation District (ECBID), South Columbia Basin Irrigation District (SCBID), and Quincy-Columbia Basin Irrigation District (QCBID) – to cooperatively conduct the Study as stated in the Columbia River Initiative Memorandum of Understanding (MOU) in December 2004 (Agreement No. C0600191/06MR1U7030) (Appendix A).

1.1.1 Study Approach

This Final EIS documents the environmental, social, and economic consequences of the alternatives and is prepared pursuant to the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended, and the Washington State Environmental Policy Act (SEPA).

This chapter of the EIS describes the purpose of the Proposed Action and why it is needed. The purpose and need for the Proposed Action provide the basis for identifying the alternatives to be considered in the EIS. Background information on the Study is provided, along with a synopsis of the cooperating agencies, actions, and activities related to the Study, the nature of decisions to be made, and the organization of this EIS.[1]

[1] Additional Study information is provided at http://www.usbr.gov/pn/programs/ucao_misc/Odessa.

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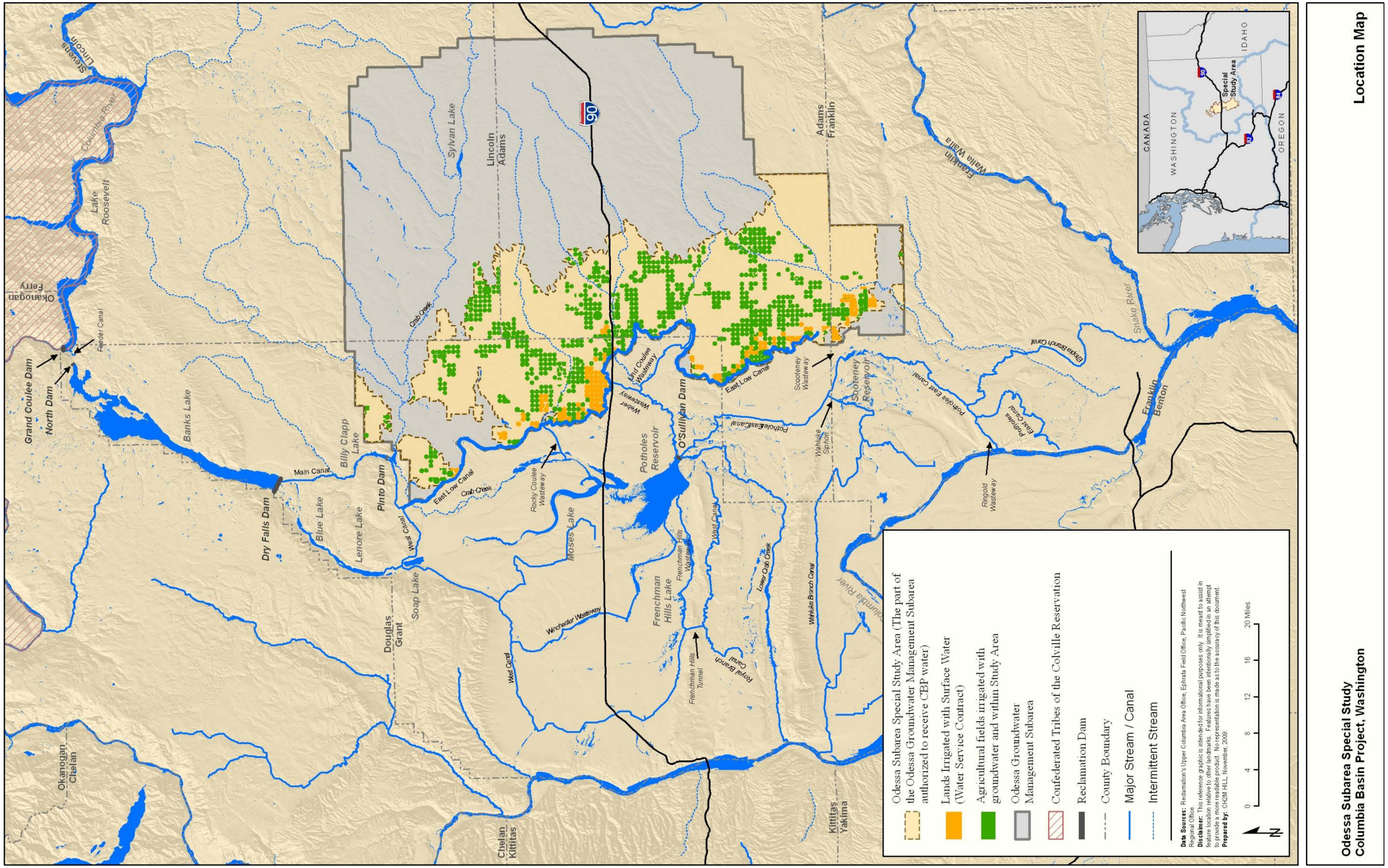

Figure 1-1. Location map.

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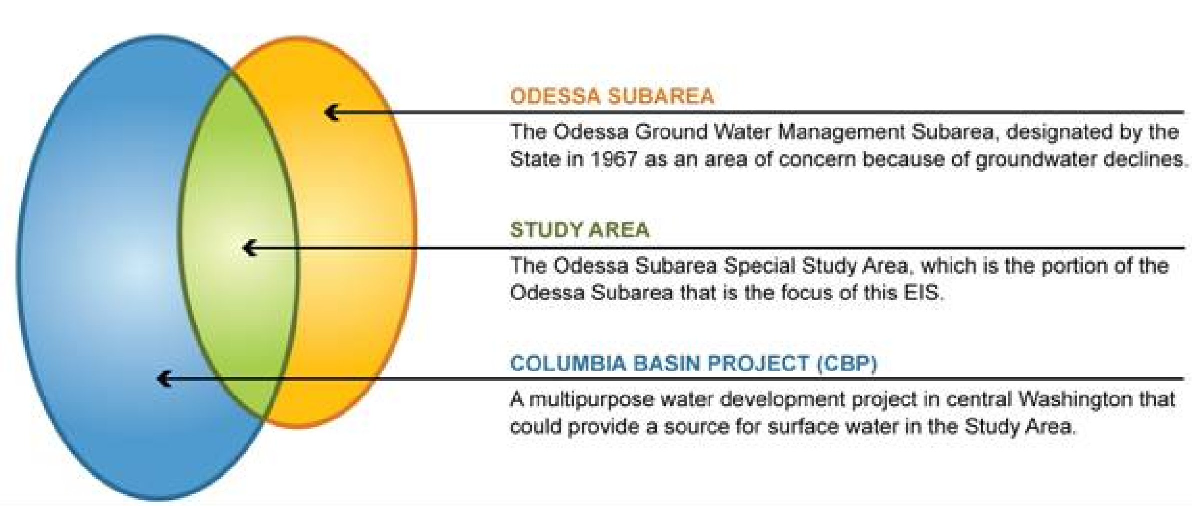

Figure 1-2. Illustration showing the common terms used in this EIS and the relationships of the three areas.

1.1.2 Location

The CBP is located in the central part of Washington, east of the Cascade Range. The key structures, Grand Coulee Dam and the John W. Keys III Pump-Generating Plant (Keys Pump-Generating Plant), are on the mainstem of the Columbia River about 90 miles west of Spokane. The Keys Pump-Generating Plant pumps water from the Columbia River into the Feeder Canal that extends to Banks Lake, an off-stream equalizing reservoir of the CBP. The CBP currently serves approximately 671,000 acres in Grant, Adams, Walla Walla, and Franklin counties, with some northern facilities located in Douglas County. The Odessa Subarea overlaps the eastern boundaries of the CBP. It is that portion of the Subarea where Reclamation is authorized to deliver water. In 1967, the Washington Legislature designated the Odessa Subarea as a groundwater management area because of groundwater level declines resulting from pumping (Washington Administrative Code [WAC] 173-128A, Odessa Ground Water Management Subarea).

1.2 Proposed Action

Reclamation and Ecology are proposing to replace groundwater currently used for irrigation in the Study Area with surface water by constructing or modifying distribution systems and appurtenant structures. There are approximately 102,600 acres of currently groundwater-irrigated lands within the Study Area that are eligible to receive CBP water as part of the continued phased development of the CBP. The surface water would be provided by further developing existing CBP water rights held by the U.S. for diversion and storage of water from the Columbia River system.

This Final EIS evaluates six action alternatives for delivering CBP water to partially or fully replace groundwater used to irrigate eligible acres in the Study Area (Table 1-1). The alternatives being evaluated are based on combinations of water delivery and water supply options. Water delivery options consist of expanding the existing East Low Canal system and potential construction of a new East High canal system or expansion of the East Low Canal by itself. The options also include construction of new pumping plants and laterals to deliver water to farms. Water supply options for providing replacement surface water supply consist of potential changes to the operations of existing CBP storage facilities, including Banks Lake and Lake Roosevelt.

Table 1-1. Alternatives considered in this EIS, groundwater acres to be replaced, associated surface water diversion needs, and estimated construction costs.

Alternatives	Groundwater-Irrigated Acres Eligible for Surface Water Replacement (acres)	Annual Additional CBP Surface Water Diversion from the Columbia River (acre-feet)	Construction Cost Estimate (million $)*
Partial Replacement (enlarge and extend East Low Canal system south of I-90).	Approximately 57,000	Approximately 138,000	Approximately $690
Full Replacement (enlarge and extend East Low Canal system south of Interstate 90, and construct a new East High canal system north of I-90).	Approximately 102,600	Approximately 273,000	Approximately $2,450
Modified Partial Replacement (enlarge East Low Canal system to deliver to both north and south of I-90).	Approximately 70,000	Approximately 164,000	Approximately $740
*October 2009 price-level (Reclamation 2012 Engineering).			

The partial replacement alternatives (described later as 2A and 2B) would divert approximately 138,000 acre-feet of water annually to irrigate 57,000 acres. The partial replacement alternatives focus on surface water replacement for acreage located primarily south of Interstate Highway 90 (I-90) that can be served by expanding and extending the existing East Low Canal (Figure 1-1).

The full replacement alternatives (described later as 3A and 3B) would divert approximately 273,000 acre-feet of water to serve all or most of the approximately 102,600 eligible acres in the Study Area. Full replacement would include surface water replacement to both the acreage located south of I-90 and the remaining lands in the Study Area north of I-90. Water provided to acreage south of I-90 would be conveyed via an expanded and extended East Low Canal while lands north of I-90 would be served by constructing a new East High Canal system.

The modified partial replacement alternatives (described later as 4A and 4B) have been developed in response to a number of concerns raised in comments on the Draft EIS. The modified partial replacement alternatives would divert approximately 164,000 acre-feet of water and provide surface water replacement for approximately 70,000 acres of currently groundwater-irrigated lands both north and south of I-90 via an expanded East Low Canal.

If an action alternative is selected during the Record of Decision process, there would likely be a variety of Federal and State actions occurring in order to implement the alternative. Construction of new and modification of existing structures, such as pumping plants, conveyance facilities, and appurtenances, would be required, as well as possible construction of a new reregulation reservoir. Land acquisition, permitting, and other activities would also need to be conducted.

The duration of construction for a partial, full, or modified partial alternative is estimated to span a period of about 10 years and could begin as early as 2014 (earlier if funding becomes available). Construction would be conducted in phases for all action alternatives to allow the delivery system to be brought online as early and efficiently as possible. For more detail, Chapter 2 – *Alternatives* provides a description of these alternatives and associated actions that would be taken if an action alternative is selected for implementation.

1.3 Purpose and Need

Under NEPA, an EIS shall briefly specify the underlying purpose and need to which the agency is responding with the proposed action (40 Code of Federal Regulations [CFR] § 1502.13). Reclamation's NEPA Handbook (2012) states that the purpose and need should briefly describe why the action is needed and what the action is designed to accomplish.

1.3.1 Purpose

The purpose of the Proposed Action is to maintain economic viability by providing surface water from the CBP to replace groundwater from declining wells currently used for irrigation in the Odessa Subarea. This purpose is consistent with the intent of the Columbia Basin Project Act by encouraging "settlement and development of the project, and for other purposes." The CBP is currently authorized for construction and development. Surface water would be provided as part of the continued phased development of the CBP and would come from existing CBP diversion and storage rights for water from the Columbia River.

1.3.1.1 Basis of Purpose

In the 1960s and 1970s, the State issued irrigation groundwater permits in the Odessa Subarea as a temporary measure in anticipation of continued phased development of the CBP to provide surface water to these lands. Measurements of groundwater levels in wells have shown a substantial decline since the 1980s (Figure 1-3). For the Final EIS, a review of the groundwater analysis was conducted and information from a USGS 2010 report was used to verify information that was used for the Draft EIS for pumping depths and rate of decline between 1984 and 2009 (Reclamation 2012 Groundwater). Figure 1-4 shows a continuous declining trend in measurements of groundwater levels of up to 180 feet over the past 30 years in three example wells. While not all wells show declines, the overall area of decline has spread and water levels have dropped over the past 30 years. This has prompted public concern about the declining aquifers and associated economic and other effects which resulted in funding from the U.S. Congress and a directive from the Washington State Legislature to investigate and identify solutions to the problem.

The State Legislature's landmark Columbia River Basin Water Management Act of 2006 (Management Act) directs Ecology to focus its efforts to develop additional water supplies for the Columbia River Basin on finding alternatives to groundwater for agricultural users in the Odessa subarea aquifer (Revised Code of Washington [RCW] 90.90).

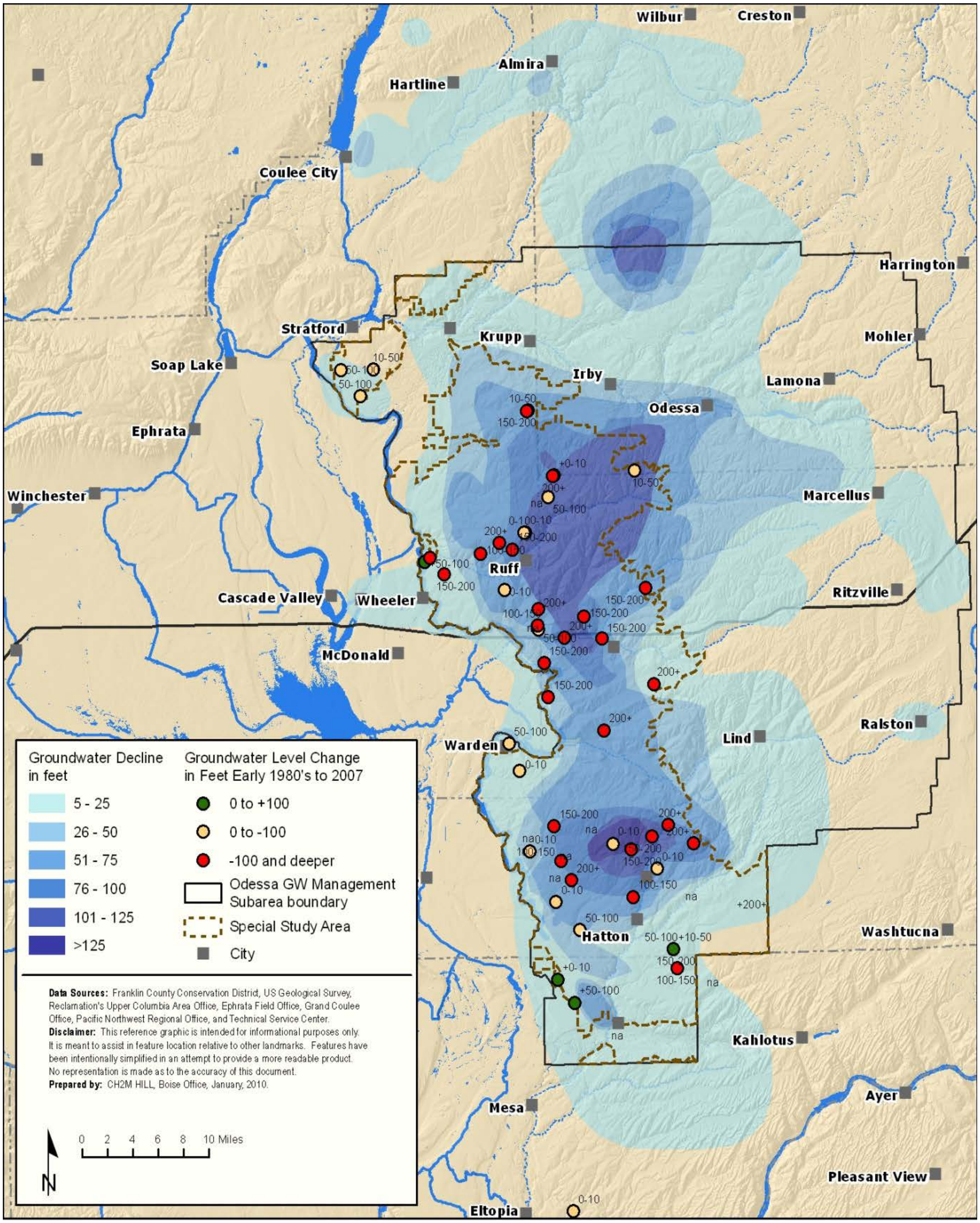

Figure 1-3. Groundwater level decline in aquifers of the Odessa Subarea, 1981 to 2007.

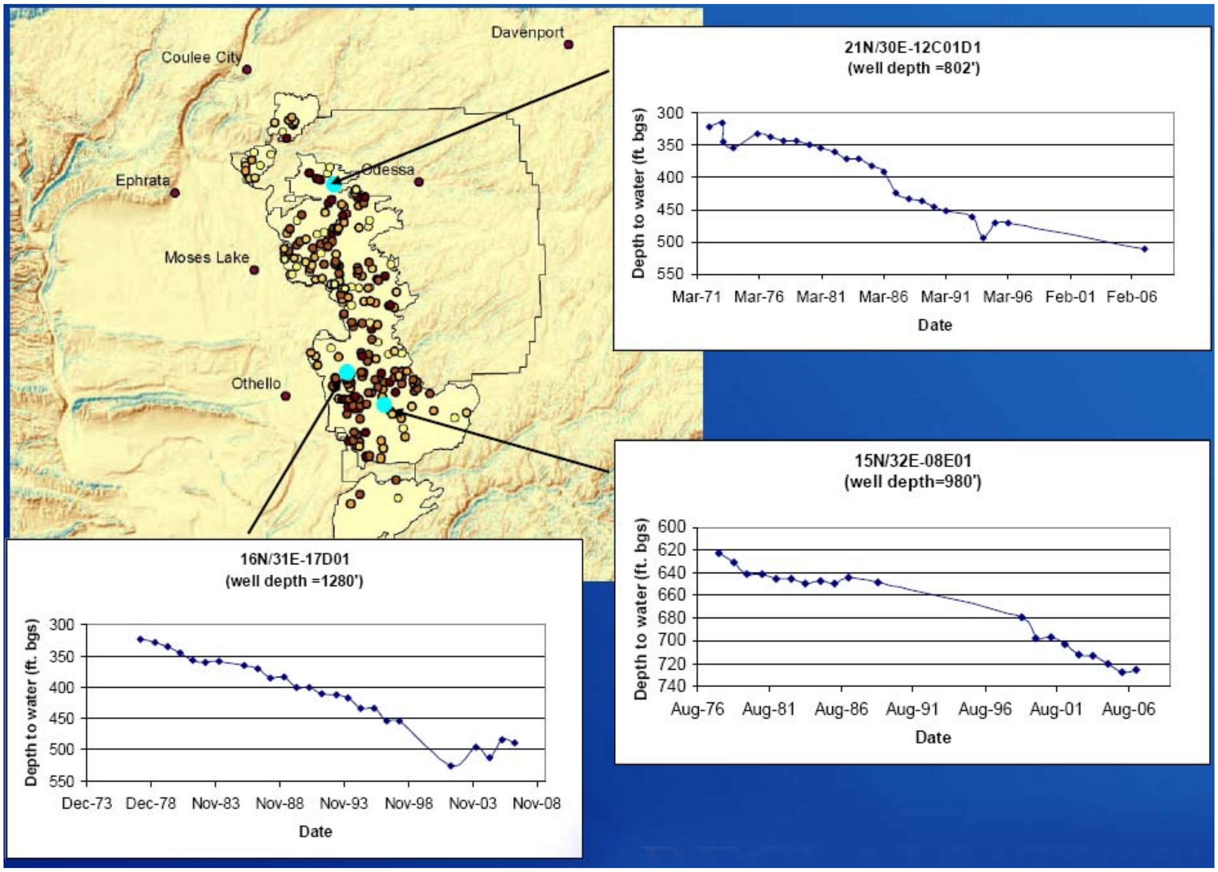

Figure 1-4. Declining trend in measurements of groundwater levels in three example wells with best available data (Reclamation 2008 Appraisal).

1.3.2 Need

The Proposed Action is needed to address declining groundwater supply in the Study Area, and avoid economic loss to the region's agricultural sector.

1.3.2.1 Address Declining Groundwater Supply for Agriculture and Other Uses

Groundwater in the Odessa Subarea is currently being depleted to such an extent that water must be pumped from great depths. Most of the groundwater wells in the area currently are drilled to a depth of 800 to 1,000 feet, with maximum well depths as great as 2,100 feet. In addition, the groundwater level in wells continues to decline steadily. In nearly half of the production wells in the Odessa Subarea, groundwater levels have dropped by more than 100 feet and some by as much as 200 feet since 1981 (Figure 1-3).[2] To date, some wells in the Study Area have been reported out of production, and the solution has generally been to drill a deeper well. However, studies show that deeper water may not be available, may be potentially unusable, and/or be too expensive to access in the future. As a result of this groundwater decline, the ability of farmers to irrigate their crops is at risk.

Those irrigating with wells, even of shallower depth, live with uncertainty about future well production. In the near term, the output from these wells in the Odessa Subarea will continue to decrease. If no action is taken, it is estimated that at the current rates of decline, about 55 percent of the wells in the Odessa Subarea would cease production by 2020.

1.3.2.2 Avoid Economic Loss

Washington State University conducted a regional economic impact study assessing the effects of lost potato production and processing in Adams, Franklin, Grant, and Lincoln counties from continued groundwater decline. Assuming that all potato production and processing is lost from the region, the analysis estimated the regional economic impact would be a loss of about $630 million dollars annually in regional sales, a loss of 3,600 jobs, and a loss of $211 million in regional income (Bhattacharjee and Holland 2005).

Since the publication of this purpose and need statement in the Federal Register Notice of Intent initiating the process for preparing the Draft EIS (published August 2008), additional economic studies have been conducted that convey differing results. Depending upon the study assumptions, geographic scope, and sectors of the economy included in each analysis, the level of projected economic impact varies. These studies capture a range of perspectives on economic impact and are described in Chapter 4, Section 4.15 – *Irrigated Agriculture and Socioeconomics*.

1.3.3 Federal Authority

The Study is being conducted under the authority of the Reclamation Act of 1939 and the Columbia Basin Project Act of 1943, as amended. Section 9(a) of the Reclamation Project Act of 1939 gave authority to the Secretary of the Interior (Secretary) to approve a finding of feasibility and thereby authorize construction of a project upon submitting a report to the President and the Congress. The Secretary approved a plan of development for the CBP, known as House Document No. 172 in 1945. House Document No. 172 anticipated that development of the CBP would occur in phases over a 70-year period.

[2] The wells depicted in Figure 1-3 are only a subset of the total wells present in the Odessa Subarea. As explained further in Section 3.3 - *Groundwater Resources*, the wells shown are those from Ecology's database that have a reliable and consistent long-term record of water level measurements.

The Proposed Action will be implemented pursuant to these authorities. These two Acts, authorized by Congress, led to the implementation of the CBP to irrigate a total of 1,029,000 acres, of which about 671,000 acres are currently irrigated. The Acts gave authority to the Secretary of the Interior (Secretary) to assess feasibility, approve plans, and implement construction of the CBP.

Acting for the Secretary, Reclamation is authorized to implement additional development phases of the CBP as long as the Secretary finds each phase to be economically justified and financially feasible. In response to the public's concern about the declining groundwater supply in areas of the CBP and associated economic and other environmental effects, Congress funded Reclamation to investigate the problem. The State partnered with Reclamation by providing funding and collaborating on various technical studies.

1.3.4 State of Washington Authority

Subsequent to the signing of the 2004 Columbia River Initiative MOU (Appendix A), the State Legislature passed the Management Act in February 2006 (RCW 90.90). The Management Act directs Ecology to aggressively pursue development of water benefiting both instream and out-of-stream uses. Among the activities identified in the legislation, Ecology is directed to focus on "development of alternatives to groundwater for agricultural users in the Odessa Subarea aquifer."

The Management Act also created a Columbia River Basin Development Account. Ecology's financial participation in this Study has largely been from that account.

Ecology's participation in the EIS process is required to provide support for state and local agency permit decisions that will likely be necessary to implement a water delivery project.

What is driving the State's Interest in the Odessa Subarea?

In 2006, the Washington Legislature tasked the Department of Ecology (Ecology) to aggressively seek out new water supplies for both instream and out-of-stream uses. The same legislation set up the Columbia River Basin Development Account and authorized $200 million to fund it. Ecology created the Office of Columbia River (OCR) to use these funds to develop new water supplies using storage and conservation.

In accordance with RCW 90.90.020 (3) a, the Department of Ecology shall focus its efforts to develop water supplies for the Columbia River Basin on the alternatives to groundwater for agricultural users in the Odessa Subarea aquifer. The growing concern in the Odessa Subarea is becoming ominous. Wells have already gone dry, and the solution has generally been to drill a deeper well. However, studies show that deeper water may not be available, may be potentially unusable, or will be too expensive to access in the future

The aquifer had about 50 million acre-feet of accessible water in 1960; 40 million acre-feet have already been pumped out. "Altogether, we pump about 1 million acre-feet a year," said Paul Stoker, executive director of the Columbia Basin Ground Water Management Area (Dininny 2012). "What happens in 10 to 12 years is that for a large portion of the area, drilling deeper won't be a solution anymore" (as reported by Shannon Dininny of the Associated Press).

In fact, there is already evidence of wells running out of water in every aspect of the area—agricultural, industrial, and municipal.

- Agricultural—Local farmers have drilled as deep as they can afford to. Connell potato grower Orman Johnson drilled deeper in two of his wells due to the declining water table, but says, "Right now, if one of our wells goes dry, we probably won't replace it. It's too expensive" (Miller 2004). Drilling deeper for local farmers can cost from $200,000 to $500,000.
- Industrial—A major potato processor and one of the largest employers in the area, reported in May 2012 that their well is out of water and it would take over 2 months to drill deeper and there is no guarantee of quantity or quality. East Columbia Basin Irrigation District (ECBID) has not been able to assist them.
- Municipal—Twenty-five communities in Eastern Washington could have their municipal wells go dry in as soon as a decade. Some of the communities most affected are Odessa, Lind, Othello, Davenport, Royal City, Sprague, Ritzville, Reardon, Connell, and Moses Lake.

1.4 Background Information

Irrigated lands in the CBP were developed primarily for Reclamation customers in the 1950s and 1960s, with some additional acreage added until 1985. Prior studies examined the merits of continuing the incremental development approach for the CBP; however, for various reasons, development did not occur.

The State issued irrigation groundwater permits in the 1960s and 1970s in the Odessa Subarea as a temporary measure in anticipation of future phased development of the CBP to provide surface water to these lands. The aquifer has now declined to such an extent that the ability of farmers to continue irrigating their crops is at risk, and domestic, commercial, municipal, and industrial uses and water quality are affected. Local constituents have advocated that Reclamation investigate further CBP development to replace groundwater with CBP surface water as a possible solution for issues associated with the declining aquifer. In response, the State, Reclamation, and the CBP irrigation districts signed the Columbia River Initiative MOU.

Congress provided funding to Reclamation beginning in fiscal year 2005 to investigate opportunities for providing CBP water to replace groundwater use in portions of the Odessa Subarea. Since 2005, the State has participated in and has partially funded Reclamation's efforts to provide a replacement for current groundwater irrigation.

1.4.1.1 Pre-Appraisal and Appraisal-level Investigations

In 2006, Reclamation prepared the Plan of Study (Reclamation 2006 POS) for the Odessa Subarea Special Study which provided the study background and purpose, described potential issues, outlined study steps and requirements, and identified required resources in the Odessa Subarea.

In 2006, Reclamation released the *Initial Alternative Development and Evaluation, Odessa Subarea Special Study*, the pre-appraisal-level investigation of water delivery and supply options for the Study Area that Reclamation completed through a Project Alternative Solutions Study (PASS) in 2006 (Reclamation 2006 PASS). The PASS was conducted over a 7-month period with the assistance of two teams – the Objectives Team and the Technical Team.

The Objectives Team was comprised of various stakeholders in the Study Area including Federal and State agencies, local governments, Tribes, CBP irrigation districts, groundwater irrigators, and other local interest groups. This team developed Study objectives that were used to rank alternative concepts, including the following:

- Replace all or a portion of current groundwater withdrawals within the Study Area with CBP water.
- Maximize use of existing infrastructure.
- Retain the possibility of full CBP development in the future.
- Address ESA issues.
- Meet NMFS seasonal flow objectives.
- Address the potential impact to shrub-steppe habitat for ESA-listed species.
- Provide environmental and recreational enhancements.
- Minimize potential delay in the Study schedule.
- Prioritize alternative concepts that can be developed in phases.

The Technical Team was comprised of technical experts from Reclamation, Ecology, and the CBP irrigation districts such as engineers, a hydrogeologist, a state watermaster, and irrigation district managers. The Technical Team developed preliminary alternative concepts that were suggested by the public and examined in previous investigations, and ranked them using the Study objectives developed by the Objectives Team. The Technical Team then recommended water delivery alternatives and water supply options for further study based on this evaluation. The PASS assumptions and recommendations helped guide the scope of the appraisal-level investigation in the PASS report.

The four water delivery alternatives described in the PASS report include proposals to construct variations of an East High Canal system that Reclamation previously examined in the late 1980s. Other proposals include relying on the existing East Low Canal by expanding the canal capacity and constructing an extension to the canal, or revising CBP operations to obtain additional capacity so that existing East Low Canal infrastructure could be used.

The report also contains a list of possible water supply options to provide a replacement surface water supply for the proposed water delivery alternatives. Additional Columbia River diversions beyond what is currently diverted for the CBP would be required to replace groundwater pumping; however, Columbia River flow requirements for fish listed under the ESA and other requirements restrict opportunities to divert water. Several water supply possibilities that could accommodate these restrictions are identified in the report. These options include relying on existing reservoirs within the CBP, adjusting current CBP operations, or constructing new storage facilities.

Based on these results, Reclamation completed an appraisal-level study in March 2008 entitled Appraisal-Level Investigation Summary of Findings (Reclamation 2008 Appraisal). The appraisal-level study covered the same study area as this Final EIS. Four water delivery alternatives and six water supply options were evaluated.

1.5 Cooperating Agencies

Reclamation and Ecology are responsible as joint lead agencies for developing the EIS, including a joint NEPA/SEPA process. Reclamation requested that Bonneville Power Administration (BPA), Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (USFWS) participate as Federal cooperating agencies for the Study and Final EIS. Reclamation received formal confirmation from BPA regarding their participation as a cooperating agency. Reclamation and BPA signed an MOU regarding roles and responsibilities of each agency in this environmental review process. In assuming this responsibility, BPA agreed to perform the following duties:

- Participate in the NEPA/SEPA process.
- Develop information and prepare environmental analyses for which BPA has specific expertise.
- Review the Draft and Final EIS documents.

1.6 Relationship of the Proposed Action to Other Projects or Activities

The Study and Final EIS are conducted within the framework of the State of Washington's Columbia River Basin Water Management Program (Management Program introduced previously) which was developed pursuant to the Management Act (RCW 90.90). The Management Program is described below in Section 1.6.1. Prior investigations and related activities in the CBP are described in Section 1.6.2.

1.6.1 Columbia River Basin Water Management Program

The major components of the Management Program include storage, conservation, and other measures intended to meet the legislative mandate of developing new water supplies to meet instream and out-of-stream needs. RCW 90.90 directs Ecology to focus efforts to develop water supplies for the Columbia River Basin to meet the following needs:

- Alternatives to groundwater pumping for agricultural users in the Odessa Subarea aquifer.
- Sources of water supply for pending water rights applications.
- A new uninterruptible supply of water for the holders of interruptible (junior) water rights on the Columbia River mainstem that are subject to instream flows or other mitigation conditions to protect streamflows.

- New municipal, domestic, industrial, and irrigation water needs within the Columbia River Basin.

In addition to funding and implementing major water supply projects, the Management Program includes administrative functions such as development of a project inventory, a water supply and demand forecast, and a data management system.

In 2007, Ecology prepared a SEPA Final Programmatic Environmental Impact Statement for the Management Program (Ecology 2007). The Management Program EIS was intended to describe and evaluate potential direct, indirect, and cumulative impacts associated with implementation of the Management Program, including policy.

Photograph 1-1. Water conservation enables efficient use of existing resources

The Management Program EIS also evaluated potential impacts associated with implementation of several early actions including the Lake Roosevelt Incremental Storage Releases Project and the Potholes Reservoir Supplemental Feed Route Project. Key components of the Management Program are summarized in the following text, with more detailed descriptions available in the Management Program EIS (Ecology 2007).

1.6.1.1 Storage

Under the State's Management Program, Ecology has been evaluating storage projects to augment water supplies for instream and out-of-stream uses. These projects include Columbia River mainstem and Columbia River tributaries and range from new surface storage facilities, modification of existing storage facilities, and groundwater (aquifer) storage. The most notable projects include the Sullivan Lake Project in northeast

Washington and the Bumping Reservoir Enlargement, Wymer Reservoir, and Kachess Inactive Storage Projects in the Yakima River Basin being conducted in conjunction with Reclamation. Ecology has also initiated aquifer storage and recovery projects in the Kennewick, Wallula, and White Salmon areas. Ecology and Reclamation have been evaluating potential off-channel storage projects along the Columbia River mainstem at an appraisal-level. Those evaluations have considered siting large surface reservoirs at Crab Creek in southern Grant County, Goose Lake in Okanogan County, and Ninemile Flats in Ferry County. The latter two sites are located within the Colville Reservation and the studies are being conducted in partnership with the Confederated Tribes of the Colville Reservation. Feasibility authorization has not been sought for any of the projects that are being investigated by the Management Program.

New storage facilities were contemplated at one point in the Odessa Subarea Special Study; however, the action alternatives identified in the Final EIS for the project rely upon the existing reservoirs for water storage. Since the action alternatives do not involve development of a new storage facility or facilities, the statutory allocation of two-thirds out-of-stream and one-third instream is not applicable to the Odessa Special Study. However, the State's Office of Columbia River is continuing to develop and implement numerous other projects that are intended to benefit instream flows in the Columbia River and its tributaries.

The statutory provision contained in RCW 90.90 for a two-thirds out-of-stream and one-third instream allocation of water pertains only to:

> Water supplies secured through the development of **new storage facilities** made possible with funding from the Columbia River Basin water supply development account. [emphasis added]

1.6.1.2 Conservation

Ecology is funding or conducting numerous conservation projects in the Columbia River Basin including efforts to improve efficiency at the irrigation district level and on-farm, improved municipal and industrial infrastructure, and pump exchanges. The most significant conservation project undertaken as part of the Management Program is the Coordinated Conservation Program. Under this program, Ecology is partnering with the East Columbia Basin Irrigation District (ECBID), South Columbia Basin Irrigation District (SCBID), and Quincy Columbia Basin Irrigation District (QCBID) to pipe and line their delivery systems in the CBP. The water saved by these infrastructure improvements will be delivered to the Odessa Subarea. Since 2009, the Coordinated Conservation Program has resulted in approximately 10,800 acre-feet of water savings, which will provide replacement water for about 3,600 acres of groundwater irrigated land in the Odessa Subarea.

1.6.1.3 Inventory and Demand Forecasting

The Management Act (RCW 90.90) directs Ecology to develop a water supply inventory and a long-term water supply and demand forecast that is updated every 5 years. The first inventory and long-term water supply and demand forecast was released in November 2006. The inventory and forecast include conservation and water storage projects, a water rights inventory, a water use inventory, a long-term water supply forecast, and a long-term demand forecast. The water supply and demand forecast was updated in 2011 and documents the need for replacement of irrigation water from ground water sources in the Odessa Subarea.

1.6.1.4 Early Actions

Ecology is implementing several early actions as part of the Management Program, including the Lake Roosevelt Project and the Potholes Supplemental Feed Route Project. These projects are described below.

- **Lake Roosevelt Incremental Storage Releases Project**. The Lake Roosevelt Incremental Storage Releases Project involves releases of water from Lake Roosevelt for multiple purposes. Under a service contract with Reclamation, Ecology has arranged for 25,000 acre-feet of water to be made available each year to improve municipal and industrial water supplies along the Columbia River mainstem. Thirty thousand acre-feet of water will be conveyed to the Odessa Subarea to replace groundwater on about 10,000 acres of existing irrigated land. Downstream of Grand Coulee Dam, 27,500 acre-feet of water will be available to enhance streamflows in the Columbia River to benefit fish. In drought years, an additional 33,000 acre-feet will be available to provide water to interruptible water rights holders; an additional 17,000 acre-feet will be available for instream flow augmentation. Ecology issued the Final Supplemental Environmental Impact Statement for the Lake Roosevelt Incremental Storage Releases Program in August 2008 (Ecology 2008), and Reclamation issued an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for the project in June 2009 (Reclamation 2009). Reclamation and Ecology began implementing the flow releases in September 2009. The project is expected to be fully implemented in 2013.

  As part of the Lake Roosevelt Incremental Storage Releases Project, Ecology provided funds to Reclamation for the design of the Weber Siphon Complex. The work consisted of constructing the second barrel of the Weber Branch and Weber Coulee Siphons on the East Low Canal. Completion of the siphons alleviates a flow capacity bottleneck where the East Low Canal crosses I-90.

  In April 2009, the Weber Siphon Complex was named an American Recovery and Reinvestment Act of 2009 (ARRA) project. Construction was completed December 2011 and the Weber Siphon Complex was operational in March 2012.

- **Potholes Reservoir Supplemental Feed Route Project**. The purpose of the supplemental feed route project is to increase the reliability of transporting water from Banks Lake to Potholes Reservoir. While about two-thirds of the water used by the SCBID each year is provided by CBP return flows from the portion of the project that lies north of Potholes Reservoir, about one-third (about 330,000 acre-feet of water) must be conveyed directly from Banks Lake to Potholes Reservoir to make it available for use in the south. This water is known as "feed water."

  Currently, most of the feed water is transported via the Main Canal south through the East Low Canal to Rocky Coulee Wasteway where it discharges into Upper Crab Creek near the north end of Moses Lake and Potholes Reservoir. Feeding is done early and late in the irrigation season when demand for irrigation water is low. At these times, the "unused" capacity in the East Low Canal is used to carry feed water to Potholes Reservoir. Changes in irrigation practices and increases in water demand have reduced the effectiveness of the existing feed route. As a result, Reclamation and Ecology initiated the Potholes Supplemental Feed Route Project.

  Reclamation prepared an EA and identified the Crab Creek and Frenchman Hills Wasteway feed route alternative as the preferred alternative for a supplemental feed route (Reclamation 2007 EA). The selected alternative would involve release of about 126,000 acre-feet of feed water each year from Billy Clapp Reservoir directly into the Crab Creek channel, then into Moses Lake and Potholes Reservoir. About 25,000 acre-feet of feed water would also be conveyed via West Canal to Frenchman Hills Wasteway and then to Potholes in the spring.

  The supplemental feed route lies outside of the Odessa Ground Water Management Area and beyond the boundaries of the Study Area. However, East Low Canal capacity improvements that result from the project will help facilitate groundwater replacement efforts in the Odessa Subarea. Ecology funded improvements to the Frenchman Hills Wasteway in 2007 and has provided funding to Reclamation for land and easement acquisitions. Reclamation received funding under the ARRA for work on the Crab Creek portion of the feed route and completed work in 2011. It is anticipated that the feed route will be complete and in operation by 2014.

- **Columbia Basin Irrigation Districts Coordinated Conservation**. Ecology is partnering with the ECBID, SCBID, and QCBID to pipe and line their delivery systems in the CBP. In 2009, the irrigation districts lined and piped over 27,600 feet of canal and saved 2,521 acre-feet of water. In 2010, the irrigation districts installed 54,388 feet of pipe and saved of 2,929 acre-feet of water. In 2011, they lined and piped 77,969 feet of canal and saved 5,357 acre-feet of water. The water saved by these infrastructure improvements will be delivered to the Odessa Subarea. Since 2009, the Coordinated Conservation Program has resulted in approximately 10,800 acre-feet of water savings, which will provide replacement water for about 3,600 acres of groundwater irrigated land in the Odessa Subarea.

1.6.2 Prior Reclamation Investigations and Related Activities in the Columbia Basin Project

Prior Reclamation investigations and activities in the CBP and their relationship to the Study and Final EIS are discussed below.

- **Draft EIS Continued Phased Development (1989) –** The Draft EIS (Reclamation 1989) described the potential beneficial and adverse impacts of the proposed continued development of the CBP. Two alternatives for continued development were analyzed and discussed: (1) complete the CBP as originally envisioned by providing irrigation service to an additional 538,600 acres, and (2) expand the CBP on a more limited scale by providing irrigation service to approximately 87,000 acres along the east bank of the East Low Canal.
- **Supplemental Draft EIS (Fish Enhancement) (1993) –** A Supplemental Draft EIS (Reclamation 1993 Supplement) was completed in September 1993 that mainly addressed fish and wildlife issues. Because of the ESA and the decline in salmon stocks, both Reclamation and Ecology put a moratorium on any additional withdrawals from the Columbia River in June 1993; therefore, the Draft EIS was suspended.
- **Banks Lake Resource Management Plan (RMP) (2001)** (Reclamation 2001) **–** The Banks Lake RMP was developed in response to the growing demand for recreational opportunities and visitor facilities while balancing resource protection and conservation objectives. The plan is designed to conserve, protect, and manage land and water resources under Reclamation's jurisdiction. Management guidance for Banks Lake determines, in part, the types of mitigation measures anticipated for Recreation Resources.
- **Banks Lake Drawdown EIS (2004) –** The Final EIS (Reclamation 2004) describes and analyzes the environmental effects of drafting the reservoir an additional 5 feet for flow augmentation beyond elevation 1565 feet by the end of August. It compared the benefit to anadromous fish against the impacts on biological and recreation resources at Banks Lake.

1.6.2.1 National Oceanic and Atmospheric Administration's National Marine Fisheries Service Federal Columbia River Power System 2008/2010 Biological Opinion

The Federal Columbia River Power System (FCRPS), as it relates to the National Marine Fisheries Service (NOAA Fisheries) 2010 FCRPS Supplemental Biological Opinion (BiOp) is comprised of 14 multipurpose hydropower projects on the mainstem Columbia and lower Snake rivers and other major tributaries. Collectively they provide about 30 percent of the electricity used in the Pacific Northwest. Reclamation and the U.S. Army Corps of Engineers (Corps) own and operate the dams in the FCRPS.

The Corps, BPA, and Reclamation operate the FCRPS in accordance with the National Marine Fisheries Service (NMFS) 2008/2010 Biological Opinion on the Operations and Maintenance of the FCRPS (2008/2010 FCRPS BiOp). The BiOp affects the timing and amount of water that is available for the Odessa Subarea through operational constraints at Grand Coulee Dam and Lake Roosevelt. In addition, the Columbia River Fish Accords, a series of agreements among the Action Agencies, several Columbia River tribes, and the States of Idaho, Montana, and Washington, also affect operations of the FCRPS. Table 1-2 lists some of the constraints under the BiOp and goals under the Fish Accords that are particularly applicable to the Proposed Action. Future operations of the any selected action alternatives for the Odessa Subarea Special Study as a component of the CBP would be addressed in future FCRPS consultations.

Table 1-2. Measures and constraints on the Odessa Subarea Special Study imposed by the 2008/2010 NMFS FCRPS BiOp and 2008 Fish Accords.

Agreement	Summary Description	Constraints on Odessa Study
Reasonable and Prudent Actions* (RPA)	Summarizes storage project operations for all types of water years. CBP operations at Grand Coulee Dam and Lake Roosevelt include drafting the reservoir to support salmon flow objectives during July and August with a variable draft limit of elevation 1278 to 1280 feet by August 31, based on the water supply forecast. Currently, the lower draft of elevation 1278 feet is to be limited to those years when the April-to-August runoff volume is less than 92 million acre-feet (approximately 50 percent of the years of record) (Graves et al. 2007). This element of reasonable and prudent alternative Action 4 is subject to	Numerous other operations at Lake Roosevelt designed to benefit flow management for listed species: • Operate to achieve an 85% probability of being at the April 10 Upper Rule Curve. • Refill to elevation 1290 feet by about June 30. • May be used to help meet tailwater elevations below Bonneville Dam to support chum spawning and incubation. • Lake Roosevelt may be operated to help support flows for Priest Rapids.

Agreement	Summary Description	Constraints on Odessa Study
	future evaluation and modeling (NMFS 2010). Grand Coulee Dam and Lake Roosevelt will be operated to support salmon flow objectives during the spring as well. By operating to achieve an 85% probability of being at the April 10 Upper Rule Curve, it maximizes the water released from the project from April 10 through June.	• Draft to elevation 1280 or 1278 by the end of August (dependent on water supply forecast) to support flows in the lower river for juvenile fish migration • Draft up to an additional 1 to 1.8 feet by the end of August for the Lake Roosevelt Incremental Storage Releases Project. • Pumping into Banks Lake is reduced in August, resulting in a 5-foot drawdown to elevation 1565 feet by the end of the month. This leaves more water in the Columbia River during summer juvenile salmon migration.
Columbia Basin Fish Accords	On May 2, 2008, several MOAs, referred to as the Columbia Basin Fish Accords, were signed by the action agencies (Reclamation, Corps, and BPA) and the following: • The Confederated Tribes of the Colville Reservation • Three of the Treaty Tribes (Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of Warm Springs Reservation of Oregon, Confederated Tribes and Bands of the Yakama Nation) and the Columbia River Inter-Tribal Fish Commission • The State of Idaho • The State of Montana • An MOA was signed between the action agencies and the Shoshone-Bannock Tribes on November 7, 2008. • An MOA for Estuary Habitat was signed between the action agencies and the State of Washington on September 16, 2009.	The goal of these agreements is to acknowledge the substantive role of Tribes and States as managers of the fish resource, provide greater long-term certainty for fish restoration funding, support and enhance the actions contemplated in the NMFS BiOps for listed salmon and steelhead and improve their prospects for recovery, foster a partnership toward a mutual goal of protecting and recovering fish and wildlife, and provide for the parties to work together to assure the agencies' responsibilities under the ESA, Northwest Power Act, and Clean Water Act are satisfied. Additional MOAs are under negotiation between other Northwest Tribes.
* RPAs are from the 2008/2010 FCRPS BiOp (NMFS 2010).		

1.7 Decisions to be Made

Following publication of this Final EIS, Reclamation and Ecology may make a decision regarding implementation of an alternative. The CBP is an authorized project and in order for continued phased development, Reclamation acting for the Secretary needs to find the Proposed Action economically justified and financially feasible. Subsequent implementation would be contingent upon appropriations.

1.7.1 Tiered Review Process

Reclamation and Ecology have clarified that this Final EIS is the initial environmental analysis within a tiered review process under NEPA and SEPA. “Tiering” refers to the process of addressing a broad, general program, policy, or proposal in an initial analyses followed by analyses of a more precisely defined site-specific proposal related to the initial program, policy, or proposal when that proposal is ready to be carried forward (see 40 CFR §§ 1502.20 and 1508.28). Tiering may also be used when an EIS is prepared on a specific action, such as the Proposed Action here, but at an early stage to consider broad issues such as general location, scope, and site selection (40 CFR § 1508.28[b]). In such cases, subsequent NEPA at a later stage in the action may be necessary. The use of tiering is encouraged in large and complex projects such as this, and allows the agencies to focus on the issues ripe for decision.

Reclamation and Ecology expect that some projects or actions advanced out of this first tier EIS may be subject to subsequent second tier, project-level environmental analysis under NEPA and SEPA before being approved for implementation. Any subsequent NEPA project-level analysis could include a combination of EIS(s), supplemental EIS(s), environmental assessments(s), and/or categorical exclusion(s) along with corresponding SEPA reviews, as appropriate, depending on the proposed action, phasing of implementation, and potential for adverse impacts. Actions described in this Final EIS that are analyzed in full will not undergo a second tier NEPA/SEPA review. Decisions relative to the general scope of the action alternative which include acreage, water supply, and general site locations would also not be subject to additional review.

An example of how the tiering process may work, the East Low Canal widening is an example of a project feature that is analyzed under this Final EIS. Locations of pumping plants are an example of projects that may require subsequent NEPA project-level reviews due to the uncertainty associated with the location of the pumping plants at this time.

1.8 Scope of the EIS

The Council on Environmental Quality (CEQ) regulations for implementing NEPA defines the scope of an EIS as consisting of the range of actions, alternatives, and potential impacts to be considered.

1.8.1 Other Actions

This EIS considers actions within the geographic scope of the Proposed Action, as well as actions outside the Study boundary, that that may be connected, cumulative, or similar. A connected action is one that is closely related to the proposed action. It may be automatically triggered by the proposed action, it may be dependent upon the proposed action, or it may be interdependent along with the proposed action for justification as part of a larger overall action. Cumulative actions are “other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions” (40 CFR Section 1508.7). Similar actions have similarities that provide a basis for evaluating their environmental consequences together with the proposed action, such as common timing or geography.

For the Final EIS, no connected actions or similar actions were identified. The following actions are considered in the environmental consequences analysis for the alternatives (Chapter 4):

- Columbia River Basin Water Management Program and its anticipated component actions (considered as part of No Action Alternative).
- Lake Roosevelt Incremental Storage Releases (considered as part of No Action Alternative).
- Coordinated Conservation Program (considered as part of No Action Alternative).
- 2008/2010 Federal Columbia River Power System (FCRPS) Biological Opinion (considered as part of No Action Alternative).
- Potholes Supplemental Feed Route Project (considered as part of No Action Alternative).
- Groundwater withdrawals of municipalities, communities, and irrigators (considered as part of No Action Alternative).
- John W. Keys III Pump-Generating Plant Modernization Project (a reasonably foreseeable future action).
- Assured Annual Flood Control provision of the Columbia River Treaty (a reasonably foreseeable future action).

- Yakima River Basin Integrated Water Resource Management Plan (a reasonable foreseeable future action).
- Umatilla Basin Aquifer Recovery (a reasonably foreseeable future action).

1.8.2 Alternatives

Reclamation and Ecology considered a No Action Alternative, as required by NEPA and SEPA implementing regulations, and a reasonable range of action alternatives to meet the purpose and need. The No Action Alternative and six action alternatives analyzed in this Final EIS are described in Chapter 2 – *Alternatives*. An alternative overview is provided in Table 2-2.

The six action alternatives fall into three groups: two partial replacement alternatives, which would replace groundwater supplies south of I-90; two full replacement alternatives, which would replace groundwater supplies throughout the Study Area both north and south of I-90; and two modified partial replacement alternatives which would replace groundwater supplies in the western portion of the Study Area both north and south of I-90. Within each of those groups, the two alternatives evaluate combinations of water supply sources from Banks Lake and Lake Roosevelt.

1.8.3 Potential Impacts

The analysis of impacts and associated mitigation measures of the alternatives are described in Chapter 4 – *Environmental Consequences*. The potential impacts that may result from the Proposed Action and alternatives are direct, indirect, and cumulative. For example, the potential environmental impacts associated with constructing an East High Canal, discussed in Chapter 4, could include direct impacts from disturbing shrub-steppe habitat, indirect impacts from creating a water source for potential fringe wetlands, and cumulative impacts if another project has impacts on shrub-steppe habitat that overlap the effects of the Proposed Action and alternatives.

The geographic area analyzed for possible impacts of the Proposed Action and alternatives for this Final EIS appears in Figure 1-1. For some resources, the analysis area may expand beyond the Study Area; for example, effects of water withdrawals on Columbia River anadromous fish downstream. In Chapter 3–*Affected Environment*, the geographic analysis area for each resource topic is identified.

1.9 Public Comment and Participation

Formulating alternatives that are responsive to the needs and desires of the American public requires planning expertise and direct public participation. Several agencies, entities, organizations, and groups participated in the Study. The degree of participation ranged from providing viewpoints and general observations to direct contributions in plan formulation. Chapter 5 provides a detailed description of public outreach efforts and public.

Both formal and informal input was encouraged and used in preparing this Final EIS. The formal setting for gathering input was provided during the scoping process for the Study, initiated in August 2008 with the publication of a Notice of Intent in the Federal Register. Study Updates were mailed to more than 240 recipients, and scoping meetings were held in September 2008 in Coulee City and Moses Lake, Washington. Scoping comments were accepted through mid-September 2008.

The Draft EIS was released in October 2010, and public meetings were held in November in Coulee City and Moses Lake, Washington. The public comment period was extended until January 31, 2011. Comments received during the public comment period are included in Volume 2–*Comments and Responses* of this Final EIS.

1.10 Commitment to Continue Coordination

Reclamation and Ecology have encouraged participation by Tribes and resource agencies as part of this environmental review process. Reclamation and Ecology remain committed to this ongoing coordination and welcome the continued opportunity to work with the Tribes, USFWS, NMFS, Washington Department of Fish and Wildlife (WDFW), State Historical Preservation Officer (SHPO), CBP Irrigation Districts, and other stakeholders to identify appropriate mitigation, monitoring, evaluation, and adaptive management programs. Both agencies have successfully collaborated on natural resource enhancements in the past with Tribes, resource agencies, and CBP irrigation districts, and believe such collaboration is a critical element to future phased development of the CBP. In addition, this Final EIS is a tiered document where, in coordination with jurisdictional agencies and/or Tribal governments, additional NEPA/SEPA analysis would be conducted, as appropriate, prior to construction of each phase of the proposed project.

1.11 Related Permits, Actions, and Laws

To implement any alternative, Reclamation and/or Ecology would need to apply for and receive various permits, take certain actions, and conform to various laws, regulations, and

Executive orders. These are described in Chapter 5–*Consultation and Coordination*. The following major Federal laws apply to each alternative:

- National Environmental Policy Act
- Endangered Species Act
- Clean Water Act
- National Historic Preservation Act
- Native American Graves Protection and Repatriation Act
- Fish and Wildlife Coordination Act

Additional permits, actions, and laws that apply to Odessa Subarea Special Study are listed in Chapter 5.

1.12 Overview of the Final EIS

This Final EIS closely follows the format recommended by the Council on Environmental Quality and is a companion volume to the *Final Odessa Subarea Special Study Report* (Special Study Report) (Reclamation 2012) that Reclamation completed.[3]

Volume 1:

- Chapter 1 identifies the Proposed Action, the purpose and the need for action; provides background information; and summarizes public involvement activities, and applicable laws and regulations.

- Chapter 2 presents discussion on the No Action alternative and action alternatives and summarizes the process of formulating the Proposed Action alternatives. A table presenting a summary comparison of the alternatives is also included.

- Chapter 3 presents the affected environment and relevant resource components that make up the baseline environment.

- Chapter 4 describes the direct and indirect environmental impacts of the alternatives considered in detail in addition to identifying mitigation measures, cumulative impacts, and Reclamation's environmental commitments.

[3] The report is available on the web at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

- Chapter 5 summarizes consultation and coordination activities, including public involvement efforts relevant to the Final EIS, and applicable laws and regulations.

- The following have also been included:
    - Acronyms
    - Bibliography
    - List of Preparers
    - Glossary
    - Index
    - Contact and Distribution List
    - Appendices A – F

Volume 2:

- Public Comments on the Draft EIS and Reclamation's Responses

1.13 Changes from the Draft EIS to the Final EIS

The changes identified here are not a comprehensive listing of all changes in the Final EIS, and include only the more substantive additions or revisions. Many other changes and corrections have been made throughout the Final EIS to update discussions of existing and anticipated future conditions, as well as to improve descriptions of the effects of the alternatives.

1.13.1 Modified Partial Replacement Alternative Developed and Analyzed

Reclamation and Ecology developed the modified partial groundwater irrigation replacement alternatives in response to a number of concerns raised in public comments regarding the partial and full groundwater replacement alternatives presented in the Odessa Subarea Special Study Draft EIS and in consultation with the ECBID.

The modified partial replacement alternatives are similar to the Alternative C option described in the Appraisal-Level Investigation Summary of Findings (Appraisal Study). Alternative C was considered but eliminated in the Draft EIS because it precluded deliveries to some lands within the SCBID and was not an economically viable option as configured. The modified partial replacement Alternatives 4A and 4B incorporate modifications to Alternative C, which makes them "reasonable" alternatives for the Proposed Action in this

Final EIS. Further review of the PASS Analysis and Appraisal Study indicated that the modified replacement alternatives would not preclude full development. Alternatives 4A and 4B would provide service to some of the SCBID lands. Reclamation and Ecology developed Alternatives 4A and 4B for the Final EIS to address expressed concerns. These alternatives were configured in such a way as to economically serve lands both north and south of I-90 while increasing the number of acres that would no longer pump from the Odessa aquifer (Reclamation 2012 Economics).

The modified partial replacement alternatives, Alternative 4A: Partial – Banks and Alternative 4B: Partial – Banks + FDR, would serve lands north and south of I-90 from the East Low Canal. Alternative 4A has been identified by Reclamation and Ecology as the preferred alternative (see Section 2.7 – *Modified Partial Groundwater Irrigation Replacement Alternatives*).

As suggested by their names, the modified partial replacement alternatives would rely on either Banks Lake (4A) or Banks Lake and Lake Roosevelt (4B) for their water supply. The amount of water proposed for diversion is within the range of diversions previously evaluated for action alternatives in the Draft EIS. Similarly, the number of acres to be served is within the range covered by the action alternatives in the Draft EIS. The lands proposed to be served south of I-90 are those included within partial replacement alternatives in the Draft EIS. The lands proposed to be served north of I-90 are a portion of the lands that would be served by the new East High Canal system under the full replacement alternatives, but instead would be served from the East Low Canal in the modified partial replacement alternatives. The modified partial replacement alternatives involve facilities, diversions, operations, and lands that were either evaluated in the Draft EIS or are within the range of alternatives considered there; therefore, the potential impacts associated with the modified partial replacement alternatives are of an equal or lesser magnitude as the effects presented in the Draft EIS and no additional impacts are anticipated. The modified partial replacement alternative and associated impacts are also fully evaluated within this Final EIS.

The modified partial replacement alternatives would allow some groundwater irrigators in areas distant from the East Low Canal to move their farming operations to previously disturbed lands closer to the canal in order to receive CBP water. It is anticipated that as much as 15 percent of the lands served under the modified partial replacement alternative would involve this type of infill. Relocations would be limited to an acre-per-acre substitution of groundwater-irrigation for surface water irrigation using CBP supplies. The land previously irrigated by groundwater would not be irrigated and State water rights would be modified accordingly.

1.13.1.1 Other Changes

- As described in Chapter 2, Section 2.8.3.5, the proposed Rocky Coulee Reservoir and action alternatives utilizing this water supply source was eliminated from further consideration.

- In the Draft EIS, the annual diversion requirement from the Columbia River was incorrectly reported as the on-farm delivery amount. On the CBP, because of recapture and reuse on-farm, deliveries are more than river diversions. This error has been corrected in this Final EIS (see Table 1-1).

- The hydrologic modeling was updated to reflect the changes in diversions discussed above and the updated HYDSIM model (see Chapter 4, Section 4.2). Also, the additional diversions available from the Columbia River were modified in fall and winter and eliminated in September.

- Based on informal ESA consultation with NMFS, an additional diversion scenario was analyzed.

- BMPs and environmental impact mitigations are more clearly identified in the Final EIS (see Chapter 4, Section 4.31).

- A cumulative impact section was added in response to comments that requested a unified section for cumulative impact analysis and discussion (Chapter 4, Section 4.27).

- Further refinements to project design resulted in reduced rights-of-way and easements for various proposed facilities for all action alternatives as shown in Table 1-3.

Table 1-3. Revised right-of-way and easement acquisition assumptions since Draft EIS.

Facility Component	Draft EIS Assumption	Final EIS Assumption
Canal-side pumping plants and re-lift stations	7.0 acres	3.0 acres
Distribution pipelines greater than 24 inches in diameter	400 feet	200 feet
Distribution pipelines less than 24 inches in diameter	200 feet	100 feet
East High Canal	600 feet	200 feet

1.14 What Comes Next?

The release of this Final EIS was announced in the Federal Register, on Reclamation's website, and in local and regional newspapers. Ecology published notices in local papers, and posted information on their website.

1.14.1 Final EIS

Reclamation and Ecology have carefully considered comments received on the Draft EIS and responded to such comments by adjusting alternatives, adding new alternatives, supplementing or improving the analysis, and making factual corrections. Each substantive comment has been carefully considered and responses are included with this Final EIS. The comments and responses to the Draft EIS are published as Volume 2 to the Final EIS. Additional public input received prior to issuance of the Record of Decision (ROD) will be considered.

1.14.2 Record of Decision

In accordance with Federal guidelines, a ROD is prepared after the Final EIS is completed and distributed to the public. It explains the decision and discusses the reasoning and rationale used in making the decision. The ROD cannot be issued until at least 30 days after the EPA publishes its notice of availability for the Final EIS in the Federal Register.

There is no requirement to formally publish the ROD in the Federal Register or the media. However, the affected public will be made aware that the ROD is available. News releases and public service announcements will be distributed to the media announcing the availability of the ROD.

CHAPTER 2 ALTERNATIVES

Chapter 2 ALTERNATIVES

2.1 Introduction

This chapter presents a description and summary comparison of the alternatives being considered to address the purpose and need discussed in Chapter 1:

- Section 2.2: Summary alternative descriptions, including related water resource management programs and activities.
- Sections 2.4 through 2.7: More detailed alternative descriptions, including how CBP water would be supplied (that is, which reservoirs would be involved) and the facilities required for delivering CBP water to groundwater-irrigated lands in the Study Area. Included with the descriptions of the required facilities is an overview of related construction timeframes and activities.
- Section 2.8: Alternatives formulation and selection process, and alternatives that were considered but eliminated from further study.
- Section 2.9: Estimated costs of the action alternatives.
- Section 2.10: Benefit-cost analysis of the action alternatives.
- Sections 2.11 and 2.12: Summary of potential environmental consequences (details of these are found in Chapter 4).

2.2 Alternatives Overview and Water Management

Six action alternatives are considered in this Final EIS, in addition to the No Action Alternative as required by NEPA and SEPA. State participation in the selection and implementation of any of the alternatives would be dependent on the alternative being consistent with the provisions of the State's Columbia River Management Program and associated agreements, described in Section 1.6.1. This section explains the general approach of each alternative and the features common to all.

Section 2.2.1 – *Overview of Alternatives,* describes the options for water delivery and water supply and indicates how those options were grouped into the seven alternatives analyzed in this Final EIS. Section 2.2.2 – *River and Reservoir Hydrologic Operational Changes under* *the Action Alternatives* describes what would change and how those changes were measured under different watershed conditions, such as average, wet, dry, and drought years.

Alternatives in the Odessa Study EIS

The Final EIS analyzes six action alternatives that met the Purpose and Need to varying degrees, as well as a No Action Alternative. These six action alternatives are composed of two aspects:

- Delivery—How much water would be delivered to the Study Area, what lands would receive the water, and the conveyance facilities that would be used to provide that water.
- Supply—The reservoir or combination of reservoirs that would provide stored water from the Columbia River.

Four of the six action alternatives in the Draft EIS would provide water to partially replace the groundwater supply in the Study Area and the other two would fully replace the groundwater irrigation supply. Three of the action alternatives considered in the Draft EIS, Alternative 2C: Partial—Banks + Rocky, Alternative 3C: Full—Banks + Rocky, and Alternative 3D: Full—Combined, were not advanced for consideration in the Final EIS, as discussed in Section 2.8.

Within each of the two broad delivery categories of partial and full replacement, two reservoir supply combinations from the Draft EIS and two new modified alternatives were analyzed, as described in Section 2.2.1 – *Overview of Alternatives*.

A number of existing, interrelated water management programs, actions, and activities in the Study Area would be a part of all alternatives. Section 2.2.3 – *Water Management Programs and Requirements Common to All Alternatives* describes how the programs and laws in Chapter 1 would relate to the Study Alternatives.

2.2.1 Overview of Alternatives

Seven alternatives are evaluated in this Final EIS, including the No Action Alternative, two partial groundwater irrigation replacement alternatives, two full groundwater irrigation replacement alternatives, and two modified partial groundwater replacement alternatives:

1. No Action Alternative
2. Partial replacement alternatives:
   - 2A. Partial—Banks
   - 2B. Partial—Banks + Lake Roosevelt (FDR)
3. Full replacement alternatives:
   - 3A. Full—Banks
   - 3B. Full—Banks + FDR

4. Modified Partial replacement alternatives:
   - 4A. Modified Partial—Banks (Preferred Alternative)
   - 4B. Modified Partial—Banks + FDR

2.2.1.1 Delivery Options

The six action alternatives fall into three groups based on how much surface water would be delivered and where it would be delivered to replace groundwater-irrigated acreage in the Study Area. Three delivery options with associated facilities, along with the No Action option, are listed below:

- No Action: No additional surface water supply would be provided from the CBP to replace groundwater-irrigated acreage in the Study Area. No new facilities would be built and no existing facilities would be expanded for this purpose. The only existing programs or activities that would address the declining groundwater conditions in the Study Area would be the incremental release from Lake Roosevelt (30,000 acre-feet to support agriculture in Study Area) and the Coordinated Conservation Program.

- Option 2—Partial Groundwater Irrigation Replacement: This delivery option focuses on enlarging and extending the existing East Low Canal and providing CBP surface water to approximately 57,000 acres currently using groundwater south of I-90 and developing a distribution system to deliver water from the canal to the farmlands (Figure 2-1). No surface water replacement would be provided to most of the remaining groundwater-irrigated acres in the Study Area north of I-90. The total CBP surface water supply needed for the partial replacement alternatives would be approximately 138,000 acre-feet.

- Option 3—Full Groundwater Irrigation Replacement: This delivery option would provide CBP surface water to most groundwater-irrigated acreage in the Study Area (approximately 102,600 acres). Lands south of I-90 would be served by enlarging the East Low Canal, as described for the partial replacement alternatives. Lands north of I-90 would be served by construction of the East High Canal system and developing a distribution system to deliver water from the canal to the farmlands, as shown on Figure 2-1. The total CBP surface water supply needed for the full replacement alternatives would be approximately 273,000 acre-feet.

- Option 4—Modified Partial Replacement Alternative: This delivery option would provide CBP surface water to approximately 70,000 groundwater-irrigated acres in the Study Area both north and south of I-90. Lands south of I-90 would be served by enlarging the East Low Canal and developing a distribution system to deliver water from the canal to the farmlands, as described for the partial replacement alternatives, except the East Low Canal would not be extended, only enlarged. Lands north of I-90 would be served by the existing East Low Canal by developing a distribution system to deliver water from the canal to the farmlands. The total CBP surface water supply needed for the modified partial replacement alternatives would be approximately 164,000 acre-feet.

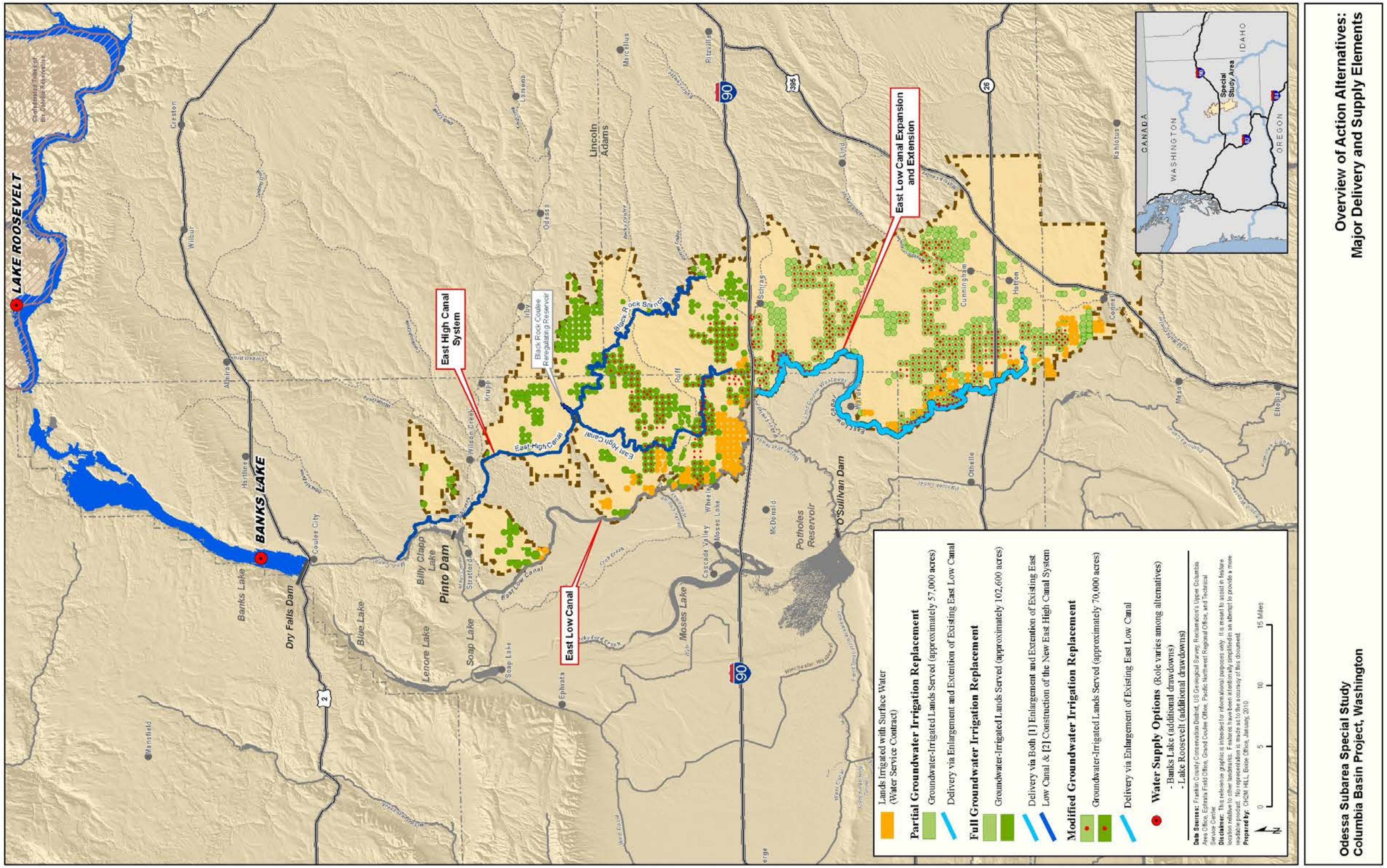

Figure 2-1. Overview of action alternatives – major delivery and supply elements.

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2.2.1.2 Supply Options for the Action Alternatives

All surface water supplies for the action alternatives would be through diversion from the Columbia River using Reclamation's existing water rights for the CBP and existing storage reservoirs, Lake Roosevelt and Banks Lake. The surface water supplies would allow stored water to be used from the reservoirs during the irrigation season and the reservoirs would be refilled during the fall and winter. Spring diversions, when possible (April through June), would be used for direct delivery to the Study Area and refill storage at Banks Lake.

Stored water for delivery to the Study Area would be provided from either Banks Lake alone or Banks Lake and Lake Roosevelt (Figure 2-1):

- Alternatives 2A, 3A, and 4A (Banks) would use storage in Banks Lake, exclusively.
- Alternative 2B, 3B, and 4B (Banks + FDR) would use storage in both Banks Lake and Lake Roosevelt.[1]

Quantity and Timing of Diversions

Two potential scenarios for diverting water from the Columbia River into the Study Area via Banks Lake are evaluated in this Final EIS for each action alternative:

Spring Diversion Scenario: This scenario is similar to that assumed in the Draft EIS except that the diversion in October through March would take place every year even when the flow objectives are not met in the Columbia River. The maximum amount of diversion in October was increased to 2,700 cfs and in addition, diversion up to 350 cfs could occur during November through March to refill Banks Lake and Lake Roosevelt. Diversions in April through June would be allowed from the Columbia River when flows exceed 135,000 cfs at Priest Rapids Dam, 260,000 cfs at McNary Dam, and there is adequate pump capacity to pump water from Lake Roosevelt to Banks Lake. This spring limitation is consistent with the previous analysis performed for the Draft EIS.

Limited Spring Diversion Scenario: During informal ESA consultation (June 2012), it was suggested that Reclamation limit diversions in the spring (April through June) for direct delivery to the Study Area to periods when the Columbia River flow downstream of Grand Coulee Dam exceeds 200,000 cfs and there is adequate pump capacity to pump water from Lake Roosevelt to Banks Lake. Diversions in October of up to 2,700 cfs would be allowed and additional diversions up to 350 cfs could occur November through March to refill Banks Lake and Lake Roosevelt. This would be within the range of drawdown scenarios for Banks

[1] The State of Washington has committed through agreements with the Confederated Tribes of the Colville Reservation and the Spokane Tribes of Indians to not seek further drawdown of Lake Roosevelt. Therefore, the State does not support Alternatives 2B, 3B, or 4B.

Lake and Lake Roosevelt presented in the Draft EIS and has been fully analyzed in this Final EIS.

The flows for the Spring and Limited Spring Diversion Scenarios are summarized in Table 2-1.

Table 2-1. Diversion scenario summary table.

Diversion Scenario	Spring (April through June)	October	November through March
Spring	Diversions from Columbia River allowed when outflows exceed 135,000 cfs at Priest Rapids Dam, 260,000 cfs at McNary Dam, and there is adequate pump capacity at Lake Roosevelt.	Diversions up to 2,700 cfs.	Up to 350 cfs each month.
Limited Spring	Diversions from Columbia River allowed when outflows exceed 200,000 cfs* downstream of Grand Coulee Dam and there is adequate pump capacity at Lake Roosevelt.	Diversions up to 2,700 cfs.	Up to 350 cfs each month.

* This flow was not modeled for the Final EIS; however, this occurs less than 10 percent of the years.

2.2.1.3 Action Alternatives—Delivery and Supply Combinations

Alternatives 2A and 2B would each provide partial groundwater irrigation replacement to approximately 57,000 acres south of I-90 through an enlarged and extended East Low Canal. The alternatives differ only in which of the two supply options would be used. Similarly, Alternatives 3A and 3B evaluate two different supply options that would each provide full groundwater irrigation replacement to approximately 102,600 acres both north and south of I-90. Approximately 57,000 acres south of I-90 would be served through an enlarged and extended East Low Canal, and approximately 45,000 acres north of I-90 would be served through a new East High Canal system. Alternatives 4A and 4B also evaluate two different supply options that would each provide partial groundwater irrigation replacement to approximately 70,000 acres. Approximately 45,000 acres south of I-90 would be served through an enlarged East Low Canal, and approximately 25,000 acres north of I-90 through the existing East Low Canal.

These six action alternatives are listed on Table 2-2 along with the No Action Alternative.

Table 2-2. Alternatives overview.

Alternative – Water Supply	Delivery Options (see also Figure 2-1)
1 – No Action	
No Action	• Current and ongoing Columbia River and CBP programs, commitments, and operations continue • No CBP surface water provided to any additional groundwater-irrigated lands in the Odessa Subarea • No additional drawdowns at either reservoir • No facility construction required
2 – Partial Groundwater Irrigation Replacement	
2A – Banks Lake **2B – Banks + FDR**	• Current and ongoing Columbia River and CBP programs, commitments, and operations continue • Additional drawdown of Banks Lake (2A and 2B) and FDR (2B) • Approximately 57,000 acres of eligible groundwater-irrigated lands south of I-90 supplied with CBP surface water • Water delivered by enlargement and extension of the existing East Low Canal and construction of a distribution system
3 – Full Groundwater Irrigation Replacement	
3A – Banks Lake **3B – Banks + FDR**	• Current and ongoing Columbia River and CBP programs, commitments, and operations continue • Additional drawdown of Banks Lake (3A and 3B) and FDR (3B) • Approximately 102,600 acres of eligible groundwater-irrigated lands supplied with CBP surface water • Water delivered south of I-90 by enlargement and extension of the existing East Low Canal and construction of a distribution system • Water delivered north of I-90 by construction of a new East High Canal system, with an associated distribution system
4 – Modified Partial Irrigation Replacement	
4A – Banks Lake (Preferred Alternative) **4B – Banks + FDR**	• Current and ongoing Columbia River and CBP programs, commitments, and operations continue. • Additional drawdown of Banks Lake (4A and 4B) and FDR (4B) • Approximately 70,000 acres of eligible groundwater-irrigated lands provided with CBP surface water • Lands supplied with surface water replacement would be both north and south of I-90 • Water delivered by enlargement of the existing East Low Canal and construction of a distribution system

2.2.2 River and Reservoir Hydrologic Operational Changes Common to All Action Alternatives

The Columbia River would provide the surface water supply that would replace groundwater irrigation in the Study Area. Hydrologic modeling using HYDSIM, CBP-RW, and spreadsheet analysis was conducted to determine the potential changes in river flows and reservoir operations (drawdown and refill patterns) that would accompany implementation of the partial replacement alternatives (Alternatives 2A and 2B), the full replacement alternatives (Alternatives 3A and 3B), the modified partial replacement alternatives (Alternatives 4A and 4B), and the No Action Alternative. These models approximate flows and drawdown elevations, but the modeled outputs will most likely differ from real-time operations. Models are used to approximate and evaluate the potential impacts of the Proposed Action.

HYDSIM Model

Reclamation used output data from BPA's HYDSIM model for the FCRPS to determine the quantity of water available for diversion from the Columbia River for the CBP. The BPA model includes all significant United States Federal and non-Federal dams and the major Canadian projects on the mainstem Columbia River and its major tributaries. It is widely accepted as accurately simulating current operations of the Columbia River system. HYDSIM uses the current FCRPS system operating requirements for each project and historic hydrologic flow conditions. It contains a data set of runoff from 1929 through 1998 to determine impacts to various resources and obligations (such as irrigation, flood control, power, instream flow, other contract obligations, project authorizations, and biological opinions).

The HYDSIM model output includes information such as inflow, outflow, end-of-month reservoir elevations, power generation at each project, and monthly average flows at different target points on the Columbia River. The HYDSIM model splits the average monthly flows for the months of April and August so the first 15 days are separate from the remaining days of those two months. This is because April and August are dynamic months in which flows can change dramatically.

HYDSIM uses the Columbia River seasonal flow objectives established by NOAA Fisheries, beginning with the 1995 FCRPS BiOp, at Priest Rapids, McNary, and Bonneville Dams. Flow objectives are used for planning and modeling purposes.

CBP-RW Model

A hydrologic simulation model of the CBP was used for this analysis. RiverWare (RW) software was used to develop a simulation model of the infrastructure downstream of the Feeder Canal on the CBP, referred to as the CBP-RW model. The CBP-RW model runs on a daily time step, simulating reservoirs, canal and lateral flows, farm deliveries, return flows, groundwater pumping and natural flows within the CBP. The model was calibrated using observed reservoir elevation and surface flow data from 1996 to 1998. The calibrated CBP-RW model was used to simulate a selected combination of the proposed water conveyance and supply options and was run for the period 1929 through 1998.

Spreadsheet Analysis

A spreadsheet analysis was used to compute the interaction of Lake Roosevelt and Banks Lake storages and downstream Columbia River flows. The spreadsheet analysis integrated the No Action Alternative conditions from the HYDSIM model with the increase in diversions for the Study Area from the CBP-RW model. The results were compared to determine the effects of each alternative on Banks Lake and Lake Roosevelt storages and Columbia River flows.

Modeling Assumptions and Results

Modeling for this Study used four representative water year scenarios, or hydrologic conditions, within the watershed:

- Wet year: 1982 was selected as being representative of these conditions; approximately 10 percent of all water years are this wet or wetter and 90 percent drier.
- Average year: 1995 was selected as being representative of these conditions; approximately 50 percent of water years would be wetter and 50 percent drier.[2]
- Dry year: 1998 was selected as being representative of these conditions; approximately 15 percent of water years would be this dry or drier and the remaining 85 percent of years would be wetter.
- Drought year: 1931 was selected as being representative of these conditions; approximately 5 percent of water years would be this dry or drier and approximately 95 percent of years would be wetter.

Using historical data to model future hydrologic and system operation patterns assumes that future hydrologic conditions will be similar to past hydrologic conditions (i.e., the 1929 to 1998 period of record). Section 4.2 – *Surface Water Quantity* describes the hydrologic record

[2] Under current (No Action) operations, Lake Roosevelt end of August drawdown is dependent on the water supply forecast at The Dalles. When the July water supply forecast of April through August volume is 92 million acre-feet (99 percent of average) or higher (between 50 and 60 percent of water years), Lake Roosevelt is drawn down to at least 11 feet from full for both flow augmentation and the Lake Roosevelt Incremental Storage Release project. In water years where the forecast is below 92 MAF (approximately 40 to 50 percent of water years), Lake Roosevelt is drawn down at least 13 feet from full.

used for modeling and how specific years within the period of record were selected to represent the four future hydrologic conditions.

In all water-year conditions, the greatest drawdown of reservoirs would occur at the end of August when there is flow augmentation in the Columbia River. Figure 2-2 and Figure 2-3 show the end-of-August drawdowns and associated pool elevations projected for Banks Lake for the No Action Alternative and the six action alternatives under wet, average, dry, and drought conditions with the Spring Diversion Scenario and the Limited Spring Diversion Scenario, respectively. Figure 2-4 and Figure 2-5 provides this same information at Lake Roosevelt for the three action alternatives that use Lake Roosevelt storage with the Spring Diversion Scenario and the Limited Spring Diversion Scenario.

With the exception of July and August, modeling in the Draft EIS was initially based on diversions from the Columbia River when flows were in excess of BiOp flow objectives, which included diversions in spring. Based on input during informal ESA consultations, the Final EIS diversion options allowed diversions during the fall and winter in all water years, but limits diversions if BiOp water management objectives were not being met. The diversions were limited to 2,700[3] cfs in October, with the balance in November through March not to exceed 350 cfs (Section 4.2 – *Surface Water Quantity* describes the diversion scenarios).

How Would the Columbia River System be Changed by the Alternatives?

None of the six action alternatives in the Final EIS would result in a significant change in Columbia River flows. Water management programs and constraints are in place (i.e., the FCRPS BiOp) for the river to protect the resource values associated with the mainstem of the Columbia River, including ESA-listed fish species in the river. These would continue to be met in the spring and summer as a first priority in all hydrologic conditions. There could be minor flow diversions from November through March, but these minor decreases would not impact operations for protection of fall Chinook or chum.

Providing CBP surface water to lands in the Study Area would require changing reservoir operations during and immediately after the irrigation season at Banks Lake for all action alternatives and at Lake Roosevelt, for Alternatives 2B, 3B, and 4B. At both reservoirs, these changes would mean increased drawdowns—and therefore, lower pool levels—when compared with the No Action Alternative. In all cases, the pool levels would reach their minimum elevations at the end of August.

[3] All cfs values reflect a monthly average pumping rate necessary to produce a certain volume of water. For example, 100 cfs per month reflects pumping a volume of approximately 6000 acre-feet per month. This volume could easily be pumped from Grand Coulee in one day with no immediate change in the flow in the Columbia River. Pumps will generally be run at times when electricity is least valuable.

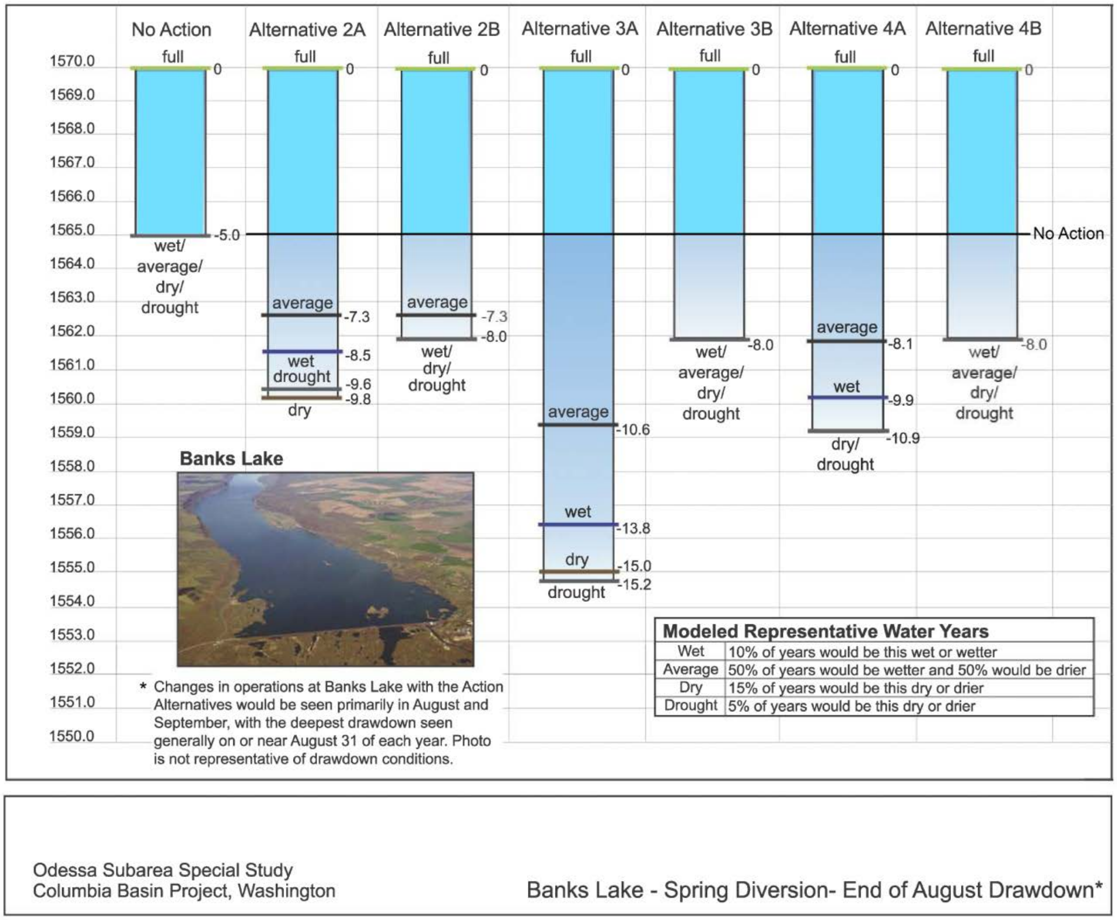


Figure 2-2. Banks Lake – Spring Diversion Scenario – end of August drawdown.

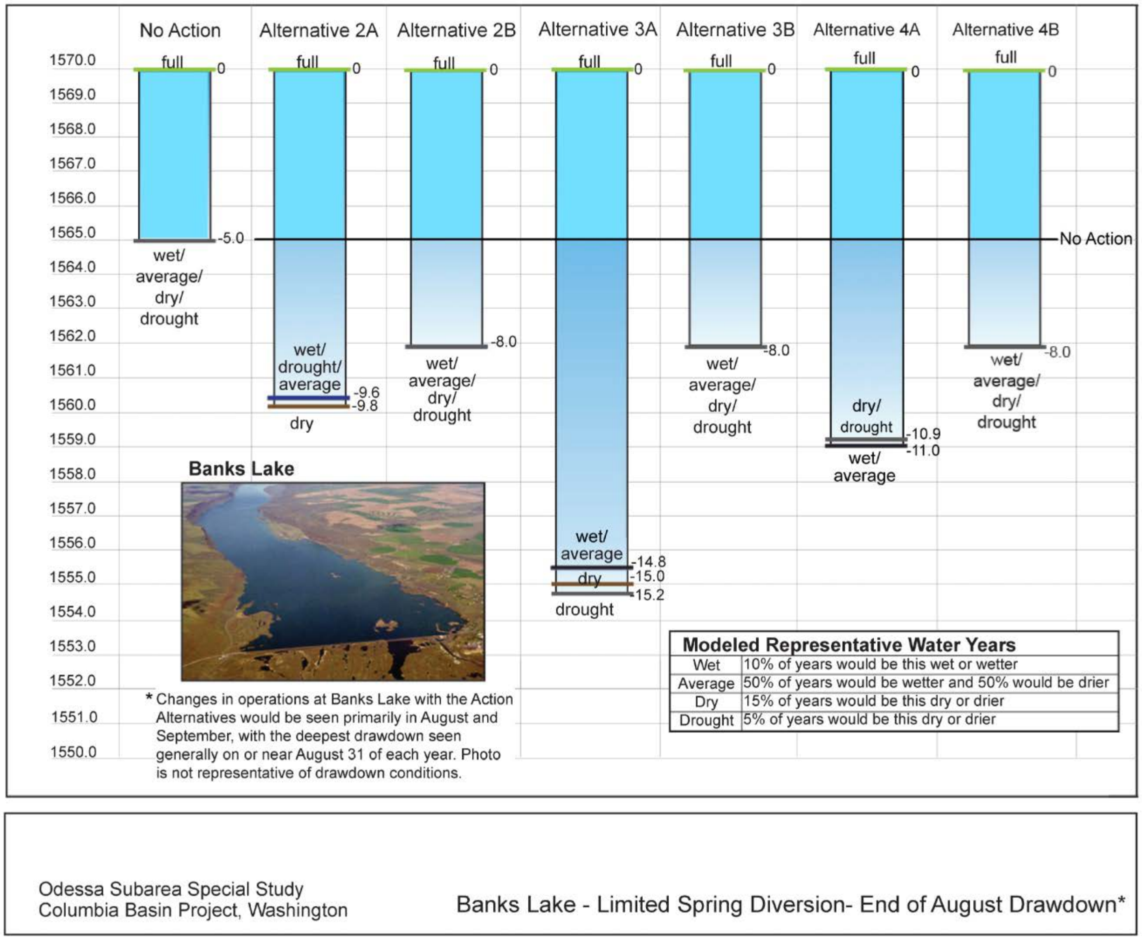
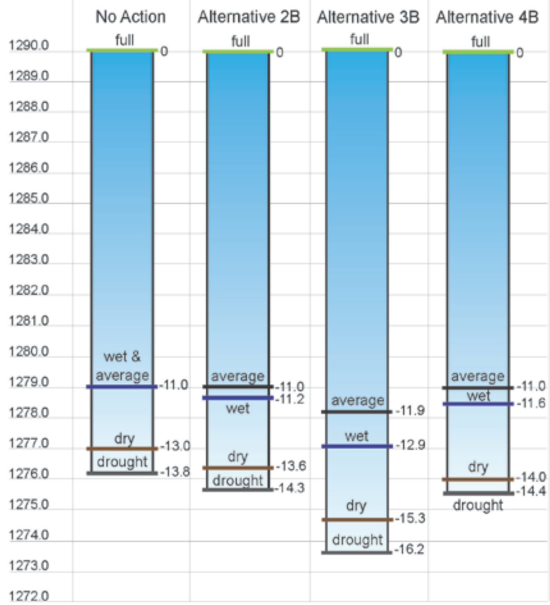


Figure 2-3. Banks Lake – Limited Spring Diversion Scenario – end of August drawdown.



Lake Roosevelt

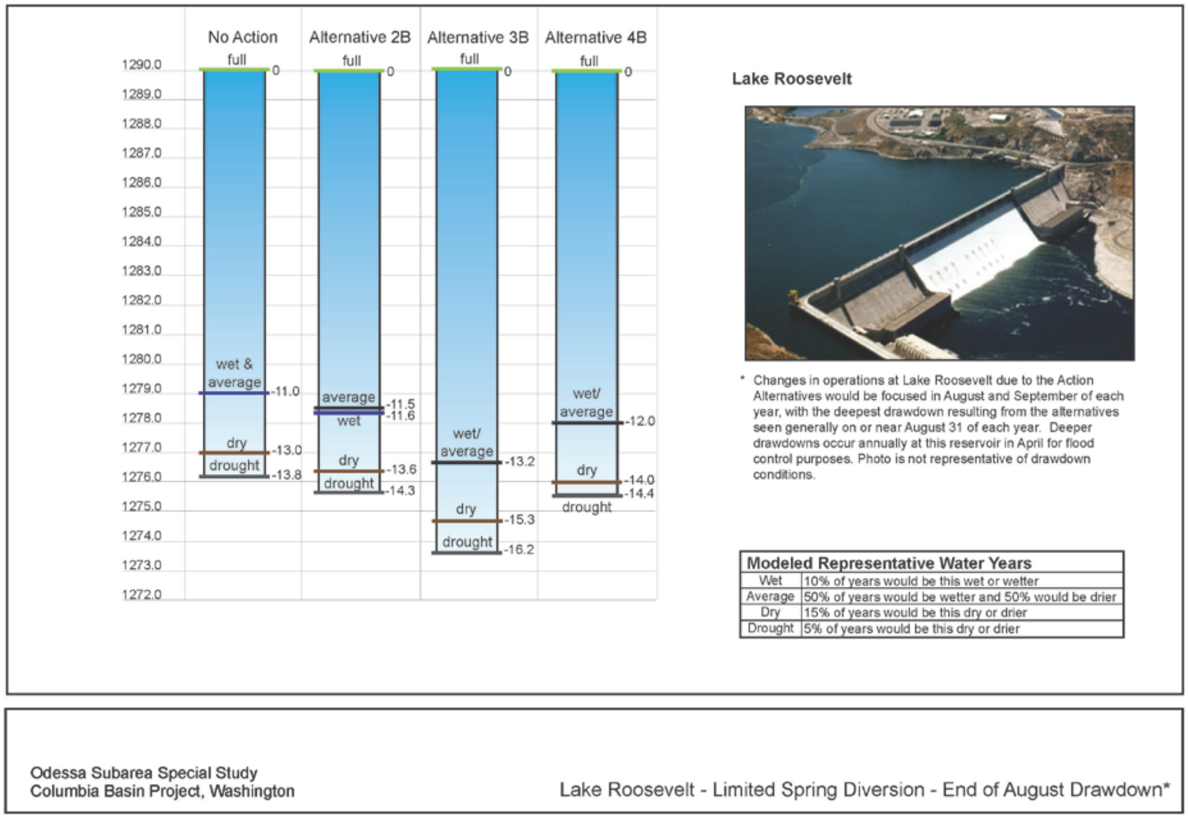
* Changes in operations at Lake Roosevelt due to the Action Alternatives would be focused in August and September of each year, with the deepest drawdown resulting from the alternatives seen generally on or near August 31 of each year. Deeper drawdowns occur annually at this reservoir in April for flood control purposes. Photo is not representative of drawdown conditions.

Modeled Representative Water Years	
Wet	10% of years would be this wet or wetter
Average	50% of years would be wetter and 50% would be drier
Dry	15% of years would be this dry or drier
Drought	5% of years would be this dry or drier

Odessa Subarea Special Study
Columbia Basin Project, Washington

Lake Roosevelt - Spring Diversion - End of August Drawdown*

Figure 2-4. Lake Roosevelt – Spring Diversion Scenario – end of August drawdown.



Modeled Representative Water Years	
Wet	10% of years would be this wet or wetter
Average	50% of years would be wetter and 50% would be drier
Dry	15% of years would be this dry or drier
Drought	5% of years would be this dry or drier

Figure 2-5. Lake Roosevelt – Limited Spring Diversion Scenario – end of August drawdown.

2.2.3 Water Management Programs and Requirements Common to All Alternatives

Water management within the Columbia River Basin is complex and is reflected in all of the alternatives, including the No Action Alternative. Delivery of irrigation water, flows in the Columbia River to support fish and environmental objectives and meet water rights, hydropower objectives, navigation, and flood control operations are all carefully timed throughout the year to meet numerous, interrelated water demands and priorities in the region.

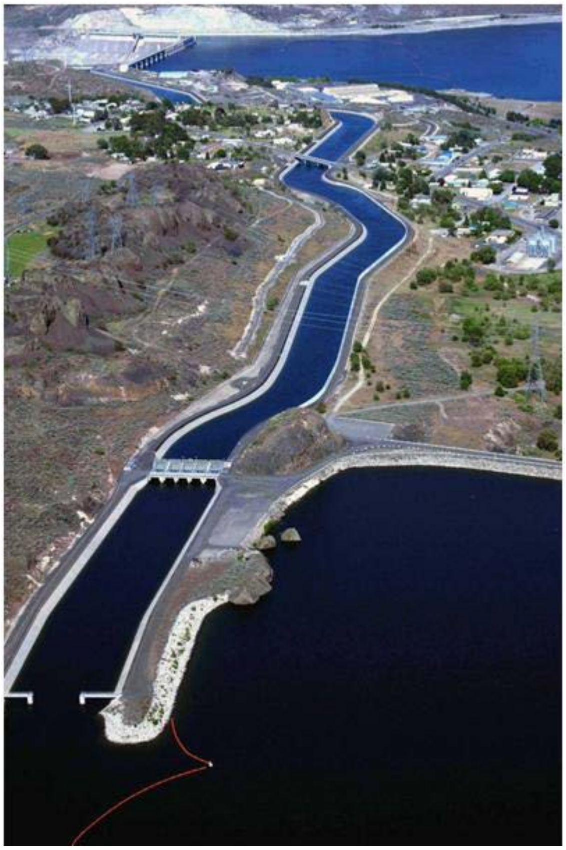
A number of programs and requirements of this water management system relate directly or indirectly to the alternatives being considered for groundwater-irrigated lands in the Study Area and would be common to all of the alternatives, including No Action. The most relevant of these programs and requirements, with brief descriptions of each provided in the following paragraphs, are:

- Operations at Lake Roosevelt and Banks Lake.
- CBP irrigation water supply, including master water service contracts in the Study Area.
- Columbia River Basin Water Management Program.
- Coordinated Conservation Program.

2.2.3.1 Operations at Lake Roosevelt and Banks Lake

The water supply for the CBP is stored behind Grand Coulee Dam in Lake Roosevelt. Congress originally authorized the Grand Coulee Project for irrigation, navigation, flood control, and hydropower. Since the original authorization, recreation and fish management have been added to the authorized purposes of the dam and reservoir. Storage and delivery of water to meet irrigation, municipal, and industrial uses are authorized Project purposes.

To supply the CBP, water from Lake Roosevelt is lifted through the John W. Keys III Pump-Generating Plant (Keys Pump-Generating Plant) approximately 280 feet to the Banks Lake Feeder Canal, which flows 1.6 miles to the Banks Lake equalizing reservoir (Photograph 2-1). Banks Lake is a storage facility formed by two dams: North and Dry Falls (Photograph 2-2 and Photograph 2-3). Banks Lake is designed to serve as a reregulation reservoir for the irrigation portion of the CBP, and is used as the forebay for pumped storage operations when the Keys Pump-Generating Plant is being used to generate electrical power. Water is delivered to CBP lands through the main canal headworks and a low-head powerplant in Dry Falls Dam at the southern end of Banks Lake (Photograph 2-4).



Photograph 2-1. Banks Lake Feeder Canal with Lake Roosevelt in background and Banks Lake in the foreground.

Photograph 2-2. Banks Lake and North Dam.

Photograph 2-3. Banks Lake, Dry Falls Dam, and the Main Canal.

Photograph 2-4. Main Canal Headworks and Powerplant at Dry Falls Dam.

Lake Roosevelt

Reclamation currently operates Grand Coulee Dam and Lake Roosevelt for flood control, hydropower generation, irrigation, municipal and industrial supply, fish and wildlife, and recreation. Operations are coordinated with BPA, Corps, and State, Tribal, and Federal fish and wildlife agencies.

At full pool, the surface elevation of Lake Roosevelt is 1290 feet above mean sea level (amsl) and has an active capacity of 5.23 million acre-feet (MAF). Lake Roosevelt receives large amounts of runoff from its tributaries with enough runoff to fill the reservoir several times in an average water year. The minimum operating pool elevation of Lake Roosevelt is 1208 feet amsl.

Lake Roosevelt is typically drafted and refilled twice during the year—a deeper draft occurs in winter and early spring for system flood control and a shallower draft occurs in July and August to provide flow augmentation water for ESA-listed fish in the river downstream. Operations under current conditions and the No Action Alternative are included in the description of the No Action Alternative (Section 2.4). The primary considerations that shape these operations are summarized in Table 2-3. Except where noted, these existing operations would continue unchanged under all Study alternatives.

Table 2-3. Operational considerations of Grand Coulee Dam and Lake Roosevelt.

Operational Goal	Description
Flood Control	Lake Roosevelt is operated under a series of “rule curves” that regulate the amount of drawdown. In late winter and early spring, flows are released from the reservoir to allow room to store upstream runoff and manage flood risk downstream. In an average water year with normal precipitation, the reservoir can be drawn down 50 feet or more. The level of drawdown is based on the volume water supply forecast and other factors. The reservoir typically refills about June 30.

Operational Goal	Description
ESA-listed Fish	Grand Coulee Dam is operated to help shape streamflows downstream to support ESA-listed fish. In the Columbia River system, 13 species of salmon and steelhead and 2 resident fish species are listed as threatened or endangered. NMFS and the USFWS have developed Biological Opinions that include objectives for Columbia River operations to benefit and protect these species. The two agencies review annual water management plans developed by Reclamation, Corps, and BPA to assist in meeting fish objectives. Grand Coulee Dam is operated to help with chum salmon below Bonneville Dam from November 1 to April 10, for fall Chinook below Priest Rapids Dam from November through May, and for other ESA-listed salmon and steelhead from April 10 to August 31. Under the Lake Roosevelt Incremental Storage Releases Program, operation of Grand Coulee Dam was modified to include additional instream flow augmentation. These releases draw down Lake Roosevelt by an additional 1 foot in nondrought years and 1.8 feet during drought years by the end of August. One-third of this draft is for instream flows to benefit fish. In addition, there are green sturgeon, eulachon, and leather back turtles that are part of the FCRPS consultation, but are primarily found in the estuary (see Section 3.11 – *Wildlife).*
CBP Irrigation Supply	Each year, about 2.65 million acre-feet is pumped from Lake Roosevelt to Banks Lake to supply irrigation water, generally from March through October.
Hydropower	In addition to seasonal fluctuations, Lake Roosevelt releases fluctuate daily for hydropower production. Grand Coulee Dam has four powerplants, including the Keys Pump-Generating Plant, and 33 turbines with a maximum generating capacity of 6,809 megawatts (MW).
Lake Roosevelt Incremental Storage Releases Program	The most recent substantive set of changes to operations at Grand Coulee Dam and Lake Roosevelt result from this component of the Management Program. This component drafts Lake Roosevelt is drafted an additional 1 foot in nondrought years and 1.8 feet in drought years by the end of August. Releases are being made to benefit agriculture, municipal and industrial users, Columbia River mainstem interruptible water right holders, and instream flows. Each year, 30,000 acre-feet go to the Study Area, 25,000 acre-feet go to meet municipal and industrial needs, and 27,500 acre-feet to augment instream flows above flow objectives (82,500 acre-feet total). An additional 50,000 acre-feet are released during drought years, with 33,000 acre-feet of that release providing relief for interruptible water right holders and 17,000 acre-feet supplementing instream flows. Within the Study Area, construction of the Weber Siphon was the primary facility modification necessary to deliver the 30,000 acre-feet of supply to the Study Area. This modification was completed in early 2012.
Secondary Considerations	Within existing operational limitations, Reclamation strives to operate Lake Roosevelt to make boat launches and marinas accessible, and beaches and campgrounds usable. Lake levels at or above 1280 feet amsl are maintained during the summer recreation season as much as possible. Management for non-ESA-listed fish is also a secondary consideration for the overall operation of the reservoir. For example, every attempt is made to refill Lake Roosevelt to a minimum elevation of 1283 feet by the end of September to benefit resident fish spawning. This operation is coordinated with the Tribes.

John W. Keys III Pump-Generating Plant

Construction of the Grand Coulee Pumping Plant (renamed John W. Keys III Pump-Generating Plant [Keys Pump-Generating Plant]) began in 1946. Six pumping units, each with a capacity to pump approximately 1,350 cubic feet per second (cfs), initially were installed in the plant to lift water 280 feet from Lake Roosevelt to the 1.6-mile-long feeder canal for delivery into Banks Lake. The plant was designed to accommodate six additional units in the future as the CBP reached full development.

In the early 1960s, with the Pacific Northwest facing power shortages, the facility was identified for modification to add pumped storage capabilities. Pumped storage is a strategy for hydroelectric power management that involves pumping water up to a reregulation reservoir during periods of low power demand and storing it for release through a generator during peak power demand periods. It was determined that the remaining six units were to be reversible pump-generators; that is, the units would function as pumps when needed, and then water could be released from Banks Lake back down through these six units to generate power. The total generating capacity of the pump-generating plant is 314 MW. The pumps and pump-generators cannot be throttled back to pump small amounts. Generally, they are either on or off, pumping during light load hours at rates of between 1,700 cfs and 2,000 cfs. The 2.65 million acre-feet of water used to irrigate the majority of the CBP is lifted through the plant using a combination of the 12 pumps and pump-generators.

Reclamation has contractual obligations to provide both on-demand delivery of irrigation water and to accommodate pumped storage at Banks Lake for balancing reserves and electrical load shaping. Balancing reserves refers to the capability to quickly balance generation with dynamic loads on the system in order to maintain the reliability of the power grid. This is accomplished at the Keys Pump-Generating Plant by adjusting short-term generation (supply) or pumping loads (demand) as needed. Load shaping is accomplished through the pumped storage capabilities of Banks Lake.

The Keys Pump-Generating Plant is generally operated to meet irrigation demand in the most cost-effective manner possible, while observing physical and regulatory operating constraints. This operational goal typically results in maximizing pumping during light-load hours or low-cost energy periods, and minimizing pumping, or even occasionally generating, during heavy-load hours or higher cost energy periods. The plant’s current condition is marginal to meet irrigation and balancing/loadshaping for power as historically provided. In addition, the ability to operate the pump-generators in generation mode is compromised beginning at Banks Lake elevations below 1568 amsl and is lost entirely below elevation 1560.5 as the siphon intakes become exposed above the lower water levels.

Banks Lake

Since its construction in the early 1950s, Banks Lake has been operated and maintained to store and deliver irrigation water to CBP lands. The lake has an active storage volume of 715,000 acre-feet between elevations 1570 feet (full pool) and 1537 feet amsl.

Reclamation operates Banks Lake within established constraints on water surface elevation to meet contractual obligations, ensure public safety, and protect property. This facility was sized to provide water for the ultimate development of the project; however, since its construction, the facility has not been operated at its maximum capabilities.

Between the late 1950s and 1986, Banks Lake was annually drawn down by about 10 to 15 feet, typically in the spring. However, in the early 1980s, normal water surface elevations in Banks Lake were stabilized such that annual fluctuations were usually approximately 3 feet from full. In recent years, the Banks Lake surface elevation has fluctuated within a 5-foot range, from elevation 1570 feet to elevation 1565 feet. Exceptions to this have included periodic drawdowns of up to 35 feet (to surface elevation of approximately 1535 feet amsl) for facility maintenance or to address other water/reservoir management issues. In late 1994 and early 1995, the reservoir level was drawn down about 25 feet (to elevation 1545 feet) to perform maintenance on constructed facilities and address an aquatic infestation of Eurasian milfoil. This past fall (2011) and winter (2012), the reservoir was drawn down again to elevation 1537.2 feet primarily for the maintenance at the Main Canal headworks at Dry Falls Dam.

Since 2000, adjustments have been made in Banks Lake operations to leave more water in the Columbia River during the summer for fish flow augmentation. Pumping to Banks Lake is reduced in August, resulting in a 5-foot drawdown by the end of the month. Refill occurs typically between September and November at rates subject to operational requirements and commitments at Grand Coulee Dam and Lake Roosevelt.

Under current conditions and the No Action Alternative, beyond this planned annual drawdown, withdrawals from Banks Lake for CBP irrigation and refill of the reservoir from Columbia River flows and Lake Roosevelt are generally balanced to result in little water level fluctuation in Banks Lake.

2.2.3.2 CBP Irrigation Water Supply, Including Water Service Contracts in the Study Area

Currently, the CBP provides irrigation water supply to more than 671,000 acres in the Columbia River Basin. Other purposes of the CBP include power production, flood control, recreation, navigation, and fish management. CBP facilities include over 330 miles of main canals, approximately 2,000 miles of laterals, and over 3,500 miles of drains and wasteways.

All of Reclamation's current water supply obligations related to the CBP would continue to be met in all Study alternatives. Specific to the Study Area, CBP water would continue to be provided to 16,864 acres under existing water service contracts through the East Columbia Basin Irrigation District (ECBID). The locations of these lands are shown on Figure 2-6 as Lands Irrigated with Surface Water. About 11,700 of these acres are located north of I-90 and 5,164 are located south of I-90.

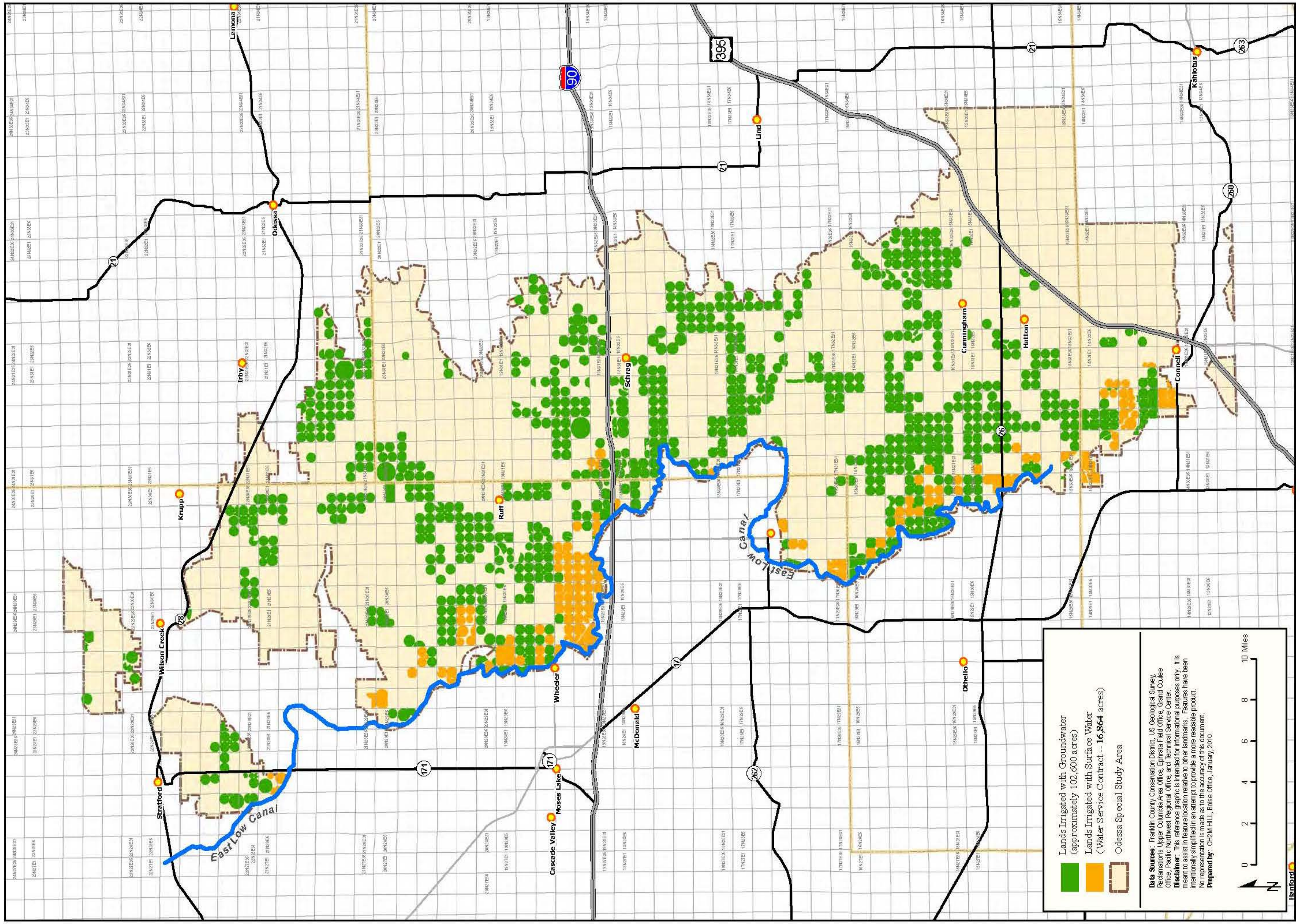


Figure 2-6. Currently Irrigated Agriculture in the Odessa Subarea Special Study Area (Study Area).

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2.2.3.3 Columbia River Basin Water Management Program

Ecology was directed through the Management Act to pursue the development of water supplies to benefit both instream and out-of-stream uses. Ecology is currently in the process of developing the Management Program to facilitate implementation of the legislation. The Management Program includes administration of the Columbia River Basin Water Supply Development Account that the Legislation created to fund storage, conservation, and other projects to provide new water supplies for the Columbia River Basin (Ecology 2007).

As part of this program, the State, Reclamation, ECBID, the South Columbia Basin Irrigation District (SCBID), and the Quincy Columbia Irrigation District (QCBID) are implementing an MOU that the parties entered into December 2004. The purpose of the MOU is to establish collaboration to secure economic and environmental benefits from improved water management within the CBP and along the mainstem Columbia River.

Specific to the Study Area, the MOU includes three provisions (MOU Sections 14 to 16):

- Cooperate to support and pursue the diversion and delivery of an additional 30,000 acre-feet of water from Lake Roosevelt to the Study Area. Water use is limited to existing agricultural lands, with priority for lands currently irrigated under State groundwater permits.
- Cooperate to explore opportunities for water delivery to additional existing agricultural lands within the Odessa Subarea.
- Conduct an appraisal-level assessment of the potential to store additional water from the Columbia River mainstem in the Odessa Aquifer.

The State would continue to pursue the Management Program, including the MOU with Reclamation and the irrigation districts, under all of the Study alternatives. The first provision of the MOU is already being implemented as the Lake Roosevelt Incremental Storage Releases Program. Action on the second provision, however, may not proceed further under the No Action Alternative, since this Study is the direct response to this provision. The third provision is ongoing, with additional analysis of two storage sites being evaluated on the Confederated Tribes of the Colville Indian Reservation.

2.2.3.4 Coordinated Conservation Program

Under this program, Ecology is partnering with the ECBID, SCBID, and QCBID to pipe and line their delivery systems in the CBP. Since 2009, the Coordinated Conservation Program has resulted in approximately 10,800 acre-feet of water savings, which will provide replacement water for about 3,600 acres of groundwater irrigated land in the Odessa Subarea. This basin-wide conservation program would continue under all action alternatives, and the water saved by these infrastructure improvements would be delivered to the Odessa Subarea.

2.3 Water Contract Actions

To protect the interests of the United States, general Reclamation law requires contracts for the delivery and storage of project and nonproject water; for the use of Federal facilities; and for the recovery of reimbursable project costs. Contracts are always required, unless a superseding Federal authority dictates otherwise, and must be executed pursuant to appropriate authority, whether found in general Reclamation law, project-specific legislation, or other congressional authorization. This is true whether the water is to be delivered for consumptive or nonconsumptive use.

Under all the action alternatives, contract(s) will be required for the repayment of reimbursable project costs based on the irrigator’s ability to pay. Contractors’ obligations to repay capital project costs under contracts made pursuant to subsection 9(d) of the 1939 Act are generally based on their ability to pay.

Reclamation’s water-related contracts must protect the Federal investment and ensure that repayment of the reimbursable capital cost is made in accordance with Reclamation law. Subsections 9(c), (d), and (e) of the Reclamation Project Act of 1939 (1939 Act) require repayment of all reimbursable costs (Public Law 76-260; 43 U.S.C. § 485h[c], [d], and [e]). The methods used in recovering these costs vary.

2.3.1 Inclusion/Exclusion and Related Land Classification Actions

Some of the land in the Study Area was excluded from project development, either at the time the irrigation district formed or prior to entering into repayment contracts for the existing developed land on the CBP. The excluded land is currently not eligible to receive a Federal water supply. In order to be eligible for water from the Federal system, these land parcels would have to go through the inclusion process with the respective irrigation district and Reclamation prior to entering into any contract for the delivery of water. The inclusion process would require that some land be classified as irrigable to determine repayment and to receive Federal water under the six action alternatives.

2.4 Alternative 1: No Action Alternative

In this EIS, no action means that the proposed Federal action would not take place and the resulting conditions from taking no action are compared to the effects of the action alternatives. Under the No Action Alternative, Reclamation and Ecology would not replace existing groundwater supplies with CBP surface water. Currently, farmers use groundwater to irrigate about 102,600 farmland acres in the Study Area, as shown in Figure 2-6.

The No Action Alterative represents the foreseeable future if an action alternative is not implemented and groundwater levels continue to decline in the Study Area aquifers. Under the No Action Alternative, irrigated agriculture in the Study Area that currently relies on groundwater would continue using that source of water. With continued dependence on groundwater, aquifers would further decline in quantity and quality. As groundwater declines, well yield and irrigation capability will progressively diminish in the Study Area, resulting in a reduction of groundwater-irrigated acreage and crop yield.

2.4.1 Conditions under the No Action Alternative

2.4.1.1 Status of Groundwater Wells in the Odessa Subarea

Drilling groundwater wells within the Odessa Subarea, including the Study Area, began in the early 1960s, but drilling new wells essentially ended in the late 1980s. Groundwater levels in wells of the Odessa Subarea have steadily declined since substantive pumping began in the 1960s. Between 1984 and 2009, groundwater levels have declined an average of approximately 3.4 feet per year in the Odessa Study area (Reclamation 2012 Groundwater). In many cases, wells have been drilled deeper to access water, or use of wells has been discontinued. Currently, most of the groundwater wells are 800 to 1,000 feet deep, but some are as deep as 2,100 feet (see Chapter 1, Figure 1−4).

During the period from September to December 2009, the Columbia Basin Ground Water Management Area (GWMA) interviewed well operators in the Odessa Subarea concerning the current status of well use and performance (GWMA 2010 Conditions). Using this information, GWMA characterized wells into five status levels, ranging from full delivery of permitted flow rates (Status Level 1) to failure and discontinued use (Status Level 5).

GWMA Status Levels: Describing Well Performance in the Odessa Subarea

- Status Level 1: Full Permit Delivery. The well operates within its original permitted delivery levels and specifications, and has never been deepened. The well performs within acceptable levels and irrigates high water use crops (such as potatoes) through a full season without unplanned interruption.
- Status Level 2: Full Permit Delivery, But Requiring Modifications. The well supports full permit delivery, but either has been substantially reconstructed or has had conservation measures implemented since construction. Reconstruction has deepened the well shaft, lowered pump intakes, or otherwise increased efficiency to irrigate high water use crops through a full season without unplanned interruption.
- Status Level 3: Partial Permit Delivery, But Still Supports Some High Water Crop Use. The well cannot support full permit delivery, but can sustain a high water use crop through part of a season. Although functioning, the well either fails to supply the original permit volume or cannot continue that volume for an entire season.
- Status Level 4: Low Permit Delivery and No Support of High Water Crop Use. The well has a low yield through the full season and cannot support high water use crops, even on reduced acreage. It can supply shorter season crops (such as wheat or peas), because these crops do not require irrigation after July 1.
- Status Level 5: Discontinued Use. The owner has discontinued use of a well, will not use it for any reason, and has chosen to not reconstruct or drill deeper.

The five status levels represent the life cycle of production wells in the Odessa Subarea. Wells were originally constructed for full permit delivery (Status Level 1). Over time as groundwater declines, well yield and irrigation capability progressively diminish. Typically, wells drop from Status Level 1 to Status Level 2, or Status Level 2 to Status Level 3, after the less expensive well changes have been implemented. Well changes include any or all of the following measures:

- Reducing irrigated acreage.
- Rotating to a shorter irrigation season crop.
- Lowering the level of in-well pump intakes (such as pump bowls) to offset groundwater declines through the irrigation season.
- Implementing water conservation measures to increase efficiency.

After these changes, a well could be drilled deeper, if feasible and affordable, to reach additional groundwater resources at a deeper level. GWMA considers wells entering Status Level 5 to have discontinued use permanently.

In January 2010, GWMA (2010 Survey) conducted an additional survey asking well operators in the Odessa Subarea to characterize the current status of their wells relative to the five status levels. This survey also asked well operators, if faced with well deepening as the only solution to water level decline, whether they intend to deepen their wells, or instead would reduce system use to shorter season or supplemental use only. Finally, the survey asked well operators to estimate what year current well use would be reduced to shorter season or supplemental use only.

GWMA estimates that only 5 percent of the wells in the Odessa Subarea currently operate within original permitted delivery levels and well specifications (Status Level 1), as shown on Table 2-4. GWMA estimates that about 30 percent of the wells deliver full permit capacity after implementation of substantial well reconstruction or conservation measures (Status Level 2). Conversely, GWMA estimates that 5 percent of wells have had their use discontinued (Status Level 5), with the remaining 60 percent of wells operating at less-than-permitted levels and providing limited, if any, support to high water use crops (Status Levels 3 and 4).

GWMA's assessment of well decline is generally supported by observations of groundwater decline based on measured data obtained from known, reliable well records (see further discussion in Sections 3.3 and 4.3 – *Groundwater Resources*). In addition for the Final EIS, a review of groundwater analysis was conducted and information from USGS 2010 report was used to verify assumption for well depths and rate of decline between 1984 and 2009 (Reclamation 2012 Groundwater).

Table 2-4. Estimated status of wells in the Odessa Subarea under current conditions and in the future.

Well Status Levels	Percent of Wells By Status Level	
	Current [a]	Future: 10 Years (about 2020) [b]
Status Level 1: Full Permit Delivery	5	5
Status Level 2: Full Permit Delivery, But Requiring Modifications	30	10
Status Level 3: Partial Permit Delivery, But Still Supports Some High Water Crop Use	30	15
Status Level 4: Low Permit Delivery and No Support of High Water Crop Use	30	15
Status Level 5: Discontinued Use	5	55

[a] Based on GWMA (2010 Survey) survey results. Assumed percent of wells equals percent of acres.

[b] Estimated by Reclamation's Economics and Resource Planning Group based on GWMA (2010 Survey) survey results as described further in Chapter 4, *Environmental Consequences*, Section 4.15 – *Irrigated Agriculture and Socioeconomics*.

2.4.1.2 Future Risks Posed by Groundwater Conditions in the Odessa Subarea

As a result of the current conditions of groundwater decline in the Odessa Subarea, including the Study Area, the ability of farmers to irrigate their crops is at risk. Domestic, commercial, municipal, and industrial uses, as well as water quality, are potentially affected. Farmers irrigating with wells live with uncertainty about future well production. If no action is taken, GWMA (2010 Survey) estimates that wells would drop into lower status levels at a rate of 10 percent per year. Using current well status levels and the estimated rate of decline from GWMA (2010 Survey), along with other local information on agricultural trends and practices, Reclamation's Economics and Resource Planning Team[4] conducted an analysis of future conditions of well status and associated cropping patterns in the Study Area under a No Action Alternative. The methods and results of this analysis are described in Chapter 4, *Environmental Consequences*, Section 4.15 – *Irrigated Agriculture and Socioeconomics*.

The results of the GWMA analysis indicate that the proportion of the production wells in the Study Area that support high water crop use would decline from 35 percent to 15 percent by 2020 (Status Levels 1 and 2; Table 2-4). Further, at the current rates of decline, 55 percent of the production wells in the Study Area would cease groundwater output and use of these wells would be permanently discontinued in 10 years. The remaining 30 percent of wells would operate at lower-than-permitted water delivery levels that would provide limited or no support for high water use crops (Status Levels 3 and 4; Table 2-4).

Several factors would continue to cause disincentive for or the inability of most well owners and operators to deepen wells. As a result, these factors would lead to a continuing trend of wells dropping into lower-than-permitted water delivery levels (Status Levels 3 and 4) or discontinued use (Status Level 5) as estimated by GWMA. These factors include the following:

- **Unreliable Groundwater Quantity from Deeper Zones**. Some of the recently-deepened wells have failed to deliver sufficient quantities of water, while others are performing, but are declining in static water level each season. The deeper zones consist of older water that has resided in these zones for a very long time (thousands of years), indicating little or no active recharge. Therefore, the prospect of deepening to low or no-recharge zones discourages investment in deeper wells.
- **Impaired Water Quality in Deeper Zones**. Deep groundwater is older water with undesirable qualities, such as high pH, high salinity, high mineral content, and warm temperature. Sustained use of such water risks damaging irrigated crops and soils.

[4] The Reclamation Technical Service Center's Economics and Resource Planning Group in Denver, Colorado, provides expertise on the social and economic aspects of water resource planning, development, and management. Their expertise includes agricultural economics and financial analyses, and associated socioeconomic effects on local and regional communities and service industries.

- **Uneconomical Pumping Limits Reached**. Most of the wells in the Odessa Subarea have lowered their in-well pump intakes as low as possible to achieve effective pumping. Pump intakes set below 900 feet are less effective because the pressure required to bring the water to the surface is beyond the performance capability of current economical pump equipment. Additionally, the electrical power required for 900-foot lifts is substantial (GWMA 2010 Conditions).
- **High Cost of Well Deepening**. At present, drilling deeper means going down 2,500 to 3,000 feet to reach additional groundwater resources at a deeper level. This is estimated to cost $700,000 to $1,000,000 per well (GWMA 2010 Conditions).

Drilling new groundwater wells is not a feasible solution to augment or replace existing irrigation water needs. New wells would be subject to the same future uncertainties as existing wells with declining groundwater levels in Study Area aquifers. In addition, the State is not issuing new water rights that would be required for new wells.[5]

2.4.1.3 Other Uses of Groundwater in the Study Area

Aquifers in the Odessa Subarea also supply commercial, domestic, M&I, and industrial users in and near the Study Area. For example, the cities of Moses Lake and Ritzville, the towns of Hatton and Wilson Creek, and numerous food processing and other agriculture-related businesses in Connell, Moses Lake, Othello, and Warden rely on this groundwater.

Under the No Action Alternative, irrigation groundwater would not be replaced with surface water, aquifers would continue to decline, and all current commercial, domestic, M&I, and industrial users would be affected in and near the Study Area.

2.4.1.4 Other Water Management Programs and Requirements

Under the No Action Alternative, operations at Lake Roosevelt and Banks Lake would continue as they now occur. Lake Roosevelt would release water to meet authorized purposes, including water delivery for irrigation, municipal, and industrial uses, flood control, hydropower, recreation, and fish management. Water from Lake Roosevelt to the CBP would be lifted via the Keys Pump-Generating Plant to Banks Lake. Banks Lake would serve as a reregulation reservoir for the irrigation portion of the CBP, and water would be delivered to CBP lands through the Main Canal headworks at Dry Falls Dam.

Since 2000, adjustments have been made in Banks Lake operations to leave more water in the Columbia River during the summer for fish flow augmentation. Under the No Action

[5] New wells may be drilled and operated using the state's groundwater exemption provisions, but the exemption only applies for livestock watering, noncommercial lawn and gardens (up to 0.5 acre in size), and domestic uses up to 5,000 gallons per day.

Alternative, this adjustment would continue, whereby pumping from Lake Roosevelt to Banks Lake would be reduced in August by 5 feet to provide for summer fish flow augmentation in the Columbia River below Grand Coulee Dam.

Under the No Action Alternative, Reclamation's current water supply obligations related to the CBP would continue. Specific to the Study Area, CBP water would be provided to 16,864 acres under existing water service contracts through the ECBID. For existing water service contracts in the Odessa Subarea, contract holders pump directly out of the East Low Canal at 34 locations. This condition, characterized by individual, unscheduled starts and stops of pumps, decreases system efficiency and can adversely affect ECBID's ability to meet delivery commitments downstream. The No Action Alternative would not address this condition.

A specific provision of the Management Program being implemented by Ecology (as described in Section 2.2.3 – *Water Management Programs and Requirements Common to All Alternatives*) is to pursue the development of water supply alternatives to groundwater for agricultural users in the Odessa Subarea, among other priorities (Section 90.90.020 of Chapter 90.90 RCW). Action on this specific provision, however, would not proceed further under the No Action Alternative, since this Study is the direct response to this particular provision. As a result, the No Action Alternative would fail to meet this specific provision of Chapter 90.90 RCW.

Under the No Action Alternative, two other specific activities of the Management Program would occur within the Study Area:

- The Coordinated Conservation Program (as described in Section 2.2.3) would continue to implement conservation efforts to create water savings in the Study Area to reduce the use of groundwater for existing irrigation. Such actions and water savings would continue under the No Action Alternative.
- The Lake Roosevelt Incremental Storage Releases Program (as described in Section 2.2.3 and Table 2-3) would continue to implement incremental storage releases from Lake Roosevelt to supplement water supplies to benefit both instream and out-of-stream uses.

2.5 Partial Groundwater Irrigation Replacement Alternatives

The partial replacement alternatives, Alternatives 2A and 2B, would provide CBP surface water supply to approximately 57,000 acres of lands in the Study Area south of I-90 (Figure 2-1 and Figure 2-6). The total volume of water diverted from the Columbia River with partial groundwater replacement is estimated at 138,000 acre-feet. A small portion of currently groundwater-irrigated lands north of I-90, nearest the East Low Canal, may also be included in the partial replacement alternatives. As the surface water supply system is brought online and this water becomes available to eligible lands, the intent would be to cease operation of associated irrigation wells. Under current State regulations, the irrigation wells would not be decommissioned or abandoned. Instead, superseding state water rights would be issued and the wells would be placed in standby status, remaining operational for use in an emergency (such as an interruption of the Federal surface water delivery system). Any different scenario or mandatory decommissioning would require that the statute to be modified.

Alternatives 2A and 2B would involve the same water delivery system facilities and the same quantity of water. The delivery system would involve enlarging and extending the East Low Canal and constructing a distribution system. The alternatives vary only in the option used to store and supply CBP water.

2.5.1 Alternative 2A: Partial—Banks

The main aspects of Alternative 2A: Partial—Banks are illustrated on Figure 2-7. As shown on the diagram, these aspects include providing water supply from Banks Lake (1), delivered through the East Low Canal (2) to currently groundwater-irrigated lands south of I-90. Major facility development associated with this alternative would be limited to enlargement and extension of the East Low Canal south of I-90 and installation of a distribution system to deliver the water from the canal to farmlands.

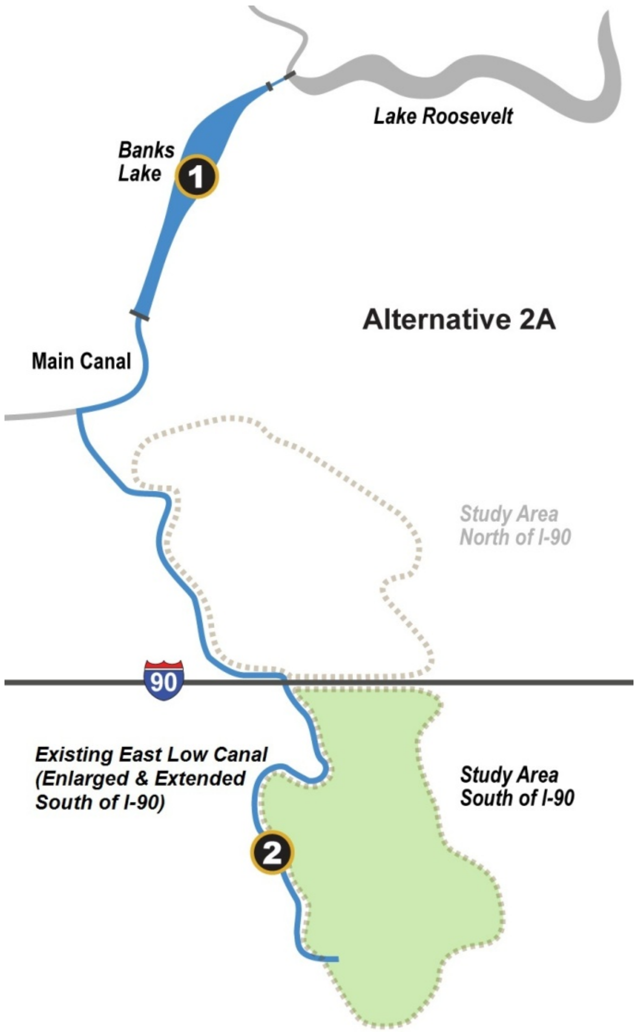

Figure 2-7. Diagram of Alternative 2A: Partial – Banks.

2.5.1.1 Water Supply

Water for the partial replacement alternatives would come from available Columbia River flows and additional drawdown of Banks Lake. Banks Lake water would be released into the Main Canal from Dry Falls Dam and diverted to the East Low Canal.

The additional drawdown of Banks Lake would be 2.3 feet (4.6 feet for Limited Spring Diversion Scenario) in an average year, beyond the 5 feet of drawdown for summer fish flow augmentation in August that is part of the No Action Alternative. The total average-year maximum drawdown would be 7.3 feet (9.6 feet for Limited Spring Diversion Scenario) at the end of August (Figure 2-2 and Figure 2-3).

Banks Lake would be refilled as soon as practicable after the irrigation season, subject to any constraints imposed by Columbia River instream flow or operational requirements.

No construction or modification of facilities is required at Banks Lake under Alternative 2A: Partial—Banks.

2.5.1.2 Delivery System

Facility Descriptions

The water delivery system necessary for Alternative 2A: Partial—Banks and 2B: Partial — Banks + FDR is shown on Figure 2-8. Facility development would include the following:

- Enlarging the capacity of the 43.3 miles of the East Low Canal south of I-90, including adding a second barrel to all five existing siphons.
- Extending the East Low Canal about 2.1 miles at its southern end.
- Constructing a pipeline distribution system fed by pumping plants along the canal and a gravity-feed turnout at mile 89. This system would require numerous meter and equipment stations along the pipeline routes, primarily at farm delivery points.

Other related requirements include the following:

- Potential reconstruction of some existing road bridges over the East Low Canal.
- Crossing of one local road by the East Low Canal extension.
- A new operations and maintenance (O&M) facility (Figure 2-8).
- Additional easement width along the existing Weber wasteway.
- New electric transmission lines to each pumping plant and the O&M facility.

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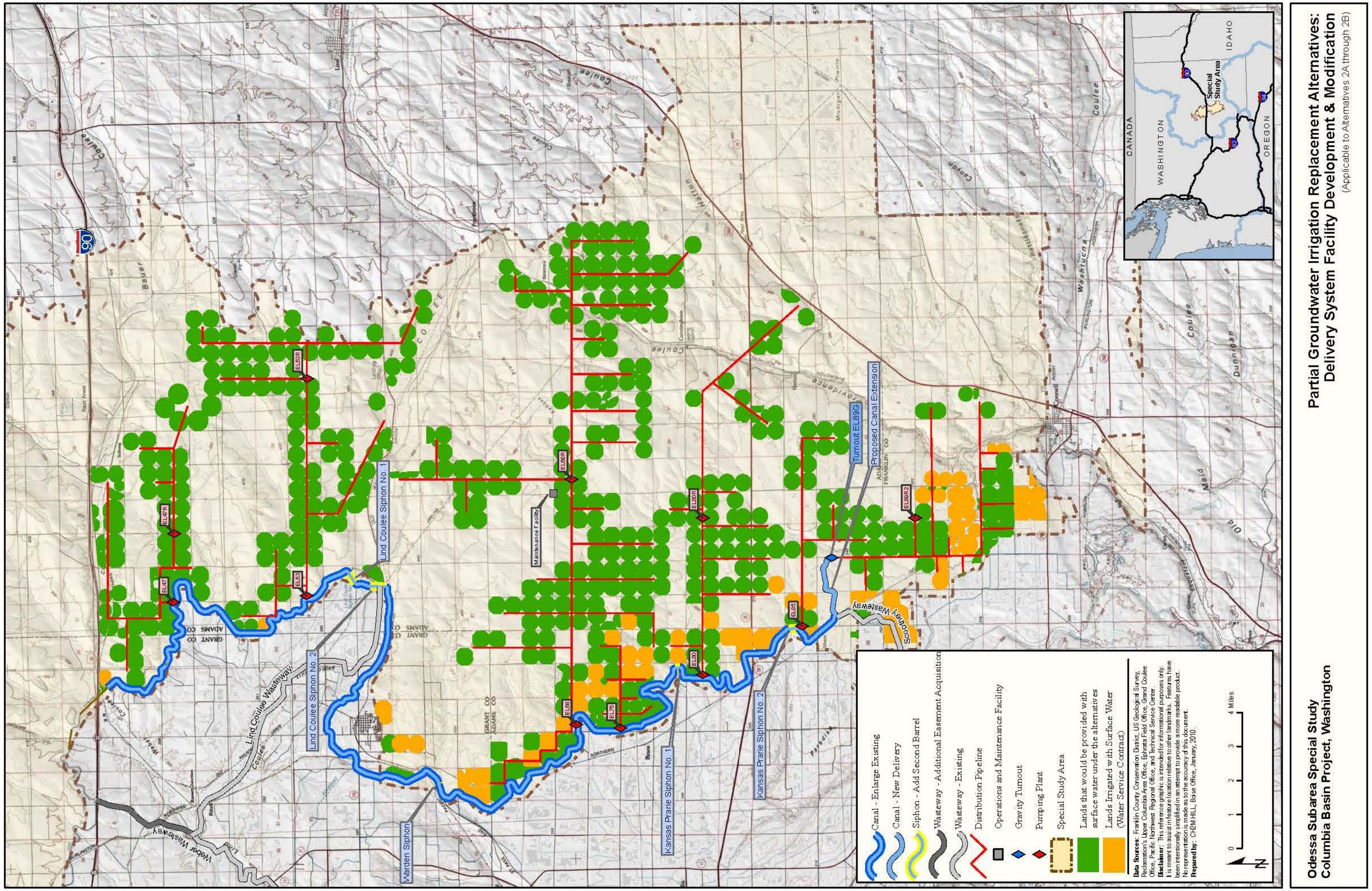

Figure 2-8. Partial groundwater irrigation replacement alternatives – delivery system facility development and modification.

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Each of these facilities is described below in Table 2-5 which provides a summary listing, including information on facility quantities and land requirements.

Table 2-5. Partial replacement alternatives – delivery system facility requirements.

Facility/Action	Quantity	Land Interest Acquisition Required	
		Type	Quantity
East Low Canal			
- Enlargement	43.3 miles	*NA--Within existing easement*	
- Extension	2.1 miles	Easement	200 feet wide
- Siphons--Add second barrel to all 5 existing	1.5 miles	*NA--Within existing easement*	
Weber Wasteway—Additional Easement Acquisition	3.0 miles	Easement	350 feet wide [a]
Pumping Plants			
Canalside Plants (along East Low Canal)	6 Sites	Fee	3 acres each
(EL47, 53, 68, 75, 80 & 85)			
Relift Plants (EL47R, 53R, 68R, 80R, & 89R2)	5 sites	Fee	3 acres each
Gravity Turnout (EL89G)	1 site	Fee	2 acres
Distribution Pipeline < 24-inch pipe	83.2 miles	Easement	100 feet wide
Distribution Pipeline > 24-inch pipe	78.1	Easement	200 feet wide
Pipeline Meter/Equipment Sites	TBD [b]	*NA—2500 square feet within pipeline easement*	
Electric Transmission Lines [c]	84 miles	Easement	100 feet wide
Road Crossings			
- Existing bridges over East Low Canal —Reconstruct	NA[d]	*NA—Within road easement and canal easement*	
- Road Crossings By New Canal [e]	1 location		

[a] Existing Weber Wasteway easement width varies but averages 250 feet (125 feet on each side of the channel); Reclamation would acquire an additional 175 feet on each side, to bring total easement width to 600 feet.

[b] To Be Determined: Number and location not determined at this level of planning; all would be within pipeline easements.

[c] Electric power supply would be needed at each pumping plant and the operations and maintenance facility. Supplying this power would require construction of new transmission lines. For the Partial Replacement alternatives, it is expected that power would be brought to facilities from the Moses Lake area. Given this projected source, total distance of new transmission lines required is estimated to be 84 miles. The locations and routes for these new transmission lines would be determined during future design phases.

[d] Some existing road bridges across the East Low Canal may need to be lengthened/reconstructed to accommodate East Low Canal enlargement. Any such requirements would be defined during more detailed planning (see Transportation discussion in Section 4.16 – of the EIS).

[e] The East Low Canal extension would cross one existing road. Through traffic on this road would be closed.

NA: Not applicable

East Low Canal Enlargement

The existing earth-lined, 43.3-mile section of the East Low Canal south of I-90 to the Scootney Wasteway was constructed at 23 to 46 percent of design capacity; design capacity was determined based on potential full development of the CBP, as described in the 1989 Draft EIS for continued phased development of the CBP (Reclamation 1989). The five siphons along this reach of canal are also below design capacity, as they were constructed with one barrel (pipe), rather than the two barrels necessary to achieve full capacity.

Beyond these limitations, many aspects of East Low Canal development anticipated the potential for future expansion in their design and construction. Sufficient easement width was acquired to allow for canal expansion and the addition of the second siphon barrels. Siphon transitions, check structures, drainage inlets, cross-drainage facilities, and many of the roadway and other bridge crossings were built to accommodate full capacity.

Actions required along the East Low Canal south of I-90 for Alternative 2A: Partial—Banks 2B: Partial—Banks + FDR would include the following:

- Widening the canal to increase its capacity to that needed for the proposed groundwater irrigation replacement. Figure 2-9 presents a typical cross-section of this widening work, which would be accomplished within the existing canal easement. All excavated material would be placed within the existing easement and existing O&M access along the canal would be maintained, similar to the approach used for initial canal construction. Concrete lining would also be added to short sections of the canal at 29 locations.
- Adding a second barrel to each of the five existing siphons (Lind Coulee 1 and 2, Warden, and Kansas Prairie 1 and 2), as illustrated in Figure 2-10.

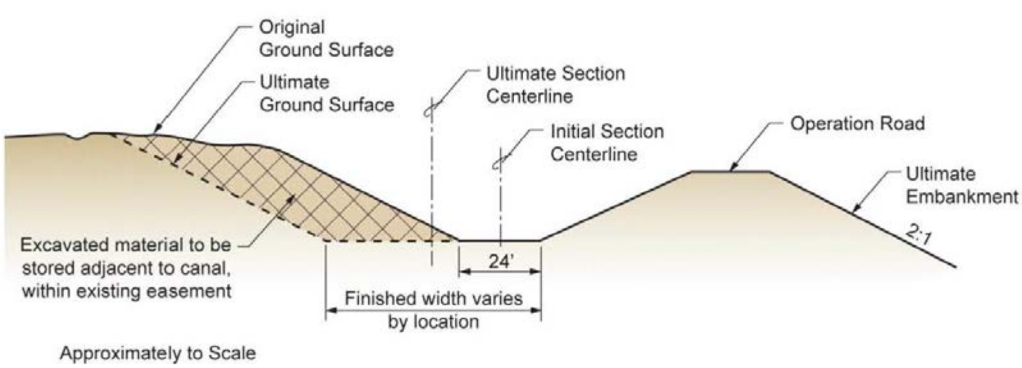

Figure 2-9. East Low Canal enlargement – typical cross section.

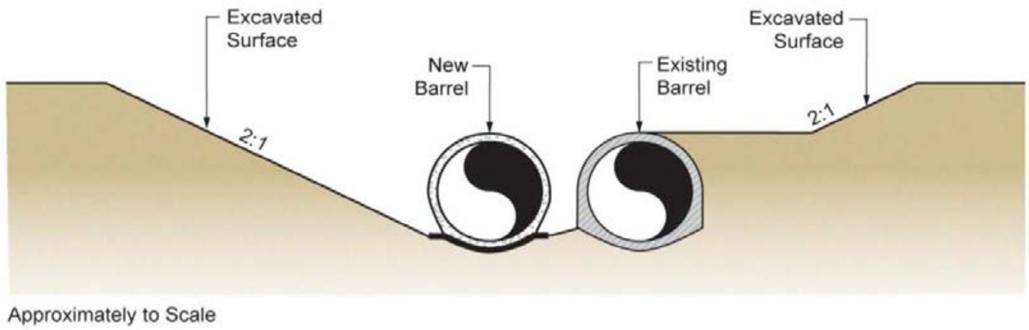

Figure 2-10. Siphon second barrel addition – typical cross section.

East Low Canal Extension

The East Low Canal would be extended approximately 2.1 miles beyond its current end. The general alignment of the extension is illustrated in Figure 2-8, and a typical cross section of the new canal is shown in Figure 2-11. Reclamation would acquire a 200-foot-wide easement to accommodate canal construction, operation, and maintenance. As with the existing East Low Canal, all excavated material would be placed within the canal easement and an access road would be developed and maintained along the full length of the new canal. This canal would be built only to the capacity needed for the proposed groundwater irrigation replacement. No new siphons, tunnels, or other major facilities would be required.

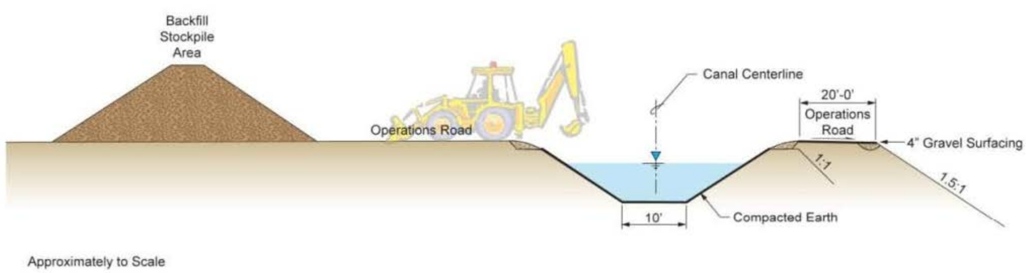

Figure 2-11. East Low Canal extension – typical cross section.

Distribution Pipeline System

CBP water from the East Low Canal would be provided by a pressurized pipeline distribution system to the groundwater-irrigated and water service contract lands south of I-90 that would be served in this alternative. The system would be pressurized by six canal-side pumping plants, five relift pumping plants, and one gravity-feed turnout to achieve 5 pounds per square inch (psi) at the highest delivery point. Metering stations would be located at numerous locations along the pipeline routes to record water deliveries. The following facilities would be included:

- **Distribution Pipelines**: The distribution system would require approximately 161.3 miles of buried pipeline. In general, as illustrated on Figure 2-8, the system is designed to locate the pipelines along section and half-section lines and deliver water to typical quarter sections. Reclamation would acquire a 200-foot-wide easement for pipeline installation and would need to retain long-term access to and within the easement for any necessary repairs or replacements. These requirements would preclude any future structure development within the easement. However, except for the locations of relift pumping plants and equipment sites described in this section, agriculture or other nonstructural uses could generally continue once the pipeline is installed and operational.
- **Canal-Side Pumping Plants**: The six canal-side pumping plants that would feed the pipeline distribution system would be located on the east side of the East Low Canal, at canal miles 47, 53, 68, 75, 80, and 85. Each plant would require about 3 acres to accommodate the pumping plant equipment (no building/structure would be involved), a 6-foot to 35-foot-tall air chamber, and an electric power substation. The entire facility would be fenced for security using chain-link topped with barbed wire. A 50-foot to 205-foot-tall regulating tank would also be necessary with each of these pumping plants; this tank would be located along the pipeline up to 2 miles from the pumping plant site. Figure 2-12 and Figure 2-13 provide a conceptual site and elevation, respectively, of these pumping plants.

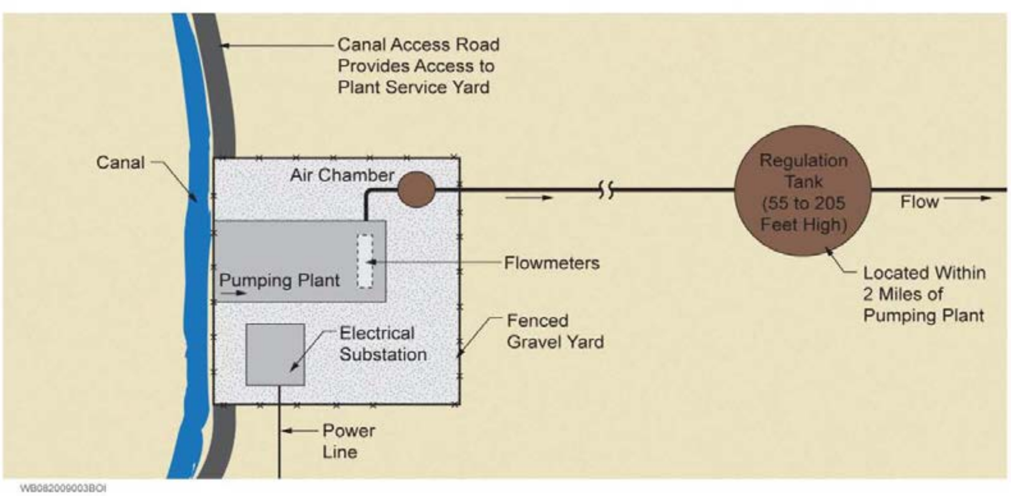

Figure 2-12. Canal side pumping plant conceptual site plan.

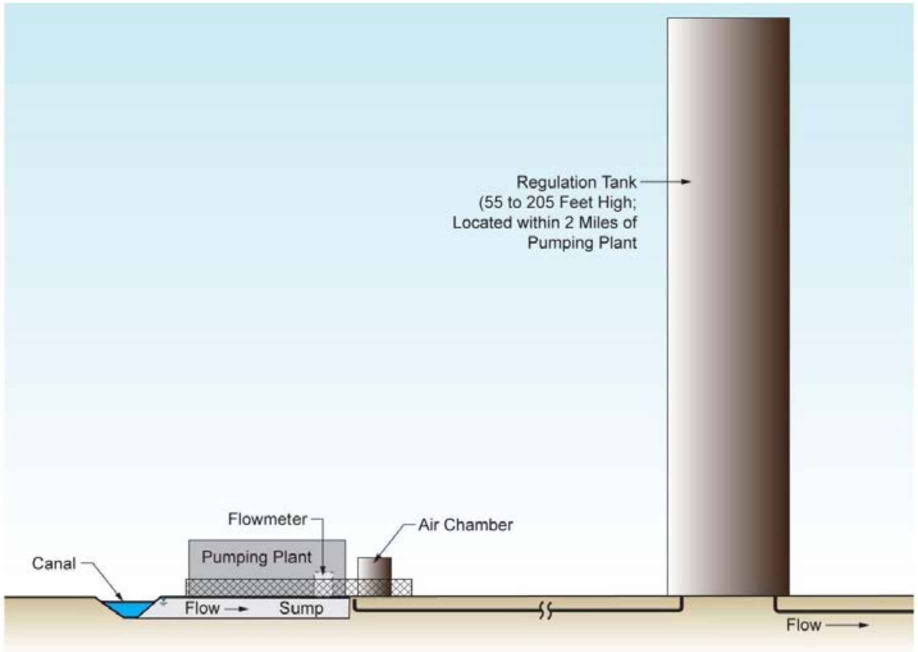

Figure 2-13. Canal side pumping plant conceptual elevation.

- **Relift Pumping Plants**: Five relift pumping plants would be required to boost pipeline pressure in the central parts of the service area to reach the eastern-most lands. The approximate locations of these plants are shown on Figure 2-8; Figure 2-14 provides a conceptual site plan. Each plant would require about 3 acres to accommodate the pumping plant equipment (as with the canal-side plants, no building would be involved), a 6- to 35-foot-tall air chamber, a 50- to 205-foot-tall regulating tank located along the pipeline up to 2 miles from the pumping plant site, and an electric power substation.

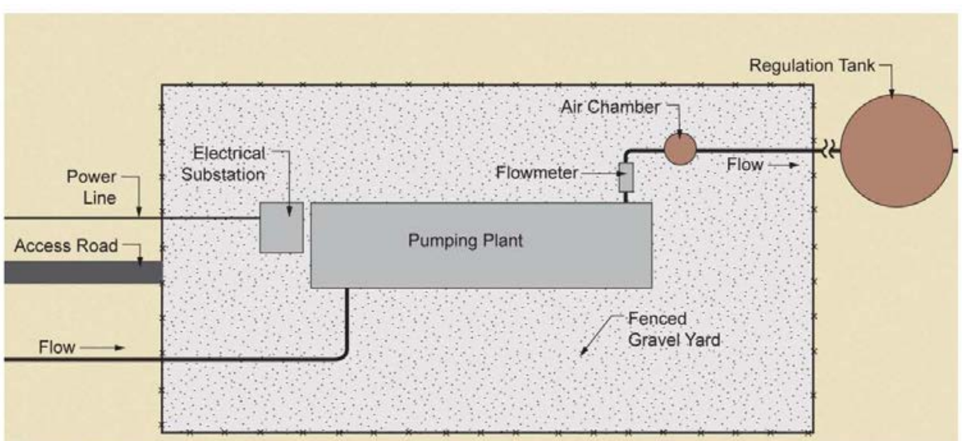

Figure 2-14. Relift pumping plant conceptual site plan.

- **Gravity Feed Turnout**: A turnout would be constructed at East Low Canal Mile 89 to deliver gravity-fed water to the pipelines serving lands at the southern end of the project area. This facility would require a 2-acre site.
- **Meter Equipment Sites**: Metering equipment would be installed at numerous locations in the water distribution pipeline system. Most of these metering sites would be located where landowners tap into the system. These sites would total approximately 2,500 square feet, all within the pipeline easement, and would be sited specifically not to interfere with existing irrigation equipment or other infrastructure. They would be placed near existing roads as much as possible.

Other Facility Requirements

- **Roadway Crossings of the East Low Canal**: Some of the existing road bridges over the East Low Canal may need to be modified to accommodate canal widening. A full review of the need for such work would be conducted during more detailed project design. In any case, it is expected that necessary modifications would remain within the existing canal and road easements.

  The East Low Canal extension would involve one new crossing of a county road. No bridge or realignment is proposed for this road. Through traffic would be rerouted to other nearby facilities (see Section 4.16 – *Transportation*).
- **O&M Facility**: An O&M facility would be built to provide support services. This facility would be approximately 7 acres in size and located at the northeast corner of South Johnson Road and West Herman Road, approximately 20 miles northeast of Othello, Washington. The main building would be 63 feet wide, 243 feet long, and 26 feet high, and would house office space, parts storage, a large maintenance shop, a welding shop, a garage area for large maintenance vehicles, and a covered outdoor storage area. Other features of the site would include two above-ground bullet-resistant double walled tanks for storage of diesel and gasoline fuel, a propane tank surrounded by concrete masonry walls, and an uncovered outdoor storage area. Much of the site would serve as a service yard for vehicle access and parking. Electrical service would need to be extended to the site. Water supply would be from a new well, and wastewater would be managed with a septic system. The entire facility would be fenced for security, using chain-link topped with barbed wire. A conceptual site plan of the facility is shown in Figure 2-15.

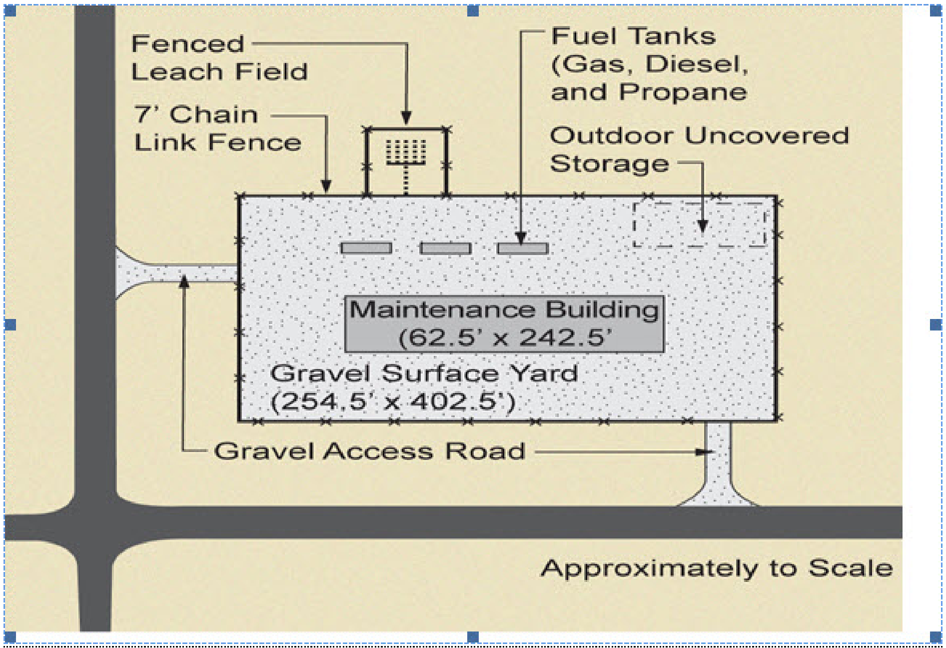

Figure 2-15. O&M facility conceptual site plan.

- **Additional Easement Width—Weber Wasteway**: The 3-mile-long constructed channel of the existing Weber Wasteway (shown on Figure 2-8) has deteriorated over time. Rather than reconstruct the channel, Reclamation would propose to acquire additional easement width to accommodate continued operation using a natural unconstructed channel. Currently, the Reclamation easement along the wasteway averages 250 feet in width (125 feet from the channel centerline on each side); an additional (average) 175 feet easement would be acquired on each side of the channel, expanding total easement width to 600 feet. This acquisition would occur along the full 3 miles of the constructed channel alignment.
- **Electric Transmission Lines:** High voltage electric power (currently estimated at 34.5 kilovolt) would need to be provided at each of the canal side and relift pumping stations, as well as at the O&M facility. New transmission lines would be needed to supply most, if not all of these facilities. The lines would be wood pole facilities, constructed in a 100-foot-wide easement. At the present stage of project planning, the locations and routes of these transmission lines have not been determined. However, it is expected that power would be brought from the Moses Lake area, with the requirement for new transmission lines estimated at 84 miles. During more detailed planning, these lines would be routed to reduce creation of new corridors in the landscape and to minimize impact on existing land uses by following existing power lines, roadways, railroads, or other existing linear infrastructure wherever possible.

- **Access Roads**: Few, if any, permanent new access roads would be required outside of the existing and facility easements and acquisition areas associated with this alternative. Existing operations and maintenance roads along the East Low Canal would be retained and similar roads would be built along the East Low Canal extension; these roads would be used to access the canal-side pumping plants and the gravity turnout facility. For the relift pumping plants and the O&M facility, locations with existing road access would be selected to the extent feasible; however, short distances of new access road may be needed for some relift plants.

  Access to distribution pipeline and power line alignments would be with existing roads or along the facility easements, as necessary. For pipeline and power line alignments, regular access would be necessary only during construction. There may be some need to use existing farm field roadways (trails) occasionally to access pipelines for appurtenant structure (air valve or blowoff) repair; any such use would be coordinated with the involved landowners.

Construction

Duration and Phasing

Development of the delivery system for Alternatives 2A and 2B would be divided into four phases, spanning a total of approximately 10 years, as shown on Figure 2-16. Each construction phase would last 3 to 4 years, with work on two or more phases overlapping at times. Construction would be conducted in phases to spread the work as evenly as possible throughout the 10-year construction period and bring the delivery system online in stages, as early as possible.

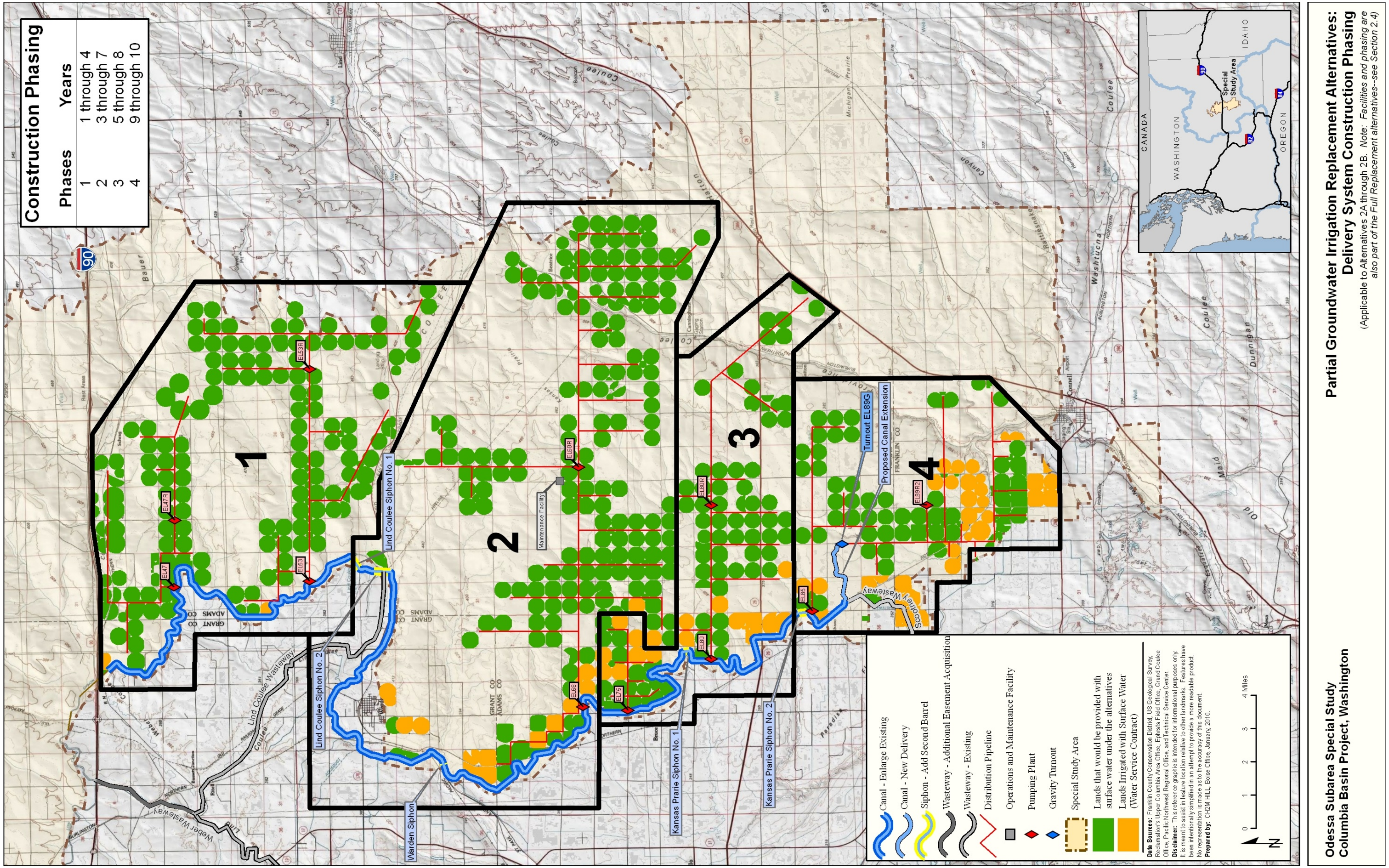

Figure 2-16. Partial groundwater irrigation replacement alternatives – delivery system construction phasing.

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Construction Workforce, Activities, Equipment, and Other Requirements

The total workforce requirement for construction of the delivery system for Alternative 2A and 2B is expected to be approximately 120 to 130 personnel at the peak level of activity, which would occur in the latter half of the construction period concurrent with work on multiple phases.

Construction activity, and thus deployment of the workforce, would occur at multiple locations simultaneously in each phase, and move progressively through the area identified for each phase. Worksites would include:

- Along the East Low Canal (widening or extension).
- Existing siphons (adding a second barrel).
- Pumping plant(s), including associated electric substations.
- Distribution pipeline alignments.
- Transmission line alignments.
- O&M facility.

Major construction in any given area is not expected to extend beyond a year and, in many cases, would be of substantially shorter duration. Work on the existing East Low Canal would be outside of the irrigation season to avoid disruption of existing water operations.

Access for facility construction would be primarily from existing public roads, Reclamation O&M roads along the East Low Canal, or temporary roads along distribution pipelines within the pipeline easements. Power lines would be installed along existing roads to the extent practical; where this is not feasible, temporary access roads would be needed along the power line easement.

Construction of the delivery system, especially canal widening and extension, would require use of heavy equipment including hydraulic excavators, large dozers, scrapers, cranes, and compaction equipment. Other equipment normally involved with major construction would also be employed, such as dump trucks, loaders, and delivery trucks (for concrete and other materials).

Staging areas would generally be located within canal, pipeline, and transmission line easements and at the sites of pumping plants and the operations and maintenance facility. To the extent possible, staging areas would be located at least 500 feet from a residence.

No disposal sites for excavated material are expected to be needed. All material excavated for canal enlargement and extension or for installation of pipelines and transmission lines would be stockpiled within the facility easements or backfilled, as appropriate.

Operation and Maintenance

Numerous activities are required to maintain irrigation system infrastructure and equipment, provide for efficient operation, and minimize unplanned outages in service. These activities include regular inspections, debris removal, cleaning, painting, resurfacing, and equipment maintenance, repair, and replacement. Collectively, these activities would not require a large workforce and only minimal use of heavy equipment. All such activities would be carried out by involved irrigation districts.

2.5.2 Alternative 2B: Partial—Banks + FDR

The primary elements of Alternative 2B: Partial—Banks + FDR are illustrated on Figure 2-17. As shown on the diagram, these aspects include providing water supply from Lake Roosevelt (1) and Banks Lake (2) delivered through the East Low Canal (3) to currently groundwater-irrigated lands south of I-90. As with Alternative 2A: Partial—Banks, major facility development would be limited to enlargement and extension of the East Low Canal south of I-90 and installation of a distribution system to deliver the water from the canal to farmlands.

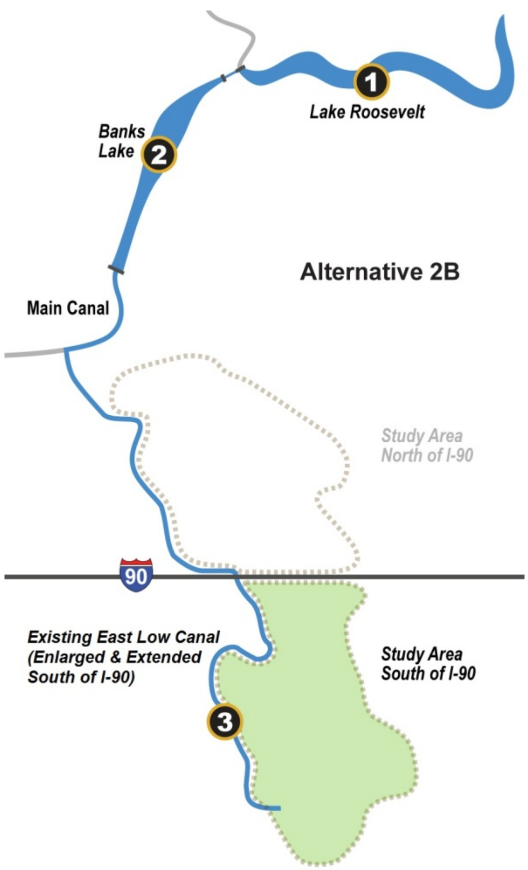

Figure 2-17. Diagram of Alternative 2B: Partial –Banks + FDR.

2.5.2.1 Water Supply

Water for this alternative would come from available Columbia River flows and additional drawdown of both Lake Roosevelt and Banks Lake. Water from Banks Lake would be released into the Main Canal from Dry Falls Dam and diverted to the East Low Canal.

The additional drawdown of Banks Lake under this alternative would be 2.3 feet (3.0 feet for the Limited Spring Diversion Scenario) in an average water year, beyond the 5 feet of drawdown for summer fish flow augmentation that is part of the No Action Alternative. The total average-year maximum drawdown at Banks Lake would be 7.3 feet (3.0 feet for the Limited Spring Diversion Scenario) at the end of August (Figure 2-2 and Figure 2-3).

The additional drawdown of Lake Roosevelt under this alternative would be 0 feet (0.5 feet for Limited Spring Diversion Scenario) in an average water year, beyond the No Action Alternative. The total average-year maximum drawdown at Lake Roosevelt would be 11.0 feet (11.5 feet for Limited Spring Diversion Scenario) at the end of August (Figure 2-2 and Figure 2-5). [6]

Reservoir refill would occur first for Lake Roosevelt, which is required to be at water surface elevation 1283 feet amsl by the end of September. Banks Lake would then be refilled as soon as practicable subject to any constraints imposed by Columbia River instream flow or other operational requirements.

No construction or modification of facilities is required at either Lake Roosevelt or Banks Lake under Alternative 2B: Partial—Banks + FDR.

2.5.2.2 Delivery System

Delivery system facility requirements, construction, and O&M for this alternative would be the same as those described in Section 2.5.2 – *Alternative 2A: Partial—Banks*.

2.6 Full Groundwater Irrigation Replacement Alternative

Full replacement alternatives would provide CBP surface water supply to replace existing groundwater supply for most lands in the Study Area now irrigated with groundwater (approximately 102,600 acres), both north and south of I-90. The total volume of water diverted from the Columbia River would be approximately 273,000 acre-feet. As the surface

[6] For 50 percent of the average water years, FDR would draft 11 feet and 50 percent would draft 13 feet (see Table 1-2). Based on this requirement, roughly 50 percent of the time in average water years, FDR would draft 13 feet.

water supply system is brought online and this water becomes available to eligible lands, the intent would be to cease operation of associated irrigation wells. Under current State regulations, the irrigation wells would not be decommissioned or abandoned. Instead, superseding state water rights would be issued and the wells would be placed in standby status, remaining operational for use in an emergency (such as an interruption of the Federal surface water delivery system). Any different scenario or mandatory decommissioning would require that the statute to be modified.

Each of the two full replacement alternatives would involve the same water delivery system facilities and the same quantity of water. Delivery would require all facilities described for the partial replacement alternatives, plus development of the East High Canal System north of I-90 (Figure 2-8). Each of the full replacement alternatives vary only in the option used to store and supply CBP water.

The two full replacement alternatives include the following:

- Alternative 3A: Full—Banks consisting of full replacement using the Banks Lake supply.
- Alternative 3B: Full—Banks + FDR consisting of full replacement using the Banks Lake and Lake Roosevelt supply.

The two full replacement alternatives are described in the following sections, including summaries of water supply aspects and more detailed information about required facility development.

2.6.1 Alternative 3A: Full—Banks

The primary elements of Alternative 3A: Full—Banks are illustrated on Figure 2-18. As shown on the diagram, these include providing a water supply from Banks Lake (1) delivered through the existing East Low Canal (2) and a new East High Canal system (3) to groundwater-irrigated lands north and south of I-90. Major facility development would include:

- The same East Low Canal enlargement and pressurized pipeline system south of I-90 described for partial replacement alternatives, and
- The new East High Canal system, a reregulating reservoir, and an associated pressurized pipeline distribution network.

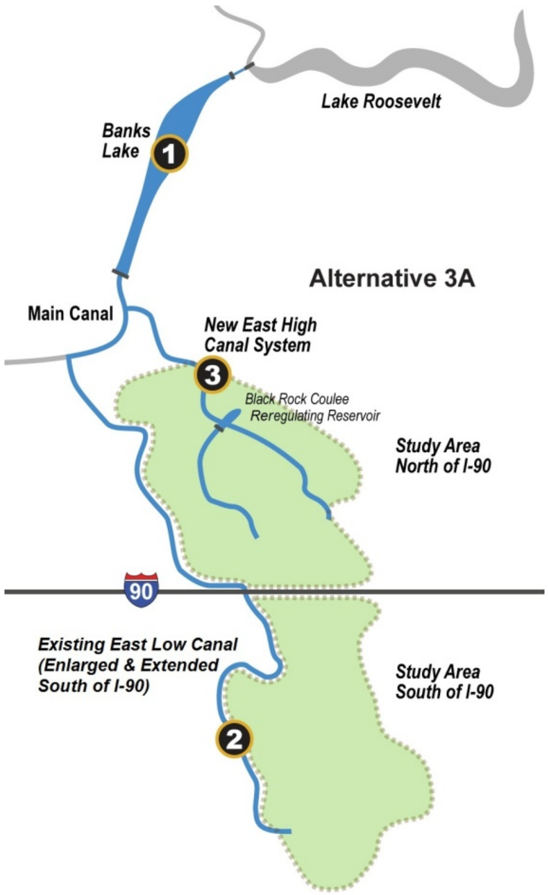

Figure 2-18. Diagram of Alternative 3A: Full – Banks.

2.6.1.1 Water Supply

Water for this alternative would come from available Columbia River flows and additional drawdown of Banks Lake. Water from Banks Lake would be released into the Main Canal from Dry Falls Dam and diverted to the East High and East Low Canals.

The additional drawdown of Banks Lake would be 5.6 feet (9.8 feet for the Limited Spring Diversion Scenario) in an average year, beyond the 5 feet of drawdown for summer fish flow augmentation that 10.6 feet (14.8 feet for the Limited Spring Diversion Scenario) at the end of August (Figure 2-2 and Figure 2-3).

Banks Lake would be refilled as soon as practicable after the irrigation season subject to any constraints imposed by Columbia River instream flow or other operational requirements.

No construction or modification of facilities at Banks Lake would be required.

2.6.1.2 Delivery System

Facility Descriptions

The water delivery system for Alternative 3A: Full—Banks would require development of all facilities described for the partial replacement alternatives under Alternative 2A: Partial—Banks (Section 2.5.1) to serve acreage south of I-90. To serve acreage north of I-90, the following additional facilities would be developed (Figure 2-19).

- 78.4 miles of new canal (including associated siphons and tunnels), comprised of the 44.8 mile East High Canal and the 26.8 mile Black Rock Branch Canal.
- Four new wasteway channels, 2.8 miles long, to manage canal flow.
- A reregulating reservoir in Black Rock Coulee (Black Rock Coulee Reregulating Reservoir), including a pumping plant to lift water from the reservoir to the Black Rock Branch Canal.
- A pipeline distribution system involving 187.3 miles of pipeline fed by 15 pumping plants and 3 gravity turnout facilities along the East High and Black Rock Branch Canals, and 3 relift pumping plants (2 associated with the East High Canal and 1 associated with the Black Rock Branch Canal).

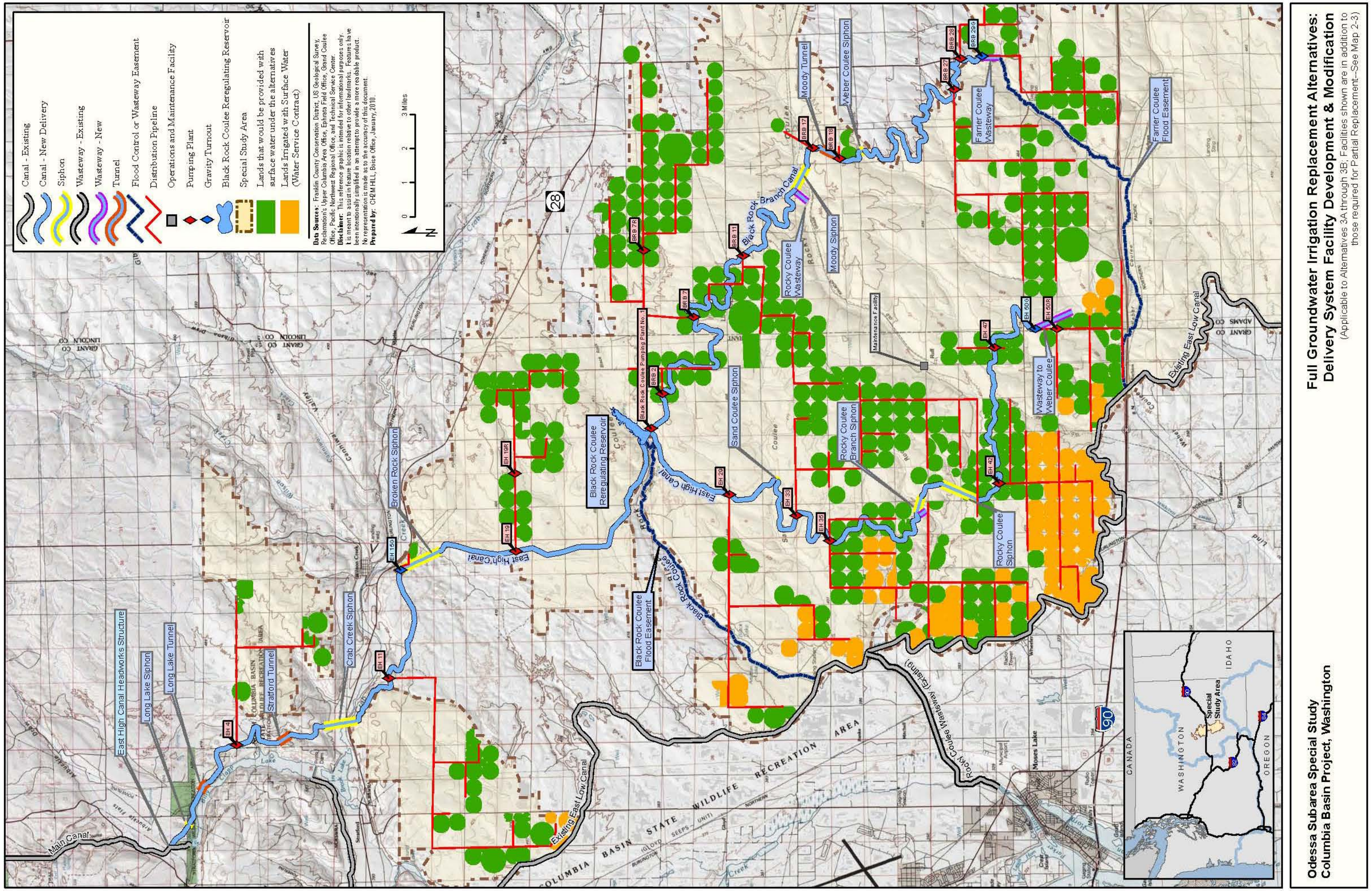

Figure 2-19. Full groundwater irrigation replacement alternatives: delivery system facility development and modification.

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Other related requirements include the following:

- Approximately 60 crossings of existing roadways and one crossing of an existing railroad by new canal.
- Limited instances and lengths of new, long-term access roads.
- Eleven wildlife crossings.
- Wildlife escape ramps at each canal check structure, at all siphon and tunnel portals, and along concrete lined canal reaches.
- A new O&M facility (Figure 2-19).
- New electric transmission lines to each pumping plant and the O&M facility.

Canals

Under Alternative 3A: Full—Banks, 71.6 miles of new canal would be required to serve groundwater-irrigated lands north of I-90. This canal would be constructed in three main reaches: East High Canal north of the reregulating reservoir (21.4 miles), East High Canal south of the reregulating reservoir (23.4 miles), and Black Rock Branch Canal originating at the reregulating reservoir (26.8 miles). These distances do not include associated siphon and tunnel reaches along the canal alignments.

The East High Canal would be concrete lined. Most of the Black Rock Branch Canal would be earth lined because the native soils along the canal alignment can be compacted to serve as canal lining with minimal seepage. In the limited instances where this is not the case, concrete lining would be installed. This new canal would be constructed within a 200-foot easement, with all material excavated for the canal deposited within the easement. A typical cross-section of the canal is shown in Figure 2-20.

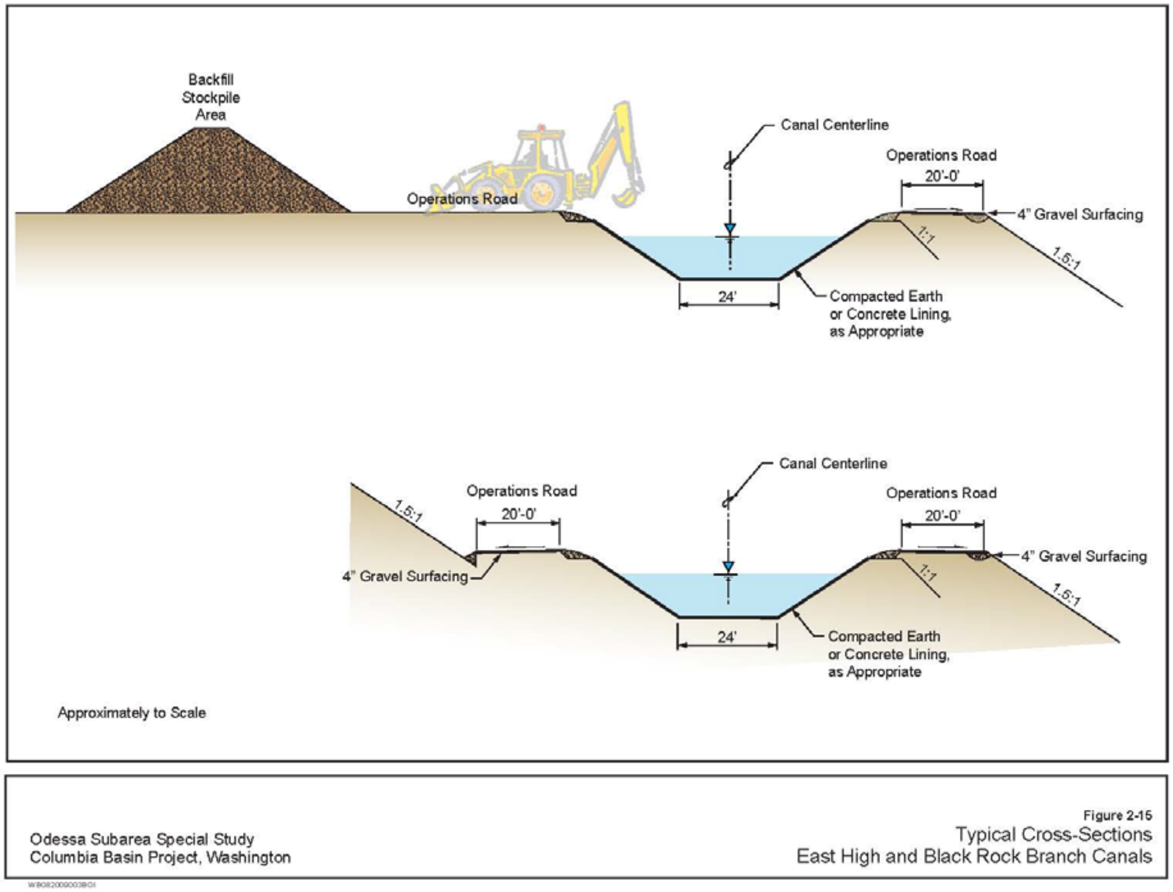

Figure 2-20. Typical cross-section East High and Black Rock Branch canals.

The new canal would not be constructed to the full capacity that would be needed to serve full development of the CBP if a decision is made in the future to pursue full CBP development. Instead, for the purposes of the full replacement alternative, the canal would be built to approximately 15 percent of full capacity which is the size necessary to serve groundwater-irrigated lands in the Study Area.

As part of East High Canal and Black Rock Branch Canal development, a bifurcation along the Main Canal (the East High Canal Headworks Structure) would be needed, as well as eight siphon and three tunnel sections. The locations of these facilities along the canals are shown on Figure 2-19. Table 2-6 lists the facilities, including information on quantities and land requirements.

Table 2-6. Full replacement alternatives – delivery system facility requirements.

Facility/Action	South of I-90 (Figure 2-8)	North of I-90 (Figure 2-19)	Total	Land Interest Acquisition Required	
				Type	Quantity
Canals					
East Low Canal (primarily enlargement)					
- Enlargement	43.3 miles	-	43.3 miles	*NA—Within existing easement*	
- Extension	2.1 miles	-	2.1 miles	Easement	200 feet wide
- Siphons--Add second barrel to all 5 existing	1.5 miles	-	1.5 miles	*NA—Within existing easement*	
East High Canal System (new facilities)					
- Headworks Structure	-	1 site	1 site	*NA—Within canal easements*	
- New Canal	-	71.6 miles	71.6 miles	Easement	200 feet wide
East High Canal North Reach	-	21.4 miles			
East High Canal South Reach	-	23.4 miles			
Black Rock Branch Canal	-	26.8 miles			
- New Siphons (8)	-	5.5 miles	5.5 miles	Easement	200 feet wide
- New Tunnels (3)	-	1.3 miles	1.3 miles	Easement	200 feet wide
Wasteways-Constructed Channels					
Existing (Weber)—Additional Easement Acquisition	3.0 miles		3.0 miles	Easement	350 feet wide[a]
New		2.8 miles	2.8 miles	Easement	200 feet wide
- To Weber Coulee from East High Canal		1.3 miles			
- To Rocky Coulee from East High Canal		0.3 miles			
- To Rocky Coulee from Black Rock Branch Canal		0.5 miles			
- To Farrier Coulee from Black Rock Branch Canal		0.6 miles			
Drainage/Flowage Easements					
Black Rock Coulee		6.0 miles	6 miles	Easement	1,200 feet wide

Facility/Action	South of I-90 (Figure 2-8)	North of I-90 (Figure 2-19)	Total	Land Interest Acquisition Required	
				Type	Quantity
Farrier Coulee		13.2 miles	13.2 miles	Easement	1,200 feet wide
Reservoir					
Black Rock Coulee Reregulating Reservoir	-	1300 acres	1,300 acres	Fee	1,300 acres
Pumping Plants					
Black Rock Coulee Pumping Plant 1 (water from reregulating reservoir to Black Rock Branch Canal)		1 site	1 site	*NA—Within reregulating reservoir acquisition area*	
Canalside Pumping Plants (distribution system)	6 sites	15 sites	21 sites	Fee	3 acres each
- East Low Canal (EL47, 53, 68, 75, 80 & 85)	6 sites	-	6 sites		
- East High Canal (EH4, 11,19, 29, 33, 35, 42, & 47)	-	8 sites	8 sites		
- Black Rock Branch Canal (BRB2, 7, 11, 17, 18, 27, 28)	-	7 sites	7 sites		
Relift Pumping Plants - East Low Canal (EL47R, 53R, 68R, 80R, & 89R2) - East High Canal (EH19R, 50R) - Black Rock Branch Canal (BRB7R)	5 sites 5 sites	3 sites 2 sites 1 site	8 sites 5 sites 2 sites 1 site	Fee	3 acres each
Gravity Turnout - East Low Canal (EL89G) - East High Canal (EH15G & EH50G) - Black Rock Branch Canal (BRB29G)	1 site 1 site	3 sites 2 sites 1 site	4 sites 1 site 2 sites 1 site	Fee	2 acres
Distribution Pipeline	161.3 miles	187.3 miles	348.6 miles	Easement	200 feet wide
Distribution Pipeline < 24-inch pipe	83.2 miles	10 miles	185.1 miles	Easement	100 feet wide
Distribution Pipeline > 24-inch pipe	78.1 miles	85.4 miles	163.5 miles	Easement	200 feet wide
East Low Canal	161.3 miles				

Facility/Action	South of I-90 (Figure 2-8)	North of I-90 (Figure 2-19)	Total	Land Interest Acquisition Required	
				Type	Quantity
East High and Black Rock Branch Canals		187.3 miles			
Pipeline Meter/Equipment Sites	TBD [b]	TBD [b]	TBD [b]	*NA—2500 square feet within pipeline easement*	
Electric Transmission Lines [c]	84 miles	127 miles	211 miles	Easement	100 feet wide
Road and Railroad Crossings					
Existing bridges over East Low Canal--Reconstruct	TBD [d]	TBD [d]	TBD [d]	*NA—Within road easement and canal easement*	
Road Crossings By New Canal [e]	1 location	~60 locations	~61 locations	*NA—Within road easement and canal easement*	
Railroad Crossings By New Canal [f]	-	1 location	1 location	*NA—Within road easement and canal easement*	
Wildlife Bridges	-	11 locations	11 locations	*NA—Within canal easements*	
New Access Roads	TBD [f]	TBD [f]	TBD [f]	Easement	TBD [f]

[a] Existing Weber Wasteway easement width varies but averages 250 feet (125 feet on each side of the channel); Reclamation would acquire an additional 175 feet on each side, to bring total easement width to 600 feet.

[b] To Be Determined: Number and location not determined at this level of planning; all would be within pipeline easements.

[c] Electric power supply would be needed at each pumping plant and the operations and maintenance facilities. Supplying this power would require construction of new transmission lines. As noted above for the Partial Replacement alternatives, it is expected that power would be brought to facilities south of I-90 from the Moses Lake area, requiring an estimated 84 miles of new transmission lines. For facilities north of I-90, power would be brought from Grand Coulee, with a requirement for new transmission lines estimated at 127 miles. The locations and routes for these new transmission lines would be determined during future design phases.

[d] To Be Determined: Some existing road bridges along the ELC canal may need to be lengthened/reconstructed to accommodate ELC expansion. Any such requirements would be defined during more detailed planning (See Transportation discussion in Section 4.16 of this Final EIS).

[e] New canal alignments cross existing roads at one location under the partial replacement alternatives and an estimated additional 60 locations under the full replacement alternatives. The full replacement alternatives would also involve one crossing of an existing railroad line. See Section 4.16 for discussion of how these crossings would be addressed.

[f] To Be Determined: For partial replacement alternatives, all construction and long-term access would be from existing roads, O&M roads along canals, and/or temporary roads along pipeline and transmission line easements. For full replacement alternatives, need for new roads is undetermined at this level of planning; both construction and long term access would be predominantly from existing roads, O&M roads along canals, and temporary roads along pipeline and transmission line easements.

NA: Not Applicable

- **East High Canal Headworks Structure**: This bifurcation is where water from the CBP Main Canal would be diverted to the East High Canal for delivery to all lands to be served north of I-90. This structure would include a radial gate at the upstream end of the East High Canal. A conceptual site plan of the structure is provided in Figure 2-21. This facility would be constructed entirely within the current easement of the existing Main Canal and the new 200-foot easement acquired for the East High Canal. All soil and rock material excavated for development of the bifurcation structure would be deposited within the easements.

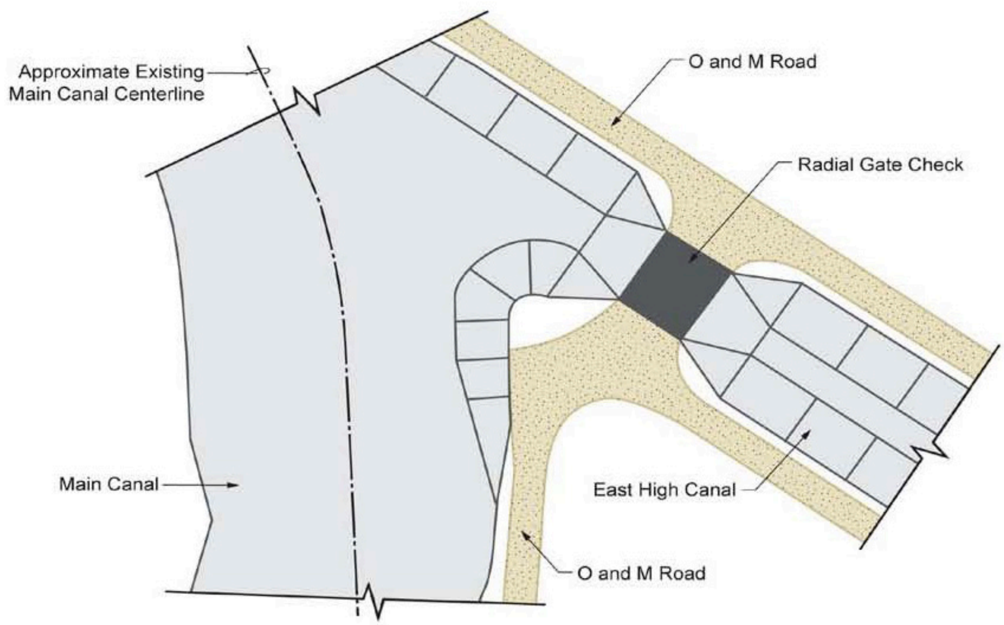

Figure 2-21. East High Canal headworks structure – conceptual site plan.

- **Siphons**: Three siphons would be constructed along the East High Canal north of the reregulating reservoir. Three would be required along the East High Canal south of the reservoir and two would be needed along the Black Rock Branch Canal. The locations of these facilities are shown on Figure 2-19. All siphons would be constructed within a 200-foot easement with all material excavated for siphon installation deposited within this easement. Figure 2-22 illustrates a typical siphon cross section.

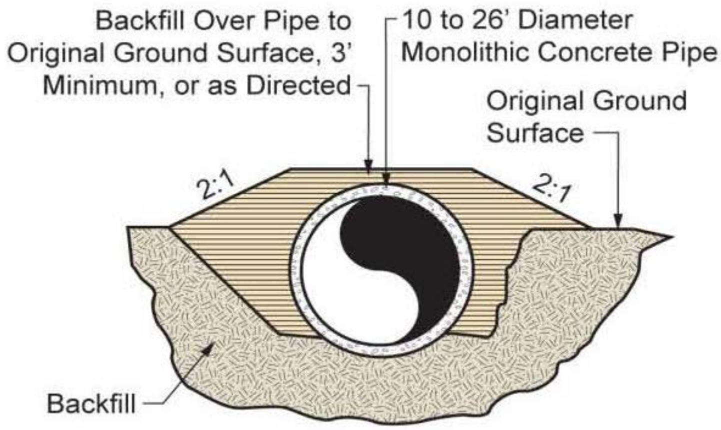

Figure 2-22. Typical siphon cross section.

- **Tunnels**: Two tunnel sections would be constructed as part of the East High Canal north of the reregulating reservoir and one would be located along the Black Rock Branch Canal. The locations of these tunnels are shown on Figure 2-19. The tunnel portals would be constructed within the 200-foot canal easement, and a 200-foot surface easement would be acquired along the tunnel alignments. Material excavated for tunnel development would be deposited within the canal easement at or near the tunnel portals.

Wasteways

Wasteways provide outlets from canals that are needed to manage water flow as demand changes, to receive return flows from irrigated lands and drains, and in case of pump equipment failure. Four wasteways would be constructed along the new canal; two along the southern portion of the East High Canal, and two along the Black Rock Branch Canal. The locations of these wasteways are illustrated on Figure 2-19. The wasteways along the East High Canal would discharge to Rocky and Weber Coulees. Those along the Black Rock Branch Canal would discharge to Rocky and Farrier Coulees. The lengths of each of these are noted on Table 2-6. Each of these wasteways would be constructed within a 200-foot-wide easement.

For the Farrier Coulee wasteway, Reclamation would also acquire a 1,200-foot-wide easement along approximately 13 miles of the natural coulee downstream of the constructed channel. This easement acquisition would be for the purposes of project operation and maintenance; additional uses of the easement land would be for fish and wildlife purposes.

Black Rock Coulee Reregulating Reservoir

A reregulating reservoir would be constructed in Black Rock Coulee to manage water delivery and distribute water to both the southern portion of the East High Canal and the Black Rock Branch Canal. The reservoir would have a storage capacity of 4,800 acre-feet, an active storage of 600 acre-feet, and a surface area of 225 acres at full pool. The reservoir dike would be a zoned earthfill embankment, approximately 50 feet high, 2,500 feet long, and 24 feet wide at its crest. Fill material for dike construction would be obtained from within the reservoir acquisition area. A conceptual site plan of the reservoir and related facilities is shown on Figure 2-23.

In its role as a reregulating reservoir, this facility would not be significantly drawn down at any point during the year. Water levels would be relatively stable near full pool, fluctuating in a narrow range.

In addition to the dike and reservoir, the site would include a pumping plant to lift water from the reservoir into the Black Rock Branch Canal, as shown on Figure 2-23.

Reclamation would also acquire a 1,200-foot-wide easement along the channel of Black Rock Coulee downstream of the reregulating reservoir dike. Similar to the easement along the Farrier Coulee channel downstream of the constructed wasteway, this easement acquisition would be for the purposes of project O&M. Additional uses of the land would be for fish and wildlife purposes.

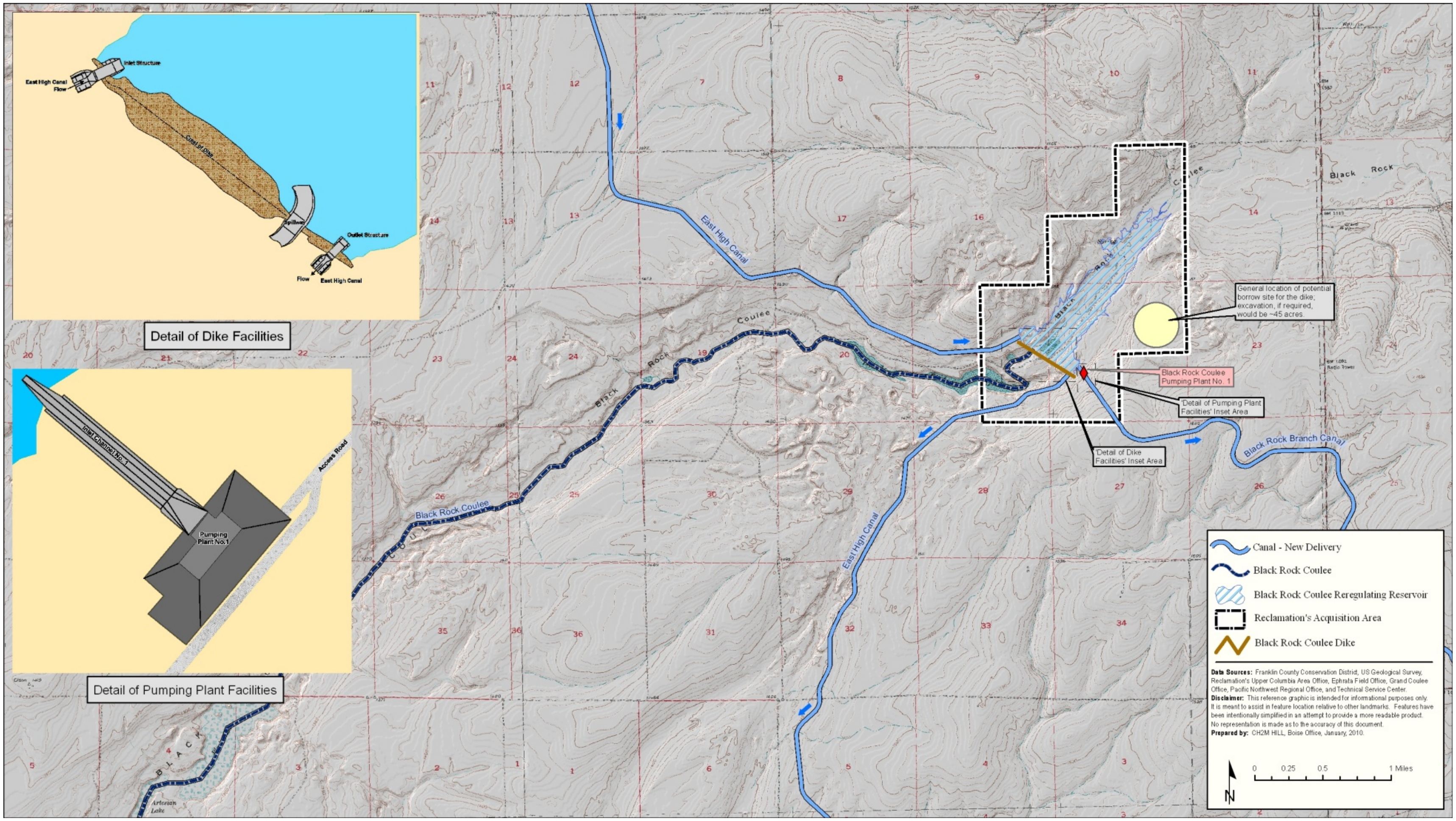

Figure 2-23. Black Rock Coulee reregulating reservoir.

Distribution Pipeline System

CBP water from the East High Canal and Black Rock Branch Canal would be provided by a pressurized pipeline distribution system to the groundwater-irrigated and water service contract lands north of I-90. The pipeline system would be fed by 15 canal-side pumping plants, 3 relift pumping plants, and 3 gravity turnouts, and would be pressurized to provide a minimum of 5 psi at the highest delivery points. At numerous locations along the pipeline routes, metering stations would be located to record water deliveries. Figure 2-19 illustrates the preliminary layout the pipeline system and locations of the pumping plants and gravity turnouts. Additional information on these facilities is provided below and summarized on Table 2-6.

- **Distribution Pipelines**: The distribution system from the East High Canal and Black Rock Branch Canal would consist of approximately 187.3 miles of buried pipeline. In general, as illustrated on Figure 2-19, the system is designed to locate the pipelines along half-section lines and deliver water to quarter-sections. Reclamation would acquire a 200-foot-wide easement for pipeline installation, and to retain long-term access for any necessary repairs or replacements. These requirements would preclude any future structure development within the long-term easement; however, agriculture or other nonstructural uses could generally continue once the pipeline is installed and operational.
- **Canal-Side Pumping Plants**: As shown on Figure 2-19, three canal-side pumping plants would be located along the East High Canal north of Black Rock Coulee Reregulating Reservoir (at canal miles 4, 11, and 19), five would be along the East High Canal south of the reservoir (at canal miles 29, 33, 35, 42, and 47), and seven would be along the Black Rock Branch Canal (at canal miles 2, 7, 11, 17, 18, 27, and 28). The site requirements and facilities at each of these stations would be the same as described for the plants south of I-90 in Section 2.5.1.2 and illustrated in Figure 2-12 and Figure 2-13.
- **Relift Pumping Plants**: Three relift pumping plants (two associated with the East High Canal and one associated with the Black Rock Branch Canal) would be required to boost pipeline pressure in the central parts of the service area to reach higher-elevation lands. The approximate locations of these plants are shown on Figure 2-19. The site requirements and facilities at each of these stations would be the same as described for the plants south of I-90 in Section 2.5.1.2 and illustrated on Figure 2-14.
- **Gravity Feed Turnout**: Two turnouts would be constructed at East High Canal Mile 15 and 50 and one turnout would be constructed at Black Rock Branch Canal Mile 29 to deliver gravity-fed water to the pipelines serving lands in these areas (see Figure 2-19 for the locations of these turnouts). Each facility would require a 2-acre site.
- **Meter Equipment Sites**: Metering equipment would be installed at numerous locations in the water distribution pipeline system. Most of these metering sites

would be associated with the locations where landowners tap into the system. These sites would be approximately 2,500 square feet, be within the pipeline easement, and be sited specifically to not interfere with existing irrigation equipment or other infrastructure.

Other Facility Requirements

- **Road and Railroad Crossings**: The new canal would cross existing roads at an estimated 60 locations. The exact treatment of these crossings would be defined in collaboration with involved jurisdictions during more detailed design work for the project. Bridges over the canal or pipelines under the road would be constructed at important through and all-weather roads and at the crossing of State Highway 28. At other locations, road realignments or closures with local re-routes may be implemented.

  The East High Canal also intersects one railroad line located along Crab Creek, west of the town of Wilson Creek. At this location, the canal alignment would be piped under the railroad.

  No additional easements are expected to be needed for bridges at road and railroad crossings. All construction would occur within the combination of existing road or railroad easement and the easement would be acquired by Reclamation for the new canal. In cases where road realignments would be needed, additional easements would need to be acquired.

- **Access Roads**: With minor exceptions, no new access roads outside of Reclamation easements and acquisition areas would be required for O&M or facility development. O&M roads would be built within the Reclamation easement along all new canals, siphons, and wasteways. To the extent that distribution pipelines and power lines cannot be aligned along existing roads, temporary access roads would be built within the Reclamation easements for construction of these facilities. A new road connection outside of Reclamation lands would be required for the Black Rock Coulee Reregulating Reservoir, where access from the reservoir eastward to County Road W NE is proposed. The alignment of this road has not been determined. Other possible access road locations are not known.

- **Wildlife Crossings and Escape Ramps**: As part of East High Canal development, 11 wildlife crossings would be installed over the East High Canal: 9 along the reach north of Black Rock Coulee Reregulating Reservoir and 2 along the reach south of Black Rock Coulee Reregulating Reservoir. The canal would present a barrier to wildlife movement in the area, and the crossings are intended to mitigate the extent of those effects. The conceptual design of these crossings is illustrated on Figure 2-24.

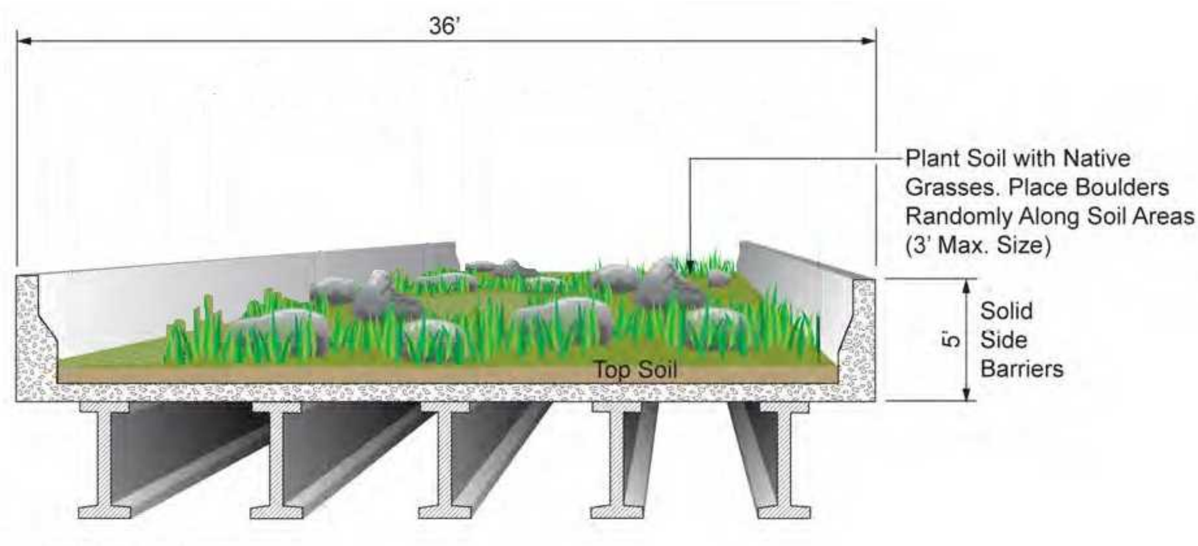

Figure 2-24. Wildlife crossing bridge typical cross-section.

Animal escape ramps would be located upstream of each structure (such as checks, siphons, and tunnel portals) in the canal alignment and along concrete-lined reaches. Figure 2-25 illustrates these ramps, which would be concrete lined and placed perpendicular to the canal centerline. Overall design and placement of the ramps would be coordinated with the WDFW.

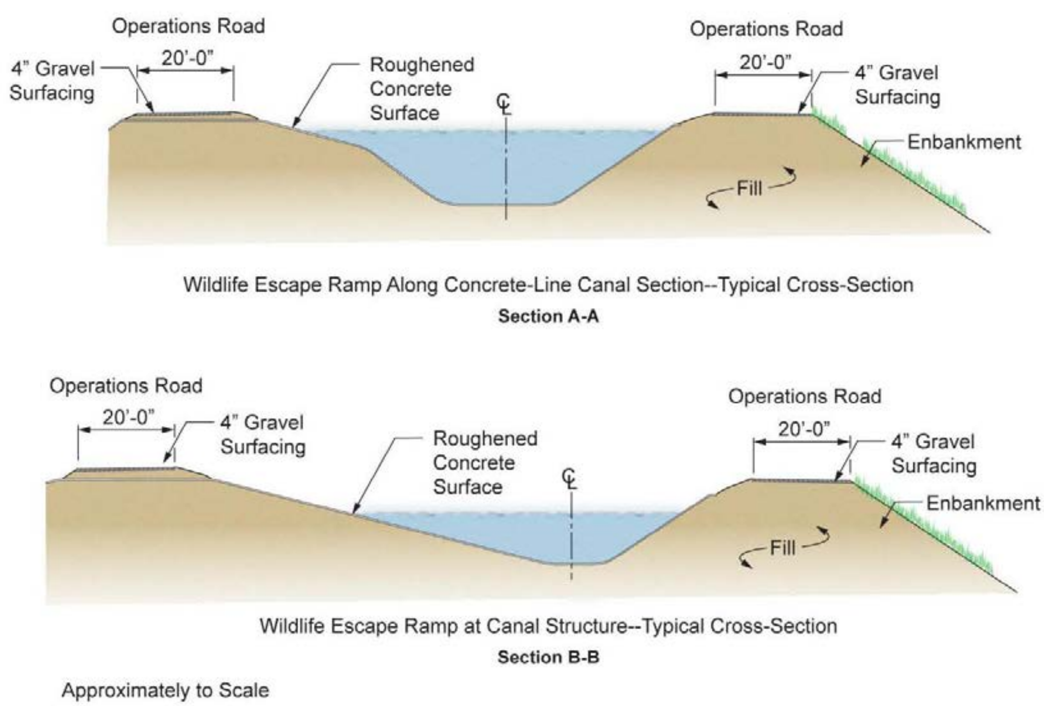

Figure 2-25. Wildlife escape ramps typical cross-section.

- **Operations and Maintenance Facility**: A second O&M facility (in addition to the one described in Section 2.5.1) would be built at the northeast corner of the intersection of County Road 6 NE and County Road W NE, approximately 0.25 mile north of Ruff, Washington. This facility would be the same as that described for location south of I-90 in Section 2.5.1.2 and illustrated in Figure 2-15.
- **Electric Transmission Lines**: High voltage electric power supply would be needed at each pumping plant and the O&M facilities. Supplying this power would require construction of new transmission lines. As noted above for the partial replacement alternatives, it is expected that power would be brought to facilities south of I-90 from the Moses Lake area, requiring an estimated 84 miles of new transmission lines. For facilities north of I-90, power would be brought from Grand Coulee, requiring an estimated 127 miles of new transmission lines. The locations and routes for these new transmission lines have not been determined. During more detailed planning, the goal would be to route these lines to reduce creation of new corridors in the landscape and to minimize impact on existing land uses by following existing power lines, roadways, railroads, or other existing linear infrastructure wherever possible.

Construction

Duration and Phasing

Development of the delivery system for the full replacement alternatives would be divided into nine phases, as shown on Figure 2-16 and Figure 2-26 (showing phasing of facilities south and north of I-90, respectively). The total construction period is projected to be approximately 10 years, with phases being built simultaneously north and south of I-90. Construction within each phase would last 3 to 4 years.

Construction would be conducted in phases to both spread the work as evenly as possible throughout the 10-year construction period and bring the delivery system online in stages, as early as possible.

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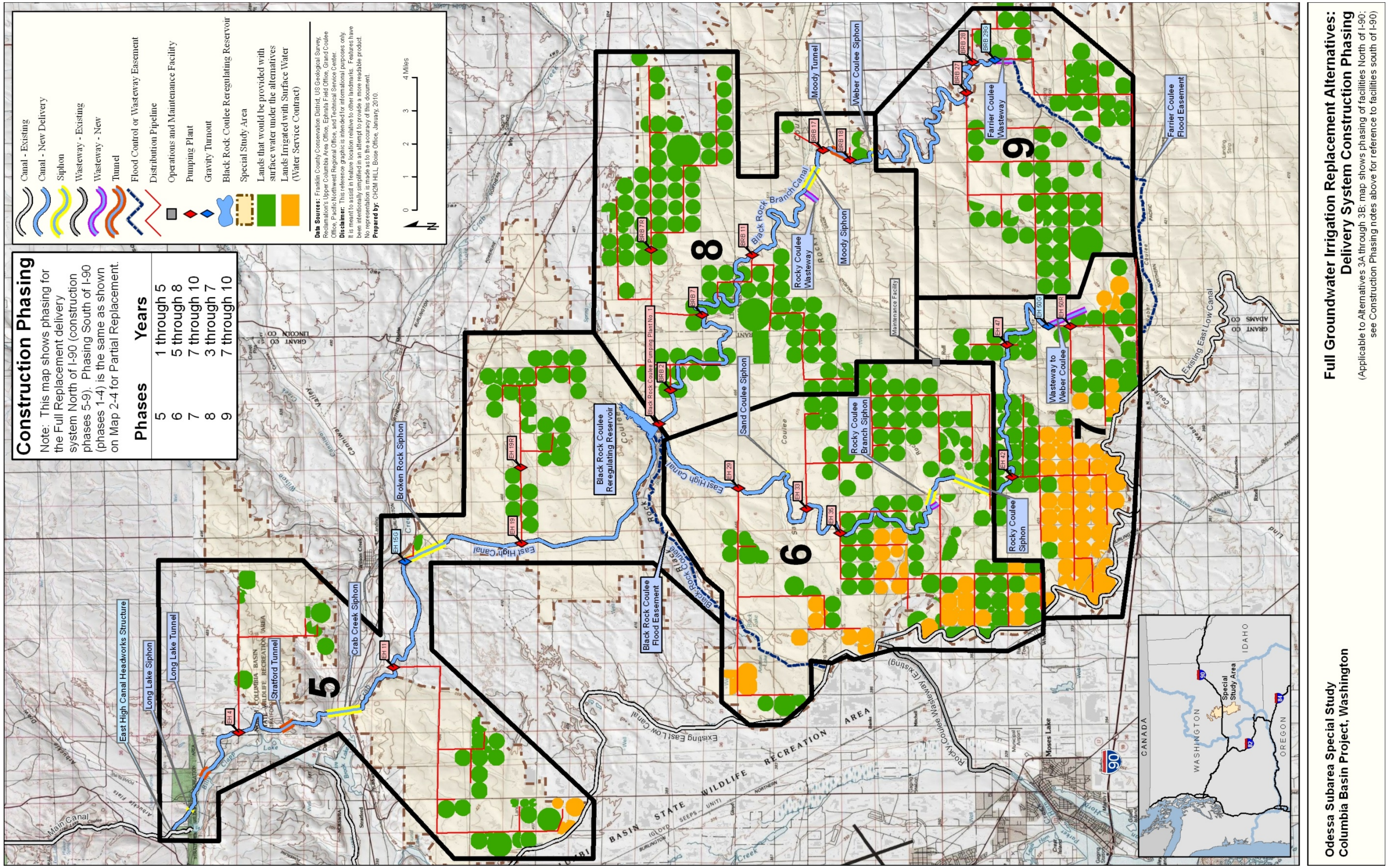

Figure 2-26. Full groundwater irrigation replacement alternatives: delivery system construction phasing.

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Construction Workforce, Activities, Equipment, and Other Requirements

The total workforce requirement for construction of the delivery system for the full replacement alternatives is expected to be 410 to 420 personnel on facilities north of I-90 and 120 to 130 personnel on facilities south of I-90. This would total 530 to 550 personnel at the peak level of activity during the latter half of the construction period, when work on several phases is occurring simultaneously.

Construction activity, and thus deployment of the workforce, would occur at multiple locations simultaneously in each phase and move progressively through the area identified for each phase. Primary work locations for facilities south of I-90 were listed in discussion of the partial replacement alternatives (Section 2.5.1.2); primary work locations for facilities north of I-90 would include:

- East High Canal Headworks structure (Phase 5 only).
- Black Rock Coulee Reregulating Reservoir (Phase 5 only).
- New canal alignments (East High or Black Rock Branch.)
- New siphons, tunnels, and wasteways.
- Pumping plant(s), including associated electric substations.
- Distribution pipeline alignments.
- Transmission line alignments.
- O&M facility.

With the exception of Black Rock Coulee Reregulating Reservoir, major construction in any given area is not expected to extend beyond a year, and in many cases would be of substantially shorter duration. Wherever possible, work would be planned and scheduled to avoid or minimize disruption of existing irrigation operations or other land uses.

Access for facility construction within Reclamation easements and acquisition areas would be primarily from existing public roads. In the case of canal alignments, long-term operations and maintenance roads would remain after construction is complete. Permanent access would also be required along power line and pipeline easements, although developed roads would generally not be necessary after construction is completed.

Construction of the delivery system, especially the canals and reregulating reservoir dike, would require use of heavy equipment including hydraulic excavators, large dozers, scrapers, cranes, and compaction equipment. Other equipment normally involved with major construction would also be employed, such as dump trucks, loaders, and delivery trucks (for concrete and other materials). Blasting may be necessary during construction of the tunnels north of I-90, along some reaches of the new canals, and at the site of the reregulating reservoir dike.

Staging areas would generally be located within canal, pipeline, and transmission line easements and within facility acquisition areas including the reregulating reservoir, pumping plants, and O&M facilities. To the extent possible, staging areas would be located at least 500 feet from a residence.

No offsite disposal sites for excavated material, borrow sites, or construction material processing facilities are expected to be needed. All material excavated for canal development and installation of pipelines and transmission lines would be stockpiled within the facility easements or backfilled, as appropriate. All material necessary for the reregulating reservoir dike is expected to be available from within the reservoir acquisition area, primarily from within the inundation zone. All construction materials would be acquired through available existing local and regional sources.

Operation and Maintenance

O&M activities for Alternative 3A: Full—Banks would be generally the same as described for O&M of the partial replacement facilities in Section 2.5.1.2.

2.6.2 Alternative 3B: Full—Banks + FDR

The main aspects of Alternative 3B: Full—Banks + FDR are illustrated on Figure 2-27. As shown on the diagram, these include providing water supply from Lake Roosevelt (1) and Banks Lake (2) delivered through the East Low Canal (3) and East High Canal system (4) to currently groundwater-irrigated lands north and south of I-90. Major facility development would include enlargement of the East Low Canal south of I-90 and construction of a new East High Canal system north of I-90. Water would be delivered to farmlands from both canals by a pressurized pipeline system.

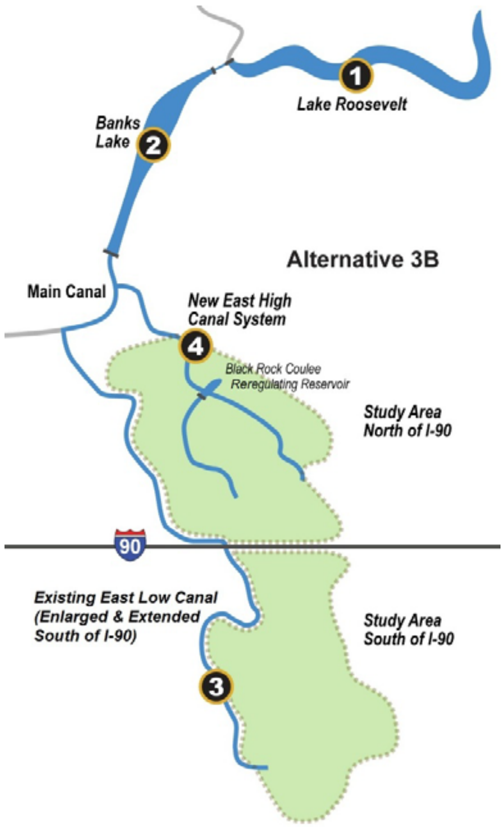

Figure 2-27. Alternative 3B: Full – Banks + FDR.

2.6.2.1 Water Supply

Water for this alternative would come from available Columbia River flows and additional drawdown of both Lake Roosevelt and Banks Lake. Water from Banks Lake would be released into the Main Canal from Dry Falls Dam and diverted to the East High and East Low Canals.

The additional drawdown of Banks Lake under this alternative would be 3 feet (the same as the Limited Spring Diversion Scenario) in an average year, beyond the 5 feet of drawdown for summer fish flow augmentation that is part of the No Action Alternative. The total average-year maximum drawdown at Banks Lake would be 8 feet (the same as the Limited Spring Diversion Scenario) at the end of August (Figure 2-2 and Figure 2-3).

The additional drawdown in an average year at Lake Roosevelt would be 0.9 feet (2.2 feet for the Limited Spring Diversion Scenario) at the end of August beyond the No Action Alternative. Currently, 92 MAF water supply forecast is the dividing line between 10 and 12 feet end of August draft at Lake Roosevelt under the No Action Alternative. The total maximum drawdown at Lake Roosevelt for the representative average water year (1995) is

11.9 feet (13.2 feet for the Limited Spring Diversion Scenario) at the end of August (Figure 2-2 and Figure 2-5). Other average years that have volumes less than 92 MAF would be drawn down 2 feet lower.

Reservoir refill would occur first at Lake Roosevelt, which is required to be at water surface elevation 1283 feet amsl by the end of September; refill to No Action Alternative levels would be completed by the end of October. Banks Lake would be refilled by the end of March.

No construction or modification of facilities is required at either Lake Roosevelt or Banks Lake under Alternative 3B: Full—Banks + FDR.

2.6.2.2 Delivery System

Delivery system facility requirements, construction, and O&M for Alternative 3B: Full—Banks + FDR would be the same as those described in Section 2.5.1 – Alternative 3A: Full—Banks.

2.7 Modified Partial Groundwater Irrigation Replacement Alternatives

In response to public comments and in consultation with the ECBID, Reclamation and Ecology developed the modified partial groundwater irrigation replacement alternatives for the Final EIS in response to a number of concerns regarding the partial and full groundwater replacement alternatives presented in the Odessa Subarea Special Study Draft EIS. The modified partial replacement alternatives are similar to the Alternative C option described in the Appraisal-Level Investigation Summary of Findings (Appraisal Study). Alternative C was considered but eliminated in the Draft EIS because it precluded deliveries to some lands within the SCBID and was not an economically viable option as configured. The Modified Partial Replacement Alternatives 4A and 4B incorporate modifications to Alternative C, which makes them “reasonable” alternatives for the Proposed Action in this Final EIS.

Further review of the PASS Analysis and Appraisal Study indicated that the modified replacement alternatives would not preclude full development. Alternatives 4A and 4B would in fact provide service to some of the SCBID lands. Reclamation and Ecology developed Alternatives 4A and 4B for the Final EIS to address expressed concerns. These alternatives were configured in such a way as to economically serve lands both north and south of I-90 while increasing the number of acres that would no longer pump from the Odessa aquifer (Reclamation 2012 Economics).

The action alternatives 4A: Modified Partial—Banks (Preferred) and 4B: Modified Partial —Banks + FDR would provide a CBP surface water supply to approximately 70,000 acres of lands in the Study Area north and south of I-90 (Figure 2-1 and Figure 2-6). The total volume of water diverted from the Columbia River with the modified partial groundwater replacement alternatives is estimated at 164,000 acre-feet. As the surface water supply system is brought online and this water becomes available to eligible lands, the intent would be to cease operation of associated irrigation wells. Under current State regulations, the irrigation wells would not be decommissioned or abandoned. Instead, superseding state water rights would be issued and the wells would be placed in standby status, remaining operational for use in an emergency (such as an interruption of the Federal surface water delivery system). Any different scenario or mandatory decommissioning would require that the statute to be modified.

As part of these alternatives, the 16,864 acres of existing water service contracts that pump out of the East Low Canal at 34 locations would not be incorporated into the delivery system. This action would have no effect on current system operations or ECBID's ability to meet scheduled deliveries.

Alternatives 4A: Modified Partial—Banks (Preferred) and 4B: Modified Partial — Banks + FDR would involve the same water delivery system facilities and the same quantity of water. The delivery system would involve enlarging the East Low Canal and constructing a distribution system. The alternatives vary in the option used to store and supply CBP water.

A component of the modified partial alternatives would include an "infill" option to allow some groundwater irrigators in areas distant from the East Low Canal to move their operations to previously disturbed lands closer to the canal. It is anticipated that as much as 15 percent of the lands served under the Preferred Alternative would involve relocation of current operations. Relocation would be limited to an acre-per-acre exchange; that is, one acre of currently groundwater-irrigated land would be retired for each acre of relocated irrigated land served with replacement water.

The modified partial replacement alternatives have been fully analyzed in this Final EIS and are within the range of the partial and full groundwater replacement alternatives evaluated in the Draft EIS. The amount of water proposed for diversion is within the range of diversions previously evaluated for action alternatives in the Draft EIS. Similarly the number of acres to be served is within the range covered by the action alternatives in the Draft EIS. The lands proposed to be served south of I-90 were included within partial replacement alternatives in the Draft EIS. The lands proposed to be served north of I-90 are a portion of the lands that would be served by the new East High Canal system under the full replacement alternatives, but instead would be served from the East Low Canal in the modified partial replacement alternatives. The modified partial replacement alternatives involve facilities, diversions, operations, and lands that were either evaluated in the Draft EIS or are within the range of alternatives considered in that document; therefore, the potential impacts associated with the modified partial replacement alternatives are of an equal or lesser magnitude as the effects presented in the Draft EIS and no additional impacts are anticipated.

2.7.1 Alternative 4A: Modified Partial—Banks (Preferred)

Alternative 4A: Modified Partial—Banks, Limited Spring Diversion has been identified as the Preferred Alternative by the co-lead agencies for the Final EIS. The modified partial groundwater replacement Alternative 4A meets the Purpose and Need of the project and was selected as the Preferred Alternative because it:

- Provides the most benefits to the aquifer with the least impacts to other environmental resources as compared to the partial and full replacement alternatives.
- Delivers water to the most acreage as possible with existing infrastructure.
- Has the highest Benefit-Cost Ratio of all the replacement alternatives.
- It is the environmentally preferred alternative.
- No additional drawdown of Lake Roosevelt.

The main aspects of Alternative 4A are illustrated on Figure 2-28. As shown on the map, these aspects include providing water supply from Banks Lake, via East Low Canal, to currently groundwater-irrigated lands north and south of I-90. Major facility development associated with this alternative would be limited to enlargement of the East Low Canal south of I-90 and installation of a distribution system to deliver the water from the canal to farmlands. Neither modified partial replacement alternatives involves extension (lengthening) of the East Low Canal.

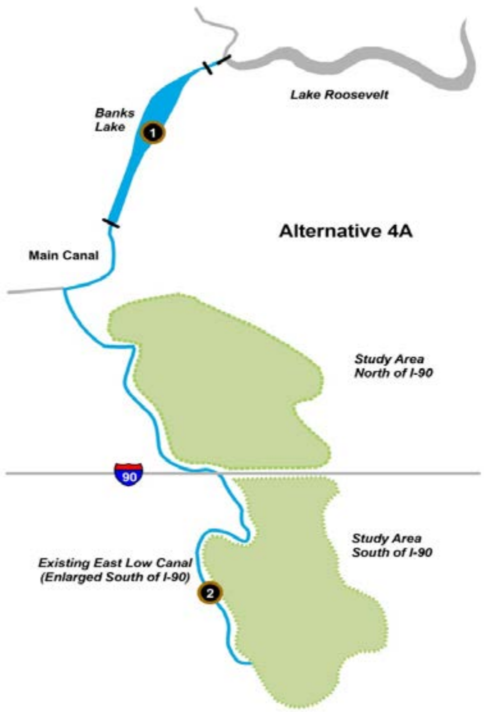

Figure 2-28. Alternative 4A: Modified Partial – Banks (Preferred).

2.7.1.1 Water Supply

Water for this alternative comes from available Columbia River flows and additional drawdown of Banks Lake. Banks Lake water would be released into the Main Canal from Dry Falls Dam and diverted to the East Low Canal.

The additional drawdown of Banks Lake would be 3.1 feet (6.0 feet for the Limited Spring Diversion Scenario) in an average year, beyond the 5 feet of drawdown for summer fish flow augmentation that is part of the No Action Alternative. The total average-year maximum drawdown would be 8.1 feet (11.0 feet for the Limited Spring Diversion Scenario) at the end of August (Figure 2-2 and Figure 2-3).

Banks Lake would be refilled by the end of October, subject to any unusual constraints imposed by operational requirements.

The Limited Spring Diversion Scenario is the preferred diversion scenario.

No construction or modification of facilities is required at Banks Lake under Alternative 4A: Modified Partial—Banks.

2.7.1.2 Delivery System

Facility Descriptions

The water delivery system necessary for Alternatives 4A: Modified Partial—Banks (Preferred) and 4B: Modified Partial — Banks + FDR is shown on Figure 2-29. Facility development would the same south of I-90 as described for Alternative 2A: Partial—Banks and 2B: Partial — Banks + FDR in Section 2.5.1.2 except for:

- No extension of East Low Canal.
- No gravity feed turnout at mile 89.

North of I-90 facility development would include:

- Constructing a pipeline distribution system fed by pumping plants along the canal. This system would require numerous meter and equipment stations along the pipeline routes, primarily at farm delivery points.
- New electric transmission lines to each pumping plant and the O&M facility.

Each of these facilities is described below. Table 2-7 provides a summary listing, including information on facility quantities and land requirements.

Table 2-7. Modified partial replacement alternatives – delivery system facility requirements.

Facility/Action	Quantity	Land Interest Acquisition Required	
		Type	Quantity
East Low Canal			
- Enlargement	43.3 miles	*NA--Within existing easement*	
- Siphons--Add second barrel to all 5 existing	1.5 miles	*NA--Within existing easement*	
Weber Wasteway—Additional Easement Acquisition	3.0 miles	Easement	350 feet wide [a]
Pumping Plants			
Canalside Plants (along East Low Canal)	8 Sites	Fee	3 acres each
(EL47, 53, 68, 75, 80 & 85)			
Relift Plants (EL47R, 53R, 68R, 80R, & 89R2)	3 sites	Fee	3 acres each
Distribution Pipeline < 24 inches	72 miles	Easement	100 feet wide
Distribution Pipeline > 24 inches	78 miles	Easement	200 feet wide
Pipeline Meter/Equipment Sites	TBD [b]	*NA—2,500 square feet within pipeline easement*	
Electric Transmission Lines [c]	150 miles	Easement	100 feet wide
Road Crossings			
- Existing bridges over East Low Canal — Reconstruct	NA[d]	*NA—Within road easement and canal easement*	

[a] Existing Weber Wasteway easement width varies but averages 250 feet (125 feet on each side of the channel); Reclamation would acquire an additional 175 feet on each side, to bring total easement width to 600 feet.

[b] To Be Determined: Number and location not determined at this level of planning; all would be within pipeline easements.

[c] Electric power supply would be needed at each pumping plant and the operations and maintenance facility. Supplying this power would require construction of new transmission lines. For the Modified Partial Replacement alternatives, it is expected that power would be brought to facilities from the Moses Lake area. Given this projected source, total distance of new transmission lines required is estimated to be 150 miles. The locations and routes for these new transmission lines would be determined during future design phases.

[d] Some existing road bridges across the East Low Canal may need to be lengthened/reconstructed to accommodate East Low Canal enlargement. Any such requirements would be defined during more detailed planning (see Transportation discussion in Section 4.16 of the Final EIS).

NA: Not applicable

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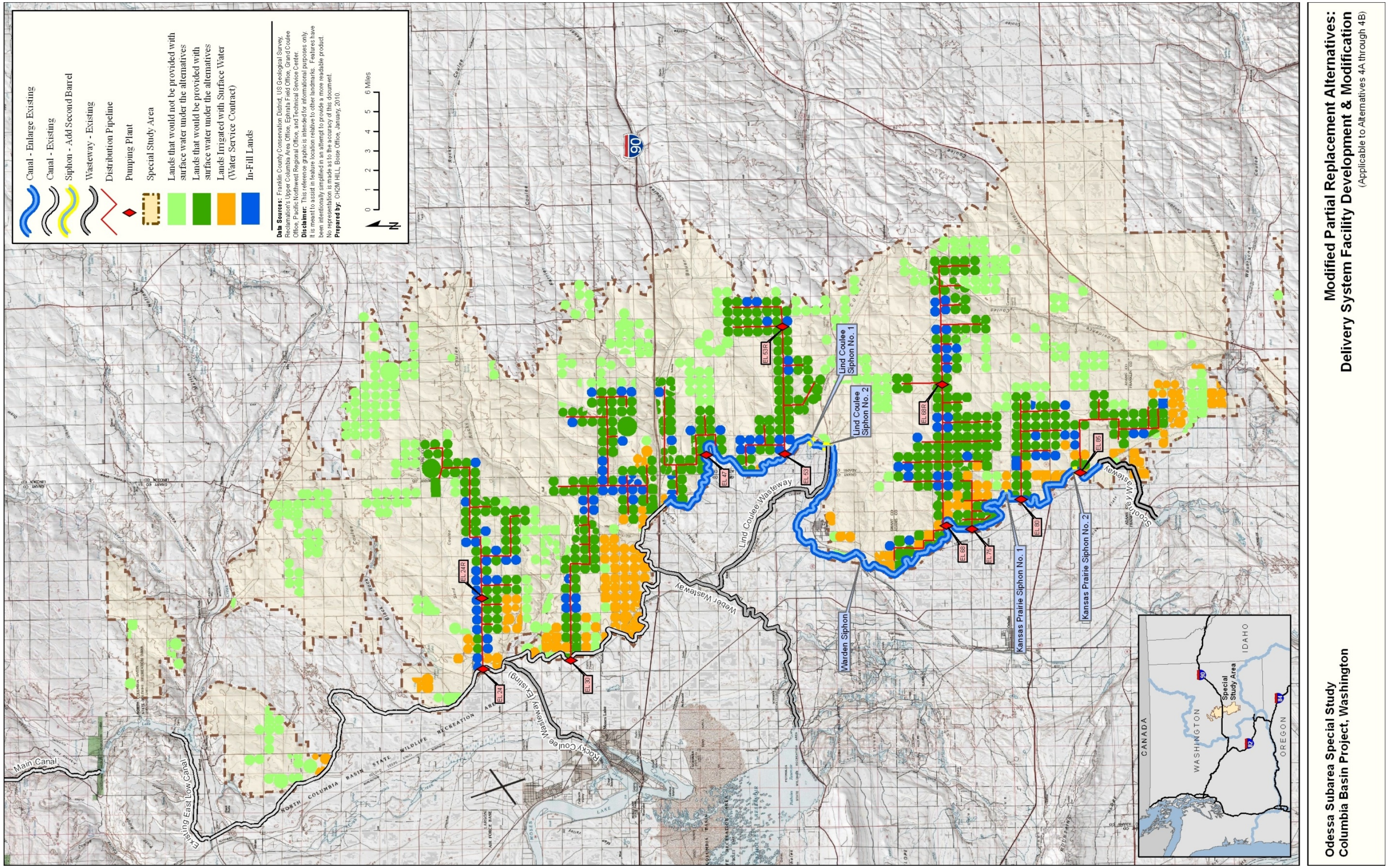

Figure 2-29. Modified partial replacement alternatives: delivery system facility development and modifications.

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East Low Canal Enlargement

Same as Alternative 2A and 2B.

Distribution Pipeline System

CBP water from the East Low Canal would be provided by a pressurized pipeline distribution system to the groundwater-irrigated and water service contract lands north and south of I-90 that would be served in this alternative. The system would be pressurized by eight canal-side pumping plants and three relift pumping plants. Metering stations would be located at numerous locations along the pipeline routes to record water deliveries. The following facilities would be included:

- **Distribution Pipelines**: The Preferred Alternative distribution system would require approximately 150 miles of buried pipeline. In general, the system is designed to locate the pipelines along section and half-section lines and deliver water to typical quarter sections. Depending on the size of the pipeline, Reclamation would acquire a 100- to 200-foot-wide easement for pipeline installation and would need to retain long-term access to and within the easement for any necessary repairs or replacements. These requirements would preclude any future structure development within the easement. However, except for the locations of relift pumping plants and equipment sites described below, agriculture or other nonstructural uses could generally continue once the pipeline is installed and operational.
- **Canal-Side Pumping Plants**: The eight canal-side pumping plants that would feed the pipeline distribution system would be located on the east side of the East Low Canal at canal miles 24, 30, 47, 53, 68, 75, 80, and 85. Each plant would require about 3 acres to accommodate the pumping plant and equipment, an air chamber, and an electric power substation. Each plant would be fenced for security using chain-link topped with barbed wire. A regulating tank would also be necessary with each of these pumping plants; this tank would be located along the pipeline up to 2 miles from the pumping plant site. Figure 2-12 and Figure 2-13 provide a conceptual site and elevation, respectively, of these pumping plants.
- **Relift Pumping Plants**: Three relift pumping plants required for the pipeline distribution system would be required to boost pipeline pressure in the central parts of the service area to reach the eastern-most lands. One plant would be north of I-90 on the pipeline system that would be fed from the pump station at canal mile 24. Two additional plants would be south of I-90, one serving the pipeline from the pumping plant at canal mile 53 and another associated with the pipeline receiving water from the pumping plant at canal mile 68. The approximate locations of these plants are shown on Figure 2-29; Figure 2-14 provides a conceptual site plan. Each plant would require about 3 acres to accommodate the pumping plant structure and equipment (no

metal building would be constructed), an air chamber, and an electric power substation.

- **Meter Equipment Sites**: Metering equipment would be installed at numerous locations in the water distribution pipeline system. Most of these metering sites would be located where landowners tap into the system. These sites would total approximately 2,500 square feet, all within the pipeline easement, and would be sited specifically not to interfere with existing irrigation equipment or other infrastructure. They would be placed near existing roads as much as possible.

Other Facility Requirements

The facility requirements would be the same as Alternative 2A and 2B (Figure 2 30), except there would be no extension of East Low Canal.

Construction

Construction would be the same as Alternative 2A and 2B, except there would be a total workforce requirement of 145 to 160 personnel at the peak level of activity and there would be pumping plants and relift plants as well as distribution systems north of I-90. There would be no extension of East Low Canal (Figure 2-30).

Operation and Maintenance

O&M activities for Alternative 4A: Partial—Banks would be generally the same as described for O&M of Alternatives 2A and 2B as described in Section 2.5 – *Partial Groundwater Irrigation Replacement Alternatives*.

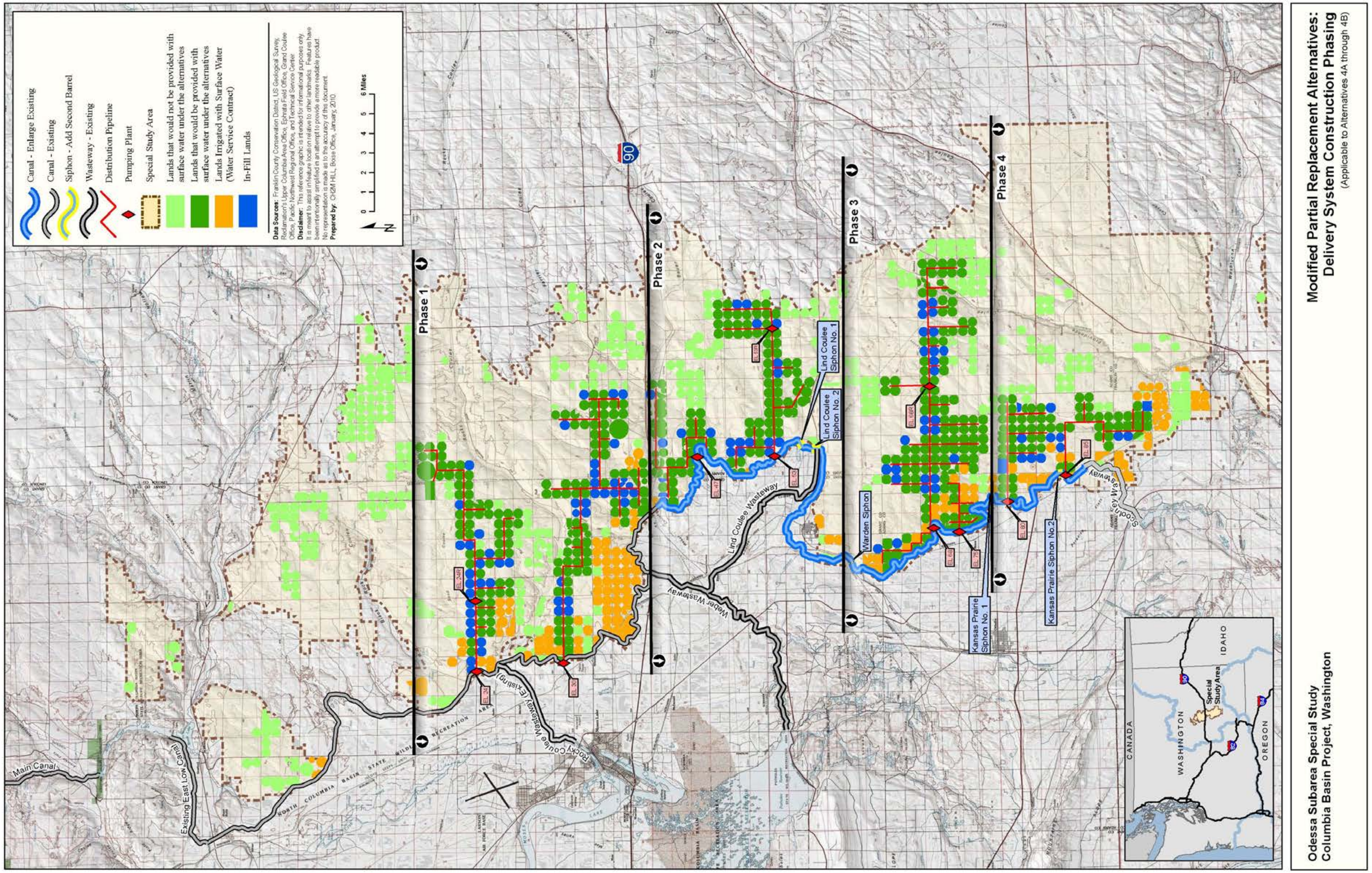

Figure 2-30. Modified partial replacement alternatives: delivery system construction phasing.

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2.7.2 Alternative 4B: Modified Partial—Banks + FDR

The delivery system for Alternatives 4B is the same as Alternative 4A with the main elements illustrated on Figure 2-31. As shown on the diagram, Alternative 4B differs from 4A in that the water supply source would utilize both Banks Lake and Lake Roosevelt.

Figure 2-31. Alternative 4B: Modified Partial – Banks + FDR.

2.7.2.1 Water Supply

Water for this alternative comes from available Columbia River flows and additional drawdown of Banks Lake and Lake Roosevelt. Banks Lake water would be released into the Main Canal from Dry Falls Dam and diverted to the East Low Canal.

The additional drawdown of Banks Lake would be 3.0 feet (the same as the Limited Spring Diversion Scenario) in an average year, beyond the 5 feet of drawdown for summer fish flow augmentation that is part of the No Action Alternative. The total average-year maximum drawdown would be 8.0 feet (the same as the Limited Spring Diversion Scenario) at the end of August (Figure 2-2 and Figure 2-3).

The additional drawdown of Lake Roosevelt under this alternative would be 0 feet (1.0 feet for Limited Spring Diversion Scenario) in an average water year, beyond the No Action Alternative. The total maximum drawdown at Lake Roosevelt for an average water year is 11.0 feet (12.0 feet for the Limited Spring Diversion Scenario) at the end of August. Other average years that have volumes less than 92 MAF would be drawn down 2 feet lower (Figure 2-2 and Figure 2-5).

Reservoir refill would occur first at Lake Roosevelt, which is required to be at water surface elevation 1283 feet amsl by the end of September; refill to No Action Alternative levels would be completed by the end of October. Banks Lake would be refilled by the end of March.

No construction or modification of facilities is required at either Lake Roosevelt or Banks Lake under Alternative 4B.

2.7.2.2 Delivery System

Delivery system facility requirements, construction, and O&M for this alternative would be the same as those described for Alternative 4A.

2.8 Alternatives Considered but Eliminated from Further Study

2.8.1 Alternative Formulation and Evaluation

The alternatives formulation process was conducted in three stages. Each successive stage is more detailed than the last to refine potential alternatives, assess their relative engineering and economic feasibility, and compare their relative performance in meeting the Purpose and Need described in Chapter 1.

The first stage of alternatives formulation and evaluation was Reclamation's PASS, completed September 2006 with publication of a report entitled, *Initial Alternative Development and Evaluation*. Using input received from the public at a February 2006 public meeting and through written correspondence as well as the information from previous related investigations, the PASS defined and evaluated alternative concepts and solutions to resolve problems posed by groundwater decline in aquifers of the Odessa Subarea.

PASS Study Objectives

According to criteria used in the PASS evaluation, a reasonable, alternatives should accomplish these objectives:

- Replace all or a portion of the current groundwater withdrawals for irrigation within the CBP portion of the Odessa Subarea with CBP water.
- Maximize use of existing infrastructure.
- Retain the possibility of full CBP development in the future.
- Address environmental concerns and interests, including NMFS Columbia River seasonal flow objectives and impacts to ESA-listed and other sensitive species.
- Provide environmental and recreational mitigation and enhancements.
- Minimize potential delay in the Study schedule.
- Be conducive to development in phases for early and efficient implementation based on funding expectations, physical and operational constraints, and rate of groundwater decline.

The PASS identified four broadly-defined alternatives that combined various options for supply and delivery of surface water to replace groundwater for irrigation use in the Study Area, as shown on Table 2-8. These were carried forward through an appraisal-level investigation, the results of which were published in the March 2008 report *Appraisal-Level Investigation Summary of Findings* (Reclamation 2008 Appraisal).

Table 2-8. Alternatives identified through the 2006 PASS process and considered in the 2008 appraisal investigation.

Delivery Alternatives	
A	Full replacement of groundwater with a CBP surface water supply for irrigation. Construct an East High Canal System reaching eligible acreage both north and south of I-90.
B	Full replacement by developing an East High Canal system to serve lands north of I-90, and expanding the capacity of the existing East Low Canal to serve acreage south of I-90.
C	Partial replacement using only the existing East Low Canal. North of I-90, lands would be served from available capacity in the existing canal without major modification. South of I-90, lands would be served by expanding the capacity of the canal system.
D	Partial replacement to lands that could be served through existing capacity in the East Low Canal system without major modification.

Delivery Alternatives	
Supply Options	
Banks Lake Drawdown	Drawdown the existing reservoir to lower levels than under current operations.
Banks Lake Raise	Raise the operational water surface of the reservoir by 2 feet by raising the crest of the two dams and allowing more storage.
Potholes Reservoir Reoperation	Adjust the timing of water storage in the reservoir by feeding some water in the fall, rather than in the spring, and thus freeing up available water in the spring for use in the Study Area. Some modifications of the dam may also be required.
New Reservoirs	Build new reservoirs at Dry Coulee, Lower Crab Creek, and Rocky Coulee

In the appraisal-level study report, Reclamation and Ecology chose to further investigate Alternative B. Supply options identified for further consideration were the Banks Lake Drawdown and Raise, Potholes Operation, and a new reservoir in Rocky Coulee. Potential new reservoirs in Dry Coulee and Lower Crab Creek were eliminated from further study.

2.8.2 Delivery Alternatives Considered But Eliminated From Further Study

2.8.2.1 Appraisal Alternative A

Although it would provide full replacement, Alternative A was eliminated because it was not economically feasible. It would involve substantially higher cost, longer implementation times, and greater potential for environmental impact when compared with Alternative B, without an increase in benefits. These disadvantages arose from the fact that Alternative A would require development of a new East High Canal system to serve lands south of I-90. By comparison, Alternative B would serve this area instead by expanding the existing East Low Canal. Expanding the East Low Canal to serve this area would cost considerably less than a new canal system, could allow earlier implementation because it would not rely on completion of the East High Canal system north of the highway, and would involve less land acquisition and other effects involved with developing new canals.

2.8.2.2 2.8.2.2 Appraisal Alternatives C

Alternative C would use all available capacity in the East Low Canal to serve groundwater-irrigated lands in the Study Area; thus, SCBID could not receive water for additional lands, as originally planned. Further, Alternative C would not include the potential to provide full replacement of groundwater with CBP surface water for all eligible acreage in the Study

Area. Alternative C would offer significantly less potential than Alternative B to meet the fundamental Purpose and Need. It would not substantially address the challenge of the groundwater decline in aquifers of the Odessa Subarea and would not avoid economic loss (see Section 2.7).

Alternative C is similar to the modified partial replacement Alternatives 4A and 4B; however, modifications were made which made them "reasonable" alternatives for the Proposed Action in this Final EIS.

2.8.2.3 Appraisal Alternative D

Alternative D was eliminated from consideration for the same reasons as Alternative C. This option served the least amount (less than half) of irrigated acreage in the Subarea, especially when compared with Alternative B.

2.8.3 Supply Options Considered But Eliminated From Further Study

2.8.3.1 Banks Lake Raise

This supply option would raise the two dams that create Banks Lake by 2 feet, resulting in an increase of 2 feet in the reservoir full pool level and a gain of 50,000 acre-feet of additional storage. This option was eliminated from consideration because it was not viable due to cost concerns and the potential for significant impact to lands, facilities, and environmental resources. Problems associated with raising the Banks Lake pool level included:

- Most expensive among the options available for using existing reservoirs.
- Major relocations and modifications of infrastructure required, such as the Feeder Canal and State Highway 155.
- Potentially significant adverse impacts to existing developed land uses around the reservoir, such as Coulee Playland, Sunbanks Resort, Steamboat Rock State Park, and Coulee City Park.
- Potential for adverse impacts to the environment, such as increased acres of vegetation lost to inundation, increased erosion as vegetation is lost, wave action higher on the shoreline, and impacts to cultural resources around the reservoir.

2.8.3.2 Potholes Reservoir Reoperation

Use of storage in Potholes Reservoir would not be a reasonable or feasible alternative for providing CBP water to the Study Area primarily because this reservoir is too low in the CBP system, making its use technically infeasible to meet the purpose and need. In addition, the reservoir's role in providing flood storage and release is generally not compatible with reliably retaining water in storage at the time of year required to meet the additional irrigation needs in the Study Area.

2.8.3.3 Lake Roosevelt Sole Supply

This supply option would use storage from Lake Roosevelt by drawing it down when Columbia River flows are not available as the sole supply option for the Study Area. This option was eliminated from consideration because it is not a viable alternative. It would result in summer drawdown levels that conflict with other water management objectives at Grand Coulee Dam and Lake Roosevelt, making this option technically infeasible. It would also result in adverse impacts to recreation and shoreline environmental resources managed by the National Park Service and the Tribes.

2.8.3.4 Dry Coulee and Lower Crab Creek Reservoirs

Both of these potential locations for new reservoirs were eliminated from consideration as supply options because of substantial additional cost without additional benefits, making them economically infeasible and therefore, eliminating them from the list of viable alternatives. In addition, environmental impact concerns exist, as reported in the appraisal-level investigation report. Each of these reservoir options would involve substantially higher cost and greater potential for adverse environmental impact than the Rocky Coulee option.

2.8.3.5 Proposed Rocky Coulee Reservoir Supply Options C and D

Subsequent to publication of the Draft EIS, Reclamation and Ecology received over 1,000 comments from the public, agencies, local governments, and Tribes. Careful review and consideration of these comments, coupled with cost considerations and potential environmental impacts, led to the elimination of alternatives utilizing the proposed new Rocky Coulee Reservoir water supply source.

Alternatives 2C: Partial—Banks + Rocky, 2D: Partial—Combined, 3C: Full—Banks + Rocky, and 3D: Full—Combined were eliminated from further consideration in this Final EIS. These partial and full groundwater replacement alternatives included the new Rocky Coulee Reservoir that would have been filled generally during the winter months while Columbia River flows were available for diversion. Rocky Coulee Reservoir would have been utilized to supply project water on farmland during the summer and fall, when Columbia River flows are not available for diversion. This irrigation water storage facility offered a buffer to reservoir pool level impacts on the existing Banks Lake and Lake Roosevelt reservoirs. The new Rocky Coulee Reservoir would have inundated almost 3,000 acres impacting roads, farms, wildlife, and power delivery systems. Rocky Coulee Reservoir was estimated to cost over $300 million which would be in addition to the cost of each action alternative if this option would have been carried forward. Construction of a new reservoir would not be economically justified when existing storage is available in Banks and Lake Roosevelt to meet the need. The existing water supply, including Lake Roosevelt and Banks Lake reservoirs, were designed to serve over one million acres of irrigated farmland. Recreational benefits from the new Rocky Coulee Reservoir would be seasonal as the facility would be completely drawn down annually, eliminating most recreational benefit for much of the year. Comments received on the Draft EIS reflected strong concern for potential environmental impacts and added project cost associated with the construction of this seasonal water storage facility. Therefore, these alternatives are not considered reasonable or viable alternatives to the Proposed Action.

2.9 Estimated Cost of Alternatives

This section compares estimated costs of the alternatives completed by Reclamation engineers, as described in the Engineering Report (Reclamation 2012 Engineering), and Reclamation economists, as described in the Economics Technical Report (Reclamation 2012 Economics). These estimates were prepared for each alternative for the Final EIS and include costs of construction, interest during construction (IDC), land acquisition, and annual operating, maintenance, replacement, and power (OMR&P) costs.

The cost estimates are summarized in this section to allow direct comparison of alternatives. Estimates were prepared using the same assumptions and unit prices to be directly comparable from a cost standpoint. Additional specific information on methods and results of cost estimation are described in Reclamation's Engineering Report (Reclamation 2012 Engineering).

The estimated construction costs include noncontract costs and field costs of construction contracts. Noncontract costs refer to work or services to support the project and other work that is of such a broad, nonspecific nature that it can only be attributed to the project as a whole. These costs generally originate for work or services provided by agency personnel or contractor personnel used to augment agency resources or land or right-of-way acquisitions for project development. Construction contract costs include itemized pay items, mobilization, design contingencies, and construction contingencies. Construction costs reflect water supply and delivery facilities, as described in Sections 2.5 - *Partial Groundwater Irrigation Alternatives* and Section 2.6 – *Full Groundwater Irrigation Replacement Facilities*, with phased construction occurring in the 2015 to 2025 timeframe. The IDC costs are interest costs charged on the field costs of construction contracts and noncontract costs during the water supply/delivery facilities construction period. Noncontract costs incurred prior to the start of this construction period were aggregated into the first year of the construction period before calculating IDC costs.

In lieu of constructing drainage systems, it was assumed that lands that become too wet for agriculture would be purchased and converted into wetlands. As a result, the costs of land acquisition were included for each alternative.

The OMR&P costs are the estimated annual costs to operate, maintain, replace, and power the facilities.

Note that these costs will not agree with those described in later Section 2.10 – *Benefit-Cost Analysis* or with those presented in the national economic development (NED) benefit-cost analysis presented in the Odessa Special Study Report (Reclamation 2012 Study) since they have not been adjusted (compounded or discounted) to the end of the canal construction period (year 2025).

2.9.1 Estimated Costs for the No Action Alternative

Under the No Action Alternative, no new facilities would be constructed and no construction costs would be incurred; however, an OMR&P expense is provided as the estimated annual cost for existing pumping facilities that supply irrigation water. The OMR&P cost for the No Action Alternative is estimated at $3.3 million annually.

2.9.2 Estimated Costs for Alternatives 2A: Partial—Banks and 2B: Partial—Banks + FDR

Table 2-9 lists the estimated total construction costs, land acquisition costs, and OMR&P costs for Alternatives 2A and 2B. In addition to the total cost for each alternative, separate costs are presented for the four water delivery system construction phases applicable to Alternatives 2A and 2B. For a description of the specific features within each phase, see Section 2.5 – *Partial Groundwater Replacement Alternatives.*

Table 2-9. Cost estimates for Alternatives 2A: Partial – Banks and 2B: Partial – Banks + FDR (millions of dollars).

All Water Supply & Delivery System Facilities, (2015-2025) (million $)				
Feature	**Construction & Land Acquisition Costs**	**IDC Costs**	**Total**	**Annual OMR&P Costs**
Phase 1	$194.2	$23.1	$217.3	$2.0
Phase 2	$288.7	$41.6	$330.3	$2.6
Phase 3	$108.0	$12.8	$120.8	$1.2
Phase 4	$97.3	$11.6	$108.9	$0.9
Land Acquisition	$3.2	0	$3.2	n/a
Totals	$691.3	$89.1	$780.4	$6.6
Construction Period: Phase 1: 2015-2019, Phase 2: 2017-2022, Phase 3: 2019-2023, Phase 4: 2021-2025				

Table 2-9 contains a single set of cost values that apply to both Alternatives 2A: Partial—Banks and 2B: Partial—Banks + FDR; that is, the estimated total construction costs, land acquisition costs, and OMR&P costs for both alternatives are identical. The source of water supply (Banks Lake for 2A, and Banks Lake plus Lake Roosevelt for 2B) does not affect the estimated costs of the facilities needed to deliver water.

The construction costs column in Table 2-9 reflects the sum of the field costs of construction contracts and the noncontract costs for all water delivery facilities. The total column combines construction costs and associated IDC costs. Land acquisition costs are one-time costs which do not accrue IDC. OMR&P costs in Table 2-9 represent average annual costs. These OMR&P costs are assumed to begin after completion of each construction phase and continue across the entire period of analysis (through year 2118 which is the operational life of the first phase; see Section 2.10 – *Benefit-Cost Analysis*).

2.9.3 Estimated Costs for Alternatives 3A: Full—Banks and 3B: Full—Banks + FDR

Table 2-10 lists the estimated total construction costs, land acquisition costs, and OMR&P costs for Alternatives 3A and 3B. In addition to the total cost for each alternative, separate costs are presented for the nine construction phases applicable to Alternatives 3A and 3B. For a description of the specific features within each phase, see Section 2.6 – *Full Groundwater Irrigation Replacement Alternatives*. Table 2-10 contains a single set of cost values that apply to both Alternatives 3A and 3B. As described for the partial replacement alternatives, the source of water supply does not affect the estimated costs of the facilities needed to deliver water. The construction costs and OMR&P costs for Alternatives 3A and 3B are significantly higher than the estimated costs for Alternatives 2A: Partial—Banks and

2B: Partial—Banks + FDR because of the additional facilities necessary to serve project land north of I-90.

Table 2-10. Cost estimates for Alternatives 3A: Full—Banks and 3B: Full—Banks + FDR (millions of dollars).

All Water Supply & Delivery System Facilities, (2015-2025) (million $)				
Feature	**Construction & Land Acquisition Costs**	**IDC Costs**	**Total**	**Annual OMR&P Costs**
Phase 1	$194.2	$23.1	$217.3	$2.0
Phase 2	$288.7	$41.6	$330.3	$2.6
Phase 3	$108.0	$12.8	$120.8	$1.2
Phase 4	$97.3	$11.6	$108.9	$0.9
Phase 5	$855.3	$123.1	$978.4	$2.2
Phase 6	$302.1	$36.0	$338.1	$1.8
Phase 7	$219.8	$26.2	$246.0	$1.2
Phase 8	$275.9	$39.7	$315.6	$2.3
Phase 9	$112.6	$13.8	$126.4	$0.8
Land Acquisition	4.0	0	4.0	n/a
Totals	$2,457.7	$327.8	$2,785.5	$15.0
Construction Period: Phase 1: 2015-2019, Phase 2: 2017-2022, Phase 3: 2019-2023, Phase 4: 2021-2025, Phase 5: 2015-2020, Phase 6: 2019-2023, Phase 7: 2021-2025, Phase 8: 2017-2022, Phase 9: 2021-2025				

2.9.4 Estimated Costs for Alternatives 4A: Modified Partial – Banks (Preferred) and 4B: Modified Partial – Banks + FDR

Table 2-11 lists the estimated total construction costs, land acquisition costs, and OMR&P costs for Alternatives 4A: Modified Partial—Banks (Preferred) and 4B: Modified Partial—Banks + FDR. In addition to the total cost for each alternative, separate costs are presented for the four construction phases applicable to Alternatives 4A and 4B. For a description of the specific features within each phase, see Section 2.7 – *Modified Partial Groundwater Irrigation Replacement Alternatives*.

Table 2-11 contains a single set of cost values that apply to both Alternatives 4A and 4B. As described for the partial and full replacement alternatives, the source of water supply does not affect the estimated costs of the facilities needed to deliver water.

Table 2-11. Cost estimates for Alternatives 4A: Modified Partial – Banks and 4B: Modified Partial – Banks + FDR (millions of dollars).

All Water Supply & Delivery System Facilities, (2015-2025) (million $)				
Feature	**Construction & Land Acquisition Costs**	**IDC Costs**	**Total**	**Annual OMR&P Costs**
Phase 1	$244.5	$29.0	$273.5	$2.3
Phase 2	$158.1	$22.7	$180.8	$3.1
Phase 3	$237.7	$28.2	$265.9	$1.4
Phase 4	$93.9	$11.1	$105.0	$1.0
Land Acquisition	$2.5	0	$2.5	n/a
Totals	$736.5	$91.0	$827.5	$7.9
Construction Period: Phase 1: 2015-2019, Phase 2: 2017-2022, Phase 3: 2019-2023, Phase 4: 2021-2025.				

2.9.5 Summary of Estimated Costs

Table 2-12 provides a summary of the estimated costs for the alternatives. These cost estimates should only be used to compare alternatives. All the alternatives used the same assumptions and unit prices, so these are directly comparable from a cost standpoint.

Table 2-12. Summary of alternative cost estimates (millions of dollars).

Alternative	Construction & Land Acquisition Costs	IDC Costs	Total	Maximum Annual OMR&P Costs (Year 2025+)*
1: No Action	--	--	--	$3.3
2A: Partial—Banks	$691.3	$89.1	$780.4	$6.6
2B: Partial—Banks + FDR	$691.3	$89.1	$780.4	$6.6
3A: Full—Banks	$2,457.7	$327.8	$2,785.5	$15.0
3B: Full—Banks + FDR	$2,457.7	$327.8	$2,785.5	$15.0
4A: Modified Partial—Banks (preferred)	$736.5	$91.0	$827.5	$7.9
4B: Modified Partial—Banks + FDR	$736.5	$91.0	$827.5	$7.9
*Since the construction periods vary by phase, this maximum annual OMR&P cost does not occur until year 2025 after all construction phases are complete.				

2.10 Benefit-Cost Analysis

This section summarizes the results of a benefit-cost analysis (BCA) of the Proposed Action alternatives. For a more detailed discussion of the BCA, see the Odessa Special Study Report (Reclamation 2012 Study).

A BCA compares the benefits of a proposed project to its costs. The total costs of the project are subtracted from the total benefits to measure net benefits. If the net benefits are positive, implying that benefits exceed costs, the project would be considered economically justified. In studies where multiple alternatives are being considered, the alternative with the greatest positive net benefit would be preferred strictly from an economics perspective. Another way of displaying this benefit-cost comparison involves dividing total project benefits by total project costs—resulting in the benefit-cost ratio (BCR). A BCR greater than one is analogous to a positive net benefit.

Costs and benefits must be converted to a common point in time before comparisons can be made. As is typical in Reclamation studies, the decision was made to measure all the costs and benefits at the end of the construction period (see section 2.9 - *Estimated Cost of Alternatives* for information on the phased construction period). Since construction is divided into phases, the end of the construction period was defined as the end of the last construction phase for each alternative (year 2025). Since each canal phase is dependent on the operational life of the first phase and the operational life of the first phase of this project would end in year 2118 (100 years after the end of construction of the first phase), the end of the period of analysis for all phases is set at year 2118. Costs and benefits incurred prior to year 2025 are compounded (increased) to year 2025, while costs and benefits incurred after year 2025 are discounted (decreased) back to year 2025. All compounding and discounting is accomplished using the Federal 2011 to 2012 water project planning rate of 4.0 percent. While emphasis is placed on the results using the required current planning rate, benefit-cost comparisons were also done for informational purposes only using the 3.0 percent planning rate in place when the CBP was initially authorized.

As described in Section 2.9 – *Estimated Cost of Alternatives*, the cost components include canal construction, IDC, land acquisition, and OMR&P. In addition, lost hydropower benefits were estimated and included within total costs. Total benefits are comprised of agricultural, municipal, and industrial benefits (Table 2-13 and Table 2-14). Because all benefits and costs must be adjusted to the same point in time for the BCA, the unadjusted total costs presented in Section 2.9 – *Estimated Cost of Alternatives* do not agree with the costs presented within this section.

The benefit-cost results were developed by alternative and estimated using the two hydrologic scenarios and two municipal benefit estimates. The hydrologic scenarios include a “With Spring Diversion” option and a “Limited Spring Diversion” option. The municipal benefit options varied based on the water supply transition path assumed for each town. Option 1 assumed towns ultimately move to either a deep well system or a combined deep well and surface water system. Option 2 assumed all towns move to a deep well system. Since these different scenarios resulted in four benefit-cost estimates for each alternative, the decision was made to present only the high and low results in Table 2-13. For the entire range of benefit-cost results for each alternative, see the Economics Technical Appendix (Reclamation 2012 Economics).

Table 2-13. Results of BCA based on original CBP planning rate of 4.0 percent, millions of dollars.

	Partial Replacement Alternatives (2A/2B)		Full Replacement Alternatives (3A/3B)		Modified Partial Replacement Alternatives (4A/4B)	
	High Estimate (With Spring Diversion & Municipal Benefit Option 1)	Low Estimate (Limited Spring Diversion & Municipal Benefit Option 2)	High Estimate (With Spring Diversion & Municipal Benefit Option 1)	Low Estimate (Limited Spring Diversion & Municipal Benefit Option 2)	High Estimate (With Spring Diversion & Municipal Benefit Option 1)	Low Estimate (Limited Spring Diversion & Municipal Benefit Option 2)
1) Total Benefits:	1,109.3	1,102.4	2,006.0	1,982.5	1,378.9	1,366.9
a) Agriculture	1,070.0	1,070.0	1,884.9	1,884.9	1,315.4	1,315.4
b) Municipal	34.1	27.2	116.2	92.7	58.6	46.6
c) Industrial	5.2	5.2	4.9	4.9	4.9	4.9
2) Total Costs (including Lost Benefits):	1,250.0	1,271.9	3,920.8	3,952.4	1,367.9	1,399.6
a) Canal & Reservoir Construction & IDC Costs	886.0	886.0	3,169.3	3,169.3	942.0	942.0
b) Canal & Reservoir OMR&P Costs	192.5	192.5	428.1	428.1	228.7	228.7
c) Land Acquisition Costs	3.2	3.2	3.9	3.9	2.5	2.5
d) Reduced Hydropower Benefits	168.3	190.2	319.5	351.1	194.7	226.4
3) Net Benefits (row 1 minus row 2):	(140.7)	(169.5)	(1,914.8)	(1,969.9)	11.0	(32.7)
4) Benefit-Cost Ratio (row 1 divided by row 2)	.887	.867	.512	.502	1.008	.977

Table 2-14. Results of BCA based on current planning rate of 3.0 percent (millions of dollars).

	Partial Replacement Alternatives (2A/2B)		Full Replacement Alternatives (3A/3B)		Modified Partial Replacement Alternatives (4A/4B)	
	High Estimate (With Spring Diversion & Municipal Benefit Option 1)	Low Estimate (Limited Spring Diversion & Municipal Benefit Option 2)	High Estimate (With Spring Diversion & Municipal Benefit Option 1)	Low Estimate (Limited Spring Diversion & Municipal Benefit Option 2)	High Estimate (With Spring Diversion & Municipal Benefit Option 1)	Low Estimate (Limited Spring Diversion & Municipal Benefit Option 2)
1) Total Benefits:	1359.0	1,352.6	2,463.3	2,438.4	1,688.5	1,676.5
a) Agriculture	1,321.4	1,321.4	2,337.5	2,337.5	1,625.5	1,625.5
b) Municipal	31.0	24.6	119.6	94.7	56.8	44.8
c) Industrial	6.6	6.6	6.2	6.2	6.2	6.2
2) Total Costs (including Lost Benefits):	1,279.4	1,306.4	3,901.6	3,940.7	1,409.3	1,448.3
a) Canal & Reservoir Construction & IDC Costs	831.8	831.8	2,972.9	2,972.9	885.1	885.1
b) Canal & Reservoir OMR&P Costs	237.2	237.2	529.5	529.5	281.9	281.9
c) Land Acquisition Costs	3.2	3.2	3.9	3.9	2.5	2.5
d) Reduced Hydropower Benefits	207.2	234.2	395.3	434.4	239.8	278.8
3) Net Benefits (row 1 minus row 2)	79.6	46.2	(1,438.3)	(1,502.3)	279.2	228.2
4) Benefit-Cost Ratio (row 1 divided by row 2)	1.062	1.035	.631	.619	1.198	1.158

2.10.1 BCA for No Action Alternative

Since all costs and benefits are estimated as changes from the No Action Alternative, a BCA was not developed for the No Action Alternative.

2.10.2 BCA for Alternatives 2A: Partial—Banks and 2B: Partial—Banks + FDR

Alternatives 2A and 2B involve the same costs and benefits; therefore, they generate the same BCA results. Using the current 4.0 percent planning rate and the high end benefit-cost result, total benefits were estimated at $1,109.3 million and total costs at $1,250 million, resulting in a negative net benefit of -$140.7 million and a .887 BCR. For the low end benefit-cost result, total benefits were estimated at $1,102.4 million and total costs at $1,271.9 million, resulting in a negative net benefit of -$169.5 million and a .867 BCR. None of the benefit-cost results under the range of scenarios evaluated for alternatives 2A/B generated a positive net benefit or BCR greater than 1 (Table 2-14).

2.10.3 BCA for Alternatives 3A: Full—Banks and 3B: Full—Banks + FDR

Alternatives 3A and 3B involve the same costs and benefits and generate the same BCA results. Using the current 4.0 percent planning rate and the high end benefit-cost result, total benefits were estimated at $2,006.0 million and total costs at $3,920.8 million, resulting in a negative net benefit of -$1,914.8 million and a .512 BCR. For the low end benefit-cost result, total benefits were estimated at $1,982.5 million and total costs at $3,952.4 million, resulting in a negative net benefit of -$1,969.9 million and a .502 BCR. None of the benefit-cost results under the range of scenarios evaluated for alternatives 3A/B generated a positive net benefit or BCR greater than 1 (Table 2-14).

2.10.4 BCA for Alternatives 4A: Modified Partial—Banks (Preferred Alternative) and 4B: Modified Partial—Banks + FDR

Alternatives 4A and 4B involve the same costs and benefits and generate the same BCA results. Using the current 4.0 percent planning rate and the high end benefit-cost result, total benefits were estimated at $1,315.4 million and total costs at $1,367.9 million, resulting in a positive net benefit of $11.0 million and a 1.008 BCR. For the low end benefit-cost result, total benefits were estimated at $1,366.9 million and total costs at $1,399.6 million, resulting in a negative net benefit of -$32.7 million and a .977 BCR. While the benefit-cost results for all of the scenarios evaluated for alternatives 4A/B approached a positive net benefit and a BCR greater than 1, only the high end benefit-cost result actually achieved economic justification (Table 2-14).

2.11 Consequences of No Action

The consequences of the No Action Alternative over the next 10 years[7] (approximately 2020) (see Chapter 4.3.2.2 *Groundwater Resources*) would include:

- Only 15 percent of the production wells in the Study Area would continue to support irrigation for valuable high-water crops, such as potatoes.
- About 55 percent of the production wells in the Study Area would cease groundwater output and use of these wells would be permanently discontinued.
- The remaining 30 percent of the production wells in the Study Area would no longer support high water use crops, even on reduced acreage.

The consequences of the No Action Alternative to various environmental and socioeconomic resources are discussed further in Chapter 4 – *Environmental Consequences*.

Under the No Action Alternative, the following would occur related to other water management programs:

- Operations at Lake Roosevelt and Banks Lake would continue as they do currently, providing water supply to meet authorized CBP purposes, including water delivery for irrigation, fish management, municipal and industrial uses, and recreation.
- Actions by the Management Program to pursue the development of water supply alternatives to groundwater for agricultural users in the Odessa Subarea would not proceed further under the No Action Alternative since this Study is the direct response to this specific provision of Chapter 90.90 RCW – *Columbia River Water Management Act*.
- The No Action Alternative would not address existing East Low Canal system constraints that affect ECBID's ability to meet delivery commitments to existing water service contract holders in the Study Area (as described in Section 2.3).
- The Coordinated Conservation Program (as described in Section 2.2.3) would continue to implement conservation efforts to create water savings in the Study Area to reduce the use of groundwater for existing irrigation.

[7] Based on information provided by GWMA, as well as others, Reclamation interpreted the rate at which wells would go out of production to be approximately 26 years (Reclamation 2012 Groundwater).

- The Lake Roosevelt Incremental Storage Releases Program (as described in Section 2.2.3) would continue to implement additional incremental storage releases from Lake Roosevelt to supplement water supplies for instream flows, existing agricultural lands in the Study Area, and municipal and industrial needs.

2.12 Comparative Evaluation of Alternatives

Table 2-15 displays the results of the Study alternatives for all resource topics. For each resource topic, one or more impact indicators are listed in the left-hand column. These indicators identify how changes to the environment are measured. The criteria used to judge whether those changes are significant is provided at the beginning of each resource topic section in Chapter 4.

A short description of the benefit or adverse impact for each of these impact indicators is listed under the alternatives and describes the relative magnitude of the effects of the alternatives, the same as shown on Table 2-15. If the impact is significant, it is identified in the text and explained further in Chapter 4.

For all of the resource topics, the expected impacts shown are those that would remain after all regulatory requirements and best management practices are met. The impact analysis shown on Table 2-15 reflects the application of mitigation measures. Available mitigation and the extent to which mitigation measures would reduce impacts are assessed in under each resource topic in Chapter 4 and summarized in Chapter 4, Section 4.31 –*Environmental Commitments*.

Table 2-15. Overview of the benefits and impacts from the alternatives on all resource topics and areas assessed.

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Surface Water Quantity							
Instream flow requirements	No impact	Minimal Impact with both diversion scenarios.	Minimal Impact with both diversion scenarios.	Minimal Impact with both diversion scenarios.	Minimal Impact with both diversion scenarios.	Minimal Impact with both diversion scenarios.	Minimal Impact with both diversion scenarios.
Reduction of surface water elevations in Lake Roosevelt	No impact	No impact with both diversion scenarios	Minimal additional drawdown in late August and September with both diversion scenarios. Minimal hydrologic impact.	No impact with both diversion scenarios	Minimal additional drawdown in late August and September with both diversion scenarios. Minimal hydrologic impact.	No impact with both diversion scenarios	Additional drawdown in August and September with both diversion scenarios. Minimal hydrologic impact.
Reduction of surface water elevations in Banks Lake	No impact	Drawdown starting April through late September with both diversion scenarios. Minimal hydrologic impact.	Drawdown starting April through late September with both diversion scenarios. Minimal hydrologic impact.	Drawdown starting April through late September with both diversion scenarios. Minimal hydrologic impact.	Drawdown starting April through late September with both diversion scenarios. Minimal hydrologic impact.	Drawdown starting April through late September with both diversion scenarios. Minimal hydrologic impact.	Drawdown starting April through late September with both diversion scenarios. Minimal hydrologic impact.
Changes to flows, geomorphology, or connectivity from inundation under a planned reservoir or spillway flow from a reservoir	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	Inundation by Black Rock Coulee Reregulating Reservoir. Minimal impact with both diversion scenarios.	Inundation by Black Rock Coulee Reregulating Reservoir. Minimal impact with both diversion scenarios.	Minimal impact with both diversion scenarios.	Minimal impact with both diversion scenarios.
Changes to areas that receive water from the wasteways	No impact	Minimal impact with both diversion scenarios.	Minimal impact with both diversion scenarios.	Minimal impact in Black Rock Coulee with both diversion scenarios	Minimal impact in Black Rock Coulee with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Groundwater Resources							
Groundwater level declines	Continued decline in levels and high level of discontinued use in next 10-20 years. Adverse impact.	Conservation of about 138,000 ac-ft/year of groundwater; level declines continue, but at slower rate with both diversion scenarios. Beneficial impact.	Conservation of about 138,000 ac-ft/year of groundwater; level declines continue, but at slower rate with both diversion scenarios. Beneficial impact.	Conservation of about 273,000 ac-ft/year of groundwater; level declines continue and may rise slightly with both diversion scenarios. Beneficial impact.	Conservation of about 273,000 ac-ft/year of groundwater; level declines continue and may rise slightly with both diversion scenarios. Beneficial impact.	Conservation of about 164,000 ac-ft/year of groundwater; level declines continue, but at slower rate with both diversion scenarios. Beneficial impact.	Conservation of about 164,000 ac-ft/year of groundwater; level declines continue, but at slower rate with both diversion scenarios. Beneficial impact.
Recharge or seepage in Black Rock Coulee	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	Local recharge to shallow groundwater from reservoir with both diversion scenarios	Local recharge to shallow groundwater from reservoir with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Municipal and industrial users	Continued decline in levels. Adverse impact.	Reduced rate of declining groundwater levels. Beneficial effect south of I-90. Continued decline in levels north of I-90 with both diversion scenarios. Adverse impact.	Reduced rate of declining groundwater levels. Beneficial effect south of I-90. Continued decline in levels north of I-90 with both diversion scenarios. Adverse impact.	Reduced rate of declining groundwater levels as shallow aquifer seeps into deep aquifer with both diversion scenarios. Beneficial impact.	Reduced rate of declining groundwater levels as shallow aquifer seeps into deep aquifer with both diversion scenarios. Beneficial effect.	Reduced rate of declining groundwater levels with both diversion scenarios. Beneficial effect.	Reduced rate of declining groundwater levels with both diversion scenarios. Beneficial effect.

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Water Quality							
Temperature (FDR)	No impact	No impact with both diversion scenarios	Minimal impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios
Dissolved oxygen (FDR)	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Heavy metals (FDR)	No impact	No impact with both diversion scenarios	Minimal impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios
Temperature (Banks)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact, but greater than 2A with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact, but greater than 2A with both diversion scenarios	Minimal impact with both diversion scenarios
Dissolved oxygen (Banks)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact, but greater than 2A with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact, but greater than 2A with both diversion scenarios	Minimal impact with both diversion scenarios
Turbidity (Banks)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Temperature (Columbia)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Total dissolved gas (Columbia)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Temperature (CBP)	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
pH (CBP)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Salinity (CBP)	No impact	Minor beneficial effect with both diversion scenarios	Minor beneficial effect with both diversion scenarios	Minor beneficial effect with both diversion scenarios	Minor beneficial effect with both diversion scenarios	Minor beneficial effect with both diversion scenarios	Minor beneficial effect with both diversion scenarios
Nutrients (CBP)	Potential minor beneficial effect	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Water Rights							
Loss or curtailment of groundwater rights	No impact	Minor impacts with both diversion scenarios	Minor impacts with both diversion scenarios	Minor impacts with both diversion scenarios	Minor impacts with both diversion scenarios	Minor impacts with both diversion scenarios	Minor impacts with both diversion scenarios
Columbia River and Lake Roosevelt Tribal water rights	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Geology							
Commitment of geologic resources	No impact	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios
Geologic hazards	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Unique geologic features	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Soils							
Farmland Protection Policy Act	No impact	No impacts with both diversion scenarios with implementation of legal requirements, BMPs, and mitigation measures	No impacts with both diversion scenarios with implementation of legal requirements, BMPs, and mitigation measures	No impacts with both diversion scenarios with implementation of legal requirements, BMPs, and mitigation measures	No impacts with both diversion scenarios with implementation of legal requirements, BMPs, and mitigation measures	No impacts with both diversion scenarios with implementation of legal requirements, BMPs, and mitigation measures	No impacts with both diversion scenarios with implementation of legal requirements, BMPs, and mitigation measures
Vegetation and Wetlands							
Impact on native plant communities	No impact	Adverse impact on native plant communities with both diversion scenarios	Adverse impact on native plant communities with both diversion scenarios	Significant impact with both diversion scenarios, including Black Rock Coulee Reregulating Reservoir	Significant impact with both diversion scenarios, including Black Rock Coulee Reregulating Reservoir	Adverse impact on native plant communities with both diversion scenarios	Adverse impact on native plant communities with both diversion scenarios
Fragmentation of native plant communities	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Adverse impact with both diversion scenarios with construction of new canals	Adverse impact with both diversion scenarios with construction of new canals	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Impact on special status plants	No impact	Potential impacts with both diversion scenarios; not yet quantified	Potential impacts with both diversion scenarios; not yet quantified	Potential impacts with both diversion scenarios; not yet quantified, but approximately an order of magnitude greater than 2A	Potential impacts with both diversion scenarios; not yet quantified, but approximately an order of magnitude greater than 2A	Potential impacts with both diversion scenarios; not yet quantified	Potential impacts with both diversion scenarios; not yet quantified
Habitat restoration	No impact	Long time periods for restoration of disturbed habitat with both diversion scenarios	Significant requirement for restoration of disturbed habitat with both diversion scenarios	Long time periods for restoration of disturbed habitat over larger areas than 2A with both diversion scenarios	Significant requirement for restoration of disturbed habitat over larger areas than 2A with both diversion scenarios	Long time periods for restoration of disturbed habitat with both diversion scenarios	Significant requirement for restoration of disturbed habitat with both diversion scenarios
Long-term loss of wetland area	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Adverse impact at Banks Lake with both diversion scenarios	Adverse impact at Banks Lake with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Long-term loss or degradation of wetland function	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal to adverse impact at Banks Lake depending on water year with both diversion scenarios	Minimal to adverse impact at Banks Lake depending on water year with both diversion scenarios	Minimal impact at Banks Lake depending on water year with both diversion scenarios	Minimal impact at Banks Lake depending on water year with both diversion scenarios

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Wildlife and Wildlife Habitat							
Impact on intact shrub-steppe habitat	Minimal impact on wildlife that use farm lands because wheat fields would be fallowed every other year	Adverse impact with both diversion scenarios with removal of shrub-steppe habitat	Adverse impact with both diversion scenarios with removal of shrub-steppe habitat	Significant impact with both diversion scenarios over substantially larger area than with Alternative 2A	Significant impact over substantially larger area than with Alternative 2A	Adverse impact over slightly larger area than with Alternative 2A	Adverse impact over slightly larger area than with Alternative 2A
Barriers to unrestricted movement by wildlife	No impact	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios	Significant impact with both diversion scenarios from extended canal system	Significant impact with both diversion scenarios from extended canal system	No impact to minimal impact with both diversion scenarios	No impact to minimal impact with both diversion scenarios
Impact on special status species, including migratory birds	No impact	Significant impact on multiple species with both diversion scenarios. Impacts to grebes would be more pronounced with the limited spring diversion scenario.	Significant impact on multiple species with both diversion scenarios. Impacts to grebes would be more pronounced with the limited spring diversion scenario.	Significant impact on multiple species with both diversion scenarios, involving substantially larger area and a number of species than with Alternative 2A	Significant impact on multiple species with both diversion scenarios, involving substantially larger area and a number of species than with Alternative 2A	Significant impact on multiple species with both diversion scenarios, involving slightly larger area and a number of species than with Alternative 2A	Significant impact on multiple species with both diversion scenarios, involving slightly larger area and a number of species than with Alternative 2A
Habitat fragmentation and population viability	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	Significant impact from extended canal system	Significant impact from extended canal system	No impact with both diversion scenarios	No impact with both diversion scenarios
Fisheries and Aquatic Resources							
Columbia River: Downstream migration of salmonid smolts (mid-April to August)	No impact	No to minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	No to minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	No to minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	No to minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	No to minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	No to minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario
Columbia River: Upstream migration of adult salmon and steelhead (September to October for Fall Chinook, Steelhead)	No impact	No to minimal impact under both diversion scenarios	No to minimal impact under both diversion scenarios	No to minimal impact under both diversion scenarios	No to minimal impact under both diversion scenarios	No to minimal impact under both diversion scenarios	No to minimal impact under both diversion scenarios
Columbia River: Chum salmon spawning below Bonneville Dam (November to mid-April)	No impact	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios
FDR: Zooplankton production	No impact	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios
FDR: Rainbow trout net pen program	No impact	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios
FDR: Kokanee salmon spawner access to San Poil River	No impact	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	No impact to minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Banks Lake: Fish and zooplankton entrainment	No impact	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal to adverse impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal to adverse impact under both diversion scenarios	Minimal impact under both diversion scenarios
Surface areas of littoral habitat temporarily exposed during drawdowns	No impact	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	Significant impact from greater drawdown under both diversion scenarios.	Minimal impact under both diversion scenarios	Minimal to adverse impact under both diversion scenarios	Minimal impact under both diversion scenarios
Banks Lake: Overall condition of the fishery	No impact	Minimal under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal to adverse impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal to adverse impact under both diversion scenarios	Minimal impact under both diversion scenarios
Threatened and Endangered Species							
Pygmy rabbits	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Downstream migration of salmonid smolts	No impact	Minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	Minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	Minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	Minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	Minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario	Minimal impact Spring Diversion Scenario No impact Limited Spring Diversion Scenario
Upstream migration of adult salmon, steelhead, and bull trout	No impact	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios	Minimal impact under both diversion scenarios
Chum salmon spawning below Bonneville Dam	No impact	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios	No impact under both diversion scenarios
Air Quality							
Primary air quality standards	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Secondary air quality standards	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Attainment area classification	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Land Use and Shoreline Resources							
Changes in land ownership and land status	Potential for consolidation of farms	About 5,150 acres acquired (easements and fee title) with both diversion scenarios. Adverse impact	About 5,150 acres acquired (easements and fee title) with both diversion scenarios. Adverse impact	About 17,360 acres acquired (easements and fee title) with both diversion scenarios. Adverse impact	About 17,360 acres acquired (easements and fee title) with both diversion scenarios. Adverse impact	About 4,740 acres acquired (easements and fee title) with both diversion scenarios. Adverse impact	About 4,740 acres acquired (easements and fee title) with both diversion scenarios. Adverse impact
Changes in land or shoreline uses: Protection of irrigated agriculture	Adverse impact with significant change from irrigated to dryland agriculture.	57,000 acres of irrigated agriculture preserved with both diversion scenarios. Beneficial effect.	57,000 acres of irrigated agriculture preserved with both diversion scenarios. Beneficial effect.	102,600 acres of irrigated agriculture preserved with both diversion scenarios. Beneficial effect.	102,600 acres of irrigated agriculture preserved with both diversion scenarios. Beneficial effect.	70,000 acres of irrigated agriculture preserved with both diversion scenarios. Beneficial effect.	70,000 acres of irrigated agriculture preserved with both diversion scenarios. Beneficial effect.

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Consistency with relevant plans, policies and programs	Adverse impact from inconsistent plans across 102,614 acres.	Supports county comprehensive plans across 57,000 acres with both diversion scenarios. Beneficial effect.	Supports county comprehensive plans across 57,000 acres with both diversion scenarios. Beneficial effect.	Supports county comprehensive plans across 102,600 acres with both diversion scenarios. Beneficial effect.	Supports county comprehensive plans across 102,600 acres with both diversion scenarios. Beneficial effect.	Supports county comprehensive plans across 70,000 acres with both diversion scenarios. Beneficial effect.	Supports county comprehensive plans across 70,000 acres with both diversion scenarios. Beneficial effect.
Recreation							
FDR: Loss of boating capacity	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	In dry years, 6 of 22 launches unavailable for 1-3 weeks. Slight increase in impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	No impact with both diversion scenarios	Minimal impact with both diversion scenarios
FDR: Exposure of boating hazards	No impact	No impact with both diversion scenarios	Minimal impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios
FDR: Loss of fishing opportunities	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
FDR: Loss of usability at developed swimming areas	No impact	No impact with both diversion scenarios	Increased distance to water's edge with both diversion scenarios. Minimal impact.	No impact with both diversion scenarios	Increased distance to water's edge with both diversion scenarios. Adverse impact.	No impact with both diversion scenarios	Increased distance to water's edge with both diversion scenarios. Minimal impact.
FDR: Decrease in usability or aesthetic quality at developed camping or day use facilities	No impact	No impact with both diversion scenarios	Increased distance to water's edge with both diversion scenarios. Minimal impact.	No impact with both diversion scenarios	Increased distance to water's edge with both diversion scenarios. Adverse impact.	No impact with both diversion scenarios	Increased distance to water's edge with both diversion scenarios. Minimal impact.
FDR: Dispersed recreation	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	Minimal impact with both diversion scenarios
FDR: Loss of opportunity for hunting, wildlife viewing, hiking, etc. on lands surrounding the reservoirs	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Banks: Loss in boat launch capacity and related impacts on fishing access, camping, and day use	No impact	In dry years, two of five high-capacity launches unavailable for 3-4 weeks with both diversion scenarios. Adverse impact.	With both diversion scenarios, minimal impact at high-capacity ramps, but low-capacity ramps would be out of service for up to 5 weeks	All but one boat ramp unavailable for 6 weeks with both scenarios. Adverse impact.	With both diversion scenarios, minimal impact at high-capacity ramps, but low-capacity ramps would be out of service for up to 5 weeks	In dry years, high capacity ramps unavailable for 1-4 weeks. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	With both diversion scenarios, minimal impact at high-capacity ramps, but low-capacity ramps would be out of service for up to 5 weeks

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Banks: Exposure of boating hazards	Minimal impact	Drawdown exposure of hazards would last for about 3-6 weeks. Potential for increased hazard exposure with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Drawdown exposure of hazards would last for about 6-7 weeks. Potential for increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Drawdown exposure of hazards would last for about 10-13 weeks. Potential for increased hazard exposure with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Drawdown exposure of hazards would last for about 10-13 weeks. Potential for increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Drawdown exposure of hazards would last for about 4-7 weeks. Potential for increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Drawdown exposure of hazards would last for about 6-7 weeks. Potential for increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.
Banks: Loss of fishing opportunities (because of impact on fishery; impact on fishing access reflected in boating capacity indicator)	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal Impact with both diversion scenarios.	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Banks: Loss of usability at developed swimming areas	No impact	Three of four swimming areas unusable for about 6 weeks. Slight increase in impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Three of four swimming areas unusable for about 5-6 weeks. Potential increased impact with limited spring diversion scenario than with spring diversion scenario Adverse impact.	All four swimming areas would be unusable for up to 12 weeks. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Three of four swimming areas unusable for about 5-6 weeks. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Three of four swimming areas unusable for about 6 weeks. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Three of four swimming areas unusable for about 5-6 weeks. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.
Banks: Decrease in usability or aesthetic quality at developed camping or day use facilities	Minimal impact	Distance to water's edge would be about 20-260 feet for dry years with both diversion scenarios. Adverse impact.	Distance to water's edge would be about 20-260 feet for dry years with both diversion scenarios. Adverse impact.	Distance to water's edge would be about 50-850 feet in dry years. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Distance to water's edge would be about 20-260 feet for dry years with both diversion scenarios. Adverse impact.	Distance to water's edge would be about 50-450 feet in dry years. Potential increased hazard exposure with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Distance to water's edge would be about 20-260 feet for dry years with both diversion scenarios. Adverse impact.
Banks: Decrease in usability of aesthetic quality at dispersed recreation sites	Minimal impact	Distance to water's edge would be about 20-445 feet for dry years with both diversion scenarios. Adverse impact.	Distance to water's edge would be about 20-420 feet for dry years with both diversion scenarios. Adverse impact.	Distance to water's edge would be over 50-890 feet for dry years. Potential increased impact with limited spring diversion scenario than with spring diversion scenario. Adverse impact.	Distance to water's edge would be about 20-420 feet for dry years. Adverse impact.	Distance to water's edge would be about 25-470 feet for dry years. Adverse impact.	Distance to water's edge would be about 20-420 feet for dry years. Adverse impact.
Banks: Loss of opportunity for hunting, wildlife viewing, hiking, etc. on lands surrounding the reservoirs	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Loss of hunting and/or wildlife viewing opportunities in Odessa Special Study Area	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Irrigated Agriculture							
Gross Farm Income 2025 Study Area Compared to Four-County Analysis Area	Adverse long-term impact: gross farm income drops from about $119.1 million to $54.5 million	Beneficial long-term effect: gross farm income increases from about $119.1 million to $156.8 million	Beneficial long-term effect: gross farm income increases from about $119.1 million to $156.8 million	Beneficial long-term effect: gross farm income increases from about $119.1 million to $243.5 million	Beneficial long-term effect: gross farm income increases from about $119.1 million to $243.5 million	Beneficial long-term effect: gross farm income increases from about $119.1 million to $182.6 million	Beneficial long-term effect: gross farm income increases from about $119.1 million to $182.6 million
Socioeconomics							
Change in regional employment (number of jobs) within the four-county analysis area	Minimal long–term impact: less than 1 percent decrease in jobs	Short–term beneficial effects: less than one percent increase in jobs. Net long–term beneficial effects: less than 1 percent increase in jobs. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 4 percent increase in jobs. Net long–term beneficial effects: less than 1 percent increase in jobs. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 4 percent increase in jobs. Net long–term beneficial effects. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 2 percent in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 2 percent increase in jobs.
Change in regional labor income within the four-county analysis area	Minimal long–term impact: less than 0.5 percent decrease in labor income	Short–term beneficial effects: less than 2 percent increase in labor income. Net long–term beneficial effects. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 2 percent increase in labor income. Net long–term beneficial effects: less than 1 percent increase in labor income. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 6 percent increase in labor income. Net long–term beneficial effects: less than 1 percent increase in labor income. Ag: less than 3 percent increase in jobs.	Short–term beneficial effects: less than 6 percent increase in labor income. Net long–term beneficial effects. Ag: less than 3 percent increase in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 2 percent in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 2 percent increase in jobs.
Change in regional sales within the four-county analysis area	Minimal long–term impact: less than 0.5 percent decrease in sales	Short–term beneficial effects: less than 1 percent increase in sales. Net long–term beneficial effects. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 1 percent increase in sales. Net long–term beneficial effects. Ag: less than 2 percent increase in jobs.	Short–term beneficial effects: less than 4 percent increase in sales. Net long–term beneficial effects: less than 1 percent increase in sales. Ag: less than 4 percent increase in jobs.	Short–term beneficial effects: less than 4 percent increase in sales. Net long–term beneficial effects. Ag: less than 4 percent increase in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than one percent increase in jobs. Ag: less than 3 percent increase in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 3 percent increase in jobs.
Transportation							
Short- or long-term increases in traffic (general average daily and peak hour) on regional or local roads	No impact	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Increases in large and/or heavy-load vehicle traffic on regional or local roads	No impact	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios	Minimal Impact with both diversion scenarios
Existing roads and railroads: crossings by new surface facilities or inundation by new reservoirs	No impact	Minimal impact given committed Transportation Management Plan (TMP)	Minimal impact given committed TMP	Minimal impact given committed TMP	Minimal impact given committed TMP	Minimal impact given committed TMP	Minimal impact given committed TMP
Energy							
Change in net energy available in region	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Keys PGP reserves, reliability and diurnal load shifting	No impact	Adverse to significant impact with both diversion scenarios	Adverse impact with both diversion scenarios	Significant impact with both diversion scenarios	Adverse impact with both diversion scenarios	Significant impact with both diversion scenarios	Adverse impact with both diversion scenarios
Public Services and Utilities							
Exceedance of service or utility capacity (long-term)	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Disruption of services or utilities for existing residents and landowners (short-term, construction-phase)	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Impact on emergency response times (short-term, construction-phase)	No impact	Minimal Impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Noise							
Short-term (construction) increases in noise levels	No impact	Localized adverse impact	Localized adverse impact	Localized adverse impact	Localized adverse impact	Localized adverse impact	Localized adverse impact
Long-term increases in noise levels	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Public Health (Hazardous Materials)							
Hazardous sites	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Mosquito habitat	No impact	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios	Minimal impact with both diversion scenarios
Visual Resources							
Landscape-level change: conversion from irrigated agriculture to dryland or fallow over approximately 30-year period	About 100,000 acres would convert to dryland or fallow. Adverse impact.	About 48,000 acres would convert to dryland or fallow. Adverse impact.	About 48,000 acres would convert to dryland or fallow. Adverse impact.	General landscape appearance does not change.	General landscape appearance does not change.	About 35,000 acres would convert to dryland or fallow. Adverse impact.	About 35,000 acres would convert to dryland or fallow. Adverse impact.

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives		Modified Partial Groundwater Irrigation Replacement Alternatives	
		2A: Partial—Banks	2B: Partial—Banks + FDR	3A: Full—Banks	3B: Full—Banks + FDR	4A: Modified Partial—Banks	4B: Modified Partial—Banks + FDR
Introduction of new developed facilities	No impact	Pumping plants and regulating tanks south of I-90 only. Adverse impact.	Pumping plants and regulating tanks south of I-90 only. Adverse impact.	Canal, laterals, pumping plants, and regulating tanks north and south of I-90. Adverse impact.	Canal, laterals, pumping plants, and regulating tanks north and south of I-90. Adverse impact.	Pumping plants and regulating tanks north and south of I-90. Adverse impact.	Pumping plants and regulating tanks north and south of I-90. Adverse impact.
Changes in reservoir drawdown patterns at Banks Lake and Lake Roosevelt	Minimal Impact	Adverse impact at Banks Lake generally related to depth of additional drawdown. Adverse impact with both diversion scenarios.	Adverse impact at Banks Lake generally related to depth of additional drawdown. Adverse impact with both diversion scenarios.	Adverse impact at Banks Lake generally related to depth of additional drawdown. Impacts would be slightly more pronounced with the limited spring diversion scenario.	Adverse impact at Banks Lake generally related to depth of additional drawdown. Impacts would be slightly more pronounced with the limited spring diversion scenario.	Adverse impact at Banks Lake generally related to depth of additional drawdown. Adverse impact with both diversion scenarios.	Adverse impact at Banks Lake generally related to depth of additional drawdown. Adverse impact with both diversion scenarios.
Cultural and Historic Resources *Potential for construction to encounter and impact significant cultural resources*							
Miles of new linear facilities with high potential	No impact	166 miles. Adverse impact.	166 miles. Adverse impact.	245 miles. Adverse impact.	245 miles. Adverse impact.	162 miles. Adverse impact.	162 miles. Adverse impact.
Acres of facility site acquisition with high potential	No impact	38 acres. Adverse impact.	38 acres. Adverse impact.	100 acres. Adverse impact.	100 acres. Adverse impact.	27 acres. Adverse impact.	27 acres. Adverse impact.
Additional acreage exposed by drawdowns at Banks Lake	No impact	About 560 acres exposed with spring diversion scenario and about 1,079 acres with limited spring diversion scenario. Adverse impact.	About 560 acres exposed with spring diversion scenario and about 700 acres with limited spring diversion scenario. Adverse impact.	About 1,395 acres exposed with spring diversion scenario and about 2,433 acres with limited spring diversion scenario. Adverse impact.	About 700 acres exposed with spring diversion scenario and about 700 acres with limited spring diversion scenario. Adverse impact.	About 790 acres exposed with spring diversion scenario and about 1,479 acres with limited spring diversion scenario. Adverse impact.	About 700 acres exposed with spring diversion scenario and about 700 acres with limited spring diversion scenario. Adverse impact.
Indian Sacred Sites							
Potential for facility development to impact known sacred sites	No impact	Potential impacts; not yet quantified	Potential impacts; not yet quantified	Potential impacts; not yet quantified	Potential impacts; not yet quantified	Potential impacts; not yet quantified	Potential impacts; not yet quantified
Indian Trust Assets							
Potential for facility development to impact known ITAs	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios
Environmental Justice							
Disproportionate impact to minority or low-Income populations	No impact	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios	No impact with both diversion scenarios

CHAPTER 3 AFFECTED ENVIRONMENT

Chapter 3 AFFECTED ENVIRONMENT

3.1 Introduction

This chapter describes the environmental setting and existing conditions of the resources that could be affected by the action alternatives described in Chapter 2.

The analysis area is defined for each environmental resource or topic discussed in Chapter 3 and may be different from the Odessa Subarea Special Study area (Study Area). As shown on Figure 1-1, the Odessa Groundwater Management Subarea (Odessa Subarea) is where groundwater levels are declining. Within the western portion of the Odessa Subarea lies the Study Area, which is the focus of this Final EIS and the location where the alternatives could potentially be constructed.

The analysis area varies according to the physical or geographic extent where effects from the alternatives may occur. For example, the analysis area for fisheries includes the Study Area and the Columbia River downstream of Lake Roosevelt, because changes in water levels may affect downstream resources. By contrast, the analysis area for vegetation is the physical footprint of facilities to be constructed and immediately adjacent areas that may be affected by the alternatives. Each section in this chapter begins with a description of the analysis area.

3.2 Surface Water Quantity

Surface water quantity issues associated with the Study alternatives consist of potential changes to the amount of water available in the following systems:

- Columbia River watershed
- Major reservoirs
- Other surface water resources

3.2.1 Analysis Area and Methods

The analysis area includes the Columbia River, major reservoirs that could be used for water supply in the alternatives (Lake Roosevelt [FDR] and Banks Lake), and other surface water features in the Study Area. The Study Area is located within the multipurpose Columbia Basin

Project (CBP), which provides irrigation, power production, flood control, navigation, municipal water supply, recreation, and fish and wildlife benefits. The Study Area is defined by those lands within the larger Odessa Subarea eligible to receive CBP water (Figure 1-1).

Methods for this analysis focused on creating an inventory of potentially affected surface water features. Where data were available, flows, volumes, lengths, and other physical characteristics of surface water features were documented. Within the Study Area, analysis focused on modifications to the East Low Canal or construction of the East High Canal, and how the associated changes in irrigation operations may impact existing waterways, creeks, springs, or areas receiving water from wasteways.

3.2.2 Columbia River Watershed

The Columbia River watershed encompasses about 260,000 square miles in the northwestern U.S. and southwestern Canada. The Columbia River Basin is bounded by the Rocky Mountains to the east and north, the Cascade Range on the west, and the Great Basin to the south. The Columbia River originates at Columbia Lake on the west slope of British Columbia's Rocky Mountains. The river flows south from Canada into the U.S., and then west to the Pacific Ocean, forming the border between Oregon and Washington. The mouth of the Columbia River is near Astoria, Oregon, and its total length is 1,214 miles. Numerous subbasins are formed by tributaries of the mainstem river, including the Kootenai, Flathead and Pend Oreille, Snake, and Willamette rivers. Figure 3-1 shows the extent of the Columbia River watershed and the dams built along its course.

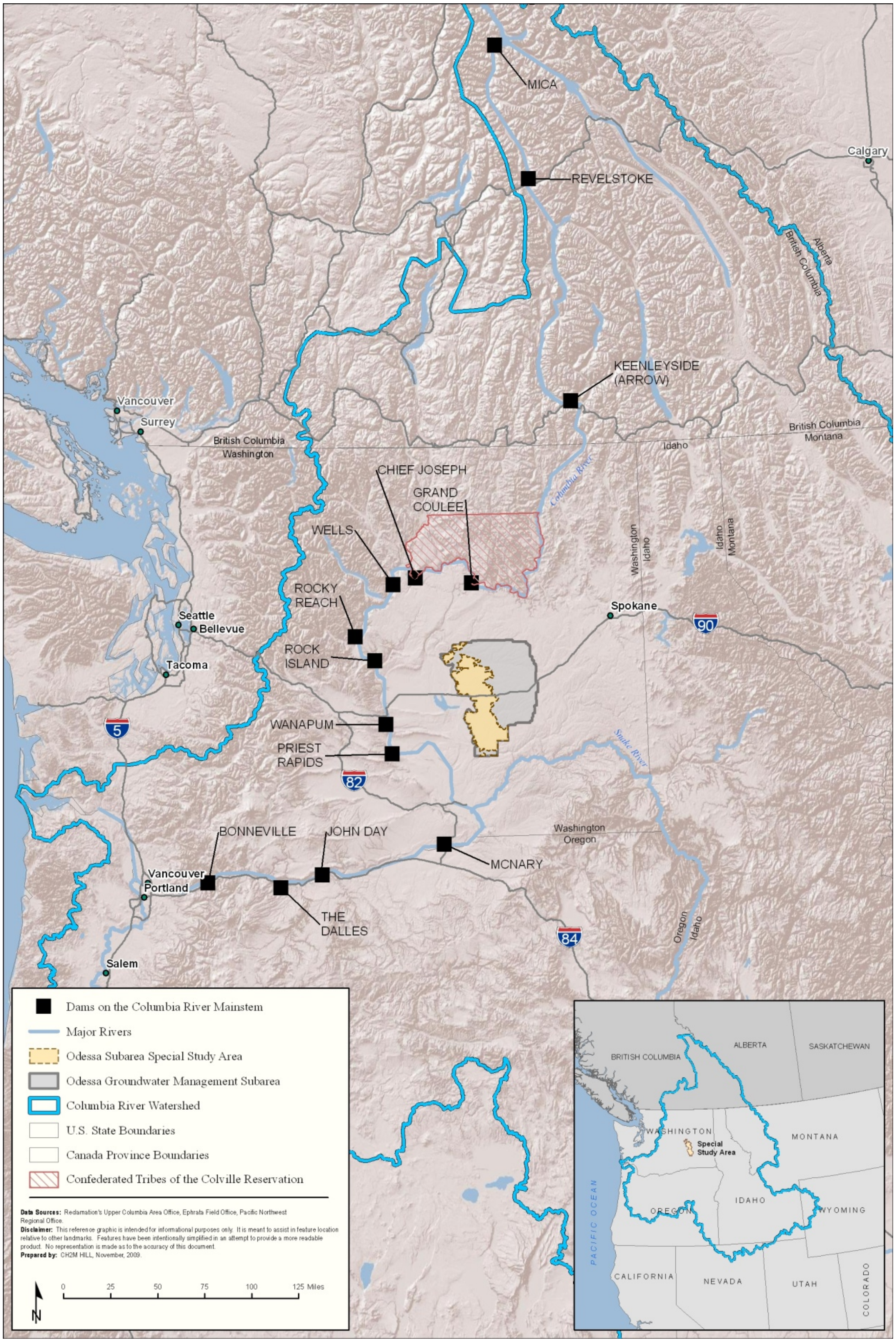

Figure 3-1. Columbia River system overview with mainstem dam sites.

Runoff from the forested slopes of the Rocky Mountains in British Columbia, western Montana, and northern Idaho contributes the main portion of the Columbia River Basin's water supply. Most of the annual precipitation occurs in the winter, with the largest share falling in the mountains as snow. The basin's snowpack melts in the spring and early summer, resulting in heavy, prolonged flows during the summer months with the peak flows usually occurring in mid-June. About 60 percent of the natural runoff in the basin occurs May through July. Average annual runoff at the mouth of the Columbia River is about 198 million acre-feet. Within the U.S., only the Missouri-Mississippi River system has more runoff.

3.2.2.1 Columbia River Flows at Grand Coulee Dam

Based on a 70-year period of record from 1929 through 1998, the average annual discharge of the Columbia River at Grand Coulee Dam was 78 million acre-feet with an average annual flow of 108,000 cubic feet per second (cfs) and a median annual flow of 88,000 cfs. Figure 3-2 presents data from U.S. Geological Survey (USGS) Gage 12436500 for the Columbia River at Grand Coulee Dam. This plot represents the regulated flow below the dam.

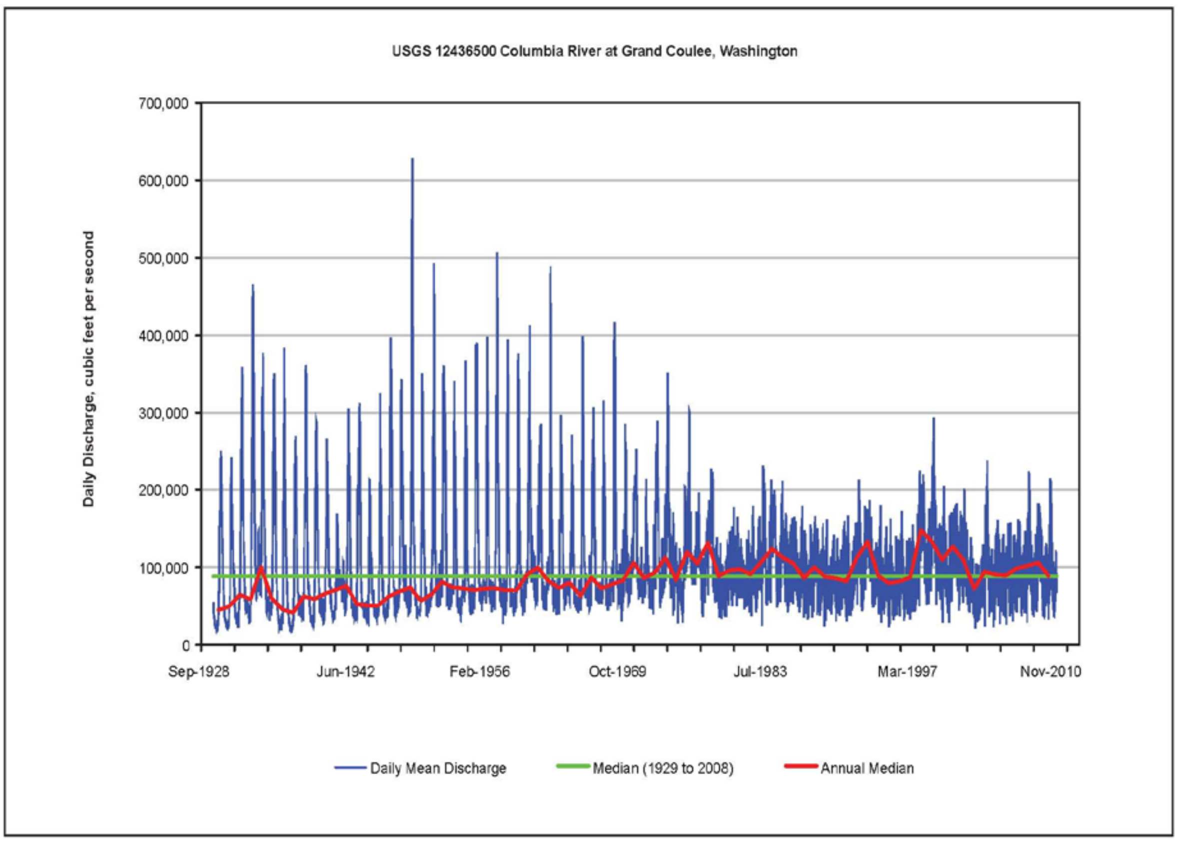

Figure 3-2. Columbia River flows at Grand Coulee, Washington (USGS 2009).

3.2.2.2 Columbia River System Development

Multiple dams have been constructed on the Columbia River, largely for hydroelectric power development. The Columbia River was ideally suited for large-scale hydropower development with a solid rock channel, low levels of silt, and relatively steep gradient. The hydroelectric dams in the Columbia River Basin are the foundation of the Pacific Northwest's power supply and have a maximum capacity of 22,500 megawatts (MW). As defined in the *Appraisal Level Investigation Odessa Subarea Special Study* (Reclamation 2008 Appraisal), the Columbia River system has been extensively developed for many additional uses, including flood control, irrigation, navigation, recreation, and water supply.

As shown on Figure 3-1, there are 11 dams on the U.S. portion of the mainstem of the Columbia River (Grand Coulee, Chief Joseph, Wells, Rocky Reach, Rock Island, Wanapum, Priest Rapids, McNary, John Day, The Dalles, and Bonneville), and 3 dams on the Canadian portion of the mainstem of the Columbia River (Mica, Revelstoke, and Keenleyside).

3.2.2.3 Columbia Basin Project

The irrigation portion of the CBP begins at the head of the Grand Coulee and extends 152 miles to the confluence of the Snake and Columbia rivers. The Columbia River forms the western boundary of the CBP near Quincy, Washington and the project extends east 60 miles to near Odessa and Lind, Washington.

The CBP includes 330 miles of main canals, 1,990 miles of smaller canals, and 3,500 miles of open drains and wasteways served by more than 240 pumping plants. The project irrigates about 671,000 acres with an average annual diversion of 2.65 million acre-feet as measured at the Main Canal during the 2000 to 2004 period (Photograph 3-1). Up to 67 different crops are grown including apples, cherries, wine grapes, potatoes, onions, alfalfa and Timothy hay, wheat, sweet corn, green peas, and carrots, with more than $1.4 billion of crop value each year.

In addition to irrigation, the CBP provides power production, flood control, municipal water supply, navigation, recreation, and fish and wildlife benefits. Irrigation return flows from the CBP are discharged into the Columbia River through wasteways, creeks, and groundwater seepage.

Photograph 3-1. CBP Main Canal.

3.2.2.4 Columbia River Regulation

The construction and operation of dams and reservoirs on the river's mainstem and tributary streams, as well as system operations, have significantly impacted the annual flow patterns (hydrograph) of the Columbia River. Regulation of the system through the use of dams has compressed the river's annual discharge patterns, as original high-season flows have decreased and low-season flows have increased.

3.2.3 Major Reservoirs in the Analysis Area

Physical characteristics, storage volumes, and operations for Lake Roosevelt and Banks Lake were described in Chapter 2, Section 2.2.3 – *Water Management Programs and Requirements Common to All Alternatives*. Lake Roosevelt's surface elevations fluctuate seasonally and daily in response to a complex set of demands, from irrigation and flood control to fish flows and hydropower. Within these constraints, Reclamation also strives to support recreational use by minimizing drawdowns during the recreation season. Figure 3-3 illustrates historical drawdowns in Lake Roosevelt. The deep drawdowns shown in 1969 and 1974 were due to construction of the third powerplant associated with the Grand Coulee Powerplant Complex.

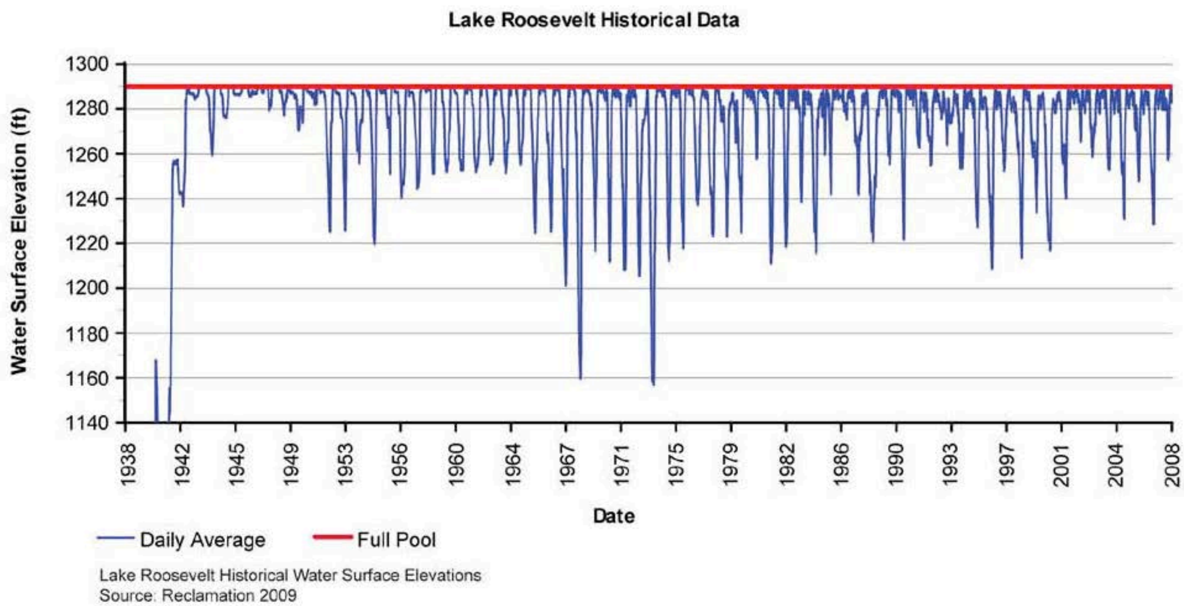

Figure 3-3. Lake Roosevelt historical water surface elevations (Reclamation 2009).

Similarly, Banks Lake is operated within established constraints to meet water delivery contractual obligations, ensure public safety, and protect property, while striving to allow for recreational use and power generation. Banks Lake drawdowns generally begin around August 1. The irrigation season typically extends from mid-March through October. Since 2000, the reservoir has been drawn down 5 feet (to elevation 1565 feet above mean sea level [amsl]) by the end of August to provide fish flow augmentation in the Columbia River through reduced pumping from the river. Larger drawdowns typically correspond with maintenance or weed control efforts. Figure 3-4 illustrates historical drawdowns in Banks Lake.

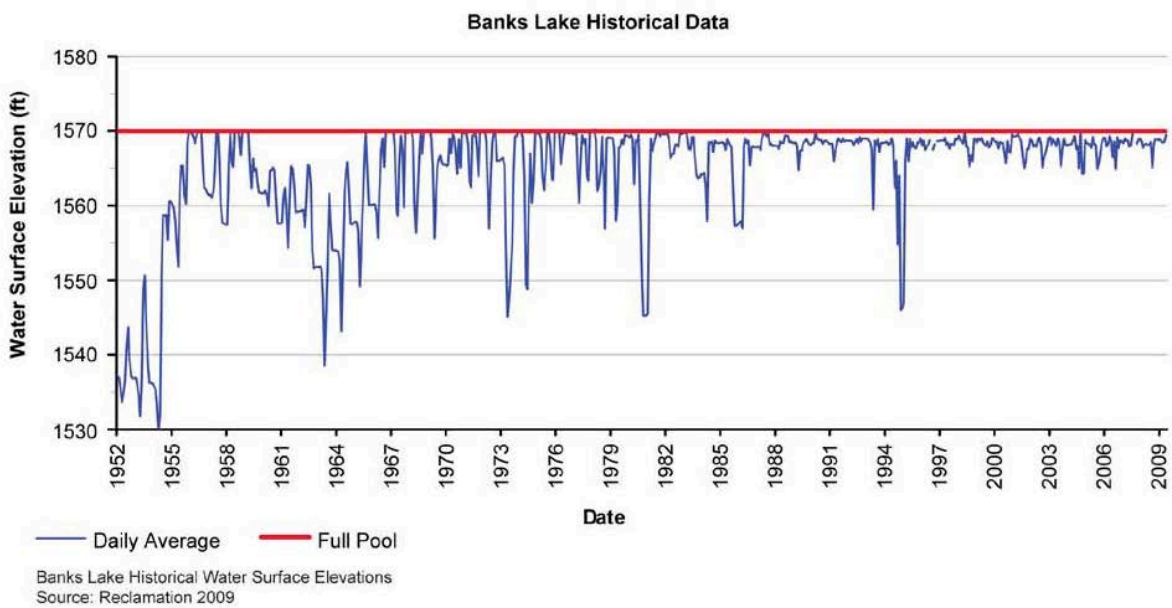

Figure 3-4. Banks Lake historical water surface elevations (Reclamation 2009).

3.2.4 Surface Water Resources in Analysis Area

The following surface water features are found in the analysis area and have the potential to be impacted by the action alternatives (Figure 1-1):

- **Feeder Canal:** Conveys pumped water (20,000 cfs capacity) 1.6 miles from Lake Roosevelt to Banks Lake.
- **Main Canal:** Conveys water (initial capacity of 19,300 cfs) 18.4 miles south from Banks Lake through Billy Clapp Lake to the north end of the irrigable area. After passing through Billy Clapp Lake, the Main Canal conveys water (capacity of 10,000 cfs) to the bifurcation, where it splits into the East Low Canal and the West Canal.
- **Billy Clapp Lake**: Equalizing reservoir along the Main Canal that is roughly 6 miles long.
- **West Canal**: Conveys water (initial capacity of 4,800 cfs) 82.2 miles from the bifurcation, along the northwest edge of the CBP, and finally flows south toward Frenchman Hills Wasteway.
- **East Low Canal**: Conveys water (initial capacity of 4,300 cfs) 86 miles from the bifurcation to the end of the canal, south of Othello. Currently carries 3,600 cfs during peak irrigation season.
- **Crab Creek**: Natural stream that drains 3,080 square miles in its upper section (from its origin east of Davenport to its outlet in Moses Lake). A lower section of the creek

runs through Potholes Reservoir before emptying into the Columbia River near Beverly.

- **Potholes Reservoir**: A 27,800-acre reservoir formed by O'Sullivan Dam on Crab Creek about 15 miles south of Moses Lake. The reservoir collects irrigation return flows from the upper CBP for reuse in the southern portion. Potholes Canal conveys the water (3,600 cfs capacity) 62.4 miles to the southern portions of the CBP.
- **Wasteways and Ephemeral Drainages**: Rocky Coulee Wasteway (2,500 cfs capacity) and Lind Coulee Wasteway (400 cfs) carry irrigation return flows back to the Crab Creek/Potholes Reservoir system. Some drainages, including Rocky Coulee, Lind Coulee, and Red Rock Coulee, were once ephemeral, but have transformed into perennial streams because of the irrigation system network. Other minor drains have been constructed throughout the analysis area.
- **Springs and Seeps**: Numerous springs and seeps are found in the analysis area, including within the proposed Black Rock Coulee Reregulating Reservoir footprint in the Banks Lake vicinity and along the Crab Creek corridor.

Lake Roosevelt Incremental Storage Releases Program is one proposal under the Management Program to improve water management in the Columbia River Basin. The purpose of this Incremental Storage Releases Program is to release additional water from Lake Roosevelt to provide drought relief, improve municipal and industrial water supplies, provide water to replace some groundwater use in the Odessa Subarea, and enhance streamflows in the Columbia River to benefit fish. Of this water released from Lake Roosevelt, 30,000 acre-feet of water is used for irrigation water for replacement of some groundwater supplies in the Odessa Subarea. This program has already been implemented and drafts Lake Roosevelt an additional foot below the end-of-August draft for flow augmentation under the NOAA Fisheries 2010 Federal Columbia River Power System (FCRPS) Biological Opinion[1] (BiOp).

3.2.5 Climate Variability and Change

Water discharge and temperatures are impacted by changes and variability in regional climate across the Columbia River Basin. Seasonal variation in the Columbia River discharge is impacted by winter precipitation amounts and snowpack depths in higher elevation areas throughout the basin. Possible future climate warming across the basin could have impacts on snowpack and runoff patterns. Recent research suggests that warmer temperatures across the basin are contributing to declines in total snow accumulations. The implications are that the snowpack would melt earlier in the spring and reduce summer streamflow.

[1] The NOAA Fisheries 2010 FCRPS Supplemental BiOp incorporates, in whole, the NOAA Fisheries 2008 BiOp and the 2009 FCRPS Adaptive Management Implementation Plan.

3.3 Groundwater Resources

The Odessa Subarea was designated by the Washington State Legislature in 1967 because groundwater levels had declined as a result of groundwater pumping. The aquifers underlying the Study Area for this Final EIS are part of the larger Columbia Plateau aquifer system (Figure 3-5). The aquifer system under the Study Area is the area's primary source of municipal, industrial, domestic, and irrigation water.

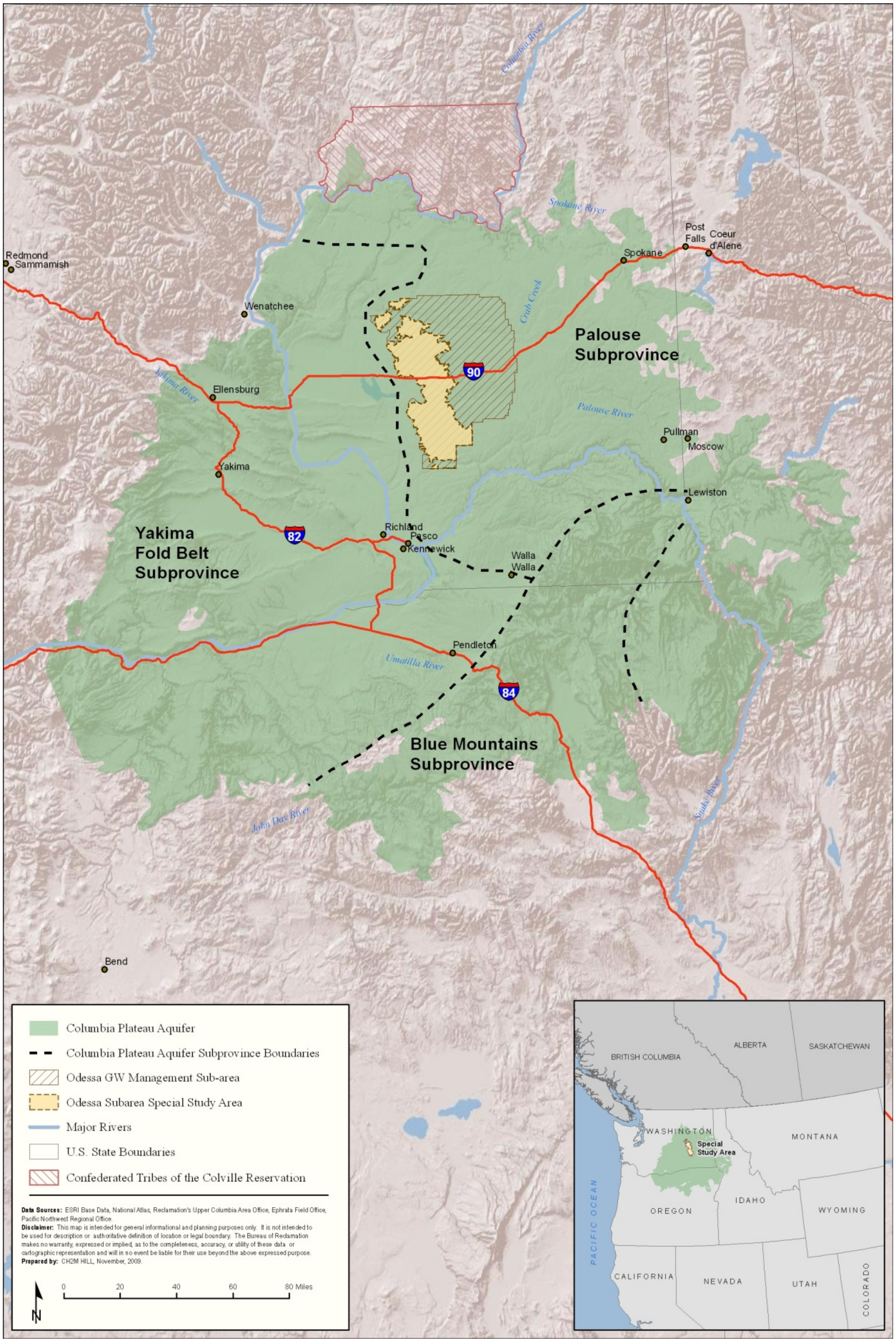

Figure 3-5. Regional aquifer context.

The Columbia Basin Ground Water Management Area (GWMA) was designated by the State of Washington in 1998. GWMA is a proactive, voluntary, nonregulatory organization comprised of local area citizens, stakeholders, and elected leaders located in Adams, Franklin, Grant, and Lincoln counties in eastern Washington, where over 90 percent of its residents rely heavily on groundwater as their only source of water. Recognizing the importance of protecting local groundwater resources, GWMA's participants work diligently to understand the groundwater conditions of this area through science-based studies and programs. GWMA provides citizens and decision makers with sound scientific information to assist them in making informed and educated decisions relating to this area's water issues.

The deep aquifers are being depleted within and beyond the Study Area, which impacts all groundwater users. An understanding of the groundwater flow system and present rates of groundwater level declines are required to assess anticipated impacts from the action alternatives.

3.3.1 Analysis Area and Methods

Because groundwater declines occur outside the boundaries of the Study Area, the analysis area extends beyond the boundaries of the Study Area, and includes groundwater users near Moses Lake, Warden, Othello, Ritzville, Connell, Odessa, Lind, Hatton, and Wilson Creek. The analysis area especially focuses on locations within the Study Area where proposed facilities would be constructed and could impact groundwater, including the Black Rock Coulee Reregulating Reservoir site, the Banks Lake area, and along canal construction, expansion, and extension areas.

Methods for this analysis focused on inventorying and documenting the hydrogeologic setting, aquifer characteristics, and groundwater quality of the analysis area.

3.3.2 Area Geology and Hydrogeologic Setting

The Study Area is underlain by flood basalts of the Columbia River Basalt Group. As described in Section 3.6 – *Geology*, these basaltic flows include the Wanapum and Grande Ronde basalts, which comprise the majority of the aquifer system. The internal structure and physical properties of the individual basaltic flows have considerable influence on the local occurrence and movement of groundwater by either creating preferred flow paths or blocking the flow of groundwater. In addition, geologic structures such as folds, dipping basalt flows, and faults can influence groundwater movement (Reclamation 2008 Feasibility; Reclamation 2007 Geology).

3.3.3 Aquifers and Hydraulic Properties

The upper aquifer includes the Wanapum basalt and upper 200 feet of the Grande Ronde basalt. The lower aquifer is within the Grande Ronde basalt, which is not exposed at the surface in the Study Area. Groundwater moves most readily through the near-horizontal basalt interflow zones. Very little vertical groundwater movement occurs between the basalt layers. The horizontal hydraulic conductivity of the Grande Ronde basalt averages 4.9 feet per day (Reclamation 2007 Geology; Whiteman et al. 1994).

Precipitation, applied irrigation water, and leakage from irrigation canals and streams are the primary sources of recharge to the shallow aquifer system. Within the Study Area, groundwater discharge mainly results from pumping by large-capacity irrigation wells.

Groundwater pumping in the Study Area has increased discharge from the aquifer system and resulted in significant water level declines. Water level data reflects that groundwater levels have declined an average of approximately 3.4 feet per year between 1984 and 2009 in the Study Area. Rates of groundwater decline are as much as 9 feet per year, and total groundwater declines in some parts of the Study Area are as much as 200 feet. Seasonal groundwater changes generally exceed 50 feet between irrigation and nonirrigation season because of pumping (Ecology 2009 Groundwater).

Several of the wells within the Study Area are uncased (open-hole) through multiple aquifers (which results in downward leakage), some wells only partially penetrate an aquifer, and many wells have been deepened as water levels have declined and may be pumping from a different aquifer than they were originally. All of these conditions make comparisons and interpretation of groundwater level data difficult (Reclamation 2007 Geology).

3.3.4 Groundwater Quality in the Study Area

General indicators of water quality in the Study Area include temperature, dissolved solids, nitrates, and pesticides. The water quality in these two aquifers is within water quality standards set by the EPA. Over time, temperatures and concentrations of dissolved solids, including salinity, in the Grande Ronde aquifer have been increasing which leads to overall degraded groundwater quality (Williamson et al. 1985; Frans and Helsel 2005; Whiteman et al. 1994; Cook 1996).

Groundwater in the shallow aquifer is impacted more by infiltration of surface water. Recharge from irrigation water in areas receiving high rates of fertilizer application delivers nitrate into shallow groundwater. Conversely, groundwater in the deeper aquifer is not as impacted by infiltrating surface water, but is more impacted by residence time and chemistry of the bedrock aquifers. Deeper groundwater, which is farther from sources of nitrate applied on the land surface, is less susceptible to contamination.

The water quality data necessary to evaluate salinity and sodicity issues related to soil productivity are presented in Table 3-1. The most recent groundwater quality data set (2002-2010) was provided by growers in the subarea and represents samples from 14 groundwater wells. A more extensive groundwater quality data set (52 wells from 1982-2008) was obtained from the GWMA groundwater quality database and includes spatial information on all wells, but is largely comprised of samples collected over 25 years ago. Surface water quality is characterized by 35 surface water samples collected at the main canal bifurcation between 2002 and 2008. Although these results may not be representative of all potential water sources, they allow a general comparison between groundwater and surface water irrigation sources under the action and No Action alternatives. As seen in Table 3-1, groundwater is generally higher in pH, sodium adsorption ratio (SAR), and electrical conductivity (EC) and exhibits higher concentrations of all major cations and anions than the proposed surface water source.

Table 3-1. Range of irrigation water quality for a subset of groundwater and surface water samples.

		Groundwater (2002-2010) [a]			Groundwater (1982-2008) [b]			Surface Water (2002-2008) [c]		
	Units	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
pH	-	8.9	8.2	9.5	8.3	7.4	9.4	7.8	7.3	8.1
Electrical Conductivity (EC)	dS/m	0.37	0.31	0.53	0.47	0.29	2.1	0.14	0.13	0.15
Sodium Adsorption Ratio (SAR)	-	13.3	2.0	32.5	4.4	0.4	20.9	0.1	0.1	0.2
Sodium (Na^+)	mg/L	73	54	97	52	0	137	2.7	2.4	2.9
Potassium (K^+)	mg/L	8.3	6.5	10	10	0.3	134	0.8	0.6	0.9
Calcium (Ca^{2+})	mg/L	4.9	0.7	33	24	1.2	141	19	18	20
Magnesium (Mg^{2+})	mg/L	1.5	0.004	13	11	0.05	94	4.6	4.3	5.0
Carbonate ($C0_3^{2-}$)	mg/L	13	1.5	30	6.1	0	48	0.0	0.0	0.0
Bicarbonate ($HC0_3^-$)	mg/L	153	122	182	167	114	521	75	72	79
Chloride (Cl^-)	mg/L	15	5.3	40	25	3.8	261	1.1	0.70	3.7

[a] Ranges represent samples from 14 groundwater wells within the Study Area over 2002 through 2010.
[b] Ranges represent samples from 52 groundwater wells within the Study Area over 1982 through 2008.
[c] Ranges represent data from 35 samples collected between 2002 and 2008 at the main canal bifurcation.

3.3.5 Geologic and Hydrogeologic Setting of Specific Features within the Affected Environment

A reregulating reservoir would be constructed in Black Rock Coulee for the full replacement alternatives (3A and 3B). The bedrock at the abutments of the proposed dam consists of Wanapum Basalt. It appears that the basalt bedrock in the sides and walls of the Black Rock

Coulee is unsaturated. When the reservoir is full, water would move laterally and vertically into the walls and bottoms of the coulee and become shallow groundwater. Hydraulic conductivity values (defined as the rate at which water moves through the subsurface) at the site of the Black Rock Coulee Reregulating Reservoir range from 0.0 to 0.69 foot per day. The borrow site may need to be dewatered prior to excavation (Reclamation 2007 Appraisal).

Shallow groundwater in the sediments surrounding Banks Lake responds to changes in reservoir elevation. Piezometer data indicate that shallow groundwater in these sediments responds quickly to reservoir drawdown. As the reservoir fills back up, the groundwater rises accordingly.

3.3.6 Groundwater Wells and Uses in the Study Area

3.3.6.1 Groundwater Irrigation

The Study Area has approximately 102,600 groundwater-irrigated acres within Adams, Franklin, Grant, and Lincoln counties. Adams County has the largest number of groundwater-irrigated acres, followed by Grant, Lincoln, and Franklin. Adams and Grant counties have groundwater-irrigated lands both north and south of I-90. All the groundwater-irrigated lands in Franklin County that are within the Study Area are located south of I-90 while all the acres in Lincoln County are located north of I-90. Table 3-2 presents the acreage data for the groundwater-irrigated lands in the Study Area.

Table 3-2. Study Area groundwater-irrigated acres by county.

	Adams	Franklin	Grant	Lincoln	Total
GW Acres	63,618	3,575	28,487	6,932	102,612
GW Acres N. of I-90	11,229	0	27,383	6,932	45,544
GW Acres S. of I-90	52,389	3,575	1,104	0	57,068
Source: Personal Communication, Reclamation GIS Specialist, Yakima					

GWMA estimated that about 600 groundwater wells for irrigation exist in the Study Area (Figure 3-6). These wells have been classified into five levels that rank the wells from most dependable to least dependable. Level 1 (5 percent of all wells) and Level 2 wells (30 percent of all wells) are suitable for meeting the irrigation requirements of high water use crops such as potatoes for an entire irrigation season. Level 3 and Level 4 wells (together, 60 percent of all wells) may be able to meet irrigation requirements for part of the year, but would not be able to meet the irrigation requirements for high water use crops for an entire irrigation season. Level 5 wells (5 percent of all wells) are assumed to have been abandoned. Acres previously irrigated with these wells typically go into a dryland wheat rotation.

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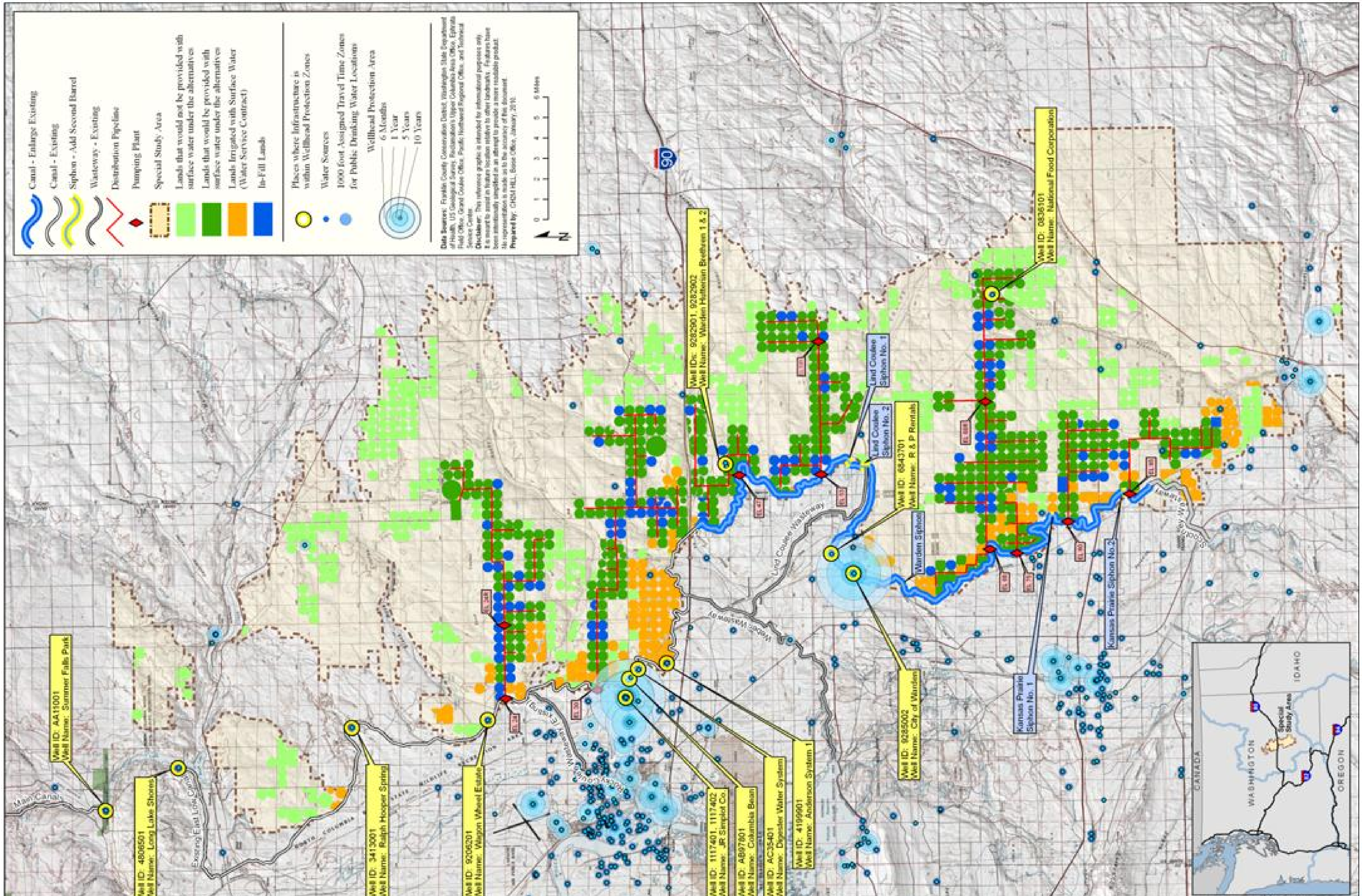

Figure 3-6. Wells and wellhead protection zones.

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The Level 2, 3, and 4 wells in the Study Area have been declining in dependability over time. Aquifer levels have been dropping, and farmers have been forced to deepen wells in order to sustain irrigated crop practices. These groundwater wells are expected to continue declining in dependability into the future, and farmers would progressively discontinue pumping altogether due to pumping costs and water quality concerns.

3.3.6.2 Municipal, Industrial, and Domestic Uses

Groundwater wells also are used to support municipal, industrial, and domestic uses in the Study Area. More than 80 percent of the public and domestic drinking water in the mid-Columbia River Basin comes from groundwater. Similar to irrigation wells, the wells for municipal, industrial, and domestic uses also are at risk from dropping aquifer levels. For example, based on historical groundwater level data, water levels in some of the municipal and industrial wells have declined more than 100 feet in the past 30 years.

The municipalities in the area that use groundwater for public supply include Moses Lake, Warden, Othello, Ritzville, Connell, Odessa, Lind, Hatton, and Wilson Creek. According to the Ecology database of well logs,[2] there are a total of 18 wells in the Study Area that serve these municipalities. These municipal wells range from about 700 to 1,000 feet in depth, and have yields ranging from 400 to 2,000 gallons per minute (gpm).

In addition, recent surveys conducted by GWMA provide a history of impacts to municipalities due to declining water levels (GWMA 2010 Survey). The towns of Odessa, Warden, Ritzville, and Connell have all been forced to deepen or abandon wells due to declines in deep groundwater. Some of the wells cannot pump adequately during summer irrigation periods because of the seasonal drop in groundwater levels while irrigation pumps are running. The City of Ritzville had proposed to drill a new supply well, but was forced to abandon the project because of the high costs associated with drilling the new well.

Industrial users of groundwater in the Study Area include primarily food processing plants located in Othello, Warden, and Moses Lake that produce frozen foods such as potatoes and beans. The Ecology database of well logs includes 19 wells in the Study Area that serve these industrial users. The wells used by these facilities range in size and depth and are based on the water needs of the facilities. The wells range in depth from 100 to more than 1,000 feet. Several of the smaller wells produce around 100 gpm, but the larger, deeper wells produce up to 2,000 gpm.

Several hundred domestic wells have been drilled in the Study Area which are used for household water supplies. These wells are typically completed in either the overburden sediments or the Wanapum Basalt unit and are usually less than about 400 feet deep. As with

[2] This database is found at http://apps.ecy.wa.gov/welllog/.

the larger wells for irrigation, municipal, and industrial uses, the shallow domestic wells are also experiencing declining water levels in some areas. In these domestic wells, the shallow groundwater seeps downward through fractures and open boreholes into the declining deeper aquifers.

3.4 Surface Water Quality

Surface water quality issues associated with the Odessa Subarea Special Study consist of temperature, dissolved oxygen, total dissolved gas (TDG), pH, nutrients, turbidity, heavy metals, and pesticides in the following systems:

- Lake Roosevelt
- Banks Lake
- Columbia River downstream of Grand Coulee Dam
- CBP irrigation network

3.4.1 Analysis Area and Methods

Water is withdrawn from Lake Roosevelt and routed through Banks Lake and the CBP for agricultural use, with return flows discharging to the Columbia River through various natural and manmade drainages. Impacts to surface water quality may be propagated in Lake Roosevelt upstream and downstream of Grand Coulee Dam as far south as Bonneville Dam, as well as in Banks Lake and the CBP irrigation network that encompasses the Odessa Subarea and lands to the south as far as Pasco, Washington. The lands and water bodies within this network are part of the analysis area for water quality.

Available water quality data for the systems identified above were evaluated and compared to Federal, State, and Tribal standards. Adherence to water quality standards is required and administered by Ecology and the Tribes, with approval done by the Environmental Protection Agency (EPA). Table 3-3 presents water quality standards for the target parameters in Lake Roosevelt, Banks Lake, and the Columbia River downstream of Grand Coulee Dam. Table 3-4 presents water quality standards for the analysis area irrigation network.

Table 3-3. Target parameter water quality standards for Lake Roosevelt, Banks Lake, and the Columbia River downstream of Grand Coulee Dam.

Standard	Lake Roosevelt	Banks Lake	Columbia River Downstream of Grand Coulee Dam[a]
Temperature	16°C; 7-day average of daily maximum	17.5°C; 7-day average of daily maximum	20°C; daily maximum
TDG	110 percent saturation; average of 12 highest consecutive hourly readings in any one day[b] N/A	N/A	110 percent saturation; average of 12 highest consecutive hourly readings in any one day[b]
Dissolved Oxygen	9.5 mg/L; minimum	8.0 mg/L; minimum	8.0 mg/L; minimum N/A
Turbidity	5 NTU above background; assumes background is less than 50 NTU N/A	5 NTU above background; assumes background is less than 50 NTU	5 NTU above background; assumes background is less than 50 NTU N/A
Heavy Metals (Mercury [c])	2.1 µg/L, acute; 1 hour average concentration 0.012 µg/L, chronic; 4-day average concentration; neither is to be exceeded more than once every 3 years	2.1 µg/L, acute; 1 hour average concentration 0.012 µg/L, chronic; 4-day average concentration; neither is to be exceeded more than once every 3 years N/A	2.1 µg/L, acute; 1 hour average concentration 0.012 µg/L, chronic; 4-day average concentration; neither is to be exceeded more than once every 3 years N/A
pH	6.5 to 8.5 with a human caused variation within the above range of less than 0.2 units N/A	6.5 to 8.5 with a human caused variation within the above range of less than 0.5 units N/A	6.5 to 8.5 with a human caused variation within the above range of less than 0.2 units N/A

Notes:

[a] Where the Columbia River is subject to more than one water quality regulation, such as Washington and Oregon State standards or Tribal standard, the criteria listed here are the most conservative criteria.

[b] 1 hour maximum is 125 percent of saturation. If flows exceed the 7-day, consecutive high flow with a 10-year return frequency, or if water is spilled to aid fish passage, criterion increases to 120 percent in tailraces and 115 percent in forebays.

[c] Mercury is presented as an example of heavy metals. Concentration limits are for mercury in solution. However, metals often bind to sediments and may exist in higher concentrations at the bottom of water bodies.

mg/L = milligrams per liter
N/A = Not Affected
NTU = nephelometric turbidity units
µg/L = micrograms per liter

Sources: WAC 173-201A, *Water Quality Standards for Surface Waters*; OSS 2009; and EPA 2009

Table 3-4. Target parameter water quality standards for the analysis area irrigation network.

Standard	Analysis Area Irrigation Network
Temperature	17.5°C; 7-day average of daily maximum
pH	6.5 to 8.5; human-caused variation not to exceed 0.5 units
Salinity Indicators (TDS or Specific Conductance)	500 mg/L TDS; regulated by the EPA as a secondary MCL for drinking water. Non-enforceable limit for aesthetic considerations, but salinity also has implications for agricultural productivity.
Nutrients	10 ppm NO_3, 1 ppm NO_2; regulated by EPA as a maximum contaminant level for drinking water
DO	8.0 mg/L; minimum
Turbidity	5 NTU above background; assumes background is less than 50 NTU

MCL = maximum contaminant level
NO_2 = nitrite
NO_3 = nitrate
TDS = total dissolved solids
DO = dissolved oxygen
Sources: WAC 173-201A, *Water Quality Standards for Surface Waters*, and EPA 2009

When a water body is unable to meet water quality standards, a Total Maximum Daily Load (TMDL) is developed to help it meet the standards. Table 3-5 presents the TMDLs for TDG in Lake Roosevelt and the Columbia River downstream of Grand Coulee Dam. No EPA-approved TMDLs have been established for the Banks Lake target parameters or for the CBP irrigation network.

Table 3-5. TMDLs for TDG in Lake Roosevelt and the Columbia River downstream of Grand Coulee Dam.

Water Feature	Load Allocation for TDG	TMDL Report
Lake Roosevelt*	72 mm Hg above saturation	*Total Maximum Daily Load for TDG in the Mid-Columbia River and Lake Roosevelt* (Ecology et al. 2004)
Grand Coulee Dam to Okanogan River (includes Grand Coulee Dam tailrace and Chief Joseph Dam forebay and tailrace)	73 mm Hg over saturation	Same as above
Wells Dam to Yakima River (includes Priest Rapids Dam forebay and tailrace)	74 mm Hg over saturation, except 115 percent (forebay) and 120 percent (tailrace) of saturation during fish passage spills	Same as above
Lower Columbia River	75 mm Hg above saturation	*Total Maximum Daily Load for Lower Columbia River TDG* (Ecology and ODEQ 2002)

mm HG = millimeters of mercury

*TDG in Lake Roosevelt was not designated as a target water quality parameter because the action alternatives were not anticipated to change TDG levels.

Sources: Ecology et al. 2004, Ecology and ODEQ 2002

3.4.2 Lake Roosevelt

Lake Roosevelt is listed as water quality impaired for temperature (Ecology 2007 CRWMP; Ecology 2007 Water). The Lake Roosevelt temperature standard is based upon the reservoir's designated aquatic life use of core summer salmonid habitat. Under that category, the 7-day average of the daily maximum temperature may not exceed 16°C (60.8°F) (WSL 2006). EPA is leading an effort to develop a temperature TMDL for the Columbia River system, but the TMDL has not been finalized.

Temperature data collected for Lake Roosevelt at Spring Canyon indicate the lake is isothermal (a relatively constant temperature from the surface waters to the bottom of the lake or reservoir) from January to March. Beginning in April, the surface waters begin to warm, changing the density of the surface waters in comparison with the deeper waters. This change in density isolates the surface waters from the deeper waters in a process called thermal stratification. Stratification often begins in mid-June. As a result, temperatures vary throughout the water column with warmer waters at the surface and cooler water at depth. The thickness of the surface water layer is dependent on solar radiation and mixing energy from wind and current. These factors also control the strength of the stratification. Lake Roosevelt only weakly stratifies due to wind, current, and the very short retention time of the water in the reservoir. For example, the temperature at approximately 80 meters in depth reaches approximately 20°C (68°F); however, the upper portion of the lake, known as the epilimnion, typically has temperatures ranging from 22°C to 24°C (72°F to 75°F) (McColloch et al. 2011 Boundary). A 2° to 4°C temperature stratification is readily broken down with a strong wind event or change in retention time of the water in a reservoir. Retention time is the difference in volume of a reservoir minus the outflow volume in days. For Lake Roosevelt, this retention time varies between 14 and 30 days, which is very short for a large reservoir.

A TMDL for TDG in the mid-Columbia River and Lake Roosevelt was developed for Lake Roosevelt to help achieve compliance with the State standard (EPA et al. 2004). The State and Tribal numeric TDG criteria for core summer salmonid habitat states that TDG shall not exceed 110 percent of saturation at any point during sampling (WSL 2006). Reclamation and the U.S. Army Corps of Engineers have begun to implement best management practices (BMP) aimed at reducing TDG generation in the Columbia River below Grand Coulee. These BMPs include swapping spill at Grand Coulee for electrical generation from Chief Joseph. Spill at Chief Joseph generates less TDG than spill at Grand Coulee. It is unknown at this time what BMPs have been implemented upstream of Lake Roosevelt. TDG concentrations[3] in excess of 110 percent saturation are common at the two monitoring points located above the dam (at the International Boundary and in the forebay of Grand Coulee Dam).[4]

Lake Roosevelt is on the 303(d)[5] list for dissolved oxygen based on low dissolved oxygen levels recorded at multiple monitoring stations. The State's numeric dissolved oxygen criterion for core summer salmonid habitat is a minimum of 9.5 mg/L (WSL 2006). From 2002 to 2005, all sampled locations on Lake Roosevelt experienced minimum dissolved oxygen concentrations below the standard (Ecology 2008). Periodic DO depletions occur in the Spokane arm of Lake Roosevelt. Because of these anoxic conditions at depth, the Spokane Tribe in conjunction with PSU developed a water quality model for this section of Lake Roosevelt.

Dissolved oxygen data collected at Spring Canyon in Lake Roosevelt ranged from 9 mg/L to 13 mg/L, with little or no vertical variation occurring during the winter, spring, and summer months. Again this is an indication that thermal stratification is very weak in Lake Roosevelt. As the deep water is isolated from the surface waters by the density differences, oxygen can become depleted at depth by bacterial respiration. This oxygen cannot be replenished from contact with the atmosphere or from the presence of aquatic plants. Uncommonly, the low dissolved oxygen levels occur in the fall months and ranged between 6 mg/L and 8 mg/L with vertical variation beginning in September (McColloch et al. 2011 Boundary).

[3] Available at http://www.usbr.gov/pn-bin/graphrt.pl?cibw_yr and http://www.usbr.gov/pn-bin/graphrt.pl?gcgw_yr
[4] Available at http://www.usbr.gov/pn/hydromet/arcread.html
[5] Clean Water Action Section 303(d) List of Impaired Waters – requires states, territories, and authorized tribes to develop lists of impaired waters that do not meet water quality standards. The law requires that these jurisdictions establish priority rankings for water on the list and develop TMDLs for these waters.

The pH levels in Lake Roosevelt are consistent annually and range from 7.0 to 9.5. Occasionally, the upper limit of this range exceeds the aquatic life criteria of 8.5 for char spawning and rearing as well as core summer salmonid habitat (McColloch et al. 2011 Boundary).

Sediments in Lake Roosevelt have significant concentrations of zinc, lead, copper, arsenic, cadmium, and mercury contamination primarily as a result of the Tech Cominco Ltd. lead-zinc smelter located roughly 10 miles upstream of the international border. The reservoir, particularly the lower end, also receives metals from mining within the watershed (Ecology 2001). Metals tend to bind to sediments rather than remain in solution, so sediments near a source may become highly contaminated and serve as secondary sources to potentially reintroduce metals back into the water column in the future. Metal concentrations in the reservoir's water column do not appear to inhibit aquatic life, although metals in the sediments may pose risks directly to the benthic macroinvertebrates that live in the sediment and the organisms, like fish, that feed on them (Underwood et al. 2004). Lake Roosevelt is also considered impaired for mercury in fish tissue, dioxins in both water and fish tissue, total polychlorinated biphenyls in fish tissue, and arsenic (Ecology 2007 CRWMP and Ecology 2007 Water).

3.4.3 Banks Lake

Physical characteristics, storage volumes, and operations for Banks Lake were described in Chapter 2, Section 2.2.3 – *Water Management Programs and Requirements Common to All Alternatives*. Because of the potential to be impacted by the action alternatives, the water quality parameters in Banks Lake examined in greater detail include temperature and dissolved oxygen. While turbidity may pose a risk during drawdown, these events would be episodic and associated more with wind events on the newly exposed shoreline and cannot be easily quantified. In addition, the nature of the sediment sources into Banks Lake is unique. Unlike most lakes and reservoirs, Banks Lake receives very little sediment from its large watershed. Most of the sediment from the Columbia River has settled out prior to the intakes of the John W. Keys III Pump-Generating Plant (Keys Pump-Generating Plant). Furthermore, the local watershed consisted of basalt rocks with a very fine veneer of sediments. Consequently, drawdown events in Banks Lake do not expose large accumulations of sediment nor does the hydrology aid in the recruitment and development of new sediment bars.

Water quality data for Banks Lake are sparse, although the Washington Department of Fish and Wildlife (WDFW) has collected data since 2002 and the Quincy Columbia Basin Irrigation District (QCBID) has two temperature probes in the reservoir. Banks Lake is not on the State's 303(d) list for temperature, dissolved oxygen, or turbidity impairments, although data suggest that the water body exceeds standards for temperature, dissolved oxygen, and pH. The lake has been listed for toxic substances (2, 3, 7, 8-TCDD and PCB [Ecology 2008]), but the sources of these pollutants is unknown at this time.

3.4.3.1 Temperature

Banks Lake summer temperature data indicate that the surface waters of the reservoir can get above the State standard for temperature (17.5°C or 63.5°F; WAC 173-201A, Water Quality Standards for Surface Waters). This temperature standard is intended to protect salmonid spawning, rearing, and migration and is measured as a 7-day average of the daily maximum.

In the Banks Lake Drawdown Final EIS (Reclamation 2004), temperature within Banks Lake is described as follows:

> Both of the basins, north and south, within Banks Lake stratify slightly during the summer months; warmer water develops near the surface and mixes downward from solar heating. Cooler water is pumped from Lake Roosevelt into Banks Lake. The cooler water mixes with the slightly warmer upper layers of the lake. This partially mixed region of the reservoir is very close to the same temperature as that region below the zone heated by air temperature and solar radiation. This mixing tends to limit the stratification of the lake in the north basin, so it is less stratified than the southern basin. Neither of the two basins becomes strongly stratified, and solar heating varies almost linearly from the surface to the lower mixed layers, with slightly more heat accumulating near the surface than in the deeper regions of the lake. During the fall of each year, the surface of the lake is cooled as the air temperature decreases and the temperature profile becomes nearly uniform.

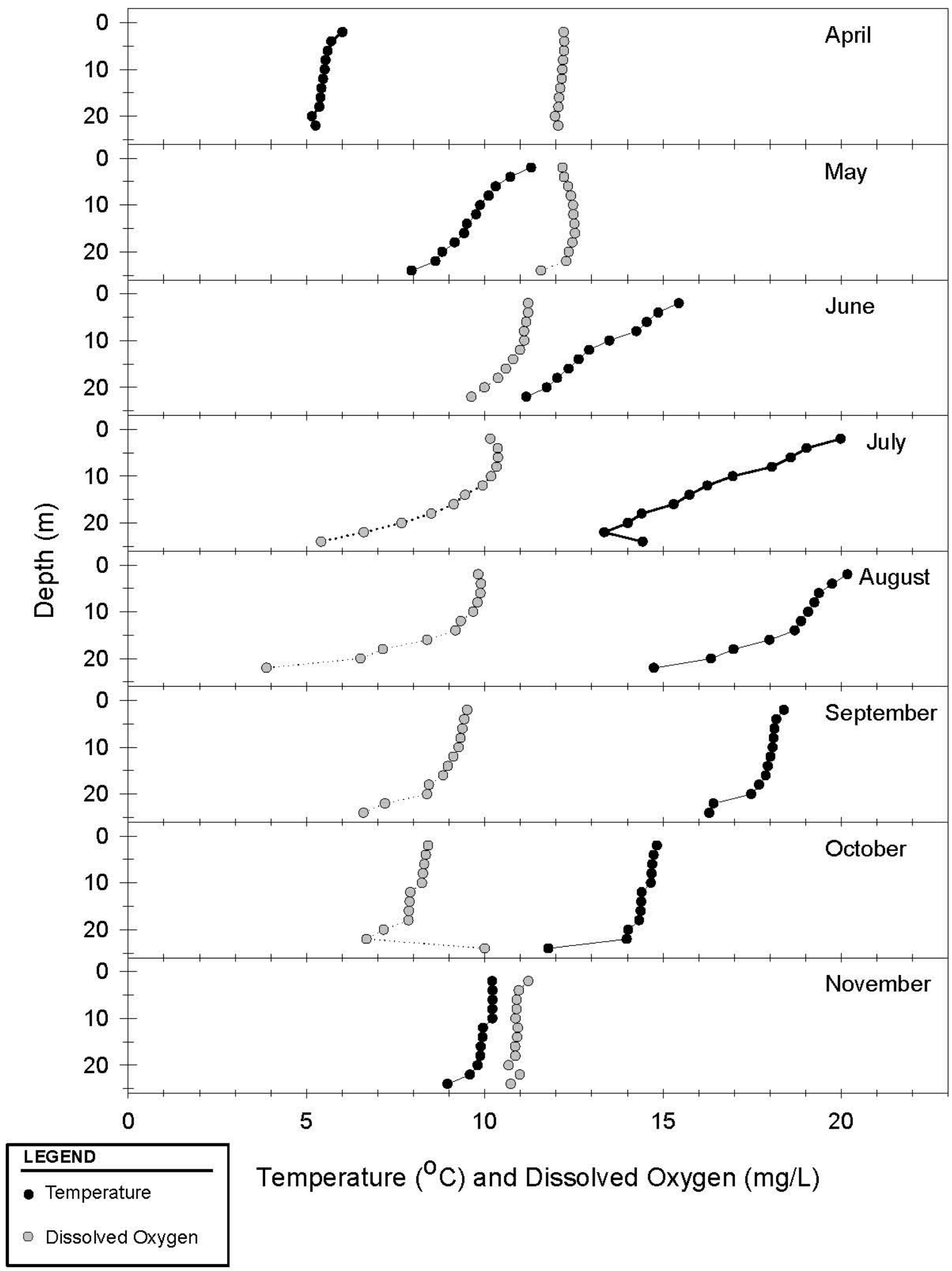
During the summer of 2004, no stratification was apparent based on data collected by temperature probes near the Dry Falls Dam headworks at the south end of the reservoir (Jordan 2009), as shown in Table 3-6.

Table 3-6. Thermal characteristics of Banks Lake, June through September.

Probe Location	Parameter (°C)	2004	2005
Reservoir Surface	Mean Temperature	18.6	NR
	Max Temperature	23.9	NR
Reservoir Bottom	Mean Temperature	18.3	17.8
	Max Temperature	23.9	21.7

NR = data not reported
Probes located at south end of reservoir near Dry Falls Dam headworks
Source: Jordan 2009

The reservoir typically begins to warm in late spring. Signs of stratification are exhibited by early- to mid-summer, and the weak thermocline is sometimes apparent by late summer. Thermal stratification characteristics vary from year to year depending on the warmth of the summer and the magnitude of the mixing events that occur that might induce mixing. For example, the thermocline dropped to roughly 66 feet (20 meters) by late August in 2003 (Polacek et al. 2003); in comparison, the thermocline dropped to only half that depth by late August 2005 (Polacek and Shipley 2005). Likewise, stratification sometimes begins to develop by May, but in other years is not apparent until June. Figure 3-7 demonstrates the seasonal variability in temperature and dissolved oxygen concentrations based on data collected throughout the reservoir during 2008.



Monthly temperature (black circles) and dissolved oxygen (gray circles) profiles for all limnetic sites combined (LIM1, LIM3, LIM5, LIM6, and LIM9) for Banks Lake, Washington from April 2008 through November 2008. Source: Polacek, 2009, Figure 3

Figure 3-7. Banks Lake mean monthly water temperatures and dissolved oxygen profiles from April through November 2008 (Polacek 2009).

3.4.3.2 Dissolved Oxygen

Dissolved oxygen concentrations in Banks Lake have been measured by WDFW since 2002. Dissolved oxygen levels generally remained above 7 mg/L to 10 mg/L until mid-summer, but typically dropped to 5 mg/L (a critical level for fish) or less at depths greater than approximately 66 feet in August of each year. In Devil's Lake, a deep embayment north of Steamboat Rock that is used as a thermal refuge for fish during the summer, temperature stratification developed earlier and lasted longer than other sites in the reservoir, causing dissolved oxygen levels in deeper parts of the reservoir to approach or reach severely low (less than 5 mg/L) oxygen concentrations (Polacek et al. 2003; Polacek and Shipley 2005; Polacek 2009).

3.4.3.3 Turbidity

Turbidity is generated by wind-driven waves and boat wakes that erode soils at the water's edge around the reservoir. Easily eroded areas consist of fine, sandy, or loam soils, and, once eroded, such soils are suspended by wave activity and lead to muddy or turbid areas in the reservoir. Very little turbidity data has been collected at Banks Lake, so it is difficult to compare lake concentrations to the State's standard. Water clarity (a surrogate for turbidity), has been measured by lowering a Secchi disk until it is no longer visible. Data used to prepare a model for Banks Lake for this study indicate that there are no seasonal trends and vertical gradients were only present occasionally. The observed values used for the model ranged from 0 to 35 NTU, "with the higher values measured near the lake sediments" (McCulloch et al. 2011 Model).

Greater observed depths correlate with less turbid water. In 2002 and 2003, Secchi depths ranged from 8.2 to 26.2 feet (2.5 to 8 meters; Polacek et al. 2003). From 2004 to 2005, Secchi depths ranged from 14.4 to 24.0 feet (4.4 to 7.3 meters; Polacek and Shipley 2005). During 2008, Secchi depths varied temporally and spatially, ranging from 8.2 to 24.6 feet (2.5 to 7.5 meters) at open water sites and from 8.2 to 19.7 feet (2.5 to 6.0 meters) at embayment sites (Polacek 2009). There is not a direct, reliable conversion from the Secchi disk depths to turbidity. However, Carlson (1977) developed a metric to relate Secchi depth (transparency) with trophic state, or a measure of a water body's productivity. Secchi depths in the range seen in Banks Lake indicate that the lake is mesotrophic (moderately productive) to oligotrophic (low productivity).

3.4.4 Columbia River Downstream of Grand Coulee Dam

Impacts on water quality in the Columbia River downstream of Grand Coulee Dam would not occur under any of the alternatives, as explained in Section 4.4 – *Surface Water Quality*. Therefore, existing water quality conditions in this area are not discussed in this section.

3.4.5 Study Area Irrigation Network

Currently, the Study Area is primarily irrigated with pumped groundwater. Following on-farm use, although very low, the majority of water in the Study Area that is not consumed by agricultural practices is conveyed to Crab Creek. Crab Creek runs through two reservoirs (Moses Lake and Potholes) before eventually returning to the Columbia River near Beverly, Washington. Some of this drainage system in the Study Area is listed as water quality impaired for temperature, pH, and fecal coliform. Other drainages in the Columbia River Basin also collect irrigation water and return it to the Columbia River, but those drainages are outside the Study Area. Since the action alternatives would replace groundwater as the irrigation source with surface water delivered from Lake Roosevelt, water quality may be impacted if the new surface water supply is of better or poorer quality than the existing groundwater source.

Reclamation and QCBID monitor surface water quality near the bifurcation, which is located upstream of agricultural diversions and should be representative of water that would be delivered to the Study Area. Regionally, representative groundwater quality data for the Wanapum and Grande Ronde aquifers were reported by the USGS and Whiteman et al. 1994.

A comparison of surface and groundwater quality parameters is presented in Table 3-7. The list following Table 3-7 highlights the relevance of the parameters and briefly reviews the status of those parameters associated with surface water and groundwater sources in the Study Area:

Table 3-7. Surface water and groundwater quality in the Study Area.

Type	Site	Temperature (°C)		pH (units)	Total Dissolved Solids (mg/L)	Specific Conductivity (µS/cm)	$NO_3 + NO_2$ (µg/L)	Total Phosphorous (µg/L)
		Avg	Max	Avg	Avg	Avg	Avg	Avg
Surface Water [a]	CBP033	13.7	19.8	7.9	NR	140	12	19
	CBP712	14.5	20.8	8.1	81	152	310	23
	Bifurcation	17.3	23.7	8.3	NR	119	NR	NR
Ground-water [b]	Wanapum	15.5	43.4	7.4	270	403	3,700	NR
	Grande Ronde	18.0	36.7	7.6[c] or 8.1[d]	234	312[c] or 383[d]	960	NR

Notes:

[a] CBP033 (located at the Bifurcation) and CBP712 (located between Pinto Dam and the Bifurcation) measurements were generally collected April through October, while Bifurcation data were limited to May through September.

[b] Wanapum and Grande Ronde are distinct aquifers on the Columbia Plateau (Grande Ronde lies below the Wanapum).

[c] Grande Ronde Aquifer samples reported in Whiteman et al. (1994).

[d] Grande Ronde Aquifer samples reported in U.S. Geological Survey (USGS) National Water Information System (NWIS).

Sources: Hoff and Cannon 2009, Reclamation 2009 (CBP033 and CBP712); Jordan 2009 (Bifurcation); Whiteman et al. 1994 (groundwater); USGS 2009 (groundwater).

- Temperature
  - Impacts the survival and reproduction of fish and other aquatic species.
  - Surface irrigation water temperature increases during summer when water flows through shallow channels or passes through relatively shallow reservoirs with large surface areas. Maximum water temperatures currently exceed the State standard of 17.5 °C (63.5 °F), while the average water temperatures approach but do not exceed the standard, at varying times of the irrigation season throughout the irrigation network for established monitoring locations.
- Groundwater extracted from deep aquifers is susceptible to geothermal heating in certain areas and the average temperature of the groundwater approaches the State surface water standard, which is then applicable following surface application. Maximum temperatures measured in the groundwater are often above the State standard.
- pH
  - Typical pH range for irrigation water is 6.5 to 8.4. Water with a pH below that range (more acidic) may corrode pipelines or equipment, while water with a

higher pH (more basic) may encourage buildup of scale deposits on infrastructure (Ayers and Westcot 1985).

- Surface water and groundwater pH both fall within the typical range for irrigation water.

- Alkalinity
  - TDS and specific conductance serve as indicators of alkalinity.
  - TDS levels in the surface water are much lower than in the groundwater.
  - Some crops cannot tolerate highly alkaline water.
  - Average specific conductance of the surface water supply falls into the low salinity hazard category (less than 250 µS/cm), and the average specific conductance of the groundwater is greater than the low salinity category threshold (Lewis 1998).

- Nutrients
  - Nutrients are essential to healthy crop growth, but excess quantities may over-stimulate growth, cause delayed maturity, or produce a poor quality product (Ayers and Westcot 1985).
  - Phosphorus and nitrogen are often applied to fields as fertilizer to stimulate crop growth, but excess nutrients can lead to algal blooms and dissolved oxygen depletion in receiving waters.
  - Nitrate plus nitrite (NO_3+NO_2-) concentrations are much lower in the surface water than in the groundwater.
  - Surface water total phosphorus concentrations were very low, but groundwater concentrations were not reported.

- Pesticides
  - Forty-two pesticides and five metabolites have been detected in samples collected from four return-flow drainage basins on the CBP (USGS 2006) and of these, there were three insecticides and one herbicide that exceeded the EPA standards (Wagner et al. 2006). EPA has recently revoked the registrations for these four pesticides. As a result, as the stock on hand of these pesticides are used up or destroyed, it is expected that the concentrations will fall to acceptable levels without further implementation required.

3.5 Water Rights

The water rights issues associated with the Odessa Special Study alternatives consist of two primary areas of concern:

- Surface water withdrawal and storage rights related to the Columbia River.
- Changing from state-based groundwater rights to surface water delivered by the CBP under Reclamation's Federal reserved water rights.

3.5.1 Analysis Area and Methods

The affected environment for the water rights resource area consists of the entire Odessa Study Area, plus downstream rights associated with the Columbia River. Many of the rules associated with water rights for the Columbia River Basin extend beyond the limits of Lake Roosevelt. However, as the proposed source of water for this project, this analysis focuses primarily on Lake Roosevelt because limited impacts would occur to downstream water rights. Existing water rights and concerns relative to these were evaluated based on staff interviews with Ecology, review of GIS databases of existing water rights and claims pertaining to the Columbia River and Odessa Subarea, and other existing documentation and laws.

3.5.2 Columbia River Water Rights

The Programmatic EIS for the Management Program provides a detailed description of water rights considerations within the Columbia River Basin (Ecology 2007 CRWMP). Four major groups of rights are immediately relevant to additional water withdrawals evaluated in the Odessa Subarea Special study:

- Instream flow rules and rights.
- Non-Tribal Federal reserved water rights.
- Tribal Federal reserved water rights.
- State-based water rights.

3.5.2.1 Instream Flow Rules and Rights

State law specifically authorizes Ecology to "establish minimum water flows or levels for streams, lakes, or other public waters (waters of the state) for purposes of protecting fish, game, birds, or other wildlife resources, or recreational or aesthetic values of said public waters whenever it appears to be in the public interest to establish the same" (RCW 90.22.010, *Establishment of Minimum Water Flows or Levels*). State law further stipulates that setting minimum flows by rule for a water body constitutes an appropriation of water (RCW 90.03, *Water Code*). State law also establishes the minimum instream flow rules for the mainstem Columbia River (WAC 173 563, *Application of Minimum Average Weekly Flows to Out-of-Stream Uses*). The flows established under this rule are, therefore, an established water right with a priority date of June 24, 1980, the date of the rule.

Rights established prior to 1980 are senior to these instream flow rights and are considered “uninterruptible water rights.” The instream flow rights are also specifically defined as subordinate to any withdrawal requests by Reclamation for the development of the CBP (RCW 90.40.030, Notice and Certificate; RCW 90.40.100, *CBP—Water Appropriated Pursuant to RCW 90.40.030*). These rights are likewise subordinate to “existing water rights, riparian, appropriate, or otherwise, existing on the effective date of this chapter, including existing rights relating to the operation of any navigation, hydroelectric, or water storage reservoir, or related facilities” (WAC 173-563-020[3], *Applicability*).

3.5.2.2 Federal Withdrawn Water

Reclamation holds state-issued water rights that entitle the agency to store and deliver water for the multiple purposes of the CBP (RCW 90.40.030, Notice and Certificate; RCW 90.40.090, *Permit for Grand Coulee Project*). Under Reservoir Certificate No. 11793, Reclamation has the right to store 6,400,000 acre-feet of water annually in Lake Roosevelt (live storage) with the boundaries of the CBP as the authorized place of use.

The water withdrawn from appropriation in 1938 by Reclamation for development of the CBP is withdrawn until “the project is declared complete or abandoned by the U.S.” (RCW 90.40.100, *Columbia Basin Project—Water Appropriated Pursuant to RCW 90.40.030*). The place of use is described as “Lands within the boundaries of the Columbia Basin Project.” Diversionary and consumptive uses of this water may need to apply for secondary use permits from the State; however, such permits would be authorized with the same priority date as the reservoir certificate (May 16, 1938). Reclamation currently holds permits and certificates for diversion for irrigation (up to 3,154,000 acre-feet of water annually) of approximately one-half of the full appropriation for the CBP.

3.5.2.3 Tribal Federal Reserved Water Rights

Tribal rights are primarily based on the Winters’ doctrine and are established from treaties and executive orders that pre-date the CBP and are senior to most other rights within the Columbia River Basin. Tribal rights consist of out-of-stream uses that are unquantified, but constitute a large potential allotment of water under the practicably irrigated acreage standard that have a priority date equal to the date the reservations were established. The Tribes also hold unquantified instream rights for fish that are time immemorial. The instream flow rights are defined as a quantity of water necessary to maintain a fishery and protect the Tribes’ right to fish.

A number of Tribes in Washington and adjoining states have rights within the Columbia River Basin. The two primary Tribes with interests to the Lake Roosevelt area are the Confederated Tribes of the Colville Reservation and the Spokane Tribe of Indians.

Water Resource Management Agreements between the State, the Confederated Tribes of the Colville, and the Spokane Tribe were established during development of the Lake Roosevelt Incremental Storage Releases Project in 2008. The agreements authorize annual payments in exchange for the Tribes' agreement to support incremental storage releases of up to 132,500 acre-feet per year from Lake Roosevelt (Ecology 2008). As stated by the Office of Governor Christine Gregoire (Washington State 2008):

> The funding does not purchase water or water rights from the Tribes, but is being provided to enhance fisheries, protect the environment, preserve cultural resources, and other activities. These agreements do not apply to the Odessa Subarea Study and do not impact either Tribe's future water right claims. Tribal rights are not subject to relinquishment or abandonment for nonuse.

3.5.2.4 State-Based Water Rights

Prior to enactment of the Surface Water Code in 1917, water rights were acquired by putting the water to beneficial use and, in limited cases, filing documentation with county auditors. In 1974, the State of Washington enacted the Claims Registration Act (RCW 90.14.041, *Claim of Right to Withdraw, Divert or Use Ground or Surface Waters*), whereby water right claims could be filed to preserve water rights established prior to 1917. Any claims not filed during this time or during subsequent registration periods, most recently from 1997 to 1998, are considered to result in the loss in the water right. Water right claims are not the same as a water right. Claims (and continued beneficial use) merely preserve the potential of a water right, but do not prove the validity of the water right. Validity of the claims as water rights may only be determined through adjudication.

Water rights claims—not held by Reclamation—are associated with the Lake Roosevelt area of the Columbia River with dates prior to 1938 (or unstated dates); however, no non-Tribal State-based rights are senior to the 1938 appropriation for the CBP. The claims that have been filed have not been proven through the adjudication process, and may not be valid given consideration that withdrawals from this portion of the Columbia River prior to 1938 would have predated construction of Grand Coulee Dam and would have required lifts from the original river bed of up to 300 feet to put to beneficial use on the lands currently irrigated adjacent to Lake Roosevelt.

3.5.3 Odessa Subarea Water Rights

Approximately 60 to 70 percent of water and rights within the Odessa Subarea are for groundwater. Elsewhere, primarily along the East Low Canal, surface water is delivered by irrigation districts under water service contracts. The existing legal framework for groundwater and surface water rights in the Odessa Subarea is complex; the types of water rights present in the Study Area are shown in Table 3-8.

Table 3-8 Summary of water rights within the Odessa subarea.

Source and Type	Irrigated Area (acres)
Groundwater permit, certificate or claim	98,854
Groundwater acreage expansion	3,760
Surface water via water service contract	7,816
Surface water via water service contract with groundwater backup	10,601
Surface water claim	386
Undocumented*	18,574
Total area	143,588
*Agricultural fields identified from aerial photographs, but not associated with water rights documents in the available databases.	

3.5.3.1 Groundwater Water Rights

Groundwater rights are governed by the Washington State Groundwater Code enacted in 1945. This code is similar to the surface water code in that it creates a system in which water rights are secured by obtaining a permit, and establishes that first in time shall be superior in right. Prior to 1945, groundwater rights were governed by common law. In 1967, the State of Washington established the Odessa Subarea as a groundwater management area because pumping was causing aquifer decline, which resulted in additional regulations. Finally, each individual groundwater permit has its own set of unique provisions that create a complex landscape of rules governing the use of groundwater within the area.

The Odessa Groundwater Subarea Management Policy requires that the following three conditions be maintained within the management area (WAC 173-130A, *Regulation of Withdrawal of Groundwater*):

- The rate of decline in groundwater level will be limited to no more than 30 feet in any 3 consecutive years.
- The total decline in groundwater level will be limited to no more than 300 feet below the static water level that existed in the spring of 1967.

- No new permits will be issued for groundwater withdrawals within the Odessa Subarea that would cause the limitations of conditions 1 and 2 above to be exceeded.

Upon complaint from a water right holder of drawdowns exceeding the limits described above, Ecology is directed to evaluate the complaint and take regulatory action. Although data and reports of significant aquifer level declines have been known for years, Ecology has not received a formal complaint requiring action to date (Brown 2009). If action was needed based on formal complaint, Ecology would be required to restrict groundwater withdrawals on the basis of priority date.

The Odessa Groundwater Subarea Management Policy also establishes an acreage expansion program in which water right certificate holders may apply to expand their authorized irrigated acreage, generally for the purposes of crop rotation, without increasing their historic withdrawal rates (Brown 2009).

To encourage conservation of groundwater within the Odessa subarea, the legislature enacted the *Odessa Groundwater Subarea—Involuntary Nonuse of Water Rights* code in 2006 (RCW 90.44.520). This code establishes that, given that specific conditions are met, nonuse of a right to withdraw groundwater from the aquifer is involuntary and that the rights shall not be harmed and are considered standby or reserve rights that may be used again after a period of nonuse. In anticipation of potential future replacement water from the CBP, the *Superseding Water Right Permit or Certificate — Water Delivered from Federal CBP* code was enacted in 2004 to authorize Ecology to issue superseding water right permits for groundwater rights should CBP water be delivered for use by the water right holder (RCW 90.44.510). This code establishes that the pre-existing groundwater rights remain a standby or reserve right that may be used should surface water be curtailed or otherwise unavailable.

Most groundwater right certificates issued or amended after 1967, and to a limited extent in the period during development of the groundwater management area, are conditioned upon future replacement water provided by the CBP. The language used in these individual “conditioned” rights is variable and may need to be evaluated on a case-by-case basis. Some certificates provide for a volumetric reduction in groundwater use in proportion to the surface water replacement. Others stipulate that the volumetric replacement does not necessarily require the user to relinquish the groundwater right. Still others stipulate that groundwater may no longer be used once surface water becomes available.

3.5.3.2 Surface Water and Water Service Contracts

Surface water irrigation within the Odessa Subarea primarily occurs on lands adjacent to the East Low Canal that can be served by CBP water. The ECBID supplies the majority of this water through water service contracts, and portions at the south end of the area are served by the SCBID (Davis-Moore 2009). Under these contracts, irrigators purchase an annual quantity of water that may, during periods of drought, be curtailed or shut off. Because capacity is limited, some lands in the south portion of the Odessa Subarea (south of I-90) receive only early and late season service. Many of the fields currently irrigated through water service contracts are supplemented by backup groundwater rights. These fields are presumed to primarily consist of fields served under Reclamation's smaller secondary use permit (No. S3 28586P), which, per the Report of Examination for Permit S3-30486, includes a provision that pre-existing groundwater rights may remain as standby or reserve water rights.

Surface water sources within the Odessa Subarea are scarce. With minor exceptions, most surface water right claims and permits within the area are for minor quantities for stock watering. A number of fields have been associated with the place of use for Reclamation's existing secondary use permits; however, these are not documented as being served by a water service contract. It is unclear what sources or water rights are associated with these fields and they were identified on Table 3-8 as "undocumented."

East of the East Low Canal, there are no existing return flows in the wasteways of the Odessa Subarea. Because the shallow aquifer is declining, if return flows occur in these wasteways they would likely be associated with water delivered by the CBP. *Ecology v. Bureau of Reclamation* (Ecology 1992) established that Reclamation retains ultimate control of all return flows within the limits of the CBP and such water is not available for further appropriation.

3.6 Geology

The geologic setting of the Study Area has a major influence on the topography, groundwater occurrence, erosion potential, and availability of resources to construct the facilities associated with action alternatives presented in this Final EIS.

3.6.1 Analysis Area and Methods

The boundaries of the analysis area are the same as the limits of the Study Area. The analysis is focused on localized areas within the Study Area where impacts are likely to occur or where geological resources would be needed in one or more of the action alternatives. Figure 2-1 shows the locations of the Study Area and project features.

Methods for this analysis focused on creating an inventory of potentially affected geologic features. Where data were available, physical characteristics such as soil and rock types, thicknesses, and depths to groundwater were documented.

3.6.2 Geologic Setting of Project Features

The geologic setting of the Study Area is in an area underlain by thick basalt deposits, with low seismicity and high structural stability (Photograph 3-2). Based on general descriptions of the geologic units, it is assumed that the recent alluvium, lacustrine fine sand and silt, loess, and fluvial gravel in the Study Area could provide materials for the various earthen structures that may be constructed as part of a Proposed Action. Basalt would be quarried for riprap and aggregate materials.

Photograph 3-2. Example of geological features in the Study Area.

3.6.2.1 East Low Canal Enlargement

The East Low Canal crosses a large area primarily underlain by silty loess and silty sand with gravel, all of which overlie basaltic bedrock. The thickness of the overburden sediments varies along the canal alignment.

3.6.2.2 East High Canal and Black Rock Branch Canal Construction

The East High Canal and Black Rock Branch Canal would cross over a large area primarily underlain by silty loess that overlies basaltic bedrock. The thickness of the overburden sediments varies along the proposed canal alignment.

3.6.2.3 Black Rock Coulee Reregulating Reservoir

The bedrock at the upper left and upper right abutments of the proposed dam consists of the Frenchman Springs Member of the Wanapum Basalt. The alluvium in the channel is about 58 feet thick and is underlain by bedrock of the Frenchman Springs Basalt. The alluvium is composed of homogeneous to crudely stratified, soft silty fines with fine sand and abundant organics. The groundwater level measured during drilling was about 2.5 feet below the ground surface (bgs) in the channel. The presence of Black Rock Lake and the smaller pond to the northeast suggest that shallow groundwater is present along the bottom of the coulee. The water table at the abutments was not encountered in test holes that were drilled to depths of 51 and 66 feet; thus it appears that the basalt bedrock in the sides and walls of the Coulee is unsaturated.

3.7 Soils

Soil productivity is important for agriculture in the Study Area. Productivity can be reduced when ground-disturbing activities that increase erosion or soil compaction occur. Irrigation water salinity and sodicity can be an important water quality issue both from the standpoint of soil and crop impacts and in terms of salt loads to receiving waters from irrigation return flows. This section describes soils and soil productivity in the Study Area that may be impacted by any of the proposed alternatives.

3.7.1 Analysis Area and Methods

The analysis area for soil impact evaluation includes the Study Area plus Banks Lake and its shoreline. The soils underlying the Study Area were described and evaluated primarily from data contained in the Soil Survey Geographic database and U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) county soil surveys.

3.7.2 Study Area Soils

Soils in the Study Area were formed in a variety of parent materials, as described in Section 3.6 – *Geology*. Primary soil-forming elements include lacustrine (lake) sediment deposits, glacial outwash deposits, and loess (wind-blown material) deposits. Soils derived from lacustrine deposits tend to be deep and well-drained, and provide a productive base for the production of plants. Loess-based soils are similar in depth and productivity to lacustrine-based soils. Soils formed in glacial deposits tend to be excessively drained, have higher proportions of coarse fragments like gravel and rock, and can be less productive than lacustrine or loess-based soil.

A wide range of soil textures are found in the Study Area, but in general, they are dominated by loamy and sandy textures (silt loam, gravelly loams, sandy loams, fine sandy loams, very fine sandy loams, and fine sand).

In the Study Area, a total of 84 soil series are found within the footprints of proposed facilities, some of which have a variety of slope classes within the soil series. Soil series are soils that have similar soil profiles. With the exception of different textures in the surface horizon, the major horizons of all the soils of one series are similar in thickness, arrangement, and other important characteristics (NRCS 1967). Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Ritzville and Shano, for example, are the names of two soil series in Adams County. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that impacts use of the soils by people.

Characteristics of existing soils that would be important in estimating impacts from the alternatives include those that describe the potential for wind and water erosion, compaction, and productivity. Soils designated as prime, state important, or unique are also important to note when estimating anticipated impacts.

Table 3-9 showing the acres of soil with various soil limitations found within the proposed facilities' footprint. These limitations indicate the potential for impacts from facilities if appropriate mitigation and avoidance measures are not implemented. Soil limitations relative to project implementation and applicable to the Study Area are erodible soils (erosion potential), soils susceptible to compaction (revegetation constraint), productive soils (potential to decrease overall project area soil productivity), and soils with special characteristics relative to agriculture (important to production of the Nation's food supply). The total of all soils with limitations exceeds the total acreage underlying the proposed facilities because some soils have more than one limitation and are counted in several places in Table 3-9.

Table 3-9. Acres of soil with potential soil limitations.

Limitation	Approximate Acres Within Facilities' Footprint
Wind erosion potential	10
Water erosion potential	12,635
Susceptible to compaction	265
Soil with good potential productivity	6,417
Soil with very good potential productivity	3,019
Prime farmland if irrigated	8,630
Farmland of statewide importance	7,949
Unique farmland	6,110

3.7.3 Salinity and Soil Productivity

Study area irrigation water salinity levels shown in Section 3.3 – *Groundwater* can be detrimental to crops when the water salinity exceeds the salt tolerance thresholds of the crops being grown or when salts accumulate in soils over time. As a crop extracts water from root zone soils, most of the soluble salts are left behind and accumulate in the soil. If these salts are not removed via leaching and drainage, they can accumulate to levels that can affect the crop, reduce yields, and potentially make soils unsuitable for continued production. Salinity risk generally increases with: 1) elevated salinity levels in irrigation water; 2) increasingly salt sensitive crops; and 3) reduced subsurface drainage capacity to remove salts via leaching. Sodicity can be an additional problem resulting in reduced soil infiltration rates, high soil bulk density, and reduced aeration (Lewis 1998). When soil infiltration problems develop, soil or irrigation water amendments may be necessary to provide calcium and stabilize soil structure.

Thirty-one percent of 111 samples collected from 52 wells in the GWMA groundwater quality database between 1982 and 2008 reported sodium adsorption ratio (SAR) values greater than 6. All samples with an SAR greater than 6 also had electrical conductivity (EC) values low enough to classify the water in the severe infiltration risk category due to sodicity. Lands irrigated with this quality of water are expected to require special management to maintain productivity. The SAR-impacted wells are fairly evenly distributed across the Study Area. Therefore, sodium issues related to soil productivity are not a geographically isolated issue.

Sodicity issues could be more extensive at present than suggested by this analysis due to factors including the age of the data set (77 percent of samples collected over 25 years ago), the documented decline in groundwater quality over time, and the fact that deeper wells with lower quality water are being used more extensively in recent years. Acknowledging these limitations, it is conservatively estimated that at least one-third of the groundwater irrigated lands within the Odessa subarea are presently being irrigated with sodic groundwater that require special management to maintain productivity.

Under current average groundwater conditions, salinity is not high enough to impact crop yields; however, the high SAR and relatively low EC of most of the recent (2002 to 2008) groundwater samples fall within the "severe reduction in infiltration rate" risk category. The impacts of high SAR in groundwater have been noted by growers to substantially reduce the yields of crops including wheat, corn, potatoes, and bluegrass seed (Gimmestad 2010). Growers with experience in using both surface water and groundwater for irrigation have noted consistent differences in irrigated wheat yields under full irrigation. They attribute a 20 to 30 percent reduction in wheat yield to poor quality groundwater compared to surface water (Johnson 2010; Stahl 2010).

3.7.4 Banks Lake Shore Zone Soils

Soils around the edge of Banks Lake are also a concern. Previous analyses conducted on the potential drawdown of Banks Lake found that exposed soils around the reservoir are susceptible to erosion (Reclamation 2004). The major areas of concern were portions of the shoreline located south of the Million Dollar Mile North Boat Launch, on the south half of the Steamboat Rock peninsula, at Barker Flat, at Kruk's Bay/Airport Bay, and the northern portion of Banks Lake.

3.8 Vegetation and Wetlands

This section describes vegetation resources that may be impacted by one or more of the Odessa action alternatives. It is divided into two main categories based on water requirements: upland vegetation and wetland vegetation. To fully depict vegetation resources across the analysis area, vegetation resources are described by plant community. Those plant communities with special State designations are noted. In addition, general information regarding noxious or invasive weed occurrences and information on the occurrence and population features of rare plants is provided.

3.8.1 Analysis Area and Methods

The analysis area for wetland habitats includes all areas within the overall Study Area in which canal construction, new reservoir inundation, or reservoir drawdown may impact existing wetland communities, including Banks Lake fringe wetlands. The wetland analysis area is discussed relative to five primary project features: Banks Lake, Black Rock Coulee Reregulating Reservoir, the East High Canal, Black Rock Branch Canal, and the East Low Canal.

Wetlands at Banks Lake and Lake Roosevelt

At Banks Lake, fringe wetlands are found within the littoral zone surrounding the shoreline. The littoral zone extends from the shore just above the influence of waves and spray to a depth where the light is barely sufficient for rooted aquatic plants to grow (Goldman and Horne 1983). This is considered a biologically critical zone because it supports aquatic plants, which in turn provide food and cover for aquatic and terrestrial species.

Wetland vegetation along Lake Roosevelt is not discussed in the Study. For the past 70 years, operation of Lake Roosevelt has included two annual drawdowns that are equal to or greater than the depth of the littoral zone around the reservoir. Additional summer drawdowns of up to 3 feet considered in this Study are not expected to adversely impact established wetland or riparian plant communities because they are already limited in distribution and extent by historic reservoir operation.

The analysis area for upland vegetation resources includes the footprint of all facilities associated with the action alternatives, plus a buffer area intended to accommodate all lands that would be required for construction. The buffer area includes a 600-foot-wide corridor centered along new canal alignments and 300-foot-wide buffer around the proposed dam site and inundation area. Upland plant communities adjacent to Banks Lake and Lake Roosevelt would not be impacted by greater summer drawdowns and are therefore not discussed. There were no rare plant surveys conducted along pipeline routes or access roads as locations were unknown at the time of the surveys.

3.8.1.1 Wetland Analysis Methods

Existing wetland conditions for the Study Area were mapped using National Wetland Inventory (NWI) data, USGS Gap Analysis Program (GAP) vegetation maps, and recent low-level color aerial photography. Wetland areas were field-verified and classified based on a dominance of wetland vegetation. Other areas where vegetation signatures were unclear, or in landscape positions with the potential to support wetland vegetation (such as a stream confluence), were also field-verified to determine wetland vegetation presence. Species composition was also determined in the field. Formal wetland delineations have not been conducted under this planning-level document.

Functional wetland areas were identified based on vegetation type and, in some cases, aerial photo interpretation. A functional analysis was completed for each wetland type within each classification to quantify water quality function, hydrologic function, habitat function, and special characteristics (Hruby 2007). The functional analysis assists in quantifying wetland impact levels across alternatives. The Eastern Washington Wetland Rating System was used to assess wetland function (Hruby 2007). No surveys or field verifications were conducted at substations, transmission lines, and pump stations considered in the action alternatives because their locations were not known at the time of surveys.

3.8.1.2 Upland Analysis Methods

For upland species, GAP analysis maps of vegetation resources, completed by the University of Idaho, were assessed as baseline data (University of Idaho 2009). Background research and literature searches revealed that no rare plant surveys had been completed for the larger expanses of native plant communities in the Study Area. For the purposes of this Study, rare plant survey areas included the same native plant communities surveyed by WDFW for rare wildlife species. Survey areas extended 300 feet on either side of linear facilities, such as the East High Canal and within the footprint of the proposed Black Rock Coulee Reregulation reservoir and dam. Rare plant surveys were conducted during the plant’s flowering periods when identification is possible. Surveys occurred for 3 weeks over a 10-week period in the spring of 2009.

Additional information was collected during rare plant surveys to assess native plant diversity and, by inference, wildlife habitat quality within native vegetation types. Relative native plant diversity ratings or classes of high, good, moderate, fair, and low were estimated from these data based on the number and integrity of sagebrush species, the number and cover of other native species present (diversity), the amount of soil disturbance from sources such as livestock or human activity, the amount of cheatgrass (*Bromus tectorum*) and other nonnative species cover, and the amount of undisturbed biotic crust found at each sampling point. Higher native species richness and lower cheatgrass cover were considered indicators of more natural and less disturbed conditions and overall higher community quality. The WDFW priority habitats and species (PHS) description of shrub-steppe habitat quality indicators is based on the degree to which a tract resembles a site potential natural community as indicated by factors such as soil condition and degree of erosion and distribution, coverage, and vigor of native shrubs, forbs, grasses, and cryptogams (biotic crusts).

3.8.2 Background and Regional Setting

The loss of native vegetation communities to agriculture conversion has been extensive across the Columbia Basin region (Daubenmire 1988). Estimated losses of shrub-steppe habitat for a four-county area overlapped by the analysis area are provided on Table 3-10 (Reclamation 2008 Appraisal).

Table 3-10. Acres of shrub-steppe habitat by county.

County	Historical	Remaining	Percent Lost
Adams	1,187,399	279,758	76
Franklin	753,716	230,778	69
Grant	1,614,555	571,830	65
Lincoln	1,260,032	473,674	62
Source: Reclamation 2008 Appraisal			

Remaining areas of native vegetation have almost all been grazed at some time, and most continue to be grazed to some degree. Historic conversion and extensive grazing have resulted in such widespread impacts that many of the remaining native plant communities found within the analysis area fall into categories designated as Washington High-Quality Plant Communities and Wetland Ecosystems by the Washington Natural Heritage Program (WNHP). WNHP priorities are primarily a measure of how well each individual ecosystem type is represented in the statewide network of designated natural areas (the statewide network includes State-managed Natural Area Preserves and Natural Resources Conservation areas, Federal Research Natural Areas and Areas of Critical Environmental Concern, and private natural areas, e.g., preserves owned by the Nature Conservancy and other land trusts). They do not directly equate to being overall conservation priorities. WNHP priorities for ecosystems do consider rarity and degree of threat to the individual ecosystem type, but only secondarily. At the ecosystem level, the Washington Department of Natural Resources (WDNR) has designated Priority Ecosystems for State lands.[6]

[6] The WNHP provides lists by county of High-Quality Plant Communities and Wetland Ecosystems on the WDNR website at http://www1.dnr.wa.gov/nhp/refdesk/lists/communitiesxco/countyindex.html.

In addition, the WDFW has designated specific plant communities as Washington Priority Habitats. See Section 3.9 – *Wildlife and Wildlife Habitat*, for more details on these categories.

Another result of native vegetation conversion to agriculture is that several plant species endemic to the region now have artificially restricted distributions and are listed as rare in Washington. Similarly, past fragmentation and disturbance of native plant communities have allowed or encouraged many nonnative species to become established within these areas.

Related to wetlands, the channeled scablands of eastern Washington contain a mosaic of depressional marshes, old flood channels, and ephemeral ponds. Other types of wetlands typical of the region include seeps near the bases of slopes, wetland meadows, wetlands associated with the fringes of reservoirs, wetlands associated with ephemeral, intermittent, and perennial streams and river, and man-made depressional wetlands in mined areas, agricultural fields, and suburban areas (Corps 2008). Wetlands have also developed along parts of the relatively flat east side of Banks Lake.

3.8.3 Uplands

Much of the land that would be crossed by the proposed East High Canal is farmland and Conservation Reserve Program land. Widening of the East Low Canal would occur largely within the existing easement. See Section 3.13 – *Land Use and Shoreline Resources*, for additional information.

Native vegetation communities are primarily located along the proposed routes of the northern segment of the East High Canal and in proposed reservoir inundation areas at Black Rock Coulee. Upland areas of native vegetation within the analysis area are primarily shrub-steppe dominated by big sagebrush (*Artemisia tridentata*) and Sandberg's bluegrass (*Poa secunda*). This is one of the major shrub-steppe vegetation types described by Daubenmire (1988) for eastern Washington. Other shrub-steppe vegetation types are found scattered within big sagebrush-Sandberg's bluegrass in a wide distribution pattern across the analysis area. Two of these shrub-steppe vegetation types are found on lithosols (thin and stony soils with basalt bedrock immediately below):

- Scabland (stiff) sagebrush (*Artemisia rigida*) and Sandberg's bluegrass.
- Thymeleaf buckwheat (*Eriogonum thymoides*) and Sandberg's bluegrass.

A variety of other steppe habitats are less commonly found in a few locations throughout remaining native vegetation in the analysis area. These include vegetation types based upon dominance of bluebunch wheatgrass (*Pseudoroegneria spicata*), inland saltgrass (*Distichlis spicata*), or needle-and-thread grass (*Hesperostipa comata*).

The WDNR lists 15 distinctive ecosystems within the Columbia Plateau Ecoregion, including shrub-steppe, as Priority 1 under the 2009 Natural Heritage Plan. The WDNR considers shrub-steppe ecosystems to be among the most threatened in Washington (WNHP 2009). The WNHP has designated specific vegetation communities as High-Quality or Rare Plant Communities and Wetland Ecosystems of Washington. In addition, the WDNR has assigned priority status to rare or threatened ecosystems, which authorizes management protection and designation of natural areas on state lands. Information regarding specific locations of known High-Quality or Rare Plant Communities of Washington within 5 miles of the analysis area was provided by the WNHP.

Table 3-11. Recorded occurrences of WNHP High-quality or Rare Plant communities occurring within a 5-mile radius of the analysis area.

includes the WNHP-designated High-quality or Rare Plant Communities and Wetland Ecosystems of Washington. This table lists those plant communities and ecosystems designated in this category by WNHP within 5 miles of the project footprint. Some appear to occur in upland areas that would not be directly impacted by the project, such as stabilized dunes in some areas around Banks Lake. Table 3-11 contains all upland plant communities listed as rare by the WNHP that were found to occur in the analysis area during field surveys. Plant community types or ecosystems with WDNR special status, WDFW Priority Habitat status, or both are noted in text.

Table 3-11. Recorded occurrences of WNHP High-quality or Rare Plant communities occurring within a 5-mile radius of the analysis area.

Scientific Name	Common Name	WNHP Database		
		Number of Observed Areas	**Date Range of Last Observation**	**Type Found During Field Surveys**
Shrub Herbaceous Vegetation				
Artemisia rigida / Poa secunda	Stiff Sagebrush/ Sandberg's Bluegrass	3	1979 - 2000	Yes
Artemisia tridentata / Festuca idahoensis	Big Sagebrush/Idaho Fescue	5	1968 - 2000	No
Artemisia tridentata ssp. *Wyomingensis / Pseudoroegneria spicata*	Wyoming Big Sagebrush/ Bluebunch Wheatgrass	6	1979 - 1990	-
Artemisia rigida / Poa secunda	Stiff Sagebrush (scabland)/ Sandberg's Bluegrass	-	-	Yes

Scientific Name	Common Name	WNHP Database		
		Number of Observed Areas	**Date Range of Last Observation**	**Type Found During Field Surveys**
Shrubland				
Artemisia tridentata	Wyoming Big Sagebrush	-	-	Yes
Artemisia tridentata ssp. / *Hesperostipa comata*	Wyoming Big Sagebrush/ Needle-and-thread	1	1986	-
Sarcobatus vermiculatus / Distichlis spicata	Greasewood/Saltgrass	-	-	Yes*
Dwarf Shrub Herbaceous Vegetation				
Eriogonum thymoides / Poa secunda	Thymeleaf buckwheat/ Sandberg's bluegrass	-	-	Yes
Herbaceous Vegetation				
Distichlis spicata	Saltgrass	-	-	Yes*
Cover Type				
Inter-mountain Basins Active and Stablized Dune	Dunes	1	2006	-
Hesperostipa comata	Needle-and-thread Grassland	-	-	Yes*
Populus tremuloides	Quaking aspen	-	-	Yes*
* Very rare in analysis area				
Source: Washington Natural Heritage Program (http://www.dnr.wa.gov/ResearchScience/Topics/NaturalHeritage/Pages/amp_nh.aspx) Washington Department of Fish and Wildlife Priority Habitats and Species Program (http://wdfw.wa.gov/conservation/phs/)				

The shrub-steppe vegetation type is a mixture of woody shrubs, grasses, and forbs generally dominated by Wyoming big sagebrush and bluebunch wheatgrass in east-central Washington (Daubenmire 1970). Within the Odessa analysis area, upland vegetation types that have not been converted to cropland are typically shrub-steppe vegetation types (Reclamation 2008 Appraisal). Daubenmire (1988) described shrub-steppe as vegetative communities consisting of one or more layers of perennial grass with a conspicuous but discontinuous overstory layer of shrubs. The dominant shrubs include one or more species of sagebrush, rabbitbrush (*Chrysothamnus spp*.), bitterbrush (*Purshia tridentata*), greasewood (*Sarcobatus spp*.), and spiny hopsage (*Grayia spinosa*). The dominant grasses include native bunchgrasses *(Poa, Stipa*, and *Agropyron spp*.) and, in some areas, nonnative cheatgrass (*Bromus tectorum*).

Upland areas of native vegetation within the analysis area are primarily shrub-steppe dominated by big sagebrush (*Artemisia tridentata*) and Sandberg's bluegrass (*Poa secunda*). Other shrub-steppe vegetation types are found scattered within big sagebrush-Sandberg's bluegrass in a wide distribution pattern across the analysis area. Field surveys conducted by CH2M HILL identified eight distinct upland plant communities within the shrub-steppe vegetation type. Other steppe habitats less commonly found in the analysis area include vegetation types based upon dominance of bluebunch wheatgrass (*Pseudoroegneria spicata*), inland saltgrass (*Distichlis spicata*), or needle-and-thread grass (*Hesperostipa comata*). Most of the remaining native shrub-steppe is located in the north and east parts of the Study Area and would be crossed by the East High Canal.

Three primary shrub-steppe vegetation types exist within the analysis area:

- **Big sagebrush—Sandberg's bluegrass** occurs in relatively large expanses on deeper soils. Diversity and habitat quality surveys at 177 sampling points in this vegetation type rated 36 percent as high quality, 36 percent as good quality, 18 percent as moderate quality, and 11 percent as either fair or low quality. The average number of native plant species observed within sample plots was 8 and cheatgrass cover was estimated to average between 12 to 13 percent.
- **Stiff (scabland) sagebrush—Sandberg's bluegrass** is another major steppe vegetation type that was found to be dominant at approximately 7 percent of sampling points. Results of diversity and habitat quality surveys at 24 sampling points in this vegetation type rated 50 percent of the sample sites as high quality, 21 percent as good quality, 25 percent as moderate quality, and only 4 percent as low quality. The average number of native plant species observed within sample plots was 9 and cheatgrass cover was estimated at about 6 percent.
- **Big sagebrush—bluebunch wheatgrass and Wyoming big sagebrush—bluebunch wheatgrass** constitute the other major shrub-steppe community in the analysis area (Photograph 3-3). Results of habitat quality surveys in this vegetation type at 16 sampling points rated 69 percent as high quality, 19 percent as moderate quality, and 13 percent as either fair or low quality. Average canopy cover of cheatgrass in this vegetation type was about 9 percent.

Photograph 3-3. View of Big Sagebrush Bluebunch Wheatgrass vegetation type with Three Tip Sagebrush in foreground. Note the high forb cover, including Carey's Balsamroot, Longleaf Phlow, Nineleaf Biscuitroot, and Basalt Milkvetch.

3.8.4 Wetland and Riparian Communities

A majority of the wetlands mapped within the analysis area are adjacent to Banks Lake within the proposed Black Rock Coulee Reregulating Reservoir, and along the East Low Canal. Wetland resources are also associated with Lake Roosevelt and the northern extent of the East High Canal alignment. Wasteways were not included within the analysis area for identification of wetlands because most only support temporary streams during large storm events and because no facilities would be constructed in these areas. Crab Creek within the Study Area is an ephemeral drainage, but any increase in flow would be minimal and not affect existing resources.

Wetland naming conventions and classification are described in Table 3-12 (Cowardin et al. 1979). Wetland systems identified within the analysis area include riverine, lacustrine, and palustrine wetlands, including alkali, vernal pool, and freshwater ponds.

Table 3-12. Wetland classifications within the Study Area.

Wetland System	System Definition
Riverine	All wetlands and deepwater habitats contained within a channel, except wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses, or lichens.
Lacustrine	Wetlands and deepwater habitats situated in a depression or dammed river channel, lacking trees, shrubs, persistent emergent vegetation, emergent mosses, or lichens with greater than 30 percent areal coverage and larger than 20 acres.
Palustrine	All nontidal wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses, or lichens. This particular system was developed to group the vegetated wetlands traditionally called by names such as marsh, swamp, bog, fen, and pond. Includes emergent (PEM), scrub shrub (PSS), and forested (PFO) vegetative classes.
Source: Cowardin et al. 1979	

3.8.4.1 Palustrine Emergent Wetlands

Palustrine emergent (PEM) wetlands are the most common type found in the analysis area. PEM wetlands are dominated by emergent vegetation. PEM wetlands have been identified at Banks Lake, within the proposed Black Rock Coulee Reregulating Reservoir, along the East High Canal alignment, and along the East Low Canal that would be widened. A total of 498.2 acres of PEM wetland, including freshwater ponds, have been identified within the analysis area:

- Banks Lake, 413.2 acres.
- East High Canal, 6.1 acres.
- East Low Canal, 42.2 acres.
- Black Rock Coulee Reregulating Reservoir, 36.7 acres.

PEM wetlands observed typically contain one (emergent) or two vegetative layers (emergent and shrub). Typical vegetation associated with PEM wetlands include common cattail (*Typha latifolia*), hardstem bulrush (*Schoenoplectus acutus*), cosmopolitan rush (*Schoenoplectus maritimus*), reed canarygrass (*Phalaris arundincacea*), and Baltic rush (*Juncus balticus*) in the emergent layer with Russian olive (*Elaeagnus angustifolia*), coyote willow (*Salix exigua*), and peachleaf willow (*Salix amydgloides*) providing less than 30 percent vegetative cover in the shrub layer.

3.8.4.2 Palustrine Scrub-Shrub Wetlands

Palustrine scrub-shrub (PSS) wetlands are dominated by woody vegetation less than 6 meters tall. A total of 105.2 acres of PSS wetland was identified within the analysis area. All of the

PSS acreage was identified adjacent to Banks Lake. PSS wetlands typically include two vegetative layers: emergent and shrub. Common dominants in the PEM and PSS layers include cattail, hardstem bulrush, cosmopolitan bulrush, and reed canarygrass in the emergent layer and Russian olive, coyote willow, or peachleaf willow in the shrub layer.

3.8.4.3 Palustrine Forested Wetlands

Palustrine forested (PFO) wetlands are characterized by woody vegetation that is 20 feet (6 meters) tall or taller (Cowardin et al. 1979). PFO wetlands possess an overstory of trees, and frequently contain an understory of young trees or shrubs, and an herbaceous layer. A total of 124.7 acres of PFO, which includes all PFO combination types (PFO, PFO/PSS, and PFO/PEM) were identified within the analysis area. This total acreage includes 121.1 acres of PFO type wetlands at Banks Lake and 3.6 acres of PFO at the Black Rock Coulee Reregulating Reservoir site. PFO wetlands also include an overstory of black cottonwood (*Populus balsamifera*), willow species (*Salix spp*.), or at one location, quaking aspen (*Populus tremuloides*).

3.8.4.4 Freshwater Ponds

Freshwater ponds are characterized as smaller, shallower depressions as compared to lacustrine wetland types. Within the analysis area, freshwater ponds are primarily identified in association with palustrine wetland fringes and as landscape or irrigation features. Approximately 47.7 acres of freshwater ponds were identified within the analysis area.

3.8.4.5 Alkali Wetlands

Alkali wetlands are characterized by the occurrence of shallow saline water. These wetlands provide the primary habitat for several species of migrant shorebirds and are heavily used by migrant waterfowl. They also have unique plants and animals that are not found elsewhere in eastern Washington. Salt concentrations in these wetlands have resulted from a relatively long-term process of groundwater surfacing and evaporating (Hruby 2007). Alkali wetlands identified at the proposed Black Rock Coulee Reregulating Reservoir site typically included and are dominated by saltgrass (*Distichlis spicata*) and in some cases, dead fourwing saltbush (*Atriplex canescens*) in the shrub layer.

3.8.4.6 Vernal Pools

Vernal pool ecosystems are formed when small depressions in the scabrock or in shallow soils fill with snowmelt or spring rains. They retain water until the late spring, when reduced precipitation and increased evapotranspiration dry them out completely. These wetlands may hold water long enough during the year to allow some strictly aquatic organisms to flourish, but not long enough for the development of a typical wetland environment (Hruby 2007).

Vernal pools identified within the Black Rock Coulee Reregulating Reservoir site did not have any vegetation within their dry basins when observed in May 2009.

3.8.5 Wetland Locations

Wetland vegetation communities are described by wetland type for each major Odessa facility location within the analysis area. Those habitats with WDNR special status are noted.

3.8.5.1 Banks Lake

Water elevations in Banks Lake vary during the irrigation season, which impedes the development of extensive wetland and riparian vegetation. However, water levels fluctuate 5 feet annually and the reservoir currently supports areas of aquatic plants between elevations 1570 feet and 1565 feet amsl. Shallow, low-gradient shorelines are present in bays and along the reservoir. The ability to tolerate periodic drawdown and drying determines which aquatic species have established in these low-gradient areas (Reclamation 2004). Wetland locations and wetland vegetation data points characterizing plant communities around Banks Lake are shown on Figure 3-8 through Figure 3-12.

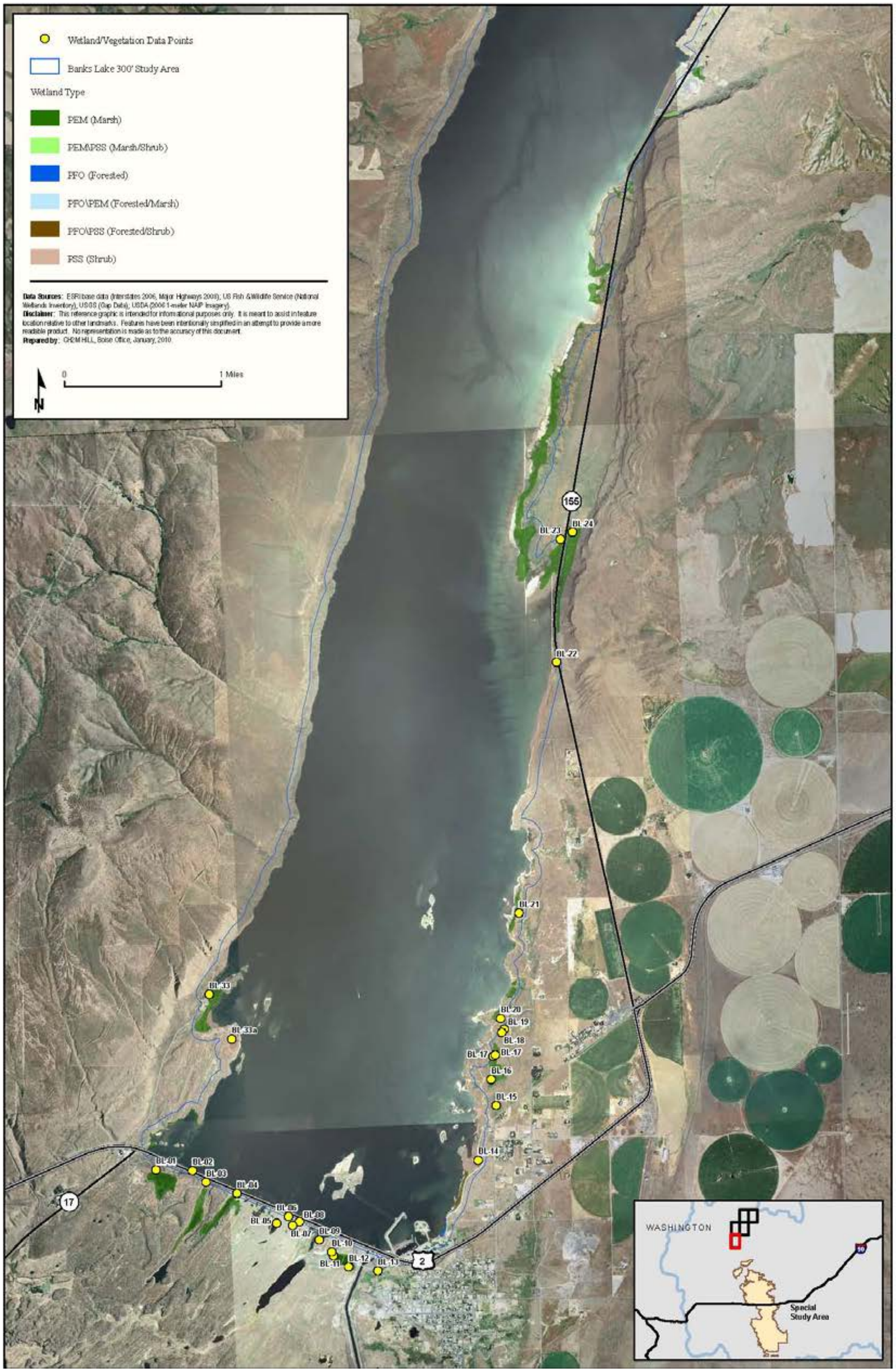


Figure 3-8. Banks Lake fringe wetlands, south.

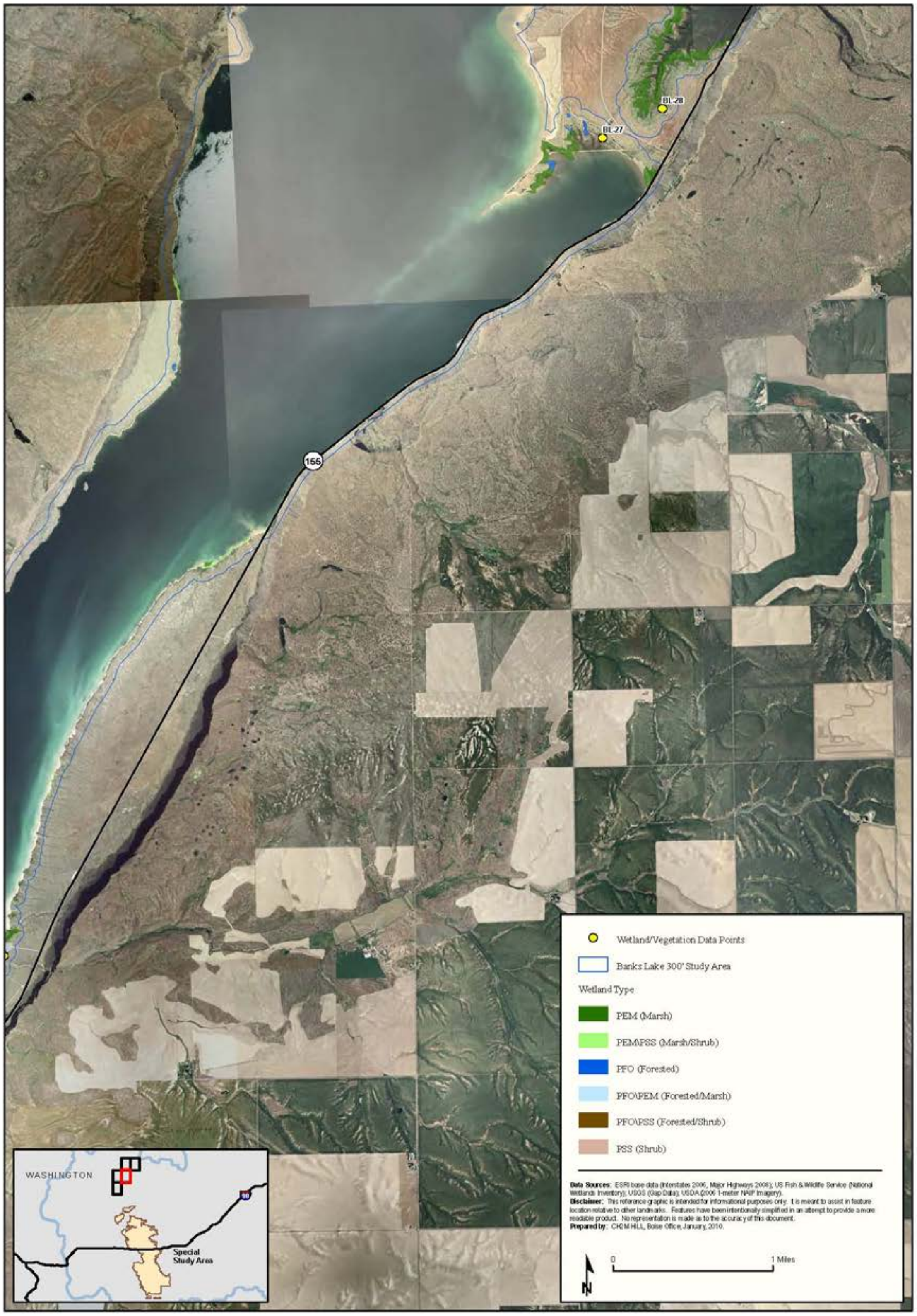


Figure 3-9. Banks Lake fringe wetlands, east central.

Figure 3-10. **Banks Lake fringe wetlands, west central.**

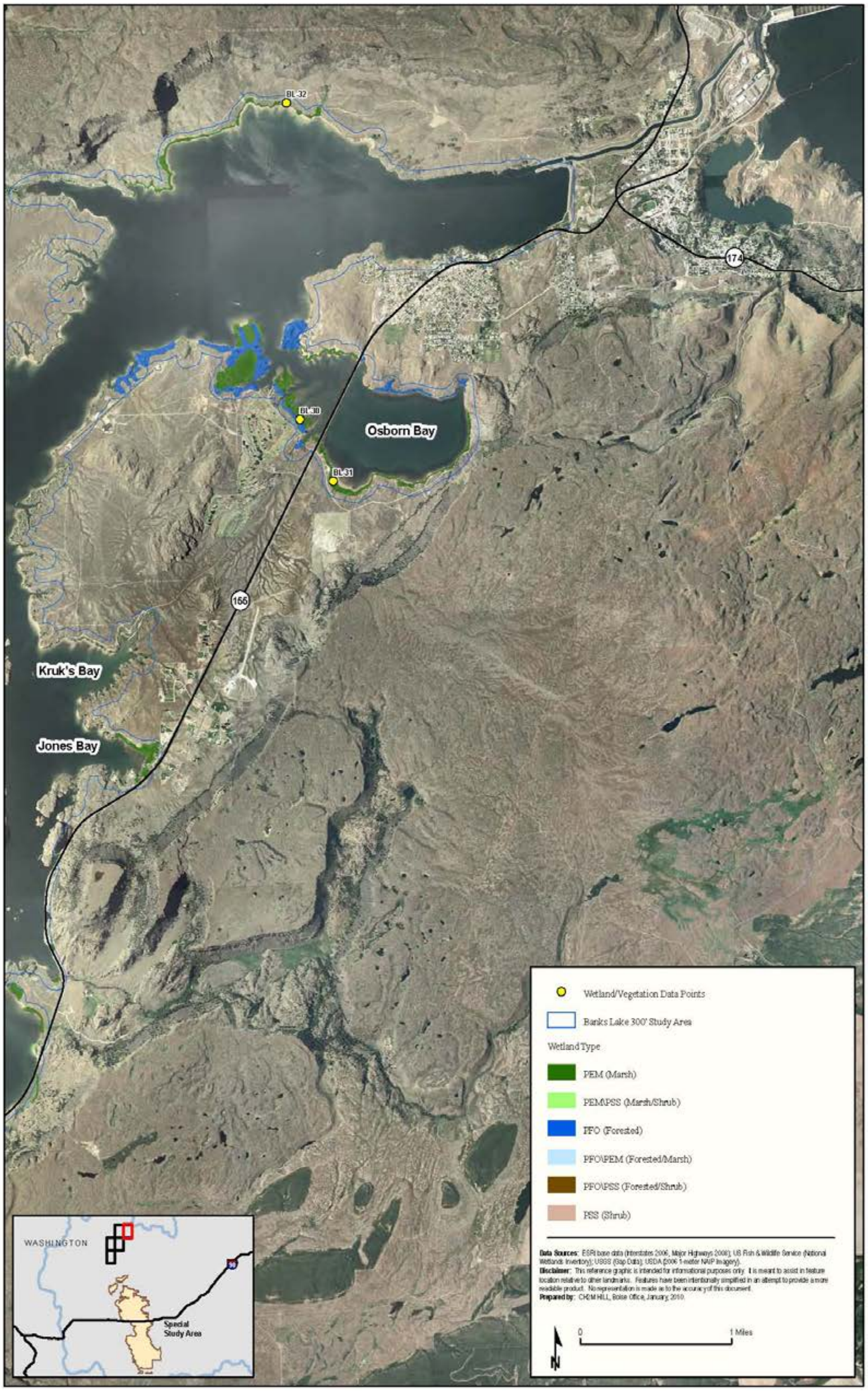


Figure 3-11. Banks Lake fringe wetlands, northeast.

Figure 3-12. Banks Lake fringe wetlands, northwest.

Field verification of wetland vegetation surrounding Banks Lake identified a total of 639.5 acres of wetland associated with the reservoir. Discrete wetland acreage by wetland type adjacent to Banks Lake includes the following:

- 413.2 acres of PEM wetland
- 105.2 acres of PSS wetland
- 0.5 acre of PFO/PEM wetland
- 10.8 acres of PFO/PSS wetland
- 109.8 acres of PFO wetland adjacent to the reservoir

PEM wetland areas adjacent to Banks Lake are typically dominated by common cattail, hardstem bulrush, cosmopolitan bulrush, reed canarygrass, three square bulrush (*Schoenoplectus pungens*), Baltic rush, and stinging nettle (*Urtica diocia*).

PSS wetlands fringing Banks Lake typically contain a dense overstory of coyote willow, peachleaf willow, pacific willow (*Salix lasiandra*), and dogbane (*Apocynum cannabinum*). The understory of PSS wetlands may contain a vegetative community similar to that described for PEM wetlands or it may be devoid of emergent vegetation. PFO wetlands associated with Banks Lake are frequently associated with PEM and PSS wetland vegetation with an overstory of black cottonwood, Russian olive, or mature willows. The landscape position or hydrogeomorphic class (Brinson 1993; Hruby 2007) for the majority of the wetlands surrounding Banks Lake are Lake Fringe; however, the wetlands located at the southern end of the reservoir are Depressional. WDNR Special Status habitats associated with Banks Lake in the Columbia Basin include Low Elevation Freshwater Wetlands.

3.8.5.2 Black Rock Coulee Reregulating Reservoir

A 25.3-acre PEM/PFO wetland system was identified within the Black Rock Coulee Reregulating Reservoir inundation area. In addition, 14.98 acres of freshwater pond are associated with the PEM/PFO wetland. The PEM wetland portion of the system (21.7 acres) originates from a seep from the northeast that flows southwest within a wide, vegetated wetland channel to its terminus in an open water pond fringed with PEM wetland and a PFO wetland lobe (3.6 acres of PFO). Vegetation commonly identified within the PEM channel community includes American speedwell (*Veronica americana*), seep monkeyflower (*Mimulus guttatus*), bittercress (*Cardamine sp.)*, Gmelin's buttercup (*Ranunculus gmelinii*), duck weed (*Lemna minor*), Baltic rush, curley dock (*Rumex crispus*), slender cinquefoil (*Potentilla gracilis*), reed canarygrass, redtop (*Agrostis stolonifera*), and Canada thistle (*Cirsium arvense*). The PEM fringe wetlands adjacent to the open water pond are typically dominated by hardstem bulrush, creeping spikerush (*Eleocharis palustris*), three square, Baltic rush, cattail, and slender cinquefoil. The tree layer is dominated by quaking aspen with Bebb willow (*Salix bebbiana*) in the shrub layer. The landscape position or hydrogeomorphic class (Brinson 1993; Hruby 2007) for the wetland system at the Black Rock Coulee Reregulating Reservoir site includes slope and depressional classes.

An upland riparian shrub community adjacent to the PEM wetland channel and the PFO community is dominated by Wood's rose (*Rosa woodsii*), golden currant (*Ribes aureum*), and to a lesser degree Bebb willow.

Several small areas of alkali wetlands and vernal pool wetlands (Special Characteristics; Hruby 2007) were identified adjacent to the PEM channel corridor within the Black Rock Coulee Reregulating Reservoir inundation area. These wetland areas were included within the PEM wetland polygon mapped for the Black Rock Coulee Reregulating Reservoir site.

WDNR Special Status habitats associated with Black Rock Coulee Reregulating Reservoir include Low Elevation Freshwater Wetlands, Vernal Pond, and Creeping Spikerush.

3.8.5.3 East High Canal

Approximately 5.2 acres of PEM wetland and 0.9 acre of freshwater pond were identified along the East High Canal alignment. Wetland resources are located in three general areas: the northern section east of Billy Clapp Lake (4.3 acres), an area east of Billy Clapp Lake (0.4 acre), and south of the town of Wilson Creek (0.5 acre). Dominant vegetation within these wetland areas includes common cattail, reed canarygrass, duck weed, and hardstem bulrush. Hydrology within ponded areas and down slope channels is likely supported by irrigation seeps from an adjacent canal. The landscape position or hydrogeomorphic class (Brinson 1993; Hruby 2007) for northern East High Canal wetlands includes Slope and Depressional classes. Wetlands that contain slope and depressional characteristics are classified and evaluated as Depressional wetlands (Hruby 2007).

3.8.5.4 East Low Canal

NWI information only identified PEM wetland types; however, field verification indicated the presence of PEM/PSS wetland types within the East Low Canal portion of the analysis area. Five PEM wetland areas (39.6 acres) and two freshwater ponds (2.6 acres) were identified within the East Low Canal analysis area (USFWS 2009). Wetland resources in this area include a narrow fringe of PEM wetland dominated by reed canarygrass along the inner East Low Canal wall (37.8 acres) and larger lobes of PEM or PEM/PSS wetlands (1.8 acres) on the downslope side of the canal supported by irrigation water seeps from the canal. Wetland vegetation is dominated by reed canarygrass (fringe wetland community), hardstem bulrush, cosmopolitan bulrush, three square bulrush, and common cattail in the emergent layer and coyote and peachleaf willow in the shrub layer where present. The landscape position or hydrogeomorphic class (Brinson 1993; Hruby 2007) for East Low Canal wetlands includes Slope and Depressional classes. WDNR Special Status habitats associated with the East Low Canal in the Columbia Basin include Low Elevation Freshwater Wetlands.

NWI acreages (USFWS 2009) for wetland resources within the East Low Canal analysis area are presented in this document because no long-term wetland impacts are anticipated in this area. All wetland areas are located in down-slope positions adjacent to the canal. Proposed canal improvements associated with the Study would be limited to the upslope side of the canal. No impacts to the wetlands located on the down-slope side of the canal are anticipated in conjunction with the Study.

3.8.6 Special Status/Priority Wetland and Riparian Vegetation Types

Wetlands and riparian areas designated as Washington High-quality Plant Communities and Wetland Ecosystems by WDNR and as Washington Priority Habitats by the WDFW are listed in Table 3-13. Some of these were found during wetland vegetation surveys to confirm NWI mapped wetlands, so they are known to be present. Other wetland communities are unlikely to occur in the analysis area.

Table 3-13. Wetlands and riparian areas designated as Washington High-quality Plant Communities and Wetland Ecosystems by WNHP.

High-Quality Plant Communities and Wetland Ecosystems	Scientific Name	Occurrence in Analysis Area
Mountain alder	*Alnus incana* shrubland	Not currently known
Water birch/red-osier dogwood	*Betula occidentalis/Cornus sericea* shrubland	Not currently known
Water birch forest	*Betula occidentalis* shrubland	No
Red-osier dogwood	*Cornus sericea* shrubland	Not currently known
Black hawthorn/Wood's rose	*Crataegus douglasii/Rosa woodsii* shrubland	Not currently known
Tufted hairgrass	*Deschampsia caespitosa* herbaceous vegetation	Not currently known
Saltgrass	*Distichlis spicata* herbaceous vegetation	Yes (Black Rock Coulee site)
Creeping spikerush	*Eleocharis palustris* intermittently flooded herbaceous vegetation	Yes (Banks Lake)
Low elevation freshwater wetland Columbia Basin	Low elevation freshwater wetland Columbia Basin	Yes (widespread)
Mock orange	*Philadelphus lewisii* intermittently flooded shrubland	Not currently known
Vernal Pond Columbia Basin	Vernal pond Columbia Basin	Yes (Black Rock Coulee site)

3.8.7 Wetland Functional Assessment

Wetlands provide a range of significant ecological functions. Functions are self-sustaining properties of a wetland ecosystem that exist in the absence of society. Functions result from both living and nonliving components of a specific wetland. These include all processes necessary for the self-maintenance of the wetland ecosystem such as primary production and nutrient cycling, among others. Therefore, functions relate to the ecological significance of wetland properties without the regard to subjective human values.

Wetland functions were assessed and assigned to each wetland in the analysis area based on the methodology presented in the Eastern Washington Wetland Rating System (EWWRS; Hruby 2007). The EWWRS lists three wetland functions by which wetlands are evaluated (Table 3-14) and describes wetland properties and functional criteria for evaluating each wetland and its functions.

Table 3-14. Wetland function descriptions (Hruby 2007).

Function	Description
Water Quality	This function considers if a wetland unit has the potential to improve water quality (characteristics of surface water flow, soil type, vegetation, and ponding /inundation) and the opportunity to improve water quality (pollutant source).
Hydrologic	This function considers if a wetland unit has the potential to reduce flooding and stream erosion (characteristics of surface water flow, depth of storage during wet periods) and if it has the opportunity to reduce flooding and erosion (protection of downstream property and aquatic resources).
Habitat	This function considers if a wetland unit has the potential to provide habitat (vegetation, surface water, richness of plant species, interspersion of habitats, special habitat features, buffers, wet corridors, priority habitats, landscape setting, and indicators of reduced habitat function).
Special Characteristics	Considers if a wetland has important or valuable characteristics that may supersede its functions. Characteristics include vernal pool, alkali wetland, Natural Heritage Wetlands, bogs, and forested wetlands.

Categorization based on special characteristics considers if a wetland has important or valuable characteristics that may supersede its functions. Characteristics include vernal pool, alkali wetland, Natural Heritage Wetlands, bogs, and forested wetlands. Wetland habitats with special characteristics that are present within the analysis area include wetland forests with stands of aspen (Black Rock Coulee Reregulating Reservoir inundation area), forested wetlands with fast growing trees (Banks Lake PFO wetlands, cottonwood), alkali wetlands (Black Rock Coulee Reregulating Reservoir inundation area), and vernal pools (Black Rock Coulee Reregulating Reservoir inundation area). A description of these special characteristics is provided in Table 3-15.

Table 3-15. Study area wetland categorization based on special characteristics.

Wetland Habitat	Rating Category	Description
Forests with stands of aspen	I	Aspen stands in a forested area are rated as Category I because their contribution as habitat far exceeds the small acreage of these stands and relatively small number of stems (Hruby 2007). Furthermore, a mature stand of aspen and its underground root system may be difficult to reproduce. Regeneration of aspen stands by sexually produced seeds is an unusual phenomenon (Hruby 2007). Aspen stands are also important because they represent a priority habitat as defined by WDFW. *Priority habitats* are those habitat types or elements with unique or significant value to a diverse assemblage of species (WDFW 2008). All wetlands are categorized as priority habitats by the WDFW. Wetlands with aspen stands, therefore, represent two priority habitats that coincide.
Forested wetlands with fast growing trees	II	Mature and old-growth forested wetlands dominated by fast growing native trees are hard to replace within the timeframe of most regulatory activities. The time needed to replace them is shorter than for forests with slow growing trees, but still significant. These forested wetlands are also important because they represent a second priority habitat type as defined by WDFW. Forested wetlands with native fast-growing wetland trees identified in the analysis area include black cottonwoods and aspen.
Alkali wetlands	I	Alkali wetlands are characterized by the occurrence of shallow saline water. The functions and biochemical properties of alkali wetlands cannot be easily reproduced through compensatory mitigation because the balance of salts, evaporation, and water inflows are complex interactions that have not been adequately researched or replicated in a mitigation setting. Alkali wetlands probably cannot be reproduced through compensatory mitigation and are relatively rare in the landscape. No information was found on any attempts to create or restore alkali wetlands. Any impacts to alkali wetlands would, therefore, probably result in a net loss of their functions and values (Hruby 2007).

Wetland Habitat	Rating Category	Description
Vernal pool wetlands	II or III	Vernal pools located in a landscape with other wetlands and that are relatively undisturbed during the early spring are rated Category II. Vernal pools that are isolated or disturbed by adjacent land use are rated Category III. Vernal pool ecosystems are formed when small depressions in the scabrock or in shallow soils fill with snowmelt or spring rains. They retain water until the late spring when reduced precipitation and increased evapotranspiration lead to a complete drying out. The wetlands hold water long enough to allow some strictly aquatic organisms to flourish, but not long enough for the development of a typical wetland environment (Hruby 2007). WNHP has recognized the vernal pool ecosystem as an important component of Washington's Natural Area System. Vernal pools in the scablands are the first to melt in the early spring. This open water provides areas where migrating waterfowl can find food while other larger bodies of water are still frozen. Thus, vernal pools in a landscape with other wetlands provide an important habitat function for waterfowl that requires a relatively high level of protection. This is the reason why relatively undisturbed vernal pools in a mosaic of other wetlands are Category II, and isolated undisturbed vernal pools are Category III (Hruby 2007).

3.8.8 Rare Plant Species within the Analysis area

Data regarding rare species identification, known occurrences, county distributions, and habitat criteria are maintained by WNHP (2009). Information regarding specific locations of known populations of rare plants was provided by the WNHP with confidentiality requirements. This information includes known populations within 5 miles of the proposed facility footprints. Table 3-16 provides the WNHP list of plant species with known occurrences, either current or historic, within 5 miles of the project footprint.

Although none of the rare plants listed on Table 3-16 were found during plant surveys, three additional rare plant species were found within the East High Canal easement and within proposed reservoir footprints during rare plant surveys in 2009. Sixteen occurrences of three rare plants were found. Avoidance and nondisturbance will be the primary focal method of preserving these identified rare plants.

Table 3-16. Current and historic known occurrences of rare plant species listed by WNHP as occurring within a 5-mile radius of the analysis area.

Scientific Name	Common Name	Current WNHP Data (number of observed areas)	Historic* WNHP Data (number of observed areas)
Washington Natural Heritage Program Listed Rare Plants			
Astragalus arrectus	Palouse milk-vetch	-	1
Corispermum pallidum	pale bugseed	-	2
Cryptantha leucophaea	gray cryptantha	-	1
Cryptantha scoparia	miner's candle	-	1
Erigeron piperianus	Piper's daisy	3	7
Hackelia hispida var. Disjuncta	sagebrush stickseed	1	
Micromonolepis pusilla	red poverty-weed	-	2
Nicotiana attenuata	coyote tobacco	-	1
Polemonium pectinatum	Washington polemonium	1	1
Thelypodium sagittatum ssp. *sagittatum*	arrow thelypody	-	1
*Most recent sighting was prior to 1977.			

3.8.8.1 Hoover's Umbrellawort (*Tauschia hooveri*)

Hoover's umbrellawort is a perennial forb with a globe tuberous root. It is a member of the Apiaceae (Parsley) plant family. Hoover's umbrellawort is a Washington Threatened species and a U.S. Fish and Wildlife Service (USFWS) Species of Concern. Eight occurrences and a total of 72 plants of Hoover's umbrellawort were found during rare plant surveys in two primary areas of distribution: the upper terraces of the Black Rock Coulee Reregulating Reservoir and south of SH 28. All occurrences were small in terms of the area supporting umbrellawort and in the total number of plants per occurrence (15 was the largest plant count). Hoover's umbrellawort found in the analysis area were found on rocky lithosol soils and all occurrences were found along upper terraces underlain by basalt on relatively flat terrain. Total plant cover on these sites was naturally low. Associated species include 20 percent or less canopy cover of Sandberg bluegrass, less than 5 percent stiff sagebrush, and less than 5 percent total canopy cover of daggerpod (*Phoenicaulis cheiranthoides*), bigseed biscuitroot (*Lomatium macrocarpum*), nodding microseris (*Microseris nutans*), and fragile onion (*Allium scilloides*). Biotic crust cover was high on these sites and ground disturbance was low.

3.8.8.2 Snake River Cryptantha (*Cryptantha spiculifera*)

Three occurrences of Snake River cryptantha were found within the survey area in the area proposed for the Black Rock Coulee Reregulating Reservoir. Snake River cryptantha is a perennial species of the Boraginaceae (Borage) Family. It is a Washington Sensitive species. Two of the three occurrences were close together and should be considered as a single population with a total population of less than 100 plants (8 in one occurrence and 84 the other). These two occurrences occupy a total area of less than 0.5 acre (150 feet by 150 feet). The second occurrence was a very small population of seven plants. It was found east of the larger occurrence, and on the same upper terrace as the Black Rock Coulee Reregulating Reservoir, in an area of approximately 20 square feet.

All occurrences were found along upper terraces along the south side of the proposed Black Rock Reregulating Reservoir on flat or slightly north-facing slopes. They were all growing on rocky lithosols in areas with little plant cover.

Snake River cryptantha were found in association with 25 percent or less canopy cover of Sandberg's bluegrass and with 15 percent or less total canopy cover of big sagebrush and stiff sagebrush. Biotic crust cover was high on these sites and ground disturbance was low. Although forb diversity (number of forb species) was high on these sites, total forb canopy comprised less than 10 percent canopy cover.

3.8.8.3 Sticky Phacelia (*Phacelia lenta*)

Sticky phacelia is a perennial member of the Hydrophyllaceae (Waterleaf) Family. Five occurrences of sticky phacelia consisting of a total of 53 plants were found during rare plant surveys in mid-May. It is a Washington Threatened species and a USFWS Species of Concern. All occurrences were found in rocky talus slopes near Billy Clapp Lake along the East High Canal alignment. The number of plants in each occurrence differed widely.

All occurrences of sticky phacelia were found in basalt crevices, rocky outcrops, or at the toe of basalt talus slopes.

3.8.9 Invasive Plant Species (Weeds) within the Analysis Area

Washington has several classes of weeds (non-native plant species). These classes are based upon the invasive characteristics and the current distribution in the state (Ecology 2009 Weeds):

- **Class A**. Weeds with a limited distribution in Washington. The statewide goal for these species is eradication.
- **Class B**. Weeds that are established in some regions of Washington, but are of limited distribution or not present in other regions of the state. Because of the differences in distribution, treatment of Class B weeds varies between regions of the state.
- **Class C**. Weeds that are already widely established in Washington or of special interest to the State's agricultural industry. Placement on the list allows counties to enforce control if locally desired. Other counties may choose to provide education or technical consultation.

Noxious weeds are a common problem in the analysis area and generally invade and occupy sites that have been previously disturbed by fire, livestock grazing, motorized travel, or dispersed camping (Reclamation 2008 Appraisal). Weeds often inhibit the health and diversity of the ecosystems they invade. Consequently, weed control is an integral part of resource management, as weeds displace native plant species, are often of lower forage value to wildlife, support fewer insects sought by wildlife, and are difficult to extirpate once established. Essential elements of wildlife habitat, such as cover and nesting habitat, are often impaired by the replacement of native plants by weedy species.

Non-native weedy plants dominant in the analysis area include cheatgrass, diffuse and spotted knapweed (*Centaurea diffusa* and *C. biebersteinii*, respectively), tumble mustard (*Sisymbrium sp.*), Canada thistle, pepperweed (*Lepidium latifolium*), kochia (*Kochia scoparia*), dalmation toadflax (*Linaria dalmatica dalmatica*), Russian knapweed (*Acroptilon repens*), purple loosestrife (*Lythrum salicaria*), and Russian thistle (*Salsola kali*) (Reclamation 2008 Appraisal). Cheatgrass has invaded many areas where native perennials have been overgrazed or eliminated. Most of the estimates for cheatgrass cover in remaining native shrub-steppe communities are relatively low. However, 6 of 324 sampling points (2 percent of the survey area) had such extensive cheatgrass invasion that it was classed as the dominant vegetation. Cheatgrass was dominant in the understory of big sagebrush at 7 of 324 sampling points (another 2 percent of the analysis area). In big sagebrush areas along the bottom of Rocky Coulee, much of the understory has been invaded by cheatgrass and flixweed (*Descurainia sophia*). Most other areas of weed invasion are more localized and limited in extent to recreational areas around Banks Lake.

Ecology (2009 Weeds) describes invasive aquatic species as "plants that are not native to Washington, are generally of limited distribution, and pose a serious threat to our state. Because non-native plants have few controls in their new habitat, they spread rapidly, destroying native plant and animal habitat, damaging recreational opportunities, lowering property values, and clogging waterways."

Eurasian watermilfoil (*Myriophyllum spicatum*) is a problem aquatic weed in Banks Lake. Reservoir maintenance drawdowns in Banks Lake also provide control for aquatic weeds, particularly Eurasian watermilfoil, and typically occur on a 10- to 15-year facility maintenance cycle (Reclamation 2008 Appraisal).

3.9 Wildlife and Wildlife Habitat

This section discusses wildlife and wildlife habitat present in areas that would be affected by the alternatives. It relies on and references Section 3.8 – *Vegetation and Wetlands*, for details about the upland and wetland plant communities that are the primary component of wildlife habitat. General wildlife use of specific locations within the analysis area is discussed by location where this information is available.

3.9.1 Analysis Area and Methods

3.9.1.1 Study Area

The analysis area for wildlife and habitat is the same as the Study Area, and corresponds with the specific areas evaluated by WDFW within the Study Area as part of this EIS. Field studies and habitat evaluations conducted by the WDFW focused on four primary areas:

- Banks Lake.
- East High Canal.
- East Low Canal.
- Black Rock Coulee Reregulating Reservoir.

The WDFW Banks Lake studies focused on western grebes. Special status species presence and location data was collected by WDFW at all of the other sites. In addition, implications of shrub-steppe habitat fragmentation are evaluated for the East High Canal and Black Rock Branch.

Wildlife habitats present in the analysis area were based largely on the information presented in Sections 3.2 – *Surface Water Quantity*, and 3.8 – *Vegetation and Wetlands*. WDFW studies included a Habitat Evaluation Procedure (HEP) analysis (WDFW 2009 Habitat) and an inventory of the occurrence of rare species at the sites of the major proposed facilities. HEP evaluates habitat quality for wildlife species based on how well the habitat matches the requirements of the species. The degree to which an area provides optimal habitat for a species is reported as the habitat suitability index (HSI), which varies from 0 (no value) to 1.0 (optimal value). WDFW used both habitat generalists and habitat obligates in their analysis. HSI values for the habitat obligate species are reported as an indicator of habitat value. The WDFW rare species survey results were used to indicate which of these species are known to occur at the major proposed facilities.

3.9.1.2 Downstream of the Study Area

The annual operations at Potholes Reservoir would not change. Water levels and operations of Moses Lake would not be expected to change under the action alternatives. No changes would be anticipated in Lower Crab Creek. Therefore, none of these areas are included in the analysis area for wildlife and wildlife habitat.

3.9.1.3 Lake Roosevelt

Either no or minimal additional impacts on wildlife or wildlife habitat at Lake Roosevelt would occur under any of the alternatives, as described in Section 4.9 – *Wildlife and Wildlife Habitat*. Therefore, wildlife and wildlife habitats present at and near Lake Roosevelt are not discussed here.

3.9.2 Wildlife and Habitats in the Analysis Area

3.9.2.1 Banks Lake

The Final EIS for the Banks Lake Drawdown (Reclamation 2004) provides a comprehensive description of wildlife and wildlife habitat at Banks Lake. Much of the following discussion of wildlife and wildlife habitat at Banks Lake is summarized from that document. It is supplemented with the results of wildlife studies conducted by WDFW in 2009 and wetland investigations. The HEP study was not conducted at Banks Lake. Upland habitats would not be affected by any possible changes in water level and will not be addressed.

Emergent wetland and riparian communities around Banks Lake are described in detail in Section 3.8 – *Vegetation and Wetlands*, and the locations of these habitats are shown on Figure 3-8 through Figure 3-12. Vegetation community mapping identified a total of 639.5 acres of wetland and riparian habitat associated with Banks Lake. This includes about 413 acres of PEM wetland, 105 acres of PSS wetland, 11 acres of PFO/PSS wetland, and about 110 acres of PFO wetland adjacent to the reservoir. Additional information about these wetland and riparian communities is included in the Banks Lake Drawdown EIS (Reclamation 2004).

The fringe wetland and riparian habitats and submerged aquatic vegetation in the more shallow and sheltered areas around Banks Lake are of extremely high value to many wildlife species. These areas support emergent aquatic plants, such as cattails, bulrush, and sedges, and riparian shrubs and trees that provide food and cover for a wide array of waterfowl, raptors, neotropical migrant song birds, mammals, and amphibians. Emergent wetland areas provide sheltered, nutrient-rich areas for waterfowl nesting and foraging. This habitat type is found primarily in Barker Cove, Osborn Bay, Kruks Bay, Jones Bay, Airport Bay, and Devil's Punch Bowl, and along shorelines in the southwest corner of Banks Lake adjacent to the Dry Falls Dam (Reclamation 2004). Many of these areas, along with a few others, also support a narrow intermittent strip of riparian vegetation that exists just above the high-water mark, as shown on Figure 3-8 through Figure 3-12.

Shoreline erosion is degrading many riparian areas or is preventing their establishment and development (Reclamation 2004). In some areas, persistent erosion is undercutting the banks and roots of mature riparian cottonwood and willow trees, causing them to fall over. Land use activities such as livestock grazing, dispersed recreation, and motor vehicle travel have accentuated the erosion problem and contribute to the lack of riparian vegetation and ground cover in many shoreline areas.

The Banks Lake Drawdown EIS (Reclamation 2004) includes a lengthy discussion of wildlife use of the immediate Banks Lake area. Table 3-17 summarizes wildlife species by group known to use Banks Lake wetland and riparian zones and the reservoir surface.

Table 3-17. Wildlife of the Banks Lake wetland and riparian zones and reservoir surface (Reclamation 2004; WDFW 2010).

Species Group	Documented species and notes
Raptors	Species present include bald eagles, red-tailed hawk, northern harrier, golden eagle, prairie falcon, peregrine falcon, long-eared owl, short-eared owl, and Cooper's hawk. The high diversity of raptor species results from the abundance of suitable raptor nesting habitat in basalt cliffs and shoreline trees.
Neotropical migrant songbirds	Sixty-six species are documented at Banks Lake. Neotropical migrant songbirds have experienced widespread habitat destruction and population declines. Wetland and riparian areas around Banks Lake are very important habitats.
Waterfowl	Twenty-two species were observed in 1998. Average winter count of 4,900 ducks, geese, and swans, ranging from a high of 20,000 birds to none when the reservoir was completely ice-covered. Southeast shoreline provides habitat for several thousand mallards and northern pintails, as well as several hundred Canada geese during fall migration. Most breeding occurs below Dry Falls Dam, in the Devil's Punch Bowl, and in Osborn Bay. More scattered use occurs in smaller bays and inlets in the main lake and adjacent wetlands (Reclamation 2004). Based on recent surveys (WDFW 2010) Banks Lake also appears to be important to a number of wintering diving ducks including redheads, canvasbacks, and scaup.

Species Group	Documented species and notes
Colonial nesting birds	Five species have been documented in the three islands in the south end of Banks Lake: great blue heron, black-crowned night heron, California gull, ring-billed gull, and Caspian tern. Western grebes have been observed nesting in Osborn Bay and Devil's Punch Bowl and in smaller numbers elsewhere in cattails and bulrushes in the littoral zone. American white pelicans are documented using the south end of Banks Lake during spring and fall migrations (Reclamation 2004).
Mammals	Forty-seven species have been documented or potentially occur at Banks Lake. Mule deer, coyote, Nuttall's cottontail, and porcupine are common.
Amphibians and reptiles	Eleven species have been documented at Banks Lake. The racer was the most common species followed by the western rattlesnake. The long-toed salamander may potentially have larvae in the water during the August drawdown period. Great Basin spadefoot, western toad, and Pacific tree frogs occupy a wide variety of habitats in eastern Washington and may potentially occur in Banks Lake. Bull frogs are present. This exotic species has adversely affected native amphibians and may have adversely affected natives at Banks Lake as well.

Reclamation (2004) noted nesting colonies of western grebes (*Aechmophorous occidentalis*) at Osborn Bay and Devil's Punch Bowl, as well as a few at other sites. Western and Clark's grebes (*A. clarkia*) nests consist of a mat of floating vegetation anchored to surrounding cattails and bulrushes along the edge of Banks Lake. Breeding colonies or concentrations of western grebes are listed as Priority Species by WDFW. WDFW surveyed Banks Lake for western and Clark's grebes during the 2009 breeding season while the birds were gathered at colonial nesting sites (WDFW 2009 Habitat). They surveyed sheltered inlets with tall emergent vegetation such as cattails and bulrushes including Osborne Bay, Jones Bay, and Devil's Punch Bowl. Table 3-18 and Table 3-19 present the results of the WDFW surveys for adult and nesting grebes at Banks Lake. WDFW reported that grebe nesting activity was just beginning at the time of the first nest survey on June 22, 2009.

Table 3-18. WDFW adult grebe survey results for Banks Lake.

Location	Western Grebe	Clark's Grebe	Species Undetermined
Osborne Bay	23	1	-
Osborne Bay – Area A/B	29	2	-
Osborne Bay – Area C	~100	-	-
Jones Bay	26	-	-
Devil's Punch Bowl	11	-	-
Osborne Bay	60	-	-
Osborne Bay/Jones Bay	74	1	3
Source: WDFW 2009 Habitat			

Table 3-19. WDFW grebe nest observations at Banks Lake.

Date	Location	Western Grebe	Clark's Grebe	Species Undetermined
June 22	Osborne Bay – Area A	-	-	4
June 23	Osborne Bay – Area B	1	-	-
July 9	Osborne Bay – Area B	-	-	1
July 9	Osborne Bay – Area C	37	1	15
July 31	Osborne Bay – Area C	21	-	10
Source: WDFW 2009 Habitat				

3.9.2.2 Black Rock Coulee Reregulating Reservoir Wetland

A wetland located within the footprint of the proposed Black Rock Coulee Reregulating Reservoir includes about 3.6 acres of PFO, 21.7 acres of PEM, and 15 acres of open water pond. Species detected during WDFW rare species surveys in this area are noted in Table 3-20. No other wildlife surveys were conducted, but the following incidental observations were made during wetland surveys:

- Virginia rail, marsh wren, and sora were seen or heard in dense emergent wetland vegetation.
- Yellow warblers and white-crowned sparrows were observed in riparian shrubs and a pair of great horned owls was nesting in a grove of aspen trees.
- Killdeer, great blue heron, great egret, black-necked stilts, American avocets, and Wilson's phalarope were seen foraging in shallow water.
- About 200 to 250 ducks were foraging or loafing on the pond. Most were mallards and teal, but a few buffleheads were also observed.

HSI values for the emergent wetland obligate species at the site of the Black Rock Coulee Reregulating Reservoir were 0.66 for the Columbia spotted frog, 0.32 for the mallard, 0.32 for the muskrat, and 0.1 for the red-winged blackbird. These indicate low to moderate habitat values for these species at this site.

HSI values for obligate species evaluated in scrub shrub/riparian habitats at Black Rock Coulee Reregulating Reservoir were 0.75 for the song sparrow and 0.66 for the yellow warbler, indicating good to very good habitat for these species.

3.9.2.3 Shrub-steppe Habitats

Many of the facilities, especially those included in Alternatives 3A and 3B in the northern half of the analysis area would be constructed through native shrub-steppe habitats. Plant species composition varies among the several specific shrub-steppe communities that occur in these areas. However, the importance of these shrub-steppe communities to wildlife is relatively consistent and high.

Shrub-steppe communities were historically the dominant upland vegetation type in eastern Washington. Current shrub-steppe conditions in the Columbia River Basin are greatly altered from those that existed prior to European-American settlement (Reclamation 2008 Appraisal). Estimates of the amount of native shrub-steppe that has been lost from within the four counties overlapped by the Odessa analysis area range from 62 to 76 percent (Reclamation 2008 Appraisal). In the Study Area, intact shrub-steppe communities are primarily located along the proposed routes of the northern segment of the East High Canal and in proposed reservoir inundation areas at Black Rock Coulee. Smaller, more widely scattered patches of shrub-steppe occur in the vicinity of the East Low Canal expansion and extension.

Upland areas of native vegetation within the analysis area are primarily shrub-steppe dominated by big sagebrush and Sandberg's bluegrass (Section 3.8 – *Vegetation and Wetlands*). An assessment of the relative quality of native shrub-steppe communities was conducted concurrent with the rare plant surveys. Higher native species richness and lower cheatgrass cover were considered indicators of more natural and less disturbed conditions, and higher quality wildlife habitat because they reflect lower levels of change from presettlement conditions. The WDFW PHS description of shrub-steppe habitat quality indicators is based on the degree to which a tract resembles a potential natural community as indicated by factors such as soil condition and degree of erosion, and by distribution, coverage, and vigor of native shrubs, forbs, grasses, and cryptogams (biotic crusts). Three primary shrub-steppe vegetation types are present within the analysis area. Fifty-five percent of the shrub-steppe habitats were rated as high quality and another 19 percent were rated as good quality based on this index of diversity and cheatgrass occurrence. Results are presented in Section 3.8 – *Vegetation and Wetlands*.

Species of wildlife that depend on sagebrush habitats during the breeding season or year-round are called sagebrush obligate species. More stable populations of these obligate species tend to occur where there are larger stands of relatively undisturbed shrub-steppe. Smaller isolated patches of habitat support fewer of these species, typically in lower densities, if at all. Many of these species are particularly sensitive to changes and fragmentation of sagebrush ecosystems. The status of rare species that are known to or may occur in the analysis area is discussed later in Section 3.9.3 – *Special Status Wildlife Species*.

Sagebrush obligates that likely occur in parts of the analysis area include species such as black-tailed jackrabbit (*Lepus californicus*), sagebrush lizard (*Sceloporus graciosus*), sage sparrow (*Amphispiza belli*), Brewer's sparrow (*Spizella breweri*), grasshopper sparrow (*Ammodramus savannarum*), and sage thrasher (*Oreoscoptes montanus*). Sharp-tail grouse (*Tympanuchus phasianellus*) and sage-grouse (*Centrocercus urophasianus*) may possibly occur. The pygmy rabbit (*Brachylagus idahoensis*) is a sagebrush obligate species that appears to no longer occur in the analysis area (WDFW 2003). HSI values for the Brewer's sparrow in shrub-steppe habitats ranged from 0.55 to 0.93 along the route of the East High Canal and from 0.56 to 0.84 along the route of the East Low Canal. HSI values were 0.88 at the site of the Black Rock Coulee Reregulating Reservoir, which indicates good-to-high-quality shrub-steppe habitat for the Brewer's sparrow, a sagebrush obligate species.

A wide variety of habitat generalists also occupy shrub-steppe habitats within the Odessa analysis area, including short-eared owls (*Asio flammeus*), burrowing owl (*Athene cunicularia*), long-billed curlew (*Numenius americanus*), ferruginous hawk (*Buteo regalis*), golden eagle (*Aquila chrysaetos*), prairie falcon (*Falco mexicanus*), loggerhead shrike (*Lanius ludovicianus*), Townsends ground squirrel (*Citellus townsendi*), Merriam's shrew (*Sorex merriami*), pallid bat (*Antrozous pallidus*) and small-footed myotis (*Myotis subulatus*). Other species that likely occur in the shrub-steppe habitats of the analysis area include the coyote (*Canus latrans*), badger (*Taxidea taxus*), western kingbird (*Tyrannus verticalis*), western meadowlark (*Sturnella neglecta*), mourning dove (*Zenaida macroura*), western rattlesnake (*Crotalus virdis*), and Great Basin spadefoot toad (*Spea intermontana*). Mule deer (*Odocoileus hemionus*) are common inhabitants of shrub-steppe that also use adjacent agricultural lands.

WDFW is studying mule deer use of the analysis area to identify patterns of habitat use and movement corridors near the East Low Canal so that the best locations for canal crossing structures can be identified. WDFW (2009 Habitat) reported these findings:

> Mule deer are an important recreational and economic resource in Washington State. The number of deer located in the Columbia River Basin varies with season. Although white-tailed deer (*O. virginianus*) also occur in this region, they do so at extremely low densities. From late-spring to early-fall mule deer are found in small numbers widely distributed across the landscape. In late fall (October/ November), however, deer begin to migrate from other regions and

become highly abundant in localized areas that provide cover and food (primarily winter wheat). Areas that meet these requirements are usually found along shrub-steppe and agricultural interfaces. For example, 1,500 to 2,000 mule deer are known to winter in areas adjacent to Billy Clapp Lake. Densities remain high throughout winter months until spring "green-up" when deer begin migrating back to their summer ranges.

3.9.2.4 Cliffs and Rock Outcrops

Nonvegetated geologic formations such as cliffs, rock outcrops, and talus slopes also provide important habitat (Reclamation 2008 Appraisal). The WDFW (2008) defines talus habitat as "homogenous areas of rock rubble ranging in average size 0.15 to 2.0 m (0.5 to 6.5 feet), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings; may be associated with cliffs." Several rare and protected species such as ferruginous hawks, peregrine falcons (*Falco peregrinus*), and golden eagles (*Aquila chrysaetos*) nest on cliffs and rock faces (Reclamation 2008 Appraisal). Rock outcrops and talus slopes are important to all of the snake species and about half of the lizard species of the Columbia River Basin (Reclamation 2008 Appraisal). Rocky slopes are also the preferred habitat of chukars (*Alectoris chukar*), a popular introduced game bird.

3.9.2.5 Agricultural Lands

Most of the analysis area is actively farmed and some other lands are enrolled in the Conservation Reserve Program. Discussion of farmland can be found in Section 3.13 – *Land Use and Shoreline Resources*. Crops include corn, wheat, barley, potatoes, and hay, with wheat occupying the largest acreage (Reclamation 2008 Appraisal). Game species associated at least partly with croplands or Conservation Reserve Program lands include ring-necked pheasant (*Phasianus colchicus*), mule deer, California quail (*Callipepla californica*), gray partridge (*Perdix perdix*), mourning dove (*Zenaida macroura*), and cottontail (*Sylvilagus floridanus*). The ring-necked pheasant was the only species evaluated on agricultural lands during the HEP study. HSI values ranged from 0.36 to 1.0 along the route of the East High Canal and from 0.33 to 0.63 along the route of the East Low Canal. These values indicate fair to excellent high habitat quality for pheasants.

3.9.3 Special Status Wildlife Species

Past and ongoing widespread loss and degradation of wetland, riparian, and shrub-steppe habitats in the West in general, as well as in eastern Washington, have resulted in significant declines in many wildlife populations. The WDFW PHS list (2009) includes the following:

> A catalog of habitats and species considered to be priorities for conservation and management. Priority species require protective measures for their survival due

> to their population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance. Priority species include State Endangered, Threatened, Sensitive, and Candidate species; animal aggregations (e.g., heron colonies, bat colonies) considered vulnerable; and species of recreational, commercial, or tribal importance that are vulnerable.

Thirty-eight wildlife species that occur in the analysis area, occurred in the recent past, or are likely to occur in the analysis area have special status with the State of Washington under the PHS program or are protected under the ESA (Table 3-20). Information regarding the status, preferred habitat, and documented or potential occurrence of these species in the analysis area was gathered from numerous sources. WDFW, USFWS, and Reclamation developed a detailed list of rare wildlife species that may occur in the Study Area. WDFW (2009 Habitat) conducted surveys for those species of highest priority because of state or federal status, the likelihood of occurrence, and the potential for negative impacts from one or more of the alternatives. WDFW survey results, as well as a general assessment of whether or not suitable habitat is likely present within the Odessa analysis area, are presented in Table 3-20. This information is supplemented with general species location data obtained from a search of the WDFW Priority Species database that contains information on important fish and wildlife species that should be considered in land use decisions and activities.

Table 3-20. Known or potential occurrence of special status wildlife species in the Odessa analysis area.

Species	Federal Status	State Status	WPHS Criterion	Preferred Habitat	Documented or Potential Occurrence in the Study Area	Known or Likely Occurrence by Alternative
Mammals						
Badger *Taxidea taxus*	-	M	-	Grasslands, meadows, sagebrush steppe, farms, and other open areas with friable soil and populations of ground squirrels and other prey.	**Documented.** Surveys by WDFW found this species within East High Canal, East Low Canal, Black Rock Coulee, and Black Rock Coulee portion.	All alternatives
Black-tailed jackrabbit *Lepus californicus*	-	C	1, 3	Mixed grasses, forbs, and shrubs or small trees for food and cover. Prefers open canopies without dense understories.	**Suitable Habitat**. The Study Area is within the core habitat for this species. Surveys conducted by WDFW did not find this species. It has been observed previously in the general vicinity of the Study Area and suitable habitat occurs within East High Canal, Black Rock Coulee, and Black Rock Coulee portion. Expected to occur in suitable habitat.	3A, 3B
Merriam's shrew *Sorex merriami*	-	C	1	Grassland, sagebrush-steppe, and riparian areas within these types.	**Suitable Habitat**. The Study Area is within the core habitat for this species. It has been collected previously in the general vicinity of the Study Area and suitable habitat occurs within East High Canal, Black Rock Coulee, and Black Rock Coulee portions of the Study Area. No formal surveys by WDFW. Expected to occur in suitable habitat.	3A, 3B

Species	Federal Status	State Status	WPHS Criterion	Preferred Habitat	Documented or Potential Occurrence in the Study Area	Known or Likely Occurrence by Alternative
Pygmy rabbit *Brachylagus idahoensis*	E	E	1	Dense sagebrush with relatively deep, loose soil.	**Not Documented**. Surveys conducted by WDFW did not find this species. No known populations exist in the Study Area.	None
Townsend's big-eared bat *Corynorhinus townsendii*	SoC	C	1, 2	Wide range of habitats including juniper pine forest, shrub-steppe grasslands, deciduous forest, and mixed coniferous forest. During winter they use small caves, mine shafts and rocky outcrops.	**Not Documented**. Suitable foraging habitat exists in the Study Area. No formal surveys for this species were conducted by WDFW.	All alternatives
Washington ground squirrel *Spermophilus washingtoni*	C	C	1	Grasslands (bunchgrass) and sagebrush steppe in low clay soils.	**Documented**. Surveys by WDFW found this species at many locations within East High Canal, Black Rock Coulee, and Black Rock Coulee portions of the Study Area. The colony in Black Rock Coulee may be the largest in the State.	3A, 3B
White-tailed jackrabbit *Lepus townsendii*	-	C	1, 3	Bunchgrass grasslands, sagebrush steppe, and other open habitat.	**Not Documented**. The Study Area is within a zone of peripheral habitat for this species. A few historical accounts document presence near the Study Area. Surveys conducted by WDFW did not find this species. Habitat in the Study Area is marginal.	Likely none

Species	Federal Status	State Status	WPHS Criterion	Preferred Habitat	Documented or Potential Occurrence in the Study Area	Known or Likely Occurrence by Alternative
Birds						
American white pelican *Pelecanus erythrorhynchos*	-	E	1, 2	Colonial nesters that typically breed on isolated islands in freshwater lakes and occasionally on isolated islands in rivers. Require shallow water for foraging.	**Documented.** Surveys for this species conducted by WDFW found this species in the East High Canal Study Area. Banks Lake may provide migration and foraging habitat. The Study Area does not appear to have suitable breeding habitat for this species.	All (Banks Lake)
Bald eagle *Haliaeetus leucocephalus*	SoC	S	1	Late-successional forests, shorelines adjacent to open water in areas with a large prey base for successful brood rearing, and large, mature trees for nesting, roosting, and wintering.	**Documented**. Formal surveys conducted by WDFW found this species along the East High Canal Study Area. They regularly use large trees around Banks Lake. Eight different nest sites at Banks Lake in 2005, 2006, and 2009, with five of these in 2005.	All (Banks Lake)
Black-crowned night heron *Nycticorax nycticorax*	-	-	2	Typically found in relatively large wetlands, including swamps, riverine wetlands, marshes, mud flats and lake shores vegetated with rushes and cattails.	**Documented.** Surveys for this species were conducted by WDFW. This species was observed within the East Low Canal portion of the Study Area. Suitable habitat also exists in wetland areas associated with Black Rock Coulee and Banks Lake.	All (Banks Lake)
Black-necked stilt *Himantopus mexicanus*	-	M	2	Pond/lake margins and wetlands in the arid sagebrush steppe and bunchgrass areas.	**Documented.** Surveys conducted by WDFW found this species within the East High Canal, Black Rock Coulee, and East Low Canal portions of the Study Area.	All

Species	Federal Status	State Status	WPHS Criterion	Preferred Habitat	Documented or Potential Occurrence in the Study Area	Known or Likely Occurrence by Alternative
Ferruginous hawk *Buteo regalis*	SoC	T	1	Flat and rolling terrain in grassland or shrub-steppe with buttes or elevated areas for nesting.	**Not documented.** Surveys conducted by WDFW did not find this species in the Study Area. Some areas of along the East High Canal have suitable foraging habitat. The WPHS data base indicates several nests along the northern part of the Black Rock Branch of the East High Canal.	3A. 3B
Golden eagle *Aquila chrysaetos*	-	C	1	Open country from barren areas to open coniferous forests. Typically nest on cliff ledges overlooking grasslands that support prey such as jackrabbits or ground squirrels.	**Suitable Habitat.** Surveys conducted by WDFW did not find this species in the Study Area. Portions of the Study Area of along the East High Canal and Black Rock Coulee flood storage have suitable nesting sites. Foraging habitat is available across the Study Area in sagebrush steppe.	3A. 3B
Grasshopper sparrow *Ammodramus savannarum*	-	M	-	Grasslands or open shrub-steppe with a few scattered shrubs for perching.	**Documented.** Surveys conducted by WDFW observed this across all portions of the Study Area.	All
Great blue heron *Ardea herodias*	-	M	2	Colonial nesting in a variety of deciduous and evergreen tree species, typically in areas with low disturbance. Forage in shallow waters.	**Documented.** Surveys conducted by WDFW found this species in the East High Canal, Black Rock Coulee and East Low Canal portions of the Study Area. Suitable foraging habitat also exists in wetlands associated with Banks Lake.	All

Species	Federal Status	State Status	WPHS Criterion	Preferred Habitat	Documented or Potential Occurrence in the Study Area	Known or Likely Occurrence by Alternative
Great egret *Ardea alba*	-	M	-	Freshwater wetlands, forage in open areas of lakes, large marshes, and along large rivers. Nest near water, in trees, shrubs, or thickets.	**Documented.** Surveys conducted by WDFW found this species within the East High Canal portion of the Study Area. They were also incidental observations by CH2M HILL of this species during wetland evaluations of this species wading in the shallows of the existing pond in Black Rock Coulee footprint.	3A, 3B
Greater sage-grouse *Centrocercus urophasianus*	C	T	S1	Sagebrush for brood habitat, nesting cover, and year-round diet. Open areas such as swales, meadows, burns, and areas with low, sparse sagebrush cover are used as leks in spring.	**Suitable Habitat**. Surveys conducted by WDFW did not find this species. Some areas of East High Canal near Black Rock Coulee have suitable habitat.	Possibly 3A. 3B
Lewis woodpecker *Melanerpes lewis*	-	C	1	Open forests with brush understories and snags for nesting, typically forested riversides with large cottonwoods and other hardwoods or the lower edge of Ponderosa pine stands.	**Suitable Habitat**. Surveys were not conducted by WDFW for this species. Suitable habitat for this species is limited to Black Rock Coulee aspen stand and treed areas along Banks Lake.	Low potential for all alternatives (Banks Lake)

Species	Federal Status	State Status	WPHS Criterion	Preferred Habitat	Documented or Potential Occurrence in the Study Area	Known or Likely Occurrence by Alternative
Loggerhead shrike *Lanius ludovicianus*	SoC	C	1	Preferred nesting habitat is sagebrush stands with abundant grass understory and in sagebrush stands mixed with grass openings.	**Documented**. Surveys conducted by WDFW found this species within the Study Area. Shrikes were found in suitable habitat in the East Low Canal, East High Canal, Black Rock Coulee, and Black Rock Coulee portions of the Study Area.	All
Long-billed curlew *Numenius americanus*	-	M	-	Uncultivated rangelands and pastures and other areas with short vegetation and bare ground.	**Documented.** Surveys conducted by WDFW found this species within the East High Canal, East Low Canal, and Black Rock Coulee portions of the Study Area.	All
Merlin *Falco columbarius*	-	C	1	Nests in conifer woodland or wooded prairie or shrub-steppe; often near water. Nests in trees in abandoned crow, magpie, hawk, or squirrel nest; also in natural tree cavity or abandoned woodpecker hole, on bare cliff ledge.	**Not Documented.** Surveys conducted by WDFW did not find this species in the Study Area. Areas with suitable habitat for this species occur in the Study Area, but the Study Area is not within core habitat for this species.	Potentially 3A, 3B
Osprey *Pandion haliaetus*	-	M	-	Wide range of habitats near water, primarily lakes, rivers, and coastal waters with adequate supplies of fish. Typically nests in snags or manmade structures.	**Documented.** Surveys conducted by WDFW found this species within the East High Canal portion of the Study Area.	All (Banks Lake)

Species	Federal Status	State Status	WPHS Criterion	Preferred Habitat	Documented or Potential Occurrence in the Study Area	Known or Likely Occurrence by Alternative
Peregrine falcon *Falco peregrinus*	SoC	S	1	Nests mainly on cliffs, rarely in trees, and usually near water.	**Documented.** Surveys conducted by WDFW found this species along the East High Canal portion of the Study Area. There is also suitable habitat for this species at Black Rock Coulee.	3A. 3B
Prairie falcon *Falco mexicanus*	-	M	-	Open treeless terrain including prairies, deserts, riverine escarpments, canyons, foothills, and mountains in relatively arid western regions. Nests on cliffs and escarpments.	**Documented.** Surveys conducted by WDFW found this species within the East High Canal, East Low Canal, and Black Rock Coulee portions of the Study Area.	All
Sage sparrow *Amphispiza belli*	-	C	1	Sagebrush stands with mature big sagebrush. May prefer sites with sagebrush cover, arranged in patches, with bare ground in between.	**Documented.** Surveys conducted by WDFW found this species within the Study Area. Sage sparrows were found in suitable habitat in the East Low Canal, East High Canal, and Black Rock Coulee portions of the Study Area. There is also suitable habitat in the Black Rock Coulee portion of the Study Area.	All
Sage thrasher *Oreoscoptes montanus*	-	C	1	Sagebrush obligates that nest in large stands of dense sagebrush.	**Documented.** Surveys conducted by WDFW found this species within the East High Canal, Black Rock Coulee, and Black Rock Coulee portions of the Study Area.	3A, 3B

Species	Federal Status	State Status	WPHS Criterion	Preferred Habitat	Documented or Potential Occurrence in the Study Area	Known or Likely Occurrence by Alternative
Sandhill crane *Grus candensis*	-	E	1	Wet meadows, grasslands, and wetlands, often surrounded by trees. Nest in marsh wetlands.	**Documented.** Surveys conducted by WDFW found this species within the East High Canal and East Low Canal portions of the Study Area.	All
Swainson's hawk *Buteo swainsoni*	-	M	-	Semi-open to open areas in tundra, valleys, plains, dry meadows, foothills, and flat uplands at low to middle elevations. Nests in trees.	**Documented.** Surveys conducted by WDFW found this species within the East High Canal, East Low Canal, Black Rock Coulee, and Black Rock Coulee portions of the Study Area.	All
Turkey vulture *Cathartes aura*	-	M	-	Forage over lower elevation forests, grasslands, and sagebrush-steppe habitats. Nests in small caves or ledges on high cliffs.	**Documented.** Surveys conducted by WDFW found this species within the East High Canal and East Low Canal portions of the Study Area.	All
Western burrowing owl *Athene cunicularia hypugea*	SoC	C	1	Breed in open grassland with deep, cohesive loamy soils that have relatively large ground squirrel, coyote or badger holes.	**Documented**. Surveys conducted by WDFW found this species along the East Low Canal portion of the Study Area. The WPHS data base indicates numerous nest sites near the East Low Canal.	2A, 2B, 4A, 4B
Western grebe *Aechmophorus occidentalis*	SoC	C	1,2	Winter on saltwater bays. Breed inland in freshwater wetlands with a mix of open water and emergent vegetation.	**Documented.** Surveys along Banks Lake conducted by WDFW found nesting colonies of this species. Suitable nesting habitat is very limited in the Study Area outside of Banks Lake.	All (Banks Lake)

Species	Federal Status	State Status	WPHS Criterion	Preferred Habitat	Documented or Potential Occurrence in the Study Area	Known or Likely Occurrence by Alternative
Yellow-billed cuckoo *Coccyzus americanus*	C	C	1	Riparian habitat consisting primarily of cottonwood/willow habitats with dense sub-canopies.	**Suitable Habitat.** Not documented in Washington since the 1930s. No formal surveys were conducted by WDFW. Small areas of marginally suitable habitat are present at a few areas along Banks Lake.	Very low potential for all alternatives (Banks Lake)
Amphibians and Reptiles						
Western toad *Bufo boreas*	C	C	1	Breeds in seasonally wet marsh or riparian areas. Peak season: March through July.	**Suitable Habitat**. Limited breeding habitat occurs in seasonally wet riparian areas. Black Rock Coulee and Banks Lake have suitable breeding habitat.	No formal surveys were conducted by WDFW.
Columbia spotted frog *Rana luteiventris*	None	C	1	Marshy edges of ponds; pools with aquatic vegetation or algae.	**Suitable Habitat**. Breeding habitat in the Study Area is limited and is found along the pond margins within the Black Rock Coulee footprint and in vegetated shallows around Banks Lake.	No formal surveys were conducted by WDFW.
Northern leopard frog *Rana pipiens*	SoC	E	1	Breeds in well-vegetated moist meadows, marshes. Adults also use grassy woodlands.	**Suitable Habitat**. Surveys were conducted for this species by WDFW at Black Rock Coulee. None were heard or observed, although survey conditions were marginal. Suitable breeding habitat occurs within the Black Rock Coulee footprint and in vegetated shallows around Banks Lake.	Potentially for 3A, 3B (Black Rock Coulee)

Species	Federal Status	State Status	WPHS Criterion	Preferred Habitat	Documented or Potential Occurrence in the Study Area	Known or Likely Occurrence by Alternative
Striped whipsnake *Masticophis taeniatus*		C	1	Dry habitats, including deserts and dry forests. Typically found in dry valleys and plateaus.	**Suitable Habitat.** Surveys were conducted for this species by WDFW. None were observed. Suitable habitat for this species occurs in the Study Area along the East High Canal, Black Rock Coulee, and Black Rock Coulee portions of the Study Area.	3A, 3B
Pygmy short-horned lizard *Phrynosoma douglasii*	-	M	-	Shrub-steppe typically on dry soils suitable for burrowing, but also regularly found on lithosols, basalt outcrops and loam soils.	**Documented.** Surveys conducted for this species by WDFW found them in the Study Area along the East High Canal, and Black Rock Coulee portions of the Study Area segments.	All
Sagebrush lizard *Sceloporus graciosus*	SoC	C	1	Light or sandy soils with extensive sagebrush.	**Suitable Habitat**. Surveys were conducted for this species by WDFW. None were observed. The Study Area crosses core Washington habitat for this species. Suitable habitat occurs along the East High Canal and Black Rock Coulee segments and marginal habitat occurs along the Black Rock Coulee portions of the Study Area segments of the Study Area.	All

Federal Status: under the ESA as published in the *Federal Register*:

E = Listed Endangered. In danger of extinction.

T = Listed Threatened. Likely to become endangered.

C = Candidate species. Sufficient information exists to support listing as Endangered or Threatened.

SoC = Species of Concern. An unofficial status, the species appears to be in jeopardy, but insufficient information to support listing.

MBTA = Migratory Bird Treaty Act.

Species	Federal Status	State Status	WPHS Criterion	Preferred Habitat	Documented or Potential Occurrence in the Study Area	Known or Likely Occurrence by Alternative

State Status: is determined by the Washington Natural Heritage Program, Washington State Department of Fish and Wildlife, and National Marine Fisheries Service. Factors considered include abundance, occurrence patterns, vulnerability, threats, existing protection, and taxonomic distinctness. Values include:

E = Endangered. In danger of becoming extinct or extirpated from Washington.

T = Threatened. Likely to become Endangered in Washington.

S = Sensitive. Vulnerable or declining and could become Endangered or Threatened in the state.

R1 = Review group 1. Of potential concern but needs more field work to assign another rank.

R2 = Review group 2. Of potential concern but with unresolved taxonomic questions.

M = Monitor

Washington Priority Habitats and Species Criterion for Animals

Criterion 1. State-Listed and Candidate Species: State-listed species are native fish and wildlife species legally designated as Endangered (WAC 232-12-014), Threatened (WAC 232-12-011), or Sensitive (WAC 232-12-011). State Candidate species are fish and wildlife species that will be reviewed by the department (WDFW) (POL-M-6001) for possible listing as Endangered, Threatened, or Sensitive according to the process and criteria defined in WAC- 232-12-297.

Criterion 2. Vulnerable Aggregations: Vulnerable aggregations include species or groups of animals susceptible to significant population declines, within a specific area or statewide, by virtue of their inclination to aggregate. Examples include heron rookeries, seabird concentrations, marine mammal haulouts, shellfish beds, and fish spawning and rearing areas.

WPS = Washington Priority Species

Most bird species are federally protected under the Migratory Bird Treaty Act

Sources: WDFW 2009 PHS, WDFW Priority Habitats and Species data base, University of Washington. 2009. Nature Mapping Program: Wildlife Distribution Maps for the State of Washington. http://naturemappingfoundation.org/natmap/maps/wa/; WDFW. 2008. *Priority Habitats and Species List*. State of Washington. 174 p.; and WDFW. 2008. Odessa Subarea Special Study Wildlife Surveys Statement of Work.

3.9.4 Washington Priority Habitats

WDFW publishes the PHS list and a Species of Concern list (WDFW 2009 PHS). The publication was updated on August 1, 2008 (WDFW 2008). WDFW defines Priority Habitats as follows:

> A priority habitat may be described by a unique vegetation type or by a dominant plant species that is of primary importance to fish and wildlife (e.g., oak woodlands, eelgrass meadows). A priority habitat may also be described by a successional stage (e.g., old growth and mature forests). Alternatively, a priority habitat may consist of a specific habitat element (e.g., consolidated marine/ estuarine shorelines, talus slopes, caves, snags) of key value to fish and wildlife.

WDFW Priority Habitat has unique or significant value to many species. An area identified and mapped as Priority Habitat has one or more of 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.
- Unique or dependent species.

Six Washington Priority Habitats occur within and adjacent to the analysis area. These include freshwater wetlands, aspen/riparian areas, and instream habitats, prairie/steppe habitat, shrub-steppe habitat, and talus/cliffs. Detailed information about these vegetation types is included in Section 3.8 – *Vegetation and Wetlands*. The habitats are described in Table 3-21.

Table 3-21. Washington priority habitats within and adjacent to the analysis area.

Habitat Type	Location in the Analysis Area
Freshwater Wetlands	Freshwater wetlands occur at Banks Lake, the site of the proposed Black Rock Coulee Reregulating Reservoir, and at scattered locations along the East High Canal and East Low Canal. Along Crab Creek, pothole and emergent wetlands fed by groundwater seeps are present along the stream corridor. Much of the Crab Creek drainage is designated by WDFW as the North Columbia Basin Wildlife Area (Gloyd Seeps Unit).
Aspen Groves and Riparian Areas	Riparian areas within the analysis area occur at Banks Lake, the site of the proposed Black Rock Coulee Reregulating Reservoir, and a few other locations. An aspen grove is located at the east end of the pond in the area that would be flooded by the Black Rock Coulee Reregulating Reservoir.
Instream	Relatively small instream habitats are associated with a few of the coulees that have temporary or intermittent flows. Most streams in the Study Area are temporary, but the portion of Crab Creek that flows through the Study Area is ephemeral and is augmented with irrigation return flows below Stratford. Ephemeral drainages in Lind Coulee have been transformed into perennial streams as a result of development of the irrigation system network. A number of springs and seeps are evident within the analysis area. A wetland system and freshwater pond are within the Black Rock Coulee Reregulating Reservoir inundation area. These features originate from a seep that flows southwest within a wide vegetated wetland channel to the open water pond. Spring and seep areas are dispersed throughout the Banks Lake area.
Prairie-steppe	Prairie-steppe describes relatively undisturbed areas (as indicated by the dominance of native plants) where grasses or forbs form the natural climax plant community. The bluebunch wheatgrass—Sandberg's bluegrass, needle-and-thread grass—Sandberg's bluegrass, and basin wildrye communities are prairie-steppe types. They occur along parts of the proposed East High Canal and Black Rock Coulee.
Shrub-steppe	WDFW criteria for defining shrub-steppe areas as a Priority Habitat include comparatively high fish and wildlife density and species diversity, important fish and wildlife breeding habitat and seasonal ranges, limited availability, high vulnerability to habitat alteration, and unique and dependent species. Much of the undeveloped lands within the analysis area are native shrub-steppe, especially in the northern part of the area.
Talus and Cliffs	Nonvegetated geologic formations such as cliffs, rock outcrops, and talus slopes are another Washington Priority Habitat in the analysis area. Talus and cliffs are most commonly associated with the many coulees in the analysis area.

3.9.5 Wildlife Movements

Undeveloped parts of the analysis area currently allow for unimpeded movements by wildlife at several scales. The loss of movement corridors or connectivity among patches of native habitat would further isolate and fragment plant and wildlife species' populations, as well as substantially decrease or eliminate suitable habitats.

Two general types of regular, moderate- to long-distance wildlife movements are common in most species. One type includes seasonal migrations between breeding and nonbreeding ranges such as mule deer moving between summer and winter ranges. These movements may follow regularly used corridors. The primary ecological function of movement corridors is to connect two or more areas of habitat and allow unimpeded movement among and between these areas. Seasonal migrations are important to both the short- and long-term survival of individuals and populations and allow animals to use resources that vary seasonally (such as nutritious forage) or are seasonally limiting (such as deep winter snow).

The second regular type of wildlife movement is called dispersal. It involves individuals leaving the place where they are resident and looking for a new place to live (Hilty et al. 2006). Young animals or those of a particular sex make up most dispersers, and these individuals may move both within and among habitat patches. Dispersal is critical to long-term survival of populations because it allows increased gene flow between and among subpopulations, and higher levels of genetic variability improve long-term survival. Dispersal also may allow recolonization of sites that were formerly occupied by the species.

3.10 Fisheries and Aquatic Resources

Aquatic resources may be affected in the bodies of water that form the basis for water supply, such as Banks Lake and Lake Roosevelt. Additionally, the action alternatives would result in a small reduction of discharge in the Columbia River on an annual basis and could slightly alter the seasonal flow regime as well. Such flow changes could potentially affect juvenile anadromous salmonids migrating downstream in the spring and summer months as well as adult fall Chinook salmon (*Oncorhynchus tshawytscha*), which spawn in the upper Columbia River—mostly in the free-flowing Hanford Reach.

3.10.1 Analysis Area and Methods

The analysis area for fisheries and aquatic resources includes all potentially affected water bodies, extending to the ordinary high water mark. Therefore, the analysis area related to fisheries and aquatic resources includes the Columbia River anadromous fish zone from Chief Joseph Dam downstream to just below Bonneville Dam to include chum salmon spawning areas. This reach contains nine mainstem hydroelectric dams and associated reservoirs. The Columbia River analysis area does not include the lower river and estuary because the effects of the alternatives on water flow and depth would not be discernable at this point.

The analysis area also includes the complex of water bodies that would be used for water supply and conveyance with the various action alternatives:

- Banks Lake
- Billy Clapp Lake
- Proposed Black Rock Reregulating Reservoir
- Upper Crab Creek

The existing condition of fisheries and aquatic resources in the analysis area was evaluated based on existing studies and reports, topographic maps, aerial photos, available aquatic resource data, and field surveys.

3.10.1.1 Columbia River

Background

Development and operation of numerous dams in the Columbia River Basin for flood control, hydropower, and irrigation have caused changes in seasonal flow patterns, with spring and early summer flows being lower and winter flows higher than historical flows. These lower flows during spring and early summer, in conjunction with the slower water movement created by mainstem reservoirs, have reduced instream water velocities and slowed the migration rate of juvenile salmonids (smolts) as they migrate seaward, especially in dry years. Since 1983, initially as part of the Northwest Power Planning Council's Fish and Wildlife Program, flow augmentation during spring and early summer has become a key management strategy to increase smolt migration rates and survival in the system. Additional emphasis on flow augmentation has been a dominant feature of the BiOps since the early 1990s that were prepared by NMFS following the ESA listing of several salmonid populations in the basin. Primary among these documents is the NOAA Fisheries 2010 FCRPS Supplemental BiOp (NMFS 2010), which constrains storage project operations. These actions are listed in Chapter 1, Table 1-2, *Measures and constraints on the Odessa Subarea Special Study imposed by the 2008/2010 NMFS FCRPS BiOp and 2008 Fish Accords*.

Considerable research has indicated that the benefit of flow augmentation for improving smolt survival is most evident in dry years. Consequently, NMFS established water management objectives (which include seasonal planning level flow objectives) to aid in the conservation of these anadromous salmonid populations (Table 3-22). The action alternatives were developed with the assumption that the FCRPS water management objectives would not be compromised. For the purpose of this study, the FCRPS seasonal planning flow objectives and dates were used in the modeling exercises.

Table 3-22. Seasonal planning flow objectives and dates for the mainstem Columbia River.

Location	Dates	Objective (kcfs)	Dates	Objective (kcfs)
McNary Dam	4/10 to 6/30	220 to 260 [a]	7/01 to 8/31	200
Priest Rapids Dam	4/10 to 6/30	135	N/A	N/A

[a] objective varies according to water volume forecast
kcfs = thousand cubic feet per second

The Federal agencies (Reclamation, BPA, and the Corps) operate the FCRPS consistent with the NOAA Fisheries 2010 FCRPS Supplemental BiOp (NMFS 2010), including Reasonable and Prudent Alternative, Action 4. It is recognized that the flow objectives are intended for planning and in-season management purposes and that they cannot be fully achieved in some years (especially dry) because of low runoff and limited availability of stored water. The general life history of the anadromous salmonids that may be affected by the alternatives is described in the following sections. Emphasis is given to those populations originating in the upper Columbia River (upstream of the Snake River confluence to Chief Joseph Dam) because they potentially would be most affected by the Study. Additional life history detail for the ESA-listed populations, including their current population status and critical habitat, is presented in Section 3.11 – *Threatened and Endangered Species*. In addition, a Biological Assessment will be prepared if an action alternative is selected.

Anadromous Salmonids

Anadromous fish species that may be affected by the alternatives are listed in Table 3-23, along with their status under ESA.

Table 3-23. ESA status of salmon and steelhead stocks in the Columbia and Snake rivers.

Area of Origin	Species/Stock	ESA Status
Upper Columbia	Chinook Salmon *(Oncorhynchus tshawytscha)* – Spring Run	Endangered
	Chinook Salmon – Summer/Fall Run	Not Warranted
	Steelhead Trout *(Oncorhynchus mykiss)*	Threatened
	Sockeye Salmon *(Oncorhynchus nerka)*	Not Warranted
Snake River	Sockeye Salmon	Endangered
	Chinook Salmon – Spring/Summer Run	Threatened
	Chinook Salmon – Fall Run	Threatened
	Steelhead Trout	Threatened
Middle Columbia	Chinook Salmon – Spring Run	Not Warranted
	Steelhead Trout	Threatened

Area of Origin	Species/Stock	ESA Status
Lower Columbia	Chinook Salmon	Threatened
	Coho Salmon *(Oncorhynchus kisutch)*	Threatened
	Steelhead Trout	Threatened
	Chum Salmon *(Oncorhynchus keta)*	Threatened
Upper Willamette	Chinook salmon	Threatened
	Steelhead Trout	Threatened
Source: NMFS 2009		

Steelhead Trout

Steelhead trout exhibits a diverse and complex life history throughout its range (Busby et al. 1996). Adult anadromous steelhead trout enter the Columbia River between May and October and typically spawn the following spring between March and June. Eggs incubate in the gravel for 4 to 7 weeks, and fry emerge from the gravel between June and August. Most spawning occurs in tributaries where the juveniles rear for up to 7 years before they become smolts and migrate to the ocean. However, in the upper Columbia River, most juveniles reach the smolt stage by age 2 or 3. Steelhead smolts migrate seaward in the spring. Most passage at Columbia River dams occurs between late April and early June. Steelhead trout typically spend 1 to 2 years in the ocean before returning to freshwater to spawn.

The Upper Columbia River steelhead population is listed as a threatened species under the ESA. Natural production occurs in the Okanogan, Methow, Entiat, and Wenatchee River basins. Little or no spawning occurs in the mainstem Columbia River. Most adult returns are of hatchery origin.

Other steelhead populations in the Columbia River Basin that may be affected by the alternatives because of their downstream migrations include those from the Snake River Basin, middle Columbia tributaries (Yakima, Walla Walla, Umatilla, John Day, Klickitat, and Deschutes rivers, and other smaller east slope Cascade tributaries), and lower Columbia River tributaries. These populations are grouped into three Distinct Population Segments (DPS) for ESA purposes, and all three are listed as threatened species under the ESA.

Chinook Salmon

Chinook salmon exhibit the most variability and variety in their life history characteristics compared to other anadromous salmonids in the Columbia River Basin. There are many different seasonal “runs” or modes in adult Chinook salmon migration from the ocean to freshwater. Typically, spring Chinook salmon spawn higher in the watersheds where they can gain access during the high snowmelt period. Fall Chinook salmon generally spawn lowest in the watersheds.

In the upper Columbia River Basin, spring Chinook salmon typically spawn in August and September, summer Chinook salmon in September and October, and fall Chinook salmon in October and November. All spring Chinook salmon spawn in upper tributaries of the Columbia River, most summer Chinook salmon spawn in the mainstem Wenatchee, Methow and Okanogan rivers, and fall Chinook salmon spawn primarily in the mainstem Columbia River. Most fall Chinook salmon spawn in the free-flowing Hanford Reach of the Columbia River downstream of Priest Rapids Dam.

Upper Columbia River spring Chinook salmon are listed as endangered under ESA. Upper Columbia summer and fall Chinook salmon populations are grouped together as an evolutionarily significant unit (ESU) as defined by the ESA; however, they are not ESA-listed and both populations are considered healthy. All three populations are supplemented with hatchery production.

Timing of the smolt outmigration by Chinook salmon populations from the Columbia River basins is an important consideration in assessing potential effects of the proposed alternatives. Spring Chinook smolts migrate through the upper Columbia between mid-April and mid-June, with approximately 90 percent passing Rock Island Dam before June 1. Juvenile summer and fall Chinook salmon have a more protracted and directed downstream migration that alternates between stationary feeding and offshore downstream movement. Their downstream movement extends from late May into August. Approximately 90 percent of the sub-yearling Chinook smolts pass Bonneville Dam and enter the estuary by the end of July (Geist et al. 2006). While the timing of the Columbia River Chinook salmon smolt outmigration is an important consideration in supplying water to the Study Area, it is the Snake River threatened and endangered stocks (Table 3-23) that precludes withdrawing any water from the Columbia River in July and August. These special status stocks therefore have a bigger impact on seasonal water supply considerations than any other stock.

The fall Chinook salmon population that spawn in the Hanford Reach is considered the healthiest inland stock of Chinook salmon in the Pacific Northwest (Huntington et al. 1996). From 1964 to 1983, the average annual spawning escapement to the Hanford Reach was approximately 25,000 fish. Since then, the spawning run has averaged approximately 50,000 fish (Geist et al. 2006). This increase is most likely related to reduced harvest rates and implementation of mitigation and protection measures outlined in the Vernita Bar Settlement Agreement. This agreement provides for stable river flows during spawning and ensures that subsequent minimum river flows keep a high percentage of the spawning redds covered with water through fry emergence in the spring. These protective flow measures require close coordination among the FCRPS agencies and the three mid-Columbia Public Utility Districts (PUDs). The Vernita Bar Settlement Agreement, which was originally signed in 1988, was renegotiated and a newer agreement (officially called the Hanford Reach Fall Chinook Protection Program) was executed effective April 5, 2004 (Grant County PUD 2004). The new agreement stipulates certain Columbia River flow targets during the spawning and egg incubation period and limits flow fluctuations during the post-emergent fry period.

Sockeye Salmon

Nearly all sockeye salmon in the Columbia River Basin originate in the upper Columbia River from either Lake Wenatchee or Lake Osoyoos in the Okanogan system. A much smaller number of sockeye salmon originate in the Stanley Basin in Idaho. That Snake River population was listed as an endangered species under the ESA in 1991. The upper Columbia populations are considered healthy, with average run sizes of approximately 60,000 adults. Minor hatchery supplementation occurs in both upper Columbia populations, and a major supplementation program (relative to the population size) continues for the Snake River sockeye.

Sockeye salmon adults return to the Columbia River during summer and peak spawning occurs in mid-September and mid-October. Sockeye fry emerge from the gravel in late March and April and quickly move into the lake environment, where they spend the next 1 or 2 years feeding on zooplankton. Juvenile sockeye migrate downstream in the spring, primarily as yearlings with the bulk of the outmigration occurring from mid-April through late May.

Coho Salmon

Columbia Basin coho salmon are primarily confined to tributaries of the lower river downstream of Bonneville Dam and some tributaries in the mid-Columbia River. Coho salmon reintroduction efforts through hatchery planting have been attempted in the upper Columbia River using lower river and coastal stocks. Reintroduction efforts were substantial in the 1960s and 1970s, were all but eliminated in the 1980s and 1990s, and have begun again in recent years, focusing on the Wenatchee and Methow River basins (Kamphaus et al. 2009).

Coho salmon adults enter freshwater in the fall and early winter and spawn primarily in small tributaries. Fry emerge from the gravel in the spring, then rear in the stream for 1 year before migrating downstream the following spring. The peak downstream migration at Rock Island Dam is mid-May. Nearly all adult coho salmon are 3 year olds.

Chum Salmon

Chum salmon are found in the Columbia River downstream of Bonneville Dam and in nearby tributary streams. Spawning occurs primarily in November and extending into December. Fry emerge primarily in February and March and quickly move downstream into estuarine and marine waters. Adults return primarily as 3- and 4-year olds. The population in the lower Columbia River is very small and is an ESA-listed threatened species.

Initially, a chum salmon flow objective of approximately 125,000 to 160,000 cfs (depending on forecasted water supply) at Bonneville Dam from the start of spawning in November through fry emergence in March was used by the FCRPS agencies to help protect and recover this chum salmon population. Shortly after the initiation of operations for chum protection, the FCRPS action agencies changed to the tailwater elevation operations that are reflected in the 2010 BiOp Reasonable and Prudent Alternative, Action 17 for chum salmon protection (NMFS 2010). This action identifies a Bonneville Dam tailwater elevation target during daytime that takes into account river flow, tidal influence, and backwater effects from the Willamette River discharge. The target elevation of approximately 11.5 feet is maintained during the chum salmon spawning period (generally November and December). This tailwater elevation target can be adjusted based on the size of the spawning population and water supply forecasts. After completion of spawning, tailwater elevations are maintained to protect spawning redds through the period of egg incubation and fry emergence, which can extend into early April. Basically, these measures are intended to encourage chum salmon to spawn at an elevation that can remain wetted during subsequent egg incubation and fry emergence.

Other Species

Pacific Lamprey (*Lampetra tridentata*)

Pacific lamprey is an anadromous fish species distributed in areas of the Columbia River Basin with upstream passage. Lamprey migrate upriver in late summer and overwinter in areas where they will spawn. Spawning occurs over sandy or gravel substrate the following June and July (Close et al. 1995). The eggs incubate for 2 to 4 weeks. Larval lamprey (called ammocoetes) emerge from the substrate, drift downstream, and eventually burrow into silt or sand in quiet backwaters where they feed on algae and detritus for the next 4 to 6 years. The young eventually migrate seaward during the spring and early summer. In the ocean, they begin a parasitic feeding behavior after attaching onto other fish.

Available data suggest that the numbers of Pacific lamprey have declined substantially over the last several decades throughout its range, including the Columbia River Basin (Close et al. 1995). This species was petitioned for ESA listing in 2003. In December 2004, the USFWS determined that there was not substantial scientific or commercial information that would warrant listing Pacific lamprey under the ESA. They are, however, considered by the USFWS as a species of concern. The USFWS also developed a Coastwide Pacific Lamprey Conservation Initiative that focuses on conserving and restoring lamprey populations.

White Sturgeon (*Acipenser transmontanus*)

White sturgeon inhabit most of the Columbia River and its larger tributaries, most notably the Snake River. White sturgeon can have an anadromous life history, but most populations now found in the Columbia River upstream of Bonneville Dam have adapted to a freshwater life history, primarily because of their restricted ability to use conventional fishways designed for salmonids. White sturgeon spawn in the spring and early summer, with largest concentrations in the tailwaters of mainstem dams. The Hanford Reach downstream of Priest Rapids Dam also contains important sturgeon spawning habitat.

Columbia River white sturgeon are abundant in some mainstem reservoirs, but not others. They are also found in the Kootenai River and in the Columbia River above Grand Coulee. Construction of dams and reservoirs between 1938 and 1968 on the Columbia River has fragmented the population into a number of smaller populations. The population dynamics and factors regulating white sturgeon production within these reservoirs are poorly understood.

Green Sturgeon (*Acipenser medirostris*)

The southern DPS of green sturgeon was listed as threatened under ESA on April 7, 2006. The only known spawning for this population is in the Sacramento River (Adams et al. 2002). Juveniles and immature adults are known to range in near-shore marine waters from Mexico through Canadian British Columbia. Aggregations of adult green sturgeon occur in the Columbia River estuary and occasionally in the lower river up to Bonneville Dam primarily in the summer months (NMFS 2010). There is no evidence of their spawning in the lower Columbia River. Since their ESA listing, retention of green sturgeon in the lower Columbia River sport and commercial fisheries has been disallowed. Green sturgeon are benthic feeders and do not rely on salmonids for prey. ESA critical habitat was designated for green sturgeon on October 9, 2009. The area includes the Columbia River estuary and the lower river up to Bonneville Dam.

Eulachon (*Thaleichthys pacificus*)

Eulachon, commonly called Pacific smelt or candlefish, are a small anadromous fish from the eastern Pacific that ranges from northern California to the Bering Sea in Alaska. They typically spend 3 to 5 years in saltwater before returning to freshwater to spawn from late winter through mid-spring. On March 18, 2010, NMFS listed the Southern DPS (Mad River, California to Nass River, British Columbia) as a threatened species under the ESA 75 FR 13012). The listing determination identified changes in ocean conditions resulting from climate change as the most significant threat to eulachon and their habitats, and climate-induced change to freshwater habitats as a moderate threat.

Large spawning runs of eulachon occur in the lower Columbia River and several of its tributaries including the Cowlitz, Lewis, and Sandy rivers. Historically, eulachon were occasionally reported to spawn up to the Hood River prior to the construction of Bonneville Dam in the 1930s (Eulachon Biological Review Team 2010). Since completion of Bonneville Dam, spawning in the mainstem of the Columbia River has not been recorded upstream of river mile (RM) 74 (72 miles below Bonneville Dam). However, in years of high abundance, eulachon are known to spawn in the Sandy River, which enters the Columbia River at RM 120.

Eulachon spawn by broadcasting their eggs onto clean sand or small gravel (WDFW and ODFW 2001). After being fertilized, the eggs become sticky and adhere to the substrate. The eggs generally hatch within 3 to 4 weeks. After hatching, the larvae rapidly disperse downstream to the estuary and into near-shore marine areas.

Bull Trout (*Salvelinus confluentus*)

Bull trout is a char species of the *Salmonidae* family. The Columbia River population segment of bull trout was listed under the ESA as a threatened species in 1998. Most bull trout populations are found in higher elevation tributaries of the Columbia River and its major tributaries, owing primarily to their requirement for cold water for spawning and juvenile rearing. Although they have been observed in the mainstem Columbia River, bull trout were probably never abundant there (Mongillo 1993). At Rocky Reach Dam near Wenatchee, annual counts of bull trout using the upstream fishway ranged from 204 to 248 fish from 2000 to 2003 (FERC 2004). Most were observed passing between May and July. A radio telemetry study conducted in 2001 and 2002 using fish captured at Wells, Rock Island, and Rocky Reach dams found that all tagged bull trout successfully continued their upstream movement in the river, and all eventually migrated into the Wenatchee, Entiat, or Methow rivers for fall and winter residence (BioAnalysts 2004).

Resident Species

Reservoirs of the Columbia River support substantial numbers of resident fish species, both native and introduced. Recent surveys in the Priest Rapids and Wanapum reservoirs documented 34 species of fish, 20 of which were native species (Pfeifer et al. 2001). The primary game species are rainbow trout (*Oncorhynchus mykiss*), mountain whitefish (*Prosopium williamsoni*), walleye (*Stizostedion vitreum*), largemouth bass (*Micropterus salmoides*), and smallmouth bass (*Micropterus dolomieui*). The walleye and bass species are nonnative and are of management concern because of their predation on juvenile salmonids, including those listed under ESA.

3.10.1.2 Lake Roosevelt

Physical characteristics, storage volumes, and operations for Lake Roosevelt were described in Chapter 2, Section 2.2.3 – *Water Management Programs and Requirements Common to All Alternatives*. Lake Roosevelt is relatively straight and narrow over most of its 150-mile length and is generally described as having four reaches: the Northport Reach, Upper Reach, Middle Reach, and Lower Reach. The two largest tributaries to the reservoir other than the Columbia River are the Kettle River, which enters in the Upper Reach, and the Spokane

River, which enters in the Middle Reach. The moderate-sized Sanpoil River enters in the Lower Reach.

The northernmost reach (Northport Reach) extends from the Canadian border south approximately 14 miles to Onion Creek (RM 730). The Northport Reach is generally characterized as:

- Free-run river (the transition between the river and the reservoir occurs near the southern extent when water levels in the reservoir are above approximately 1270 feet in elevation).
- Narrow, relatively shallow river channel (average depth is approximately 14 feet near the U.S.-Canadian border).

The Upper Reservoir Reach starts at Onion Creek and extends approximately 22 miles downstream to Marcus Island (RM 708) and is generally characterized as:

- Relatively narrow channel with few shoreline embayments and irregularities.
- Increasing water depth over this reach, ranging from approximately 50 to 100 feet deep at full pool (elevation 1290 feet amsl).

The Middle Reservoir Reach extends approximately 69 miles from Marcus Island downstream to the Spokane River confluence (RM 639) and is generally characterized as:

- Channel widths vary between 0.25 and 1.75 miles.
- Irregular shoreline with embayments.
- Channel depths vary from 100 to 300 feet deep at full pool.

The Lower Reservoir Reach extends approximately 42 miles from the Spokane River confluence downstream to Grand Coulee Dam and is generally characterized as:

- Wide channel with water depths of about 400 feet near the dam during full pool.
- Irregular shoreline with embayments.

Grand Coulee Dam and Lake Roosevelt are part of the complex and regulated system of Columbia River dams and reservoirs, as described in Chapter 2, Section 2.2.3 – *Water Management Programs and Requirements Common to All Alternatives*. In addition to other commitments, Lake Roosevelt is operated to provide downstream flows to benefit fish in conjunction with operations at other Columbia River reservoirs. Table 2-2, *Operational Considerations of Grand Coulee Dam and Lake Roosevelt*, lists operational goals for the reservoir, including for fish.

Water passes through Lake Roosevelt relatively quickly. During average runoff years, the retention time is about 45 days, but it can be as low as 12 days during high runoff periods

(Underwood et al. 2004). This short retention time limits the amount of temperature stratification in most years (Pavlik-Kunkel et al. 2008), as described in Section 3.4 – *Surface Water Quality*.

Fish Assemblage

Lake Roosevelt supports 30 species of fish (18 game and 12 nongame species). Rainbow trout, kokanee (*Oncorhynchus nerka*), and walleye are the three primary fish harvested by anglers in the reservoir, with smallmouth bass increasing in popularity over the past 5 years.

Factors Potentially Affecting the Fisheries in Lake Roosevelt

Underwood et al. (2004) analyzed the factors influencing the fishery in Lake Roosevelt. The analysis focused on the primary game fish of concern in the reservoir, which are kokanee salmon, rainbow trout, walleye, and white sturgeon. The authors concluded that the principal factors affecting the reservoir fisheries are related to water management through the reservoir, as it alters inflow, outflow, drawdown, and retention time, specifically:

- Entrainment of fish through the turbines and the spillway.
- Water temperature.
- TDG concentrations (supersaturation).
- Nutrients and plankton production.

In addition to water management issues, Underwood et al. (2004) identified chemical issues as factors affecting fish. Walleye predation on some of the other game fish is also an issue.

3.10.1.3 Banks Lake

Physical characteristics, storage volumes, and operations for Banks Lake were described in Chapter 2, Section 2.2.3 – *Water Management Programs and Requirements Common to All Alternatives*. Between the late 1950s and 1986, Banks Lake was annually drawn down, typically during the spring, by about 10 to 15 feet. However, in the early 1980s, normal water surface elevations in Banks Lake were stabilized such that annual fluctuations were usually approximately only 3 feet from full pool. This was due, in part, to the findings of Stober et al. (1979), who identified potentially deleterious impacts to fish, particularly kokanee salmon, and wildlife associated with more extreme variations in water surface elevation. Lower water surface elevations are occasionally reached in response to special operations or maintenance activities (Reclamation 2001). Since 2000, Banks Lake has been drawn down 5 feet during August to make more water available in the Columbia River for meeting anadromous fish migration flow objectives.

Fish Assemblage

Most fish species present in Banks Lake originated from smaller lakes present in the coulee prior to reservoir inundation and also from water pumped in from Lake Roosevelt. Although no records document fish assemblages in the smaller historic lakes, local fisherman indicated that populations of largemouth bass and pumpkinseed sunfish existed (Stober et al. 1975; Thomas 1978). Other species, including rainbow trout, kokanee salmon, smallmouth bass, coho salmon, and Chinook salmon have been planted by WDFW (Reclamation 2004). Coho and Chinook salmon are no longer planted and presently do not occur in the lake.

Additional species known to occur in Banks Lake include yellow perch, bluegill sunfish (*Lepomis macrochirus*), burbot, lake whitefish, mountain whitefish, walleye, longnose sucker, bridgelip sucker, largescale sucker, carp, prickly sculpin (*Cottus asper*), peamouth, brown bullhead, yellow bullhead, white catfish (*Ictalurus catus*), channel catfish, northern pikeminnow, and black crappie.

Results of the most recent fish sampling in 2008 using gill nets and boat electrofishing indicate that the dominant fish in Banks Lake are lake whitefish, walleye, yellow perch, and smallmouth bass (Polacek 2009). Based on creel surveys in 2008, the most commonly caught fish are smallmouth bass and walleye followed by yellow perch and rainbow trout. During the late fall and winter months, anglers primarily target trout and yellow perch, but shift their efforts to smallmouth bass and walleye in the spring and summer.

A local volunteer group operates a series of fish net pens along the north and south shores of Banks Lake. WDFW provides the juvenile fish, feed, and technical assistance as needed. These net pens are used primarily to raise rainbow trout for release into Banks Lake. An average of 188,000 rainbow trout has been stocked every year since 1990 (Reclamation 2004). This voluntary cooperative net-pen project has operated on Banks Lake to enhance the fishing for 23 years. Since 1996, kokanee salmon also have been reared to fingerling and yearling size in net pens at Electric City and Coulee City according to net pen operators.

Fish Habitat

Banks Lake contains a wide variety of fish habitat types, which in turn support the diverse fish community. Habitats include deep open waters, nonvegetated embayments, vegetated embayments, gravel shoals, rocky ledges, and steep dropoffs. General characteristics of Banks Lake fish species relative to reproduction, rearing, and adult habitat requirements were outlined in a table in the Banks Lake Drawdown Final EIS (Reclamation 2004).

The Banks Lake littoral zone extends from the ordinary high waterline, just above the influence of waves and spray, to the photic zone, the depth at which light is sufficient for rooted aquatic vegetation (macrophytes) to grow and to influence the vertical migration of zooplankton. The depth of the photic zone can vary depending on turbidity levels in the lake that are influenced primarily by seasonal and environmental changes. This biologically critical zone supports aquatic macrophytes that provide spawning habitat and nursery areas for many of Banks Lake's fish species and other aquatic resources (Reclamation 2004). The quality and quantity of littoral habitat available to fish and other aquatic resources greatly influences their ability to reproduce and maintain self-sustaining populations. Most aquatic plants in the Banks Lake littoral zone occur in a band from water surface elevation 1569 feet to 1566 feet amsl. The littoral zone is currently exposed approximately 6 to 36 days annually during lake level drawdown to elevation 1565 feet amsl.

Reclamation (2004) identified three distinct littoral zone habitat types in Banks Lake:

1. Sheltered shorelines and shallow bay areas with developed aquatic macrophyte communities (shallow aquatic macrophytes).
2. Exposed shorelines composed of sand, gravel, and cobble (boulders, cobble, and gravel).
3. Exposed shorelines composed of medium to hard-packed clay (shallow unvegetated flats).

Aquatic macrophyte communities provide rearing habitat for juvenile fish species, refuge for prey species, and forage for aquatic macroinvertebrates (Photograph 3-4). They are particularly important for fish during their early larval stages. Aquatic macrophyte communities help to increase juvenile fish forage efficiency and provide cover from potential large predators such as bass and walleye. Correspondingly, macrophyte barriers also restrict the foraging efficiency of many larger predatory fish species, which can lead to declines in their growth (Reclamation 2004).

Photograph 3-4. Juvenile fish often seek refuge from larger predators in shallow water vegetation along Banks Lake shoreline.

Boulders, cobble, and gravel substrate provides spawning and rearing habitat for a number of fish species found in Banks Lake, including largemouth bass, smallmouth bass, walleye, and prickly sculpin. This habitat type is found predominantly along the steep western shoreline, as well as in the shallow protected bays and unvegetated flats described below. Additionally, boulder and cobble substrate provides habitat for benthic invertebrates and offshore refugia during the summer for many of Banks Lake's fish species as they move out from the near-shore aquatic macrophyte communities. These species include brown bullhead, smallmouth bass, black crappie, walleye, lake whitefish, mountain whitefish, peamouth chub, and common carp (Reclamation 2004).

Shallow unvegetated flats provide important habitat for various adult and juvenile life stages of fish species in Banks Lake (Photograph 3-5). Two key shallow unvegetated flats identified in *the Banks Lake Resource Management Plan and Environmental Assessment* (Reclamation 2001) are the shallow flats just south of the Million Dollar Mile North Boat Ramp and the flats east of Barker Flat. The shallow unvegetated flats adjacent to these areas are used by smallmouth bass, largemouth bass, and sunfish species. Other shallow unvegetated flats at Banks Lake that provide important adult and juvenile habitat include, but are not limited to, the extensive flats between the Million Dollar Mile North and South Boat launches on the southwest side of Banks Lake. Channel catfish juveniles are one example of a species and life stage that rely on shallow unvegetated areas (Reclamation 2004).

Photograph 3-5. Shallow unvegetated flats provide habitat for a variety of species at Banks Lake.

Food Sources

Fish and other aquatic resources in Banks Lake feed on a wide variety of food sources including aquatic vegetation, phytoplankton, zooplankton, benthic and near-shore invertebrates, and other fish species. Zooplankton and benthic invertebrates make up the bulk of food sources available to the fishery in Banks Lake. Analysis of fish collected in 2004 and 2005 indicates the importance of zooplankton, especially Daphnia, in the diet of many fish species, including juvenile bass, rainbow trout, black crappie, and all sizes of lake whitefish and yellow perch (Polacek and Shipley 2007).

Zooplankton are dispersed throughout Banks Lake. However, site-specific environmental factors including water temperature, current, nutrients, wind, and predation have all been identified as contributing to varying levels of zooplankton diversity and evenness in lakes and reservoirs.

Banks Lake flow-through of water occurs from north to south. Two distinct pools are evident in the lake, and they vary in temperature, turbidity, stratification, plant nutrient level, and zooplankton biomass. The north pool has colder water temperatures, lower turbidity, less stratification, and higher plant nutrient levels than those found in the south pool (Reclamation 2004). The south pool has a higher zooplankton biomass, dominated by Daphnia, than the north pool. Based on studies conducted by WDFW in 2002 through 2005 (Polacek and Shipley 2007), zooplankton densities were bi-modal with the highest peak in

May and a secondary peak in October-November. Lowest densities were observed in August and in the winter.

Benthic invertebrates fill a fundamental ecological niche, serving to break down plant matter, as well as providing a primary source of food for many fish species at various life stages. In Banks Lake, aquatic plants and attached organisms, such as algae, protozoans, and bacteria (periphyton), as well as detritus, provide food and habitat for a wide variety of organisms (Reclamation 2004). High invertebrate densities are typically associated with aquatic plants. Very few invertebrates or fish feed directly on the large aquatic plants; instead, they feed on the attached organisms and detritus. In addition, many benthic invertebrates collect beneath macrophytes and utilize plant remains as food and shelter.

Fish Entrainment

Entrainment of fish from Lake Roosevelt into the north end of Banks Lake and the entrainment loss from Banks Lake via the north-end pump generating units and at the south-end Dry Falls Dam were studied by Stober et al. (1979) from 1974 to 1976. Relatively few fish (mostly kokanee salmon, sculpin, and largescale sucker) were pumped into Banks Lake compared to the numbers of fish entrained out of the lake at Dry Falls Dam. Also, entrainment of fish back to Lake Roosevelt via the pump-generating units was found to be relatively minor.

Fish entrainment at Dry Falls Dam was estimated to be 436,216 fish in the 2-year period of 1975 and 1976. Most fish were relatively large, with an average fish weight of 250 grams (8.8 ounces). Relative abundance of kokanee salmon entrained in 1975 and 1976 was estimated at 67.4 percent and 59.6 percent of the total, respectively. The other primary species entrained were lake whitefish and yellow perch. More extensive studies in 1977 showed a reduced relative abundance of kokanee salmon entrained (17.8 percent of the total) compared to 1975 and 1976. In response to the relatively high entrainment rates, especially of adult kokanee salmon, Reclamation installed a barrier net in 1978 in the forebay of Dry Falls Dam. The net was found to be effective at minimizing entrainment losses of kokanee salmon and other larger fish (Stober et al. 1979). Following construction of the hydroelectric generating plant at Dry Falls Dam in 1984, the Project licensee, Grand Coulee Project Hydroelectric Authority, installed new barrier nets, which are maintained during the irrigation season. The nets (sized to reach the bottom of the lake when the reservoir is at full pool elevation of 1570 feet) are suspended from floats between the Coulee City Park breakwater and an island, and between the island and Dry Falls Dam.

WDFW conducted fish entrainment studies in 2004 and 2005 by netting the discharge canal approximately 3.5 miles downstream of Dry Falls Dam (Polecek and Shipley 2007). The results of these studies may have been affected to some degree by fish delaying or holding up in the canal between the dam and sampling location. In 2004, it was estimated that 277,588 fish passed out of the lake at Dry Falls Dam; in 2005, the estimate was 58,708 fish. Yellow perch and sculpin accounted for 92 percent and 90 percent of the species captured in the entrainment nets in 2004 and 2005, respectively. The highest entrainment rates by far occurred in June of both years. Nearly all of the entrained fish were less than a year old. The average length of entrained fish was only 33 millimeters (1.3 inches) in 2004 and 30 millimeters (1.2 inches) in 2005. These lengths represent an average fish weight of about 1 gram. This weight compares to the average entrained fish weight of 250 grams (8.8 ounces) observed prior to the installation of the first barrier net. The numbers of fish and the very high percentage of small sub-yearling fish entrained at Dry Falls Dam are consistent with findings elsewhere at reservoirs with similar fish communities (FERC 1995).

Most recently, WDFW conducted a hydroacoustic study at Dry Falls Dam during May through October 2009 and March through October 2010. The purpose of the study was to identify the magnitude and timing of fish entrainment at the powerhouse intake for two annual water irrigation cycles (Sullivan, McFadden, and Nealson 2009). An estimated 743,995 fish were entrained in 2009 with 80 percent of the hydroacoustic detections occurring during July, August, and September. In 2010, an estimated 878,652 fish were entrained with 75 percent of the hydroacoustic detections occurring during August, September, and October. The median fish length for the 2009 study period was 12.2 centimeters (4.8 inches) and for the 2010 study period was 13.4 centimeters (5.3 inches). The overall larger size of fish entrained and the increase in numbers attributable to entrainment are significant departures from earlier Banks Lake entrainment studies. These differences are likely the result of a change in sampling methodology from netting to hydroacoustics.

3.10.2 Overall Study Area and Broader Central Washington/CBP Area

Reclamation would generally not alter the current operation of waters downstream of the Odessa Subarea, including Moses Lake, Potholes Reservoir, and lower Crab Creek, and no adverse impacts on water quality are expected. Similarly, fish and aquatic resources at Billy Clapp Lake and upper Crab Creek would not be impacted by any of the proposed alternatives. Therefore, none of these water bodies are discussed.

The area of the proposed Black Rock Reregulating Reservoir contains limited aquatic resources. A small pond that provides habitat for waterfowl and other aquatic flora and fauna is fed primarily by a perennial spring originating approximately one-half mile east of the pond. The spring contributes water to the pond via a channelized meandering stream that is significantly degraded because of localized cattle grazing.

3.11 Threatened and Endangered Species

Threatened and endangered species in the Study Area and elsewhere are an important natural resource and can be impacted by various components associated with action alternatives. Any threatened and/or endangered species that are known to occur in the area are protected under the ESA and any anticipated impacts must be fully considered.

3.11.1 Analysis Area and Methods

The analysis area for ESA-listed wildlife species includes the entire Study Area and a 5-mile buffer around its perimeter. The buffer is included to account for potential movements by the ESA-listed wildlife species that may occur in the Study Area. The Study Area for ESA-listed fish species includes Lake Roosevelt (for bull trout) and the Columbia River from Chief Joseph Dam downstream to just below Bonneville Dam (for anadromous species). It does not include Banks Lake because no ESA-listed fish species are known to occur there. Also, it does not include the lower Columbia River in the intertidal area. Therefore, this determination excludes ESA-listed salmonids entering the lower Columbia from the Willamette River and other estuarine tributaries, as well as the ESA-listed green sturgeon and eulachon observed seasonally in the Columbia River estuary.

The presence of ESA-listed species in the analysis area were evaluated based on existing data from USFWS, NMFS, and WDFW, and recent 2009 WDFW surveys (WDFW 2009 Species) conducted in association with the Odessa Special Study.

3.11.2 Wildlife

On November 30, 2001, the USFWS announced an emergency listing of the Columbia River Basin DPS of the pygmy rabbit as endangered (66 FR 59734). The pygmy rabbit is the only ESA-listed wildlife species that may occur in or near the Study Area.

The pygmy rabbit is a sagebrush obligate species, meaning that it is dependent upon sagebrush, primarily big sagebrush. They are usually found in areas where big sagebrush is the predominant shrub and where it grows in very dense stands on relatively deep, loose soils. The following life history information is summarized from WDFW (1995), which includes extensive details about pygmy rabbit life history, habitat preferences, and threats.

The pygmy rabbit is the only rabbit native to North America that digs its own burrows. Dense stands of sagebrush and relatively deep, loose soil are important characteristics of pygmy rabbit habitat. Sagebrush comprises up to 99 percent of its winter diet. Female pygmy rabbit home ranges are very small, but the males have a much larger range, averaging 20.2 hectares (49.9 acres) during the spring and summer. Males made occasional long distance movements to areas occupied by adult females. Male movements averaged 155 meters (513 feet) while the maximum distance between locations ranged up to 1,200 meters (3,960 feet). Estimated average home range size for juveniles was 7.1 hectares (17.5 acres), which included the natal area and an area of resettlement after dispersal away from the natal area.

The pygmy rabbit was found in the Columbia River Basin (Washington) and Great Basin (Oregon, Idaho, Montana, Wyoming, and Nevada) of the U.S. (WDFW 2005). Historically, they occurred in native shrub-steppe habitat in five counties in Washington, including the entire Study Area. Six populations were known as recently as 1997 (WDFW 2007).

The Columbia River Basin pygmy rabbit population is genetically distinct and isolated from other pygmy rabbit populations in the Great Basin (68 FR 10388). Pygmy rabbit populations have declined severely in the Columbia River Basin largely because of habitat loss and fragmentation (WDFW 1995). Habitat loss resulting from agricultural conversion has been the primary reason for the decline of this species. WDFW (1995) indicates that most of the original pygmy rabbit habitat in Washington has been degraded to the point that it cannot support this species. Additional losses may occur through conversion of the shrub-steppe to cropland or grazing land for cattle or through wildfire. Because of low numbers and limited distribution, pygmy rabbit populations in Washington are vulnerable to fire, disease, intense predation, and the random variation in birth and death rates, sex ratios, and combinations of demographic parameters that sometimes cause the collapse of small populations (WDFW 1995).

A search of the Washington PHS data base in 2009 yielded two historic pygmy rabbit burrows located about 2 miles west of the south end of Banks Lake. There was no indication of recent activity and these locations are not mentioned in the Washington State Recovery Plan for the Pygmy Rabbit or its addenda (WDFW 1995, 2001, 2003). This area would not be affected by any activities or facilities associated with the Study.

In 1999, the documented range of the pygmy rabbit within Washington was restricted to six isolated fragments of sagebrush dominated habitat within Douglas County, west of the Study Area. They were found at only one of these sites during surveys conducted in 2001 (WDFW 2003). Active burrows were found in 2001 and 2002 at a WDFW Wildlife Management Area about 15 miles to the west of the northern-most section of the proposed East High Canal. According to WDFW (2003), fewer than 30 rabbits were believed to remain in the wild. In 2001, WDFW began a captive breeding program for this species. Approximately 23 rabbits were released in Douglas County in March of 2007 as part of a program to reestablish the species (WDFW 2007).

Sites dominated by the big sagebrush-bluebunch wheatgrass vegetation type constitute potentially suitable habitat for pygmy rabbits. This vegetation type was found on gentle side slopes and upper terraces with deeper soils in Black Rock Coulee and along the proposed

East High Canal south of SH-28 and north to Billy Clapp Lake. No assessment of soil suitability was conducted in these areas. WDFW conducted surveys within areas of potentially suitable habitat that would be impacted by Odessa facilities during 2009 and no pygmy rabbits were found (WDFW 2009 Species). Additional surveys were conducted in 2010 and again no pygmy rabbits were found.

3.11.3 Fisheries

The following section briefly describes the general life history, geographic extent, and defined critical habitat for the threatened and endangered listed fish species that may be affected by the alternatives. The species and ESU or DPS are listed in Table 3-24.

Table 3-24. Fish species listed under the ESA within the analysis area.

Species	ESU/DPS	Status/Year Listed	Designated Critical Habitat	Recovery Plan
Chinook salmon	Lower Columbia	Threatened 1999	Yes	In process
	Upper Columbia Spring Run	Endangered 1999	Yes	Yes
	Snake River Spring/Summer Run	Threatened 1992	Yes	In process
	Snake River Fall Run	Threatened 1992	Yes	In process
Coho salmon	Lower Columbia	Threatened 2005	In process	In process
Chum salmon	Lower Columbia	Threatened 1999	Yes	In process
Sockeye salmon	Snake River	Endangered 1991	Yes	In process
Steelhead trout	Lower Columbia	Threatened 1998	Yes	In process
	Middle Columbia	Threatened 1999	Yes	Yes
	Upper Columbia	Threatened 1999	Yes	Yes
	Snake River	Threatened 1997	Yes	In process
Bull trout	Columbia River Basin	Threatened 1998	Yes	In process
Source – NMFS 2009				

A brief discussion of historic changes to the Columbia River, their general effects on fish, and agreements regarding flow augmentation that are relevant to the species in Table 3-24 is presented in Section 3.10 – *Fisheries and Aquatic Resources* and is not repeated here. The alternatives were developed with the assumption that the anadromous fish flow objectives in the Columbia River measured at Priest Rapids and McNary dams (Table 3-22) would not be compromised. Meeting these objectives, to the extent possible, is part of the legal commitments under the ESA for the Federal agencies (Reclamation, BPA, and Corps) that operate the FCRPS.

3.11.3.1 Steelhead Trout

Steelhead trout exhibit a diverse and complex life history throughout its range (Busby et al. 1996). This species includes the anadromous form, steelhead trout, and the resident form, commonly referred to as rainbow or redband trout. Only the ESA-listed anadromous steelhead form is discussed here. Two genetic groups of steelhead are recognized in North America: the inland group and the coastal group. In the Columbia River Basin, steelhead using tributaries east of the Cascade crest are considered part of the inland group.

Adult steelhead trout enter the Columbia River between May and October. However, they do not spawn until the following spring, typically between March and June. Therefore, adults must overwinter in their natal (home) stream or in the mainstem Columbia or Snake rivers. Eggs incubate in the gravel for four to seven weeks, and fry emerge from the gravel between June and August. Most spawning occurs in tributaries where the juveniles rear for up to 7 years before they become smolts and migrate to the ocean. However, in the upper Columbia, most juveniles reach the smolt stage (150 to 200 millimeters [5.9 to 7.9 inches]) by age 2 or 3. Unlike salmon, some adult steelhead survive after spawning and attempt to migrate back to the ocean. These fish are known as kelts, and a small percentage survive to return again to spawn in their natal stream.

Steelhead smolts migrate seaward in the spring. Most passage at Columbia River dams occurs between late April and early June. Steelhead trout typically spend 1 to 2 years in the ocean before returning to freshwater to spawn.

Within the analysis area, there are four steelhead trout ESUs, each defined by their geographic range within the Columbia River Basin. Following is a brief description of their geographic range and designated critical habitat.

Upper Columbia River Steelhead ESU

This steelhead population is listed as a threatened species under the ESA. Natural production occurs in the Okanogan, Methow, Entiat, and Wenatchee River basins. Little or no spawning occurs in the mainstem Columbia River. Most adult returns are of hatchery origin. Hatchery programs operated by WDFW, USFWS, and the Colville Tribes release steelhead smolts in the Wenatchee, Methow, and Okanogan basins. The Wells Hatchery stock of steelhead, which is used at all of these hatcheries, is included in this ESU because it is essential for recovery, as it probably retains the genetic resources of steelhead populations above Grand Coulee Dam that are now extinct from their native habitats (NMFS 1997).

In February 2000, critical habitat for Upper Columbia River steelhead was designated to include all river reaches accessible to ESA-listed steelhead in Columbia River tributaries upstream of the Yakima River, Washington and downstream of Chief Joseph Dam. Designated critical habitat also includes adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to Chief Joseph Dam in Washington. Excluded from critical habitat designation are Tribal lands and areas above specific dams or above longstanding, naturally impassable barriers. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 9,545 square miles in Washington.

Middle Columbia River Steelhead ESU

The Middle Columbia River steelhead population occupies the Columbia River Basin from above the Wind River in Washington and the Hood River in Oregon, upstream to the Yakima River in Washington, inclusive (Busby et al. 1996). Upstream of the Dalles Dam, all steelhead are summer, inland steelhead. Winter steelhead in this ESU occur in the Klickitat and White Salmon rivers.

In February 2000, critical habitat for Middle Columbia River steelhead was designated to include all river reaches accessible to ESA-listed steelhead in Columbia River tributaries (except the Snake River) between Mosier Creek in Oregon and the Yakima River in Washington (inclusive). Also included are adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Yakima River in Washington. Excluded are Tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 26,739 square miles in Oregon and Washington.

Lower Columbia River Steelhead ESU

This steelhead ESU occupies tributaries to the Columbia River between the Cowlitz and Wind rivers in Washington and the Willamette and Hood rivers in Oregon, inclusive (Busby et al. 1996). Excluded from this ESU are steelhead in the upper Willamette River Basin above Willamette Falls, and steelhead from the Little and Big White Salmon rivers, Washington. This ESU has both winter and summer steelhead, and nonanadromous *O. mykiss* co-occur with anadromous forms in the lower Columbia River tributaries (Busby et al. 1996). The relationship between nonanadromous and anadromous forms in this geographic area is unclear (Busby et al. 1996). A number of genetic studies have shown that steelhead in this ESU are of the coastal genetic group and are part of a different ancestral lineage than inland steelhead from the Columbia River Basin (Busby et al. 1996).

In February 2000, critical habitat for Lower Columbia River steelhead was designated to include all river reaches accessible to ESA-listed steelhead in Columbia River tributaries between the Cowlitz and Wind rivers in Washington and the Willamette and Hood rivers in

Oregon, inclusive. Also included are adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Hood River in Oregon. Excluded are tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 5,017 square miles in Oregon and Washington.

Snake River Basin Steelhead ESU

This ESU occupies the Snake River Basin of southeast Washington, northeast Oregon and Idaho. This region has high ecological complexity and supports a diversity of steelhead populations. These populations have been shown to be more genetically and physically similar to each other than to other steelhead populations occurring outside the Snake River Basin (Busby et al. 1996). This ESU includes the highest elevations for steelhead spawning (up to 2,000 meters) and the longest migration distance from the ocean (up to 1,500 km) (Busby et al. 1996). Snake River steelhead are summer-run steelhead and are classified into two groups, A run and B run. These groups are based on migration timing, ocean age, and adult size (Busby et al. 1996). Only naturally spawned populations of steelhead and their progeny in this ESU residing below long-term, natural and man-made impassable barriers (dams) are listed (NMFS 1997).

In February 2000, critical habitat for Snake River steelhead was designated to include all river reaches accessible to ESA-listed steelhead in the Snake River and its tributaries in Idaho, Oregon, and Washington. Designated critical habitat also includes adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence with the Snake River. Excluded from critical habitat designation are Tribal lands and areas above specific dams identified or above longstanding, naturally impassable barriers (Napias Creek Falls and other natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 29,282 square miles in Idaho, Oregon, and Washington.

3.11.3.2 Chinook Salmon

Chinook salmon exhibit the most variability and variety in their life history characteristics compared to other anadromous salmonids in the Columbia River Basin. There are different seasonal “runs” or modes in adult migration from the ocean to freshwater. These are categorized as spring, summer, and fall Chinook salmon. Typically, spring Chinook salmon spawn higher in the watersheds where they can gain access during the high snowmelt period. Fall Chinook salmon generally spawn lowest in the watersheds. Within these defined runs, there is an additional important distinction based on the age of the outmigrating smolts. The offspring of spring Chinook salmon are referred to as “stream-type” because the juveniles spend at least 1 full year rearing in freshwater before outmigrating as yearling smolts. Fall Chinook salmon, on the other hand, are considered “ocean-type” because their offspring tend to migrate downstream to the ocean in their first spring or summer as subyearlings. Summer Chinook salmon originating in the upper Columbia River also exhibit the ocean-type life history. Summer Chinook salmon in the Snake River, however, are stream-type, and thus are often grouped with Snake River basin spring Chinook salmon, which share a similar juvenile life history.

Within the Study Area, there are four Chinook salmon ESUs, each defined by their geographic range within the Columbia River Basin. Following is a brief description of their geographic range and designated critical habitat.

Upper Columbia River Spring-run Chinook ESU

This ESU includes stream-type Chinook salmon spawning above Rock Island Dam in the Wenatchee, Entiat, and Methow rivers. It does not include Chinook salmon spawning in the Okanogan River basin. Upper Columbia River Basin spring Chinook salmon typically spawn in August and September in upper tributaries. Spring Chinook smolts migrate seaward through the upper Columbia River (as indicated by monitoring at Rock Island Dam) between mid-April and mid-June, with approximately 90 percent passing before June 1.

In February 2000, critical habitat for Upper Columbia spring Chinook salmon was designated to include all river reaches accessible to ESA-listed Chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. Also included are adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to Chief Joseph Dam in Washington. Excluded are Tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 7,003 square miles in Oregon and Washington.

Lower Columbia River Chinook Salmon ESU

This ESU includes all naturally spawned Chinook populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. Not included in this ESU are stream-type spring Chinook salmon found in the Klickitat River or the introduced Carson spring Chinook salmon. Fall Chinook salmon in the Wind and Little White Salmon rivers are included in this ESU, but not introduced upriver bright fall Chinook salmon populations in the Wind, White Salmon, and Klickitat rivers. Populations in this ESU are considered ocean-type and tend to mature at age 3 to 4.

In February 2000, critical habitat for Lower Columbia River Chinook was designated to include all river reaches accessible to ESA-listed Chinook salmon in Columbia River tributaries between the Grays and White Salmon rivers in Washington and the Willamette and Hood rivers in Oregon, inclusive. Also included are adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to The Dalles Dam. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 6,338 square miles in Oregon and Washington.

Snake River Basin Spring/Summer Chinook Salmon ESU

This ESU includes all natural populations of spring/summer Chinook salmon in the mainstem Snake River and any of the following subbasins: Tucannon, Grande Ronde, Imnaha, and Salmon (NMFS 1992). Populations in this ESU are considered stream–type. Yearling smolts migrate seaward during the mid-April to mid-June period.

In December 1993 (initial designation) and October 1999 (revised designation), critical habitat for Snake River spring/summer Chinook was designated. The habitat includes river reaches presently or historically accessible to Snake River spring/summer Chinook salmon in the Columbia River (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams), from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side). This includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers, and all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 22,390 square miles in Idaho, Oregon, and Washington.

Snake River Basin Fall Chinook Salmon ESU

This ESU includes all natural populations of fall Chinook salmon in the mainstem Snake River and any of the following subbasins: Tucannon, Grand Ronde, Imnaha, Salmon, and Clearwater (NMFS 1992). Populations in this ESU are considered primarily ocean-type, with most subyearling smolts migrating seaward between mid-May and mid-July. However, since the late 1990s, a second life history strategy has been recognized for this population. New information has determined that some later emerging and slower growing juveniles do not emigrate as subyearlings, but rather over-winter in the lower Snake River reservoirs and resume their seaward migration the following spring as yearlings (Connor et al. 2005). Analysis of scales from adult fall Chinook salmon returning to Lower Granite Dam indicate that about half of the adult fish came from this new stream-type life history (also referred to as “reservoir-type”). These yearling fall Chinook smolts emigrate in the spring and, thus, are indistinguishable from the spring/summer Chinook smolts migrating at the same time.

In December 1993, critical habitat for the Snake River fall Chinook salmon was designated. The habitat includes river reaches presently or historically accessible to Snake River fall Chinook salmon in the Columbia River (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams), from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side). This includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers; the Snake River, all river reaches from the confluence of the Columbia River, upstream to Hells Canyon Dam; the Palouse River from its confluence with the Snake River upstream to Palouse Falls; the Clearwater River from its confluence with the Snake River upstream to its confluence with Lolo Creek; and the North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 13,679 square miles in Idaho, Oregon, and Washington.

3.11.3.3 Sockeye Salmon

Nearly all sockeye salmon in the Columbia River Basin originate in the upper Columbia from either Lake Wenatchee or from Lake Osoyoos of the Okanogan system. A smaller number originate in the Stanley Basin of Idaho. That Snake River population was listed as an endangered species under the ESA in 1991. The upper Columbia sockeye populations are considered healthy. Minor hatchery supplementation occurs in both upper Columbia populations and a major supplementation program (relative to the population size) continues for the ESA-listed Snake River sockeye salmon.

Sockeye salmon adults return to the Columbia River during the summer, with peak counts at Bonneville Dam occurring in late June. Peak spawning occurs from mid-September through October. Most spawning occurs in tributaries to their rearing lakes, but some also spawn in the lakes. Sockeye fry emerge from the gravel in late March and April and quickly move into the lake environment where they spend the next 1 or 2 years feeding on zooplankton. Juvenile sockeye migrate downstream in the spring as mostly yearlings. The bulk of the outmigration occurs from mid-April through late May.

Snake River Basin Sockeye Salmon ESU

This ESU includes all natural populations of sockeye salmon in the Snake River basin below Hells Canyon Dam and below Dworshak Dam on the Clearwater River, including areas that were historically accessible to sockeye salmon.

On December 28, 1993, critical habitat for Snake River sockeye was designated. Habitat includes river reaches presently or historically accessible to Snake River sockeye salmon in the Columbia River (except reaches above impassable natural falls, and above Dworshak and Hells Canyon dams), from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side). This includes all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas lakes (including their inlet and outlet creeks); Alturas Lake Creek, and that portion of Valley Creek between Stanley Lake Creek and the Salmon River. Watersheds containing spawning and rearing habitat for this ESU comprise approximately 510 square miles in Idaho.

3.11.3.4 Coho Salmon

Coho salmon adults enter fresh water in the fall and early winter and spawn primarily in small tributaries. Fry emerge from the gravel in the spring and rear in the stream for 1 year prior to migrating downstream the following spring. The peak downstream migration is mid-May. Nearly all adult coho salmon (excluding jacks) are 3-year olds.

Columbia Basin coho salmon are mostly confined to tributaries of the lower river below Bonneville Dam and some tributaries in the mid-Columbia. There was an endemic stock from the upper Columbia, but it is considered extinct (Nehlsen et al. 1991). However, coho salmon reintroduction efforts through hatchery plantings have been attempted in the upper Columbia using lower river and coastal stocks. Reintroduction efforts were significant in the 1960s and 1970s, were all but eliminated in the 1980s and 1990s, and have begun again in recent years.

Lower Columbia River Coho Salmon ESU

This ESU includes all natural populations of coho salmon utilizing tributaries to the lower Columbia River from its mouth to the Cascade Mountain crest. The most easterly tributaries in the Columbia River Gorge within this ESU are the Big White Salmon in Washington and the Hood River basin in Oregon.

Critical habitat has not yet been designated for the Lower Columbia River coho salmon ESU.

3.11.3.5 Chum Salmon

Chum salmon are large salmon, second only to Chinook salmon in size. They spawn in the lower reaches of rivers and streams, typically within 60 miles of the Pacific Ocean. They outmigrate almost immediately to estuarine and ocean habitats after hatching. Thus, survival and growth of juvenile chum depend less on freshwater habitat conditions than on estuarine and marine habitat conditions. They usually arrive at their stream of origin from November to the end of December. Most chum salmon mature in 3 to 5 years. The weight of a mature chum salmon is 18 to 22 pounds.

Lower Columbia River Chum Salmon ESU

Chum salmon are found in the Columbia River downstream of Bonneville Dam and in nearby tributary streams. Spawning occurs primarily in November. Fry emerge in February and March and quickly move downstream into estuarine and marine waters. Adults return primarily as 3- and 4-year olds. The population in the lower Columbia River is very small and is an ESA-listed threatened species (NMFS 1999).

The FCRPS agencies use the 2010 BiOp Reasonable and Prudent Alternative, Action 17 for chum salmon protection (NMFS 2010). This alternative identifies a Bonneville Dam tailwater elevation target during daytime that takes into account river flow, tidal influence, and backwater effects from the Willamette River discharge. The target elevation of approximately 11.5 feet is maintained during the chum salmon spawning period (generally November and December). This tailwater elevation target can be adjusted based on the size of the spawning population and water supply forecasts. After completion of spawning, every attempt is made to maintain tailwater elevations to protect spawning redds through the period of egg incubation and fry emergence, which can extend into early April.

In February 2000, critical habitat for Columbia River chum was designated to include all river reaches accessible to ESA-listed chum salmon (including estuarine areas and tributaries) in the Columbia River downstream from Bonneville Dam, excluding Oregon tributaries upstream of Milton Creek at river mile 89.5 near the town of St. Helens. Designated critical habitat also includes adjacent riparian zones. Excluded from critical habitat designation are Tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 4,426 square miles in Oregon and Washington.

3.11.3.6 Bull Trout

Bull trout is a char species of the *Salmonidae* family. Most bull trout populations are found in higher elevation tributaries of the Columbia River and its major tributaries, owing primarily to their requirement for cold water for spawning and juvenile rearing. Bull trout exhibit a number of life history strategies. Stream-resident bull trout complete their life-cycle requirements in the stream where they spawn and rear. However, most bull trout are migratory, spawning in tributary streams where the juveniles rear from 1 to 4 years before migrating to either a larger river (fluvial) or lake (adfluvial) where they spend their adult life. When mature, they return to their home tributary to spawn.

Columbia Basin Bull Trout DPS

The Columbia River Basin bull trout DPS was listed in 1998 as a threatened species. Their range includes nearly the entire Columbia Basin in higher elevation tributaries in Washington, Oregon, Idaho, Montana, and a small part of Nevada. USFWS (2002) has identified 22 separate geographic units, generally corresponding to subpopulations, to facilitate recovery planning for bull trout in the Columbia River Basin. The upper Columbia River unit includes populations in the Wenatchee, Entiat, and Methow River basins. The Okanogan Basin and Lake Roosevelt are not included in the recovery planning because bull trout spawning has never been observed in any of the tributaries to these waters (WDWF 2004). Bull trout rarely have been observed in Lake Roosevelt, but they are believed to be individuals that had moved down from Canadian waters or from the Pend Oreille River (WDWF 2004). Lake Roosevelt is not designated as ESA critical habitat for the Columbia Basin bull trout DPS.

Although bull trout are observed in the mainstem Columbia River, they were probably never abundant there (Mongillo 1993). At Rocky Reach Dam near Wenatchee, annual counts of bull trout using the upstream fishway ranged from 204 to 248 for 2000 to 2003 (FERC 2004). Most were observed passing the dam between May and July. A radio telemetry study conducted in 2001 and 2002 using fish captured at Wells, Rock Island, and Rocky Reach dams found that all tagged bull trout successfully continued their upstream movement in the river, and all eventually migrated into the Wenatchee, Entiat, or Methow rivers for fall and winter residence (BioAnalysts 2004). These three rivers are believed to be the source of all bull trout that are seasonally observed in the mid-Columbia River (USFWS 2008).

Bull trout critical habitat was designated for the Columbia River Basin bull trout DPS throughout most of its range in 2010. The upper Columbia unit was not included in that critical habitat designation.

3.12 Air Quality

Air quality is an important health concern in the Study Area. The environmental setting for air quality is described in terms of air pollutant sources and existing concentrations. It also discusses the contribution of greenhouse gases (GHGs) that would be generated during construction to climate change.

3.12.1 Analysis Area and Methods

The air quality analysis describes existing conditions and evaluates anticipated impacts to air quality within Adams, Franklin, Grant, and Lincoln counties, where construction of the Odessa facilities would generate emissions. The airshed is part of the Central Basin of

Washington that stretches from the Ellensburg valley to the Washington-Oregon border to the south. The analysis area that was evaluated for construction impacts to air quality included only the Study Area. Air quality was evaluated based on existing conditions relative to air pollutant emissions into the atmosphere, fugitive dust levels, and current GHGs.

3.12.2 Current Air Quality Conditions

Air quality in the four-county region is regulated and enforced by EPA and Washington State Department of Ecology (Ecology), each with its own role in regulating air quality. Under the authority of the Clean Air Act, EPA has established nationwide air quality standards to protect public health and welfare, with an adequate margin of safety. These Federal standards, known as National Ambient Air Quality Standards (NAAQS), represent the maximum allowable atmospheric concentrations and were developed for seven criteria pollutants: ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, lead, and particulate matter (respirable particulate matter less than or equal to 10 micrometers in diameter [PM_{10}] and respirable particulate matter less than or equal to 2.5 micrometers in diameter [$PM_{2.5}$]).[7] As discussed in Section 4.2 – *Air Quality*, none of these standards would be violated so they are not discussed in more detail in this section. Primary standards protect against adverse health effects, while secondary standards protect against welfare impacts such as damage to crops, vegetation, and buildings.

Counties or regions designated as nonattainment areas for one or more pollutants must prepare a State Implementation Plan that demonstrates how the area will achieve attainment by federally mandated deadlines. Section 176(c) of the Clean Air Act requires any entity of the Federal Government that engages in, supports, or in any way provides financial support for, licenses, permits, or approves any activity to demonstrate that the action conforms to the applicable State Implementation Plan required under section 110(a). Air quality in Adams, Franklin, Grant, and Lincoln Counties is classified as attainment for all criteria pollutants. Therefore, EPA's conformity demonstration regulations do not apply to the Odessa Special Study Area and no further analysis is required.

3.12.3 Pollutants of Concern

Air quality is impacted by pollutants that are generated by both natural and man-made sources. In this area of eastern Washington, PM_{10} and $PM_{2.5}$, in the form of fugitive dust, are the primary air pollutants of concern. Local air pollutant emissions typically result from windblown dust from agricultural operations and tailpipe emissions from vehicular traffic along State and Federal highways and local roads. Fugitive dust sources include windblown

[7] Primary and secondary NAAQS for these constituents are listed on EPA's web site (http://www.epa.gov/air/criteria.html).

dust from open lands, outdoor and agricultural burning, wood burning stoves and fireplaces, wildfires, industrial sources, and motor vehicles (BCAA 2003).

The State regulates fugitive dust sources. According to State regulations, "the owner or operator of a source of fugitive dust shall take reasonable precautions to prevent fugitive dust from becoming airborne and shall maintain and operate the source to minimize emissions" (WAC 173-400-040, *General Standards for Maximum Emissions*). Typical construction or water delivery projects are regulated if they emit or have the potential to emit at least 250 tons per year of any regulated pollutant (40 CFR 52). Internal combustion engines that propel or power vehicles are exempt from Prevention of Significant Deterioration regulations. The Prevention of Significant Deterioration program was established to protect air quality that is already in attainment with NAAQS from becoming significantly worse, and was most recently updated May 20, 2009.

Table 3-25 provides a summary of the most current available $PM_{2.5}$ monitoring data measured in the four-county Analysis Area.

In 2007, a $PM_{2.5}$ monitor in Walla Walla, Washington, equaled, but did not exceed, the 24 hour standard of 35 micrograms per cubic meter ($\mu g/m^3$) one time. No $PM_{2.5}$ exceedances have occurred. No PM_{10} data were available for this area.

Table 3-25. Maximum measured ambient air quality monitoring data in the vicinity of the analysis area ($\mu g/m^3$).

Monitor Location	24-hour $PM_{2.5}$ [a]	Annual $PM_{2.5}$ [a]
Walla Walla—12th Street[b]	35.0 in 2007	7.65 in 2007
Dayton—West Main Street[c]	10.6 in 2009	No data collected
Ritzville—Alder Street[b]	22.2 in 2007	6.31 in 2008
Moses Lake—Balsam Street[b]	29.5 in 2007	7.15 in 2008
Mesa—Pepiot Way[b]	21.4 in 2008	6.28 in 2008

[a] Source: Ecology 2009 Air. NAAQS standard is listed first. The 24-hour standard for $PM_{2.5}$ is 35 ug/m^3

[b] Monitoring station began recording data in 2007
[c] Monitoring station began recording data in 2009

Notes:
ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter

3.13 Land Use and Shoreline Resources

The land use and shoreline resource issues associated with the Odessa Special Study alternatives consist of three primary areas of concern:

- Land Ownership and Land Status.
- Existing Land and Shoreline Uses, including Private Land and Public Land.
- Relevant Plans, Programs, or Policies, such as county comprehensive plans, stated goals and objectives for State lands, and requirements of the State Shoreline Management Act.

3.13.1 Analysis Area and Methods

The analysis area for land use and shoreline resources is the Study Area. This analysis area includes portions of Grant, Lincoln, Adams, and Franklin counties. Most of the analysis area falls within Grant and Adams counties. Only small portions of Lincoln County (extreme southwest corner) and Franklin County (north-central, northwest of Connell) are involved.

No analysis is included in this section for the areas around Banks Lake and Lake Roosevelt, each of which is involved with the supply options for the action alternatives. The only significant potential for land use or shoreline resource impacts at these reservoirs is related to recreational facilities and activities. Analysis of these effects is provided in Section 3.14 – *Recreation*. Beyond recreational considerations, no significant potential exists for land use or shoreline resource effects on the two reservoirs. No land ownership or land use changes would occur, and no inconsistencies with existing plans, programs, or policies would be involved with any of the Final EIS alternatives.

County involvement with the Study alternatives (that is, the potential for effects) varies widely depending on the relative proportion of groundwater-irrigated lands within each, and the geographic coverage of the partial groundwater replacement alternatives and the full replacement alternatives (see Chapter 2, Table 2-1). Within the Study Area overall, the affected area for each county is shown in Table 3-26. Land use and shoreline resources were evaluated based on existing land ownership maps, county and municipal planning documents, and topographic maps and aerial photos.

Table 3-26. Proportion of Study Area groundwater-irrigated lands in each involved county.

	Adams	**Grant**	**Franklin**	**Lincoln**
Total acreage of groundwater-irrigated land—Study Area-wide	63,618	28,487	3,575	6,932
Total percent of groundwater-irrigated land—Study Area-wide	62%	28%	3%	7%
South of I-90				
Percent of groundwater-irrigated land south of I-90 (to be provided with surface water under alternatives 2A/2B/3A/3B)	18%	96%	100%	0%
Percent of groundwater-irrigated land south of I-90 (to be provided with surface water under alternatives 4A/4B)	67%	3%	51%	0%
North of I-90				
Percent of groundwater-irrigated land north of I-90 (to be provided with surface water under the full replacement alternatives 3A/3B	82%	4%	0%	100%
Percent of groundwater-irrigated land north of I-90 (to be provided with surface water under the full replacement alternatives 4A/4B)	12%	63%	0%	0%

3.13.2 Land Ownership and Land Status

3.13.2.1 Private Land

The majority of potentially affected land in and adjacent to the Study Area is privately owned. Lands currently irrigated with groundwater in the Study Area (approximately 102,600 acres) are all in private ownership, except for a limited number of State-owned trust land parcels that are leased to private parties. Lands within and adjacent to the locations where facilities would be constructed in one or more of the action alternatives are 90 percent in private ownership. South of I-90, the predominant parcel size is from 160 to 640 areas. North of I-90, parcel size ranges generally from 80 to 640 acres.

3.13.2.2 Public Land

Approximately 10 percent of the land in the Study Area that would be involved with facility development, operation and maintenance in one or more of the action alternatives is in public ownership. Public ownership is:

- Approximately 39 percent is State Trust land administered by WDNR. This Trust land, distributed throughout the Study Area largely in 640-acre parcels (full sections), was granted to Washington by Congress for the purpose of generating revenue to support schools and other educational and state institutions.
- Approximately 50 percent is in Federal ownership under Reclamation jurisdiction, including a large ownership surrounding Billy Clapp Lake. Reclamation parcels are generally associated with existing CBP facilities.
- Approximately 5 percent is State land under the jurisdiction of the WDFW and is located at Billy Clapp Lake.
- Approximately 5 percent is State land under the jurisdiction of the Washington State Department of Transportation (WSDOT).
- Less than 1 percent is comprised of parcels owned by local cities, counties, and special districts (such as school and fire districts).

3.13.3 Existing Land Use and Shoreline Resources

3.13.3.1 Land Use

Private Land

Existing land use on private land in the Study Area is predominantly agriculture and open space. Small communities are present in and near the Study Area, generally oriented to the agricultural economy:

- Adams County—Cunningham, Hatton, and Schrag.
- Grant County—Krupp, Ruff, Stratford, Warden, Wheeler, and Wilson Creek.
- Franklin County—Connell.
- Lincoln County—Irby.

Outside of these communities, no nonagricultural developed land uses generally exist beyond isolated large-lot residential subdivisions and small commercial and industrial enterprises. Table 3-27 provides the relative proportion of these uses within and near facility footprints in each involved county.

Table 3-27. Existing land use conditions within the footprints of facilities associated with the Action Alternatives.

	Irrigated Agriculture	Dryland Agriculture	Open Land
Water Delivery System Facilities*			
South of I-90 (Associated with the Partial Replacement and Modified Partial alternatives)			
Adams County	46%	16%	38%
Grant County	66%	8%	26%
Franklin County	55%	15%	30%
Overall South of I-90	48%	15%	37%
North of I-90 (Additional area involved with the Full Replacement alternatives)			
Adams County	9%	25%	66%
Grant County	16%	15%	68%
Lincoln County	37%	51%	11%
Overall North of I-90	15%	20%	64%
Overall (All delivery facilities associated with the Full Replacement alternatives)	23%	19%	58%

*Water delivery system facilities include canals, wasteways, pipelines, flood easements, pumping plants, and O&M facilities (see Chapter 2). Estimates do not include transmission lines; the locations of these facilities will not be determined until more detailed planning occurs.

Public Land

Existing use of public lands is summarized as follows:

- **WDNR (State Trust land)**. Potentially affected State Trust land is either currently open land with no developed use, or is leased to private parties for irrigated agriculture. Many parcels south of I-90 are leased for agriculture and are part of the groundwater-irrigated lands that would be provided with surface water under the partial replacement alternatives. North of I-90, some WDNR lands are leased for irrigated agriculture, but the majority are currently open.
- **WDFW**. Land at Billy Clapp Lake is located in the northeast portion of the Billy Clapp Lake Unit of the Columbia Basin Wildlife Area (CBWA). This unit of CBWA is over 4,000 acres and is located predominantly on Federal (Reclamation) land managed by WDFW. The Stratford Game Reserve encompasses nearly all the public land in the unit.
- **WSDOT**. Potentially affected land is associated with the State and Federal highway system, including the location where the East High Canal would cross State Route 28 and where Farrier Coulee parallels I-90 in the west-central Study Area.

- **Cities, Counties and Special Districts**. Potentially affected parcels of land owned by the local jurisdictions and districts are in a combination of irrigated agriculture and open space uses.
- **Reclamation**. Lands around Billy Clapp Lake are generally open (except for the Pinto Dam area) and used for recreation and natural resource conservation purposes. Beyond this ownership, potentially affected lands under Reclamation jurisdiction are largely open and used for CBP purposes such as drainage management. Most of these lands serve as wildlife habitat and are managed under an agreement with WDFW.

3.13.3.2 Shoreline Resources

The only significant waterbody present in the Study Area is Billy Clapp Lake, a reregulating reservoir for the CBP. This lake is formed by Pinto Dam and is used to manage water in the CBP Main Canal. Land around the lake is owned predominantly by Reclamation, with some ownership by the WDFW. The shoreline of the lake is used for both recreation and natural resource conservation purposes.

Other waterbodies near the locations of potential project facilities are limited to Black Rock Lake and ephemeral impoundments located in Black Rock Coulee in Grant County. Black Rock Lake is a spring-fed pond; the impoundments are formed by rain events or groundwater seepage. No developed recreation, wildlife management, or other formal or designated uses are present.

3.13.4 Relevant Plans, Programs, or Policies

3.13.4.1 County Comprehensive Plans

Land use on all private lands in the Study Area is governed by the comprehensive plans and underlying zoning of the four involved counties. Relevant land use designations, goals, and objectives from these comprehensive plans are provided in the remainder of this section.

Adams County

With only two exceptions, all Adams County land involved with the action alternatives is designated as prime farmland. This designation encompasses both irrigated and dryland agriculture of long-term commercial significance to the County.

Related to this designation, the first 2 of 15 general community goals noted in the plan express strong support for agricultural land use and infrastructure, specifically irrigation facilities. The first formal goal of the comprehensive plan states:

> *Because of their importance to the continued economic viability of the County, agricultural lands will be preserved and maintained to the greatest extent possible.*
>
> *Policy 1. Encourage the retention of agricultural lands and prevent haphazard growth into these areas.*
>
> *Policy 2. Encourage the maintenance and viability of the family farm.*
>
> *Policy 3. Adopt a "right-to-farm" attitude whereby the County recognizes that agricultural uses and activities enjoy historical or prescriptive rights to normal farm practices such as early and late hours of operation, noise, dust generation, crop dusting, odors, slow moving vehicles, and livestock on rural roads.*
>
> *Policy 4. Protect and retain existing and future agricultural lands from conflicting nonfarm uses and influences*

The two exceptions to the Prime Agriculture designation are in the southwest portion of the county. Both are industrial land use designations on land currently being used for irrigated agriculture: a 1,650-acre area along the East Low Canal designated Heavy Industrial and a 1,800-acre area northeast of the community of Cunningham designated Light Industrial. In both cases, the distribution pipeline system associated with the action alternatives would be extended through these lands.

Grant County

All Grant County land that would be involved with the action alternatives is designed for agricultural uses, and most is designated "irrigated" on the Comprehensive Plan map. An area south of Wilson Creek and stretching to Black Rock Coulee is designated as Rangeland. As with Adams County, Grant County Comprehensive Plan goals for agricultural resource lands speak to continued long-term agricultural use and preservation of land for that purpose:

> *Goal RE-1: Agriculture land of long-term commercial significance shall be preserved in order to encourage an adequate land base for long-term farm use.*

Policies associated with this goal seek to protect and preserve these lands as a nonrenewable resource to benefit present and future generations and to discourage any kind of development that would interfere with designated agricultural uses.

Franklin County

All Franklin County land that would be involved with the action alternatives is designed Agriculture in the County's Comprehensive Plan. Relevant goals include:

- *Protect the right to farm and ensure the conservation of agricultural lands.*
- *Encourage agricultural industries in agricultural areas.*
- *Maintain and enhance productive agricultural lands and discourage uses that are incompatible with farming activities.*

Lincoln County

All potentially involved land in Lincoln County is also designated for agricultural uses. The County's Comprehensive Plan (currently being updated) contains the County's commitment to agriculture in its first goal: protect the agricultural base of Lincoln County and maintain agriculture's important position. Associated policies seek to provide safeguards to preserve productive agricultural land and to insure compatibility of land uses

County Critical Areas Ordinances

Each of the counties in the affected area has a governing Critical Areas Ordinance, pursuant to the requirements of Washington's Growth Management Act; the provisions of these Critical Areas Ordinances govern such resources as wetlands, habitat, geologically-hazardous areas, floodplains, and areas critical to aquifer recharge of potable water supplies. All counties specifically exempt operation and maintenance of CBP irrigation facilities from the requirements of the Critical Areas Ordinance.

Related to the footprints of facilities proposed in the action alternatives, few locations within the Study Area are identified in County Critical Areas Ordinances. Locations that are identified are in Grant County and include East Billy Clapp (priority species and habitat, as well as cultural resources) and Black Rock Coulee (occurrences of wetlands and priority habitat).

3.13.4.2 State Shoreline Management Act and County Shoreline Master Programs

Washington's 1971 Shoreline Management Act (RCW 90.58, modified in 2003) designates all lakes and reservoirs in the State over 20 acres in surface area as "shorelines of the State." The Shoreline Management Act requires each county to prepare a Shoreline Master Program to address and protect shoreline resources, with any "substantial development" proposed to be assessed based on policies aimed to (1) encourage water-dependent uses, (2) protect shoreline natural resources such as land, water, vegetation, and wildlife, and (3) promote public access.

Black Rock Lake in Grant County is the only water body within the purview of the Shoreline Management Act that could be affected by the Study alternatives.

3.13.4.3 Public Lands

State Department of Natural Resources (State Trust Lands)

State Trust Lands are managed to provide revenue to help pay for construction of public schools, universities, and other state institutions, and funds services in many counties. Revenue is generated selling products like timber or leasing it to private agriculture businesses. Some lands are also managed to provide fish and wildlife habitat, clean water, and public access (WDNR 2009). State Department of Fish and Wildlife (Billy Clapp Unit of the CBWA)

All units of the CBWA are managed by WDFW according to the 2006 Columbia Basin Wildlife Area Management Plan. This plan describes management objectives, issues and strategies for the Wildlife area, the first of which frames primary intent: Protect, Restore and Enhance Fish and Wildlife and Their Habitats. Emphases in the Plan is on State and Federally protected species, upland game birds, migrating waterfowl, shrub-steppe habitat, wetland habitat, shallow ponds, cliffs and talus slopes, and weed and fire management. Provision of compatible recreation is also a priority (WDFW 2006).

Cities, Counties, and Special Districts

With one exception, all lands owned by cities, counties, and special districts that could be affected by the action alternatives are in an agriculture land use designation on the respective county comprehensive plan. The exception is land owned by the Town of Warden, which is designated as Urban Open Space Recreation by the Grant County plan.

Bureau of Reclamation

Reclamation land in the Study Area was acquired for CBP purposes. As noted above, most of these lands also serve as wildlife habitat and are managed under an agreement with the WDFW as part of the CBWA.

3.14 Recreation

Recreation activities are a valuable resource that provide both economic and quality of life benefits for many individuals. Recreation resources involved with the Odessa Subarea Special Study include reservoir-oriented recreation at Banks Lake and Lake Roosevelt, as well as more dispersed activities, such as hunting and wildlife viewing, throughout rural lands in the Study Area.

3.14.1 Analysis Area and Methods

The analysis area for Recreation resources focuses on Lake Roosevelt and Banks Lake, where water-oriented recreation would be potentially directly affected by the action alternatives. Water-oriented recreation is defined as including both water-dependent recreational activities such as boating, water skiing, fishing, and swimming, and activities such as camping and picnicking that do not depend on water access, but are enhanced by being near it.

The analysis area also includes the Study Area. Recreation in this area is not well documented, but is known to be dispersed and informal, and to consist of activities such as hunting and wildlife viewing. Because there is limited publically owned land in this area, much of the recreation that occurs here, particularly hunting, takes place on private lands.

3.14.2 Reservoir-Oriented Recreation

This section provides a regional overview of the types of reservoir-oriented recreational activities that take place at Banks Lake and Lake Roosevelt. It begins with a discussion of reservoir-oriented recreation within the middle and upper Columbia River Basin, which illustrates the importance of Banks Lake and Lake Roosevelt within the regional network of reservoirs that provide water-oriented recreation.

3.14.2.1 Regional Context

Water-based recreation is an important social and economic activity in the Columbia River Basin. A study that was conducted as part of a Federal review of Columbia River Basin dam projects included a telephone survey of 831 residents in the Columbia River Basin. One of the objectives of the survey was to help determine regional participation rates for water-based recreation. The survey indicated that 68 percent of the respondents participated in water-based recreation during the previous 12 months, and that fishing and boating were the most popular activities (Corps 1995). Since that survey was conducted in 1993, demand for water-based recreation has increased.

Figure 3-13 compares reservoirs and lakes in the region in terms of water surface area and numbers of boat launches, campsites, and day use and picnic areas. As shown, Lake Roosevelt, and to a lesser extent Banks Lake, are important suppliers of recreational facilities in the mid- and upper Columbia River Basin. Of the total number of developed campsites and boat launches, almost a quarter are located at Lake Roosevelt. Banks Lake contributes 13 percent of the area's developed campgrounds and 9 percent of its boat launches. Lake Roosevelt supplies 11 percent of developed picnic areas and Banks Lake, 4 percent.

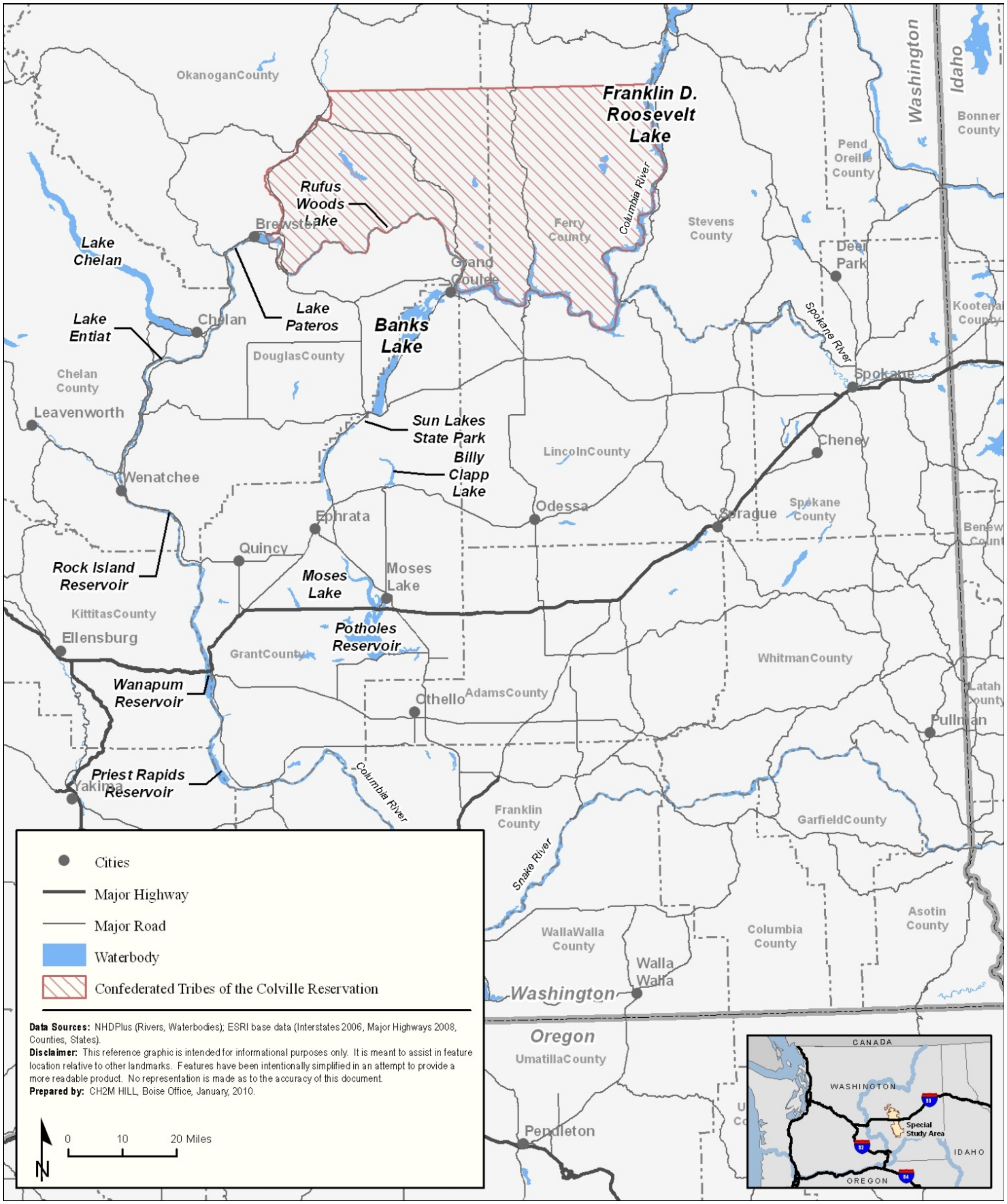


Figure 3-13. **Reservoirs that provide recreation facilities in the mid- and upper Columbia River Basin.**

Table 3-28 compares reservoirs and lakes in the region in terms of water surface area and numbers of boat launches, campsites, and day-use and picnic areas. Recreation facilities and use patterns at these water bodies are fairly similar in that most provide boating access, many have developed camping and day-use facilities adjacent to the water, many have other developed facilities including expansive areas of irrigated lawn and shade trees, and all receive their greatest use in the warm summer months. These reservoirs and lakes also are fairly similar in setting and appearance, being generally long linear bodies of water located in deep basalt canyons that are surrounded by shrub-steppe vegetation (the upper parts of Lake Roosevelt and Lake Chelan are the exceptions), with difficult access to the water because of the rugged topography.

Table 3-28. Major reservoirs and lakes in the mid- and upper Columbia River region that provide recreational facilities.

Recreation Area	Surface Water (acres)	Number of Developed Campsites (% of total)	Number of Developed Boat Launches (% of total)	Number of Developed Picnic Areas (% of total)	Number of Interpretive Facilities (% of total)
Lake Roosevelt	82,000	1,000 (24%)	24 (17%)	9 (11%)	2 (17%)
Banks Lake	27,400	661 (16%)	12 (9%)	3 (4%)	0 (0%)
Billy Clapp Lake	1,000	0 (0%)	1 (1%)	1 (1%)	0 (0%)
Sun Lakes Area	Varies	202 (5%)	8(6%)	1 (1%)	1 (8%)
Moses Lake	6,800	346 (8%)	9 (6%)	1 (1%)	0 (0%)
Potholes Reservoir	23,000	326 (8%)	10 (7%)	2 (3%)	0 (0%)
Priest Rapids Project Area*	23,000	420 (10%)	12 (9%)	7 (9%)	3 (26%)
Rock Island Reservoir	3,300	59 (1%)	2 (1%)	4 (5%)	0 (0%)
Lake Entiat	9,800	276 (6%)	7 (5%)	7 (9%)	1 (8%)
Lake Chelan	33,000	435 (10%)	19 (14%)	9 (11%)	0 (0%)
Lake Pateros	9,700	43 (1%)	8 (6%)	5 (6%)	1 (8%)
Rufus Woods Lake	8,400	42 (1%)	1 (1%)	3 (4%)	2 (17%)
Total	N/A	4,213 (100%)	138 (100%)	79 (100%)	12 (100%)

* Includes Priest Rapids and Wanapum reservoirs

Source: PUD No. 2 of Grant County 2000, PUD No. 1 of Chelan County 2000

Studies of reservoirs in the mid-Columbia River Basin indicate that the types of recreation occurring at these reservoirs and lakes are similar to those at Lake Roosevelt and Banks Lake (PUD No. 2 of Grant County 2000; PUD No. 1 of Chelan County 2000, 2001). These studies report that the subject reservoirs generally meet current recreation demand if viewed over an entire recreation season (May to October). However, in many cases, recreation demand is not being met during peak season weekends. One of the studies concluded that shifting visitor use to other reservoirs in the region is not considered a viable alternative to relieve crowding on peak weekends because all reservoirs tend to be overcrowded at those times (PUD No. 2 of Grant County 2000).

3.14.2.2 Reservoir-Oriented Recreational Activities at Lake Roosevelt and Banks Lake

The range of recreational activities at Lake Roosevelt and Banks Lake that are dependent upon access to water, or benefit from proximity to it, is similar. If access is not available or is difficult, participation rates decline or are eliminated altogether. Most of the water-oriented recreation at these two reservoirs occurs during the warmest months of the primary recreation season (May through October).

Boating

Power boating is one of the most popular activities at the two reservoirs, as both a recreational activity in its own right and to make other activities possible, such as boat fishing, water skiing, and wake boarding. Other types of boating that occur at Banks Lake and Lake Roosevelt include the use of personal watercraft, sailing, wind surfing, boat camping, and general cruising and sightseeing. Houseboats have become very popular at Lake Roosevelt and are rented at Keller Ferry, Seven Bays, and Kettle Falls (NPS 2009 Chart).

The type of boating activity varies by season. Based on aerial surveys conducted by WDFW from 2002 through 2005, fishing constituted the following percentages of boating at Banks Lake (Polacek and Shipley 2007):

- May: 96 percent
- June: 52 percent
- July: 20 percent
- August: 25 percent
- September: 70 percent

This pattern of use is likely related to weather, as the number of recreationists participating in nonfishing boating such as water skiing and personal watercraft usage increases during the warmer months. Although no data was found for Lake Roosevelt, it is likely that similar patterns occur there as well.

Seasonal changes in reservoir elevations at both reservoirs have at times impacted recreation by affecting the usability of boat launches and marinas. These facilities have been designed to operate over a variety of different reservoir elevation ranges. Pool elevations at the lower end of the operating ranges, or below them, can result in boat launch ramps not reaching water deep enough to launch boats. For boat launch ramps to be considered functional in terms of launching medium-sized recreational boats, a pool elevation 3 feet above the toe, or end, of the ramp is usually considered necessary (Photograph 3-6; Reclamation 2004). Low pool elevations have also resulted in areas offshore of marinas or berthing docks becoming too shallow to be useable. Another effect of lower pool elevations can be creation of hazards by exposing rocks, tree stumps, and shoals dangerous to boaters.

Photograph 3-6. Boat docks at Banks Lake.

Fishing

Fishing is one of the most popular recreational activities at both reservoirs. For many recreationists, fishing is the primary purpose for trips taken to reservoirs in the middle and upper Columbia River Basin (Corps 1995).

Recreation at Banks Lake is heavily based on fishing, with most visitors to the reservoir fishing at least part of the time and many of the visitors coming to the reservoir solely to fish (Reclamation 2004). Banks Lake was once known as the State’s premier walleye fishery; however, recently smallmouth bass have become a much more abundant and popular game fish in this reservoir (WDFW 2009 Fish). Other warm water game fish include crappie, bluegill, bullheads, and channel catfish. Deep water or cold water species include rainbow trout and kokanee salmon (both of which are stocked annually), burbot, and lake whitefish.

The kokanee salmon fishery has increased in popularity as the number of kokanee salmon has increased in recent years (Polacek and Shipley 2007).

The WDFW concluded that based on hours spent fishing between March and November 2008, boat anglers accounted for more than 95 percent of all hours fishing, and shoreline anglers accounted for less than 5 percent. Popular places for boat anglers to launch included Steamboat Rock State Park (SRSP; actual launch not indicated), Sunbanks Resort, Northrup Point (or SRSP) Rest Area Boat Launch, and Coulee City Community Park. Bank anglers preferred Coulee City Community Park, Coulee Playland, and the SRSP.

Because of its large size and wide distribution of boat launches, fishing occurs over a large area at Lake Roosevelt. The remote nature of much of the reservoir makes it difficult to access many shoreline areas from which to bank fish. As a result, over 90 percent of the fishing that occurs at Lake Roosevelt is done by boat anglers (Pavlik-Kunkel et al. 2008). The following species were reported as being the most popular targeted species (species the anglers were hoping to catch) based on a creel survey conducted in 2006 (Pavlik-Kunkel et al. 2008):

- Rainbow trout: 50 percent
- Walleye: 42 percent
- Smallmouth bass: 18 percent
- Kokanee salmon: 10 percent

Swimming

Swimming and water play occurs at developed swimming beaches and at dispersed sites along the shorelines of the two reservoirs. Day-use recreationists and campers often engage in swimming and both reservoirs are popular swimming locations for local residents (there are no public swimming pools at Coulee City, Electric City, or Grand Coulee).

Most developed swim areas operate over a specific range of reservoir elevations. Pool elevations near or below the lower end of these ranges disrupt the use of these facilities, particularly when the boom systems that are used to protect swimmers and mark the boundaries of swimming areas cannot be moved farther into the reservoir. Lower elevations can also expose users to reservoir bottom conditions that become unsafe because of dropoffs or rocky subsurface conditions.

Dispersed swimming and water play locations do not have safety features such as booms and, as a result, lower water levels generally cause less disruption than at developed areas because safety booms do not have to be moved and people are used to swimming without them. However, lower elevations can create the same unsafe reservoir bottom conditions at these locations as occur at developed areas. A positive aspect of somewhat lower pool elevations that can occur at some dispersed areas is that lower water levels result in a greater amount of shoreline or beach being available. Access to the water from wider beaches may be appreciated by people participating in nonswimming activities such as wind surfing and beach-launched water skiing (Corps 1995).

Camping

Camping is popular at both Banks Lake and Lake Roosevelt. Both reservoirs support developed camping areas accessed by vehicles and remote dispersed camping areas accessed by boat. At Banks Lake, some dispersed camping locations are also accessible by motor vehicle. Although camping at facilities accessed by road may not depend upon reservoir elevation, water provides an aesthetic enhancement to the camping experience. In addition, many campgrounds have water-dependent recreation facilities such as boat launches and swimming areas that are used by campers.

At developed sites accessed by vehicle, changes in reservoir pool elevations cause the waters of the reservoirs to recede farther from campgrounds, exposing the reservoir bottom and reducing aesthetic quality. When the use of facilities enjoyed by campers at these sites is compromised by low reservoir elevations, the camping experience can be adversely affected.

Lower reservoir operations can also affect boat camping. Both reservoirs contain developed boat camping areas that have basic facilities. Lower reservoir elevations can make accessing these camping areas more difficult by requiring campers to walk greater horizontal and vertical distances to reach the camping areas, and can make anchoring boats more of a challenge. Lower reservoir elevations generally have less of an effect on dispersed camping because this type of camping usually occurs along the shoreline near the water's edge.

Day-Use Activities

People engaged in day-use activities at both reservoirs typically participate in several activities such as picnicking, swimming, and playing games. Some of these activities are water dependant and some are enhanced by proximity to water. Changes to operations can affect picnicking and other day-use activities if it becomes impossible to participate in water-dependent activities or the waters of the reservoirs are further away from developed areas and the aesthetic quality of the shoreline near them is reduced.

Sightseeing

In this Final EIS, sightseeing includes driving a vehicle, boating, and bicycle touring. These activities emphasize examining the scenery and taking advantage of facilities and activities such as scenic overlooks, visitor centers, maps with routes depicted, and tours and events such as the laser light show at Grand Coulee Dam. The Grand Coulee Project offers tours and facilities that interpret project operations, as well as local and natural history. The

National Park Service (NPS) and Tribes also have interpretive resources at Lake Roosevelt that are visited by sightseers. Although much of Lake Roosevelt cannot be viewed from roads because of the rugged terrain, portions of the reservoir can be seen from them, particularly the northern part. Banks Lake is much more visible to sightseers because SR-155 parallels much of its eastern shoreline.

The portion of SR-155 that parallels much of Banks Lake also passes by Grand Coulee Dam and is part of the Coulee Corridor National Scenic Byway. The Coulee Corridor was designated as a Washington State Scenic Byway in 1997 and a National Scenic Byway in 2005. Several features at Banks Lake and Lake Roosevelt are identified as places of interest in the brochure and map that was developed for the byway (Audubon Washington 2009). An interpretive plan and design guidelines were funded by the NPS and include a number of references to areas at Banks Lake and Grand Coulee Dam (Otak 2009).

Hunting and Wildlife Viewing

Hunting takes place near and adjacent to both reservoirs, but occurs in much smaller numbers than the water-oriented recreational activities describe above. Waterfowl hunting occurs along the shorelines and waters of the reservoirs in the fall and winter. Upland bird, big-game, and small game hunting are not generally considered water-oriented (although deer hunters may use boats to access remote parts of the reservoirs), but do take place on lands adjacent to the reservoirs.

Wildlife viewing opportunities occur throughout the two reservoirs on WDFW, NPS, and other lands. Several locations (Coulee City Community Park, Southwest Banks Lake Access, Northrup Point Access, Northrup Canyon, and the Steamboat Rock Peninsula) along Banks Lake were identified in the Cascade Loop of The Great Washington State Birding Trail-Cascade Loop as destination birding locations (Audubon Washington 2009).

3.14.2.3 Banks Lake Management and Facilities

Banks Lake is recognized—regionally and locally—for its diverse and outstanding recreational opportunities. Many recreationists are drawn to Banks Lake because of the unique and scenic natural features of the area. In addition, the reservoir supports one of the finest fisheries in the State as well as a variety of camping, swimming, boating, picnicking and other recreational experiences (Reclamation 2004).

Background and Management of Recreation Resources

In 2001, the Banks Lake Resource Management Plan was developed and adopted by Reclamation to respond to the growing demand for recreational opportunities and visitor facilities. The intent of the Resource Management Plan was to develop a balance between recreational demands and the protection and conservation of other resources (Reclamation

2001). The Resource Management Plan has a number of goals related to recreation, such as site expansion and improvements, dispersed camping, off-road and primitive road motorized travel management, and specific recreation activity types, as well as resource protection.

Reclamation lands and facilities around Banks Lake are managed by the Washington State Parks and Recreation Commission (WSPRC) and the WDFW under agreements signed in 2003. These agreements were successors to a lease with the State for management that was signed in 1952. The two agencies are primarily responsible for leasing or permitting activities to third parties (private concessionaires) on lands they manage (Reclamation 2004).

The WSPRC is responsible for the operation and management of the 3,500 acre SRSP Recreation Area, which includes the Steamboat Rock Rest Area and Boat Launch, the Jones Bay Campgrounds, the Osborn Bay SW Campground and Boat Launch, the Northrup Canyon Natural Area, and the Castle Rock Natural Area Preserve located just east of Banks Lake. The SRSP has approximately 50,000 lineal feet of shoreline ranging from long stretches of straight shoreline to very complex coves and inlets. WSPRC is in the process of developing a land use plan for SRSP (WSPRC 2009). Currently, WSPRC has developed alternatives with different areas of emphasis and will be preparing preliminary recommendations in the near future.

The WDFW operates and maintains six very basic water access facilities. They are scattered across the reservoir and include unpaved boat launches and other facilities. The six facilities are Dry Falls (Ankey 1), Dry Falls Campground (Ankey 2), Million Dollar Mile South, Million Dollar Mile North, and Osborn Bay. Two other access locations (Fordair and Poplars) are managed by WDFW, but are too primitive for most recreationists to launch boats from trailers and are not considered to be functioning boat launch facilities in this EIS.

Three of the largest recreational facilities at the reservoir (Sunbanks Resort, Coulee Playland, and Coulee City Community Park) are operated by private concessionaires or lessees. The Sunbanks Resort is administered by WDNR (Reclamation 2001). Electric City and Coulee City have public park lease agreements with Reclamation and, in turn, have developed agreements or leases with other parties. The town of Electric City operates the Electric City Public Park and has a concession agreement with Coulee Playland to operate the facilities at Coulee Playland. The City of Coulee City has a public park lease from Reclamation for the operation of the park facilities at Coulee City Community Park and in turn subleases to Grant County Port District 4 to operate and maintain the breakwater system and marina near the Coulee City Community Park.

Visitation

Banks Lake attracts visitors from both the local area and from distant population centers like Puget Sound. Local residents (primarily from Grant County) tend to recreate at Banks Lake during the day, but typically do not stay overnight. Visitors from outside the immediate area, such as those traveling up to 200 miles to reach the reservoir from Puget Sound, use the overnight facilities and are generally seeking uncrowded recreational opportunities, sunny days, and warm water (Reclamation 2004).

SRSP is the most visited recreational resource at Banks Lake. As indicated in Table 3-29, SRSP received over 580,000 visitor days in 1997 (Reclamation 2004). Although annual attendance estimates for other recreation resources such as the WDFW water access facilities, Sunbanks Resort, and the Coulee City Community Park, were not included in the 1997 data, none would come close to SRSP in terms of numbers of visitors. With just the facilities included in Table 3-29, the total estimated number of visitors in 1997 was over 666,000. The actual visitation numbers that would include facilities not included in Table 3-29 were likely considerably higher.

Table 3-29. Visitation at Banks Lake in 1997.

Facility	Number of Visitor Days
Steamboat Rock State Park	583,496
Dry Falls Interpretive Center	17,542
Coulee Playland Resort	20,000
Total	666,753
Source: Reclamation 2004	

Recreational use of facilities at Banks Lake varies throughout the year, with most visitation and use occurring between May and October. As shown on Table 3-30, visitation data from SRSP for 2008 indicated that approximately three-quarters of the annual visitation occurred during this period, with half taking place between June and August. A creel survey conducted by WDFW between September 2005 and August 2006, found that most fishing occurred at Banks Lake between May and October (Polacek and Shipley 2007).

Table 3-30. Monthly visitation in 2008 at Steamboat Rock State Park.

Month	Recreational Visitor Days (percentage)
January	13,826 (3 %)
February	8,862 (2%)
March	18,490 (4%)
April	18,460 (4%)
May	46,525 (11%)
June	46,346 (11%)
July	83,887 (20%)
August	90,717 (21%)

Month	Recreational Visitor Days (percentage)
September	42,734 (11%)
October	20,977 (5%)
November	25,501 (6%)
December	9,573 (2%)
Total	416,325
Source: Poplawski 2009	

3.14.3 Reservoir-Oriented Recreation Facilities

This section describes the recreation facilities that could be affected by the action alternatives. Some of the facilities are water-dependant and some are enhanced by a proximity to water. These facilities allow the general public and customers at privately managed recreational facilities to access and enjoy the waters and shoreline of Banks Lake. Table 3-31 provides information regarding these facilities and Figure 3-14 and Figure 3-15 depict their locations.

Table 3-31. Recreational facilities at Banks Lake.

Facility (Managed By)	Boat Launch (minimum functional pool elevation—feet)	Estimated Percentage of Total Banks Lake Boat Launching Capacity	Transient Moorage Facilities Available	Developed Swimming Area (minimum functional pool elevation—feet)	Camping (Number of Individual Sites)	Picnic Area	Notes
South Sector of Banks Lake							
Coulee City Community Park (Private) [a]	Yes (1,565)	15%	Yes	Yes (1,560)	155	Yes	Launch ramp is concrete
Dry Falls Boat Launch or Ankeny #2 (WDFW)	Yes (1,565)	5%	No	No	Undefined sites		Launch ramp is gravel
Dry Falls Campground or Ankeny #1 (WDFW)	Yes (1,565)	5%	No	No	Undefined sites		Launch ramp is gravel
Middle Sector of Banks Lake							
Million Dollar Mile South Day-use Area (WDFW)	Yes (1,565)	5%	No	No	Undefined sites		Launch ramp is concrete
Million Dollar Mile North Boat Launch (WDFW)	Yes (1,565)	5%	No	No	Undefined sites		Launch ramp is graded
Steamboat Rock/Barker Flats Sector of Banks Lake							
SRSP Campground South (WSPRC)	NA	NA	NA	No	62		
SRSP Campground North (WSPRC)	NA	NA	NA	No	62		
SRSP Boat-in Campground (WSPRC)	NA	NA	NA	No	12		
SRSP Day-use Area (WSPRC)	Yes (1,562)	20%	Yes	Yes (1,566)		Yes	Launch ramp is concrete
SRSP Rest Area	Yes (1,560)	10%	No	No			Launch ramp is

Facility (Managed By)	Boat Launch (minimum functional pool elevation—feet)	Estimated Percentage of Total Banks Lake Boat Launching Capacity	Transient Moorage Facilities Available	Developed Swimming Area (minimum functional pool elevation—feet)	Camping (Number of Individual Sites)	Picnic Area	Notes
(WSPRC)							concrete
Barker Canyon (or Flats) Campground (WDFW)	Yes (1,565)	2.5%	No	No	Undefined sites		Launch ramp is concrete
North Sector of Banks Lake							
Osborn Bay SW Campground (WSPRC)	Yes (1,565)	5%	No	No	36		Launch ramp is gravel
Osborn Bay SW Boat Launch (WSPRC)	Yes (1,565)	Unknown	No	No	Undefined sites	No	
Osborn Bay SE Boat Launch (WDFW)	Yes (1,565)	2.5%	No	No			Launch ramp is graded
Jones Bay Campground (WSPRC)	NA	NA	NA	No	44		Primitive camping
Sunbanks Resort (Private) [a]	Yes (1,562)	10%	Yes	Yes (1,566)	190	Yes	Launch ramp is concrete
Coulee Playland (Private) [a]	Yes (1,560)	15%	Yes	Yes (1,566)	65	Yes	Launch ramp is concrete

[a] Lessee or Concessionaire

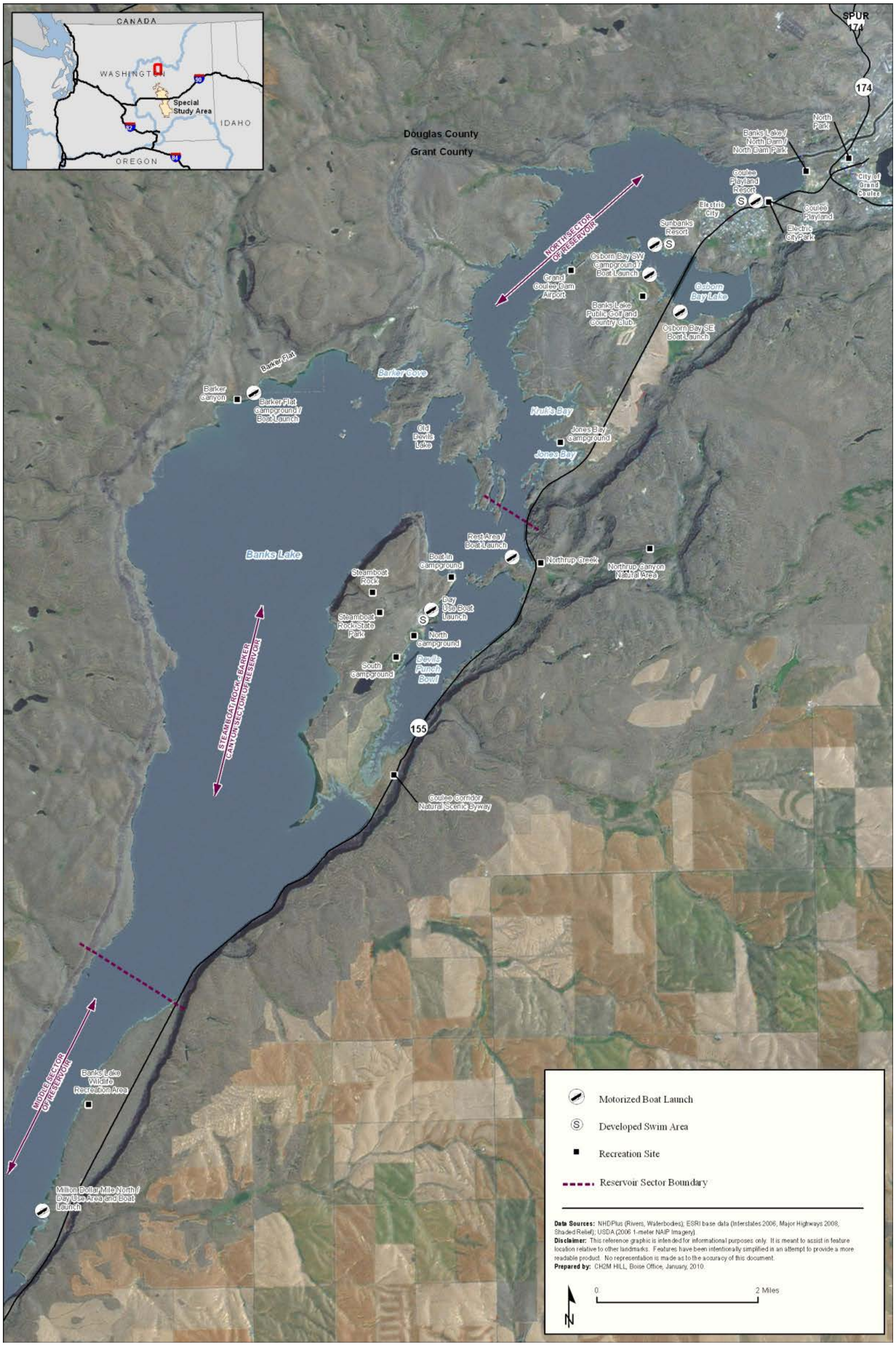


Figure 3-14. Banks Lake, north, recreation facilities and reservoir sectors.

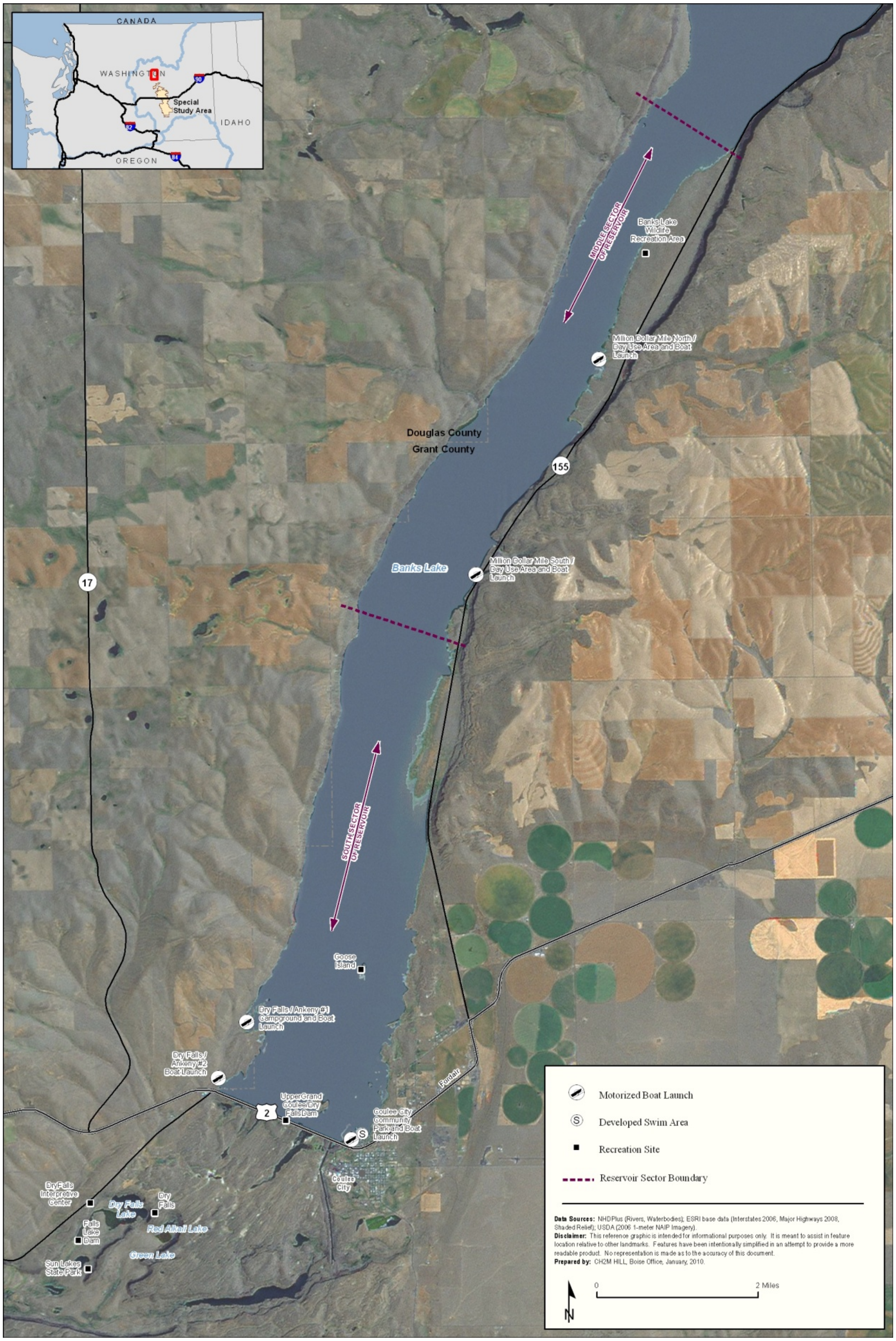


Figure 3-15. **Banks Lake, south, recreation facilities and reservoir sectors.**

3.14.3.1 Boat Launching and Moorage Facilities

There are 12 facilities at Banks Lake from which the public can launch boats from trailers. Their level of development ranges from highly developed facilities composed of concrete ramps with two lanes, floating docks, paved and marked parking for vehicles and boat trailers, restrooms, areas of irrigated lawn, shade trees, and drinking water, to very basic access facilities that include unpaved ramps (or entries into the reservoir), unpaved parking areas, vault toilets, and perhaps informal areas for camping. The largest, most developed, and most used facilities are the SRSP Day Use Area, SRSP Rest Area, Coulee Playland, and Coulee City Community Park. Each of these has two-lane concrete ramps and nearby camping, overnight, and day-use facilities. These four facilities provide the majority of the launching capacity at Banks Lake. Sunbanks Resort also has a one-lane boat launch and nearby camping, overnight, and day-use facilities.

Six of the other seven boat launches at Banks Lake are managed by WDFW, as shown on Table 3-31. These facilities provide access to parts of the reservoir not served by the larger facilities shown in Figure 3-14 and Figure 3-15. Most of the ramps for these boat launches consist of graded entries into the reservoir, some of which are graveled and some of which are not. They operate over a fairly narrow elevation range of up to 5 feet below full pool. The seventh similar facility is the Osborn Bay Southwest Campground facility, which is managed by WSPRC and is also functional down to an elevation 5 feet below full pool. The WDFW facilities also have vault toilets, graveled parking areas and picnic tables.

Banks Lake has four rather distinctive areas called sectors, as shown on Figure 3-14 and Figure 3-15:

- **South Sector**: Oriented around the Upper Grand Coulee/Dry Falls Dam and Coulee City, the south sector contains one highly developed recreation facility on the east side (Coulee City Community Park) and two less-developed water access facilities on the west side (Dry Falls Boat Launch and Dry Falls Campground).
- **Middle Sector**: The least developed and used sector, this area has only the Million Dollar South and North water access locations.
- **Steamboat Rock/Barker Flats Sector**: With three boat launch facilities that range from the highly developed SRSP Day Use and Rest Area facilities to the less developed Barker Flats facility, this is a heavily used area.
- **North Sector**: Contains five boat launch facilities, and two of the deepest functioning launches at Banks Lake, Coulee Playland, and Sunbanks Resort. The third most popular launch in this sector includes the Osborn Bay Southwest Campground launch.

No full-service marinas similar to those at Lake Roosevelt are available at Banks Lake. Slips or docks for temporarily or seasonally mooring boats are available at Coulee City Community Park, Sunbanks Resort, and Coulee Playland.

The Banks Lake Drawdown EIS reported that during reservoir drawdowns (no elevations given), sandbars are sometimes exposed or lie just below the surface at the Dry Falls, Million Dollar Mile North and South, Barker Flat, and Osborn Bay Southeast boat launches (all of which have minimum useable elevations to 5 feet below full pool) (Reclamation 2004). At low elevations, these facilities can be difficult to access and use. When this occurs, launching is reported to increase at the SRSP Rest Area and boat launch (which is useable down to an elevation of 10 feet below full pool).

Currently, all 12 boat launch ramps are functional during the recreation season, although some are at the low end of their operating range in August. All four sectors of the reservoir are generally accessible by boat launch and, with the exception of the sandbars, no new hazardous areas are currently exposed.

Under Alternative 4A, the maximum drawdown at Banks Lake will be 11 feet during the month of August. This drawdown will put the elevation of Banks Lake at 1559 feet amsl. The south sector of the reservoir will have two boat ramps operational at the 1559 foot elevation; Coulee City Park #2 with an usable elevation of 1558 feet and Dry Falls Campground (Ankeny #1) at 1538 feet. The middle sector has an operational boat launch at Million Dollar Mile South with an operational elevation of 1557 feet. The Steamboat Rock sector will have one public operational boat launch at Northup, with a usable elevation of 1550 feet. Lastly, the north sector will also have one operational launch at this elevation, Coulee Playland with an operational boat ramp down to an elevation of 1545 feet.

All four sectors will have access for public use during this drawdown period, with the possibility of additional ramps being extended in the future. No other modifications will be required.

Under Alternative 2A, the maximum drawdown will be 10 feet during the month of August. This drawdown will put the elevation of Banks Lake at 1560 feet. In addition to the above usable boat ramps, Steamboat Rock State Park Camp Ground will be operational.

Under Alternative 3A, the maximum drawdown will be 15 feet during the month of August. This drawdown will put the elevation of the Reservoir at 1555 feet. The north sector operational boat ramp will be Coulee Playland at 1545 feet. The middle sector, Million Dollar Mile South at this elevation will not be operational without extending the ramp. An estimate of this extension with labor, time, and materials is approximately $10,000 to $15,000. Steamboat Rock sector will have an operational boat ramp at Northrup; this ramp is operational down to an elevation of 1550 feet. The south sector Dry Falls Campground (Ankeny #1) will be operational down to an elevation of 1538 feet. However, as noted prior this boat ramp will launch limit size boats due to the shallow slope of the ramp and shallow water depth.

In the fall of 2011, improvements were completed to boat launches and at the Coulee City Community Park. These improvements coincided with the drawdown of the reservoir and allowed improvement work in the Coulee City Community Park's Marina, shoreline, and improvements to the Million Dollar Mile South Launch and Barker Canyon Boat Ramp. At Coulee City Community Park portions of the Marina were deepened to accommodate larger boats and more boats during periods of drawdown. Shoreline in this same location was armored to reduce beach erosion and reduce tree root exposure, hence predisposing trees to wind throw and hazards. The jetty surrounding the Marina was widened and a portion extended providing increased access and protection from wind waves into the Marina.

Lastly, during this period of drawdown underwater hazards were exposed and removed to provide an increased level of safety for both water-uses and boats.

Swimming Facilities

Developed swimming areas are located at the SRSP Day Use Area, Coulee City Community Park, Coulee Playland, and Sunbanks Resort. Under current conditions, all four developed swim areas are functional during the recreation season, except for August, when only the Coulee City Community Park swimming area is functional. Even so, Coulee City Community Park sometimes experiences stagnant water conditions in its swimming area at low pool elevations that make this area unavailable. Consequently, the city is considering the installation of an aeration device or other measures to improve the park's swimming area.

Campgrounds

Camping is a popular activity at Banks Lake and most campgrounds are at least partially located near the shoreline of Banks Lake. Eleven locations have developed camping areas. They range from fully developed recreational vehicle (RV) and tent sites to primitive areas with no designated campsites. Full-service RV utility sites and formal tent sites are provided at Coulee City Community Park, Steamboat Rock State Park, Coulee Playland, and Sunbanks Resort. Less developed facilities (with no RV utility hookups) that include vault toilets, fire rings, picnic tables, and pedestal grills are found at Jones Bay, Osborn Bay Southwest, and Dry Falls campgrounds (Reclamation 2001). Most of the developed camping facilities are in the Steamboat Rock/Barker Flats sector of the reservoir. Camping also occurs at the six WDFW sites. Dispersed camping areas are accessed by the areas primitive road system or by boat. Some of the more popular general areas for dispersed camping are southeast Banks Lake south of the Million Dollar Mile North Boat Launch, Kruk's Bay/Airport Bay, Osborn Bay, Barker Flat, Old Devil's Lake/Lovers Lane, and along the Steamboat Rock peninsula's west shore (Photograph 3-7; Reclamation 2004).

Photograph 3-7. Camping facilities at Banks Lake.

Under current conditions, the boat launch facilities adjacent to campgrounds and day-use areas are functional during the primary recreation season. In August, the inability to use the developed swimming areas at the SRSP Day Use Area, Coulee Playland, and Sunbanks Resort may contribute to a decrease in use at the campgrounds and day-use areas near them. Reservoir elevations during most of the recreation season are not low enough to negatively affect the aesthetic setting or desirability of most developed campgrounds or day-use areas. In August, the amount of exposed shoreline at most of the more developed day-use areas and campgrounds is less than 100 feet, although it is sometimes between 100 and 250 feet at the Coulee City Community Park.

Day-Use Areas

Much of the day-use activity at Banks Lake occurs near the same developed and dispersed areas used for launching boats, swimming, and camping. Developed picnic sites and playgrounds can be found at the Coulee City Community Park, SRSP Day Use Area, Coulee Playland, and Sunbanks Resort. Some of the boat launch areas operated by WDFW also have facilities such as restrooms and parking areas that are used by people participating in day-use activities. Activities that take place at, or originate from, day-use areas include individual and group picnicking, riding personal watercraft, wind surfing, scuba diving, wildlife observation, hiking, and horseback riding (Reclamation 2004).

Land-Based Recreation

The Banks Lake Management Unit of the 192,000-acre Columbia Basin Wildlife Area is located around much of Banks Lake. The unit is managed by WDFW and includes 44,700 acres of land owned by Reclamation and 41 acres owned by WDFW. It supports hunting and wildlife viewing. Waterfowl hunting near Banks Lake takes place in the fall and early winter. Upland game birds such as quail, chukar, and pheasant can be found in undeveloped brushy areas and stubble fields near the reservoir. Hunting for mule deer also occurs near the reservoir.

Wildlife viewing is an increasingly popular activity statewide and at Banks Lake. The Banks Lake area supports a variety of wildlife observation opportunities, trails, scenic vistas, and unique plant communities (such as the Northrup Canyon Natural Area). Migratory and resident birds that can be viewed include great blue herons, white pelicans, sandhill cranes, hawks, long-horned owls, and bald eagles (Reclamation 2004). Mammals like deer, coyotes, beaver, muskrat, and rabbit are abundant. Developed trails in the Steamboat Rock State Park Recreation Area provide good wildlife viewing opportunities.

3.14.3.2 Lake Roosevelt

Lake Roosevelt is a major regional and local recreational resource and, as indicated in Table 3-28, is a significant supplier of recreational facilities in the middle and upper Columbia River Basin. The Lake Roosevelt National Recreation Area is one of three National Recreation Areas in the state of Washington and its designation indicates its recreational value.

Background and Management of Recreation Resources

In 1946, NPS was designated as the manager for the Coulee Dam National Recreation Area. This name was changed to Lake Roosevelt National Recreation Area (LRNRA) in 1997. The LRNRA is composed of 312 miles of shoreline along the Columbia River, 7 miles along the Kettle River Arm, and 29 miles along the Spokane River Arm. The NPS administers approximately 47,400 acres of the approximately 81,400-acre water surface (at full pool) and approximately 12,900 acres of adjacent land (69 FR 5799). The lands of LRNRA consist primarily of a narrow band of shore above the full pool elevation of 1290 feet amsl. Much of the remainder of the shoreline and surface area of Lake Roosevelt lies within the reservation boundaries of the Spokane Tribe and the Colville Confederated Tribes and is not part of the LRNRA (69 FR 5799).

The LRNRA has been managed under the Lake Roosevelt National Recreation Area General Management Plan since 2001 (NPS 2000). This General Plan addresses goals and policies related to a number of resources, including recreation. The NPS is currently developing a shoreline management plan that will address “the challenges of increasing visitation, changing lake conditions, and managing complex resources with a range of solutions" (NPS 2009 Shoreline). The shoreline management plan is examining four different management alternatives, each of which would employ different management strategies. The alternative that is selected will be consistent with the General Plan.

On lands owned by the Colville Confederated Tribes, recreation resources are managed under the Parks and Recreation Strategic Plan (Colville Tribes DNR 2009). Reservation recreation resources on the Spokane Tribe Reservation are managed by the Tribe's Department of Natural Resources.

Visitation

The primary attraction for most visitors to Lake Roosevelt is water-based recreation and camping. Between 1998 and 2008, Lake Roosevelt received between approximately 1.25 and 1.55 million visitor days annually, as shown in Table 3-32. Visitor use at Lake Roosevelt is unevenly distributed throughout the year. Nearly 75 percent of annual use occurs during the summer months, as shown in Table 3-33. Typically visitor use dramatically increases in June, peaks in August, and falls off in September. The latest NPS visitation data for 2008 show the highest monthly visitation (approximately 290,800) occurring in August and a lowest (approximately 14,200) in January.

Table 3-32. Annual visitation (1998 to 2008) at LRNRA.

Year	Recreational Visitor Days
2008	1,337,024
2007	1,450,438
2006	1,281,586
2005	1,272,119
2004	1,279,051
2003	1,356,331
2002	1,444,751
2001	1,252,160
2000	1,415,627
1999	1,403,793
1998	1,545,150
Source: NPS 2009 Usage Report	

Table 3-33. Monthly visitation at LRNRA – 2008.

2008	Rec Visits	Concession Lodging	Tent Campers	RV Campers	Back Country Campers	Total Overnight Stays
January	14,246	0	0	98	0	98
February	25,273	0	0	68	0	68
March	43,044	0	255	588	0	843
April	71,011	0	595	1,403	0	1,998
May	125,381	40	2,275	4,765	0	7,080
June	168,331	1,640	7,085	8,465	410	17,600
July	290,792	2,640	12,618	12,420	239	31,824
August	265,440	3,240	13,970	13,748	1,003	35,186
September	137,164	1,040	2,020	6,100	0	9,160
October	100,617	0	955	3,128	0	4,083
November	70,677	0	205	1,010	0	1,215
December	25,048	0	23	73	0	96
2008 Total	**1,337,024**	**8,600**	**40,001**	**51,866**	**1,652**	**109,251**
Source: NPS 2009 Usage Report						

In 1996, NPS conducted a visitor use study (Ecology 2008). Most survey respondents lived in the State of Washington (74 percent) with approximately 13 percent from Canada and 5 percent living in other nearby states. A creel survey conducted in 2006 found that anglers overwhelmingly come from Spokane County (40 percent), with another 20 percent coming from Lincoln and Stevens counties. Another 16 percent were evenly divided between western Washington and the City of Yakima. The NPS survey found that about 46 percent of the respondents were repeat visitors and that the most popular activities were camping in a developed campground (16 percent), swimming (15 percent), motor boating (11 percent), and fishing (10 percent).

3.14.3.3 Reservoir-Oriented Recreation Facilities

This section describes the water-oriented facilities (boat lunches, marinas, and developed swimming beaches) and facilities near the reservoirs that are enhanced by proximity to water (campgrounds and day-use areas) at Lake Roosevelt that could be affected by the action alternatives. These facilities allow the general public and customers at privately managed recreational facilities to access and enjoy the waters and shoreline areas of Lake Roosevelt.

Boat Launches and Marinas

As shown in Table 3-34, there are 22 boat launch areas at Lake Roosevelt. The launches consist of ramps that allow watercraft to be launched, sometimes have docks to assist in launching and retrieval, and provide parking for vehicles and watercraft trailers. Some ramps at Lake Roosevelt are concrete, others are graded and covered in gravel, and some have been simply graded enough to allow a trailer to be backed into the reservoir.

In May, at the start of the recreation season, Lake Roosevelt is normally still filling from the late winter/spring drawdowns for flood control. In average and wet water years, when the flood control drawdowns are relatively deep, only 1 to 4 of the 22 boat launches are usable; in dry and drought years, when flood control drawdowns are not as deep, all 22 launches are generally usable in May. By June, in all but wet water years (with the deepest flood control drawdowns), all 22 boat launches are usable. In July and September of all water years, all 22 boat launches are operational. In August, launches generally remain functional under all water years, except for Hawk Creek, Marcus Island, Napoleon Bridge, Evans, North Gorge, and China Bend. Boaters who would normally use Hawk Creek for launching would be able to use the nearby Fort Spokane launch.

Table 3-34. Recreational facilities at Lake Roosevelt.

Facility	Minimum Boat Launch Elevation (feet)	Boat Launch Lanes	Marina	Developed Swimming Area	Camping (Number of Individual Sites)	Picnic Area	Notes
National Park Service—Lower Lake							
Crescent Bay	1265	1	--	--	--	--	
Spring Canyon	1222	4	--	Yes	87	Yes	
Keller Ferry (Marina)	1229	4	Yes	Yes	55	Yes	
Hanson Harbor	1253	1	--	--	--	--	
Jones Bay	1266	1	--	--	9	--	
Lincoln	1245	2	--	--	--	--	
Hawk Creek	1281	1	--	--	21	--	
Seven Bays (Marina)	1227	4	Yes	--	--	Yes	
National Park Service—Spokane River Arm							
Fort Spokane	1247	4	--	Yes	67	Yes	
Porcupine Bay	1243	4	--	Yes	31	Yes	
National Park Service—Upper Lake							
Hunters	1232	4	--	Yes	37	Yes	
Gifford	1249	4	--	--	42	Yes	
Cloverleaf	--	--	--	Yes	9	Yes	
Daisy	1265	1	--	--	--	Yes	
French Rocks	1265	1	--	--	--	--	
Bradbury Beach	1251	1	--	Yes	--	Yes	
Haag Cove	--	--	--	--	16	Yes	
Kettle Falls (Marina)	1234	4	Yes	Yes	76	Yes	

Facility	Minimum Boat Launch Elevation (feet)	Boat Launch Lanes	Marina	Developed Swimming Area	Camping (Number of Individual Sites)	Picnic Area	Notes
Marcus Island	1281	1	--	Yes	25	Yes	
Kamloops	--	--	--	--	17	--	
Kettle River	--	--	--	--	13	--	
Napoleon Bridge	1280	1	--	--	--	--	
Evans	1280	2	--	Yes	43	Yes	
Snag Cove	1277	1	--	--	9	--	
North Gorge	1280	1	--	--	10	--	
China Bend	1280	1	--	--	--	--	
Colville Indian Reservation							
Reynold's Resort	--	--	--	--	47	Yes	
Rogers Bar	--	--	--	--	19	Yes	
Wilmont Creek	--	--	--	--	12	Yes	
Barnaby Island	--	--	--	--	2	Yes	
Barnaby Creek	--	--	--	--	3	Yes	
Inchelium (Ferry)	--	--	--	--	10	Yes	1,270 minimum for ferry
Keller Park	--	--	--	--	22	--	
Spokane Indian Reservation							
Blackberry Cove	--	--	--	--	--	--	
McGuires Place	--	--	--	--	2	Yes	
Balcomb's Landing	--	--	--	--	1	Yes	
Upper Columbia	--	--	--	--	3	Yes	
Lower Columbia	--	--	--	--	6	Yes	

Facility	Minimum Boat Launch Elevation (feet)	Boat Launch Lanes	Marina	Developed Swimming Area	Camping (Number of Individual Sites)	Picnic Area	Notes
Abraham Cove	--	--	--	--	--	--	
Two Rivers (Marina)	1280	--	Yes	--	100	Yes	
Cornelius	--	--	--	--	2	--	
Hidden Beach	--	--	--	--	2	Yes	
Chief 3 Mountain	--	--	--	--	2	Yes	
Raccoon Cove	--	--	--	--	--	Yes	
Maggie Shoup	--	--	--	--	3	Yes	
No Name	--	--	--	--	2	Yes	
Sand Creek	--	--	--	--	2	Yes	
McCoys (Marina)	--	--	Yes	--	--	--	
Source: Ecology 2008							

People who would normally use the other five launches (all of which are located at the far north end of the reservoir upstream from Kettle Falls) would have fewer options of where to launch, but could do so at Kettle Falls or Snag Cove or even French Rocks and Bradbury Beach (approximately 15 miles downriver from Kettle Falls). Therefore, current operations are impacting recreation at the north end of the reservoir.

As shown in Table 3-34, the reservoir elevation at which boat launch ramps become difficult or impossible to use varies considerably. Most of the shoreline facilities mentioned previously have been designed to function within a range of summer reservoir levels that reach up to 1290 feet amsl by mid-July and slowly taper back down to an elevation of 1280 feet amsl by the end of August.

Lake Roosevelt contains five marinas which are open around Memorial Day and close anywhere from between Labor Day and mid-October (NPS 2009 Roosevelt). The marinas are accessible from upland areas via ramps that fluctuate with the water level. The marinas are all located in protected bays that tend to have large flat and shallow bottom areas that are a restricting factor during periods of low water elevations (NPS 2008).

By the end of May during average and wet water years under current operating conditions, only one of the five marinas at Lake Roosevelt is usable (the Two Rivers Marina). During dry and drought water years, all five are generally usable. For the rest of the recreation season, except for August, all five marinas function under all water years. In August, four are usable and one (the Seven Bays Marina) is not fully functional. The loss of one marina is currently a significant impact for people desiring to moor boats during August.

Swimming Areas

Ten recreation facilities contain developed swimming areas, as shown on Table 3-34. Nine of the swimming areas are located at facilities that include campgrounds. Most of the larger campgrounds at Lake Roosevelt have developed swimming areas. Developed swimming areas have gently sloping beaches that are free of large rocks. They are enclosed by one or two rings of either PVC or wood log boom systems. These boom systems serve to keep boaters out of the swim area to protect swimmers, provide a resting point for tired swimmers in areas of deeper water, and provide some wave attenuation (NPS 2008).

Developed beaches have been typically designed for depths that range from very shallow (for small children) to up to 7 feet (Corps 1995). At full pool, many of the beaches at the developed swimming areas are inundated by water and cannot be used. By June, all swimming areas are generally functional, except in wet years when seven of the ten are inundated. During July and September, all developed swimming areas are functional in all water years with current operating conditions. In August of all water years, the number of usable beaches drops to between six and eight, which currently impacts reservoir users.

Campgrounds

Campgrounds are fairly well dispersed throughout Lake Roosevelt, as shown on Table 3-34. NPS has 27 developed campgrounds at Lake Roosevelt, 16 of which can be accessed by motor vehicle and 11 that are boat-in or walk-in sites (NPS 2009 Chart). The Tribes also provide camping at several developed and primitive camping areas.

The three largest campgrounds (Spring Canyon, Keller Ferry, and Hawk Creek) in the lower part of the reservoir also have boat launches and two have developed swimming areas. In the Spokane River Arm, both of the developed campgrounds (Fort Spokane and Porcupine Bay) have boat launches and swimming areas. Five of the larger campgrounds (Hunters, Gifford, Kettle Falls, Marcus Island, and Evans) in the upper reservoir contain boat launches and all but Gifford have developed swimming areas. The Colville Indian Reservation contains and manages five campgrounds. The Spokane Reservation has 11 areas that are used for camping and are managed by the Tribe. The number of sites at the camping areas ranges from 1 to 100 at the Two Rivers facility.

Under current operational conditions, the use of many campgrounds and day-use facilities are influenced by the ability to participate in multiple activities. The ability to launch boats from nearby boat launches, access marinas, or use nearby developed swimming areas is important to many campers and people who use day-use facilities. It greatly influences the use of campgrounds and day-use areas. The boat launches and developed swimming areas that are located near campgrounds and day-use areas are functional during the recreation season except in August. In August, there is a decrease in usable boat launching facilities and developed swimming areas near campgrounds and day-use facilities that impacts current recreation users.

Day-Use Areas

Many of the facilities at the campgrounds identified above are also used for day-use activities, particularly by people who live in the general analysis area. Day-use recreationists may engage in activities that are somewhat different than campers, but still appreciate proximity to water. Day-use visitation also occurs at other noncamping facilities such as marinas (boat launching, using boats moored at the marinas for the recreation season, boat rental or dining) and visitor centers. Developed swimming beaches are popular with local residents in part because, with the exception of Kettle Falls, there are no public swimming pools in the communities near Lake Roosevelt.

Dispersed Recreation

Most recreational activities at Lake Roosevelt occur at or near developed or designated primitive recreation sites maintained by NPS (Ecology 2008). Dispersed use occurs throughout the reservoir in remote, undeveloped areas. Within the LRNRA, dispersed shoreline camping is especially popular in remote areas of the lower portion of the reservoir. It also occurs in other parts of the lake and is an ongoing management challenge for the NPS and the Tribes. Trash and human waste are the biggest management issues associated with these areas.

Other Recreational Facilities near Lake Roosevelt

In addition to the recreational facilities described previously, several nearby parks managed by municipalities add to the local supply of recreational facilities, and are particularly important to local residents for day-use activities and sporting events.

3.14.4 Odessa Special Study Area

Little information is available concerning recreation in the Study Area. Most recreation in this area is believed to consist of hunting and wildlife viewing, although some sightseeing may occur as people drive through the area. The Study Area is located within parts of five WDFW game management units. The management units are large geographical areas that have been established across the State. WDFW manages the 192,000-acre Columbia Basin Wildlife Area, which is mostly outside of the Study Area, but still influences hunting because it is such an important resource for many species of interest to hunters, particularly migrating waterfowl. The Gloyd Seeps Management Unit is located south of SR-28 and north of I-90 near the Study Area.

Because the vast majority of land in the Odessa Subarea is privately owned, most hunting likely occurs on private lands and is focused on waterfowl and upland game bird species. Some hunting on these lands is likely done by individuals with the permission of the landowners and by the landowners themselves. Other lands are hunted by private hunting guide and outfitter services. These businesses take clients hunting on lands they own and on lands owned by others under lease agreements. Many of these properties are on agricultural lands that receive irrigation. Guided mule deer hunting occurs on a large area of private land within the Study Area.

Wildlife viewing is believed to occur throughout the Study Area and likely takes place from vehicles driving public roads. Events such as the Othello Sandhill Crane Festival attract wildlife viewers to the general area and raise its profile as a wildlife viewing area. The Great Washington State Birding Trail Map—Coulee Corridor Scenic Byway shows birding locations to the west and outside of the Study Area (Audubon Washington 2009).

3.15 Irrigated Agriculture and Socioeconomics

3.15.1 Irrigated Agriculture

3.15.1.1 Analysis Area and Methods

Washington's Adams, Grant, Franklin, and Lincoln counties make up the analysis area for the irrigated agriculture section. The Study Area is located within these four counties. This analysis of irrigated agriculture is based on information about the following:

1. Groundwater irrigation in the Study Area
2. Current crops grown in the Study Area
3. Projections of changes to the types and amounts of crops that would be grown in the future under the action alternatives

Historical data about the number of acres of cropland, average farm sizes, agricultural land values, and agricultural production were collected for the four-county analysis area. All of this information came from published sources. Some of the general data is published every 5 years in the Census of Agriculture. Other pieces of information, such as average crop yield and average sales prices received for crops, are published annually by the National Agricultural Statistics Service (NASS) for the State of Washington (USDA 2010).

A general picture of agricultural production in the four-county area does not provide the depth of information needed to accurately portray the future of farms in the Study Area; therefore, more detailed information is included to make the agricultural impacts analysis as accurate as possible. In this analysis, the general picture of agricultural production in the four-county area precedes more detailed information. Generally, Census of Agriculture data shows average farm sizes for each of the four counties and land values since 1997. These data record primary crops grown in the four-county area. Additionally, annual data provided by NASS addresses county-average yields and average crop prices (USDA 2010).

GWMA provides the next level of detail for this analysis. The GWMA information is specific to lands within the Study Area and includes information about crops grown in the Study Area and irrigation wells. In addition, GWMA offers recommendations about the future of agriculture in the Study Area.

3.15.1.2 Census of Agriculture Data

Census of Agriculture data paints a general picture of agriculture. Very little Census of Agriculture data are used in this analysis, but the data help to understand what is happening in four counties in eastern Washington.

Farms and Farm Size

Census of Agriculture data for Adams, Franklin, Grant, and Lincoln counties in Washington was available for 2007, 2002, and 1997 (USDA 1997, 2002, 2007). In 2007, the four-county analysis area had 4,329 farms encompassing 3,885,663 acres of land, for an average farm size of 900 acres. The 2002 Census of Agriculture showed that the four-county analysis area had 4,208 farms with 4,039,405 total acres. Average farm size according to the 2002 Census of Agriculture was 960 acres. The 1997 Census of Agriculture showed 3,882 farms with 4,131,131 total acres and an average farm size of 1,064 acres. The general trend seen from the Census of Agriculture data is that the number of farms is increasing, while farm size is decreasing.

Census of Agriculture information documents the number of farms with irrigated lands. Farms with irrigation range from a low of about 120 farms in Lincoln County to a high of about 1,410 farms in Grant County. The average number of irrigated acres has been decreasing in Adams and Lincoln counties over time. Franklin and Grant counties have seen fairly steady amounts of irrigated land from 1997 to 2007. Overall, the number of irrigated acres per farm averages 333 acres for the four-county analysis area. Over the three Census of Agriculture periods, irrigated lands make up about 22 percent of the total farmland and 62 percent of the total number of farms are irrigated. The number of irrigated acres, according to the Census of Agriculture reports, rose from 863,330 acres in all four counties in 1997, to 900,259 acres in 2002, and then dropped in 2007 to 843,614 acres. Table 3-35 presents the Census of Agriculture data for number of farms, land in farms, and irrigated farms in the four-county area.

Table 3-35. Census of agriculture number of farm data for the four-county analysis area.

	Adams	Franklin	Grant	Lincoln	Total
2007 Data					
Number of Farms	782	891	1,858	798	4,329
Land In Farms (acres) Avg	1,098,487	609,046	1,087,952	1,090,178	3,885,663
Farm Size (acres)	1,405	684	586	1,366	898
Irrigated Land (# of farms)	304	702	1,403	125	2,534
Irrigated Land (acres)	124,515	217,238	469,790	32,071	843,614
Average # Irrigated Acres	410	309	335	257	333

	Adams	Franklin	Grant	Lincoln	Total
2002 Data					
Number of Farms	717	943	1,801	747	4,208
Land In Farms (acres)	1,067,079	664,875	1,074,074	1,233,377	4,039,405
Avg Farm Size (acres)	1,488	705	596	1,651	960
Irrigated Land (# of farms)	316	744	1,448	141	2,649
Irrigated Land (acres)	120,746	241,063	485,459	52,991	900,259
Average # Irrigated Acres	382	324	335	376	340
1997 Data					
Number of Farms	628	848	1,699	707	3,882
Land In Farms (acres)	1,096,447	563,716	1,095,099	1,375,869	4,131,131
Avg Farm Size (acres)	1,746	665	645	1,946	1,064
Irrigated Land (# of farms)	294	725	1,409	120	2,548
Irrigated Land (acres)	148,018	221,145	446,183	47,984	863,330
Average # Irrigated Acres	503	305	317	400	339
Source: USDA 1997, 2002, 2007					

The four-county analysis area encompasses the Study Area, which has approximately 102,600 acres of land currently irrigated with groundwater authorized to receive CBP water. Thus, irrigated land in the Study Area would account for about 12 percent of the irrigated land in the four-county analysis area.

Agricultural Land Values

The market value of agricultural land averaged $1,024, $2,161, $2,495, and $996 per acre for Adams, Franklin, Grant, and Lincoln counties, respectively, according to the 2007 Census of Agriculture. In general terms, when average land values from the 1997, 2002, and 2007 Census of Agriculture are examined, average land values show a pronounced upward trend. For example, the 1997 Census of Agriculture showed that Adams County average land values were $714 per acre. The average land value for Adams County was $745 per acre in the 2002 Census of Agriculture, a 4.3 percent increase. In 2007, land values increased to $1,024 per acre, a 37.5 percent increase over a 5-year period. This same trend, albeit with differing land values for each county, was seen in all four of the counties in the analysis area. Table 3-36 presents the Census of Agriculture data relating to average market values for counties in the area.

Table 3-36. Average market value of land for the four-county analysis area.

	Adams	Franklin	Grant	Lincoln	Average
2007 Data					
Market Value of Land ($)	1,438,309	1,477,309	1,460,726	1,360,226	1,434,143
Avg Market Value ($/Acre)	$1,024	$2,161	$2,495	$996	$1,669
2002 Data					
Market Value of Land ($)	1,114,407	982,716	1,115,289	1023866	1,059,070
Avg Market Value ($/Acre)	$745	$1,448	$1,923	$606	$1,181
1997 Data					
Market Value of Land ($)	1,307,300	969359	1001298	1078654	1,089,153
Avg Market Value ($/Acre)	$714	$1,469	$1,596	$537	$1,079
Source: USDA 1997, 2002, 2007					

3.15.1.3 National Agricultural Statistics Service Data

NASS gathers and publishes agricultural data specific to the State of Washington every year, including information about the number acres of harvested crops in the analysis area (USDA 2010). This source was also used for information about crop yields and prices. A 5-year average was used to determine baseline crop acreage, yield, and price received. Data from NASS are usually the only source of information about acres of harvested crops, yields, and the price received when crops are sold.

Wheat, hay, and potatoes account for almost 91 percent of all crops grown in the four-county analysis area, according to NASS (USDA 2010). Table 3-37 shows some of the most common crops harvested in the Study Area from 2004-2008. County acreage data was not available in 2009, thus data for 2004 to 2008 was used in the analysis. Wheat is by far the most common crop produced in the analysis area, accounting for 63.4 percent of the total acreage harvested. Alfalfa and other hay cover 20.2 percent of total acreage. Potatoes are 7.2 percent. Corn for grain (3.4 percent) and barley (3.4 percent) are the next most commonly produced crops. Corn silage, oats, pinto beans, pink beans, and dry edible beans comprise the remaining 2.5 percent of harvested acres. Harvested acreage over the four-county region totals 1,345,193 acres.

Table 3-37. Primary irrigated crop acreages for the four-county analysis area, 2004 to 2008.

Crop	2004	2005	2006	2007	2008	Average	Percent
All Wheat	914,600	913,200	890,700	833,100	872,000	884,720	63.4%
Corn Grain	43,000	47,400	32,700	68,900	45,200	47,440	3.4%
Corn Silage	9,700	11,700	10,800	15,500	9,000	11,340	0.8%
Oats	300		400			350	0.0%
All Barley	61,400	45,000	41,800	46,900	39,100	46,840	3.4%
Beans Pinto	2,100	4,300	3,900	4,900	5,000	4,040	0.3%
Beans Pink	1,800	1,450	1,800			1,683	0.1%
Beans_Sm_ Rd	1,900	2,500	2,000	2,900	2,100	2,280	0.2%
Beans_Dry_ Rd	15,400	19,300	19,000	10,700	8,900	14,660	1.1%
Alfalfa	259,000	243,000	239,500	230,400	182,500	230,880	16.5%
Hay Other	40,000	39,500	45,000	67,000	63,000	50,900	3.6%
Potatoes	100,800	95,500	97,500	105,500	101,000	100,060	7.2%
Total	1,450,000	1,422,850	1,385,100	1,385,800	1,327,800	1,395,193	
Source: USDA 2010							

County-Level Crop Yields and Prices

County-average crop yields of representative crops (irrigated and dryland wheat, potatoes, and mixed crops) were obtained from NASS and East Columbia Irrigation District. NASS also provided the price data for crops. A 5-year average price was used. All yields used in the analysis, are reported in Table 3-38.

Table 3-38. Weighted county average yields by crop, 2005 to 2009.

Crop	Yield Unit	2005	2006	2007	2008	2009	Average
Irrigated Wheat	Bushels	108.3	102.4	103.6	101.5	N/A	103.9
Dryland Wheat	Bushels	28.9	43.6	35.6	N/A	N/A	35.3
Mixed Crops	Pounds	2,261.1	1,615	2,433.5	2,335.1	2,290	2,191
Potatoes	Cwt	585.0	595.0	656.0	592.6	614.6	608.6
Source: USDA 2010 (Irrigated and Dryland Wheat, Mixed Crops), East Columbia Irrigation District Block 46 (Potatoes).							

Prices received for the crops came from NASS (USDA 2010). The prices used for this analysis are in Table 3-39.

Table 3-39. Prices received by crop, 2005 to 2009.

		State Average Prices					
Crop	**Yield Unit**	**2005**	**2006**	**2007**	**2008**	**2009**	**Average**
Wheat	Bushel	$3.21	$4.35	$7.51	$6.25	$4.85	$5.23
Mixed Crops	Pounds	$0.218	$0.229	$0.4069	$0.308	$0.286	$0.2894
Potatoes	Cwt	$5.60	$6.00	$6.70	$7.95	$7.40	$6.63
Source: USDA 2010							

The county-average published statistics were used to determine commonly grown crops in the Study Area, but a higher level of detail was needed. More detailed information was obtained from GWMA, who provided cropping patterns specific to Study Area lands irrigated from groundwater sources. NASS county-level yield and state-level price information was incorporated with GWMA acreage data in this analysis.

3.15.1.4 GWMA Data

GWMA provided annual data for the types of crops grown in the Study Area and the number of acres of each crop, as well as information regarding irrigation well status. In this analysis, this specific level of detail was needed, because the Study Area covers parts of four counties.

Crop Acreages in the Study Area

GWMA supplied data about crops and respective acreages for years 2001 to 2005, but GWMA was unable to exactly reproduce the boundaries of the Study Area as Reclamation has defined them. Therefore, total harvested acres from the GWMA dataset cover 102,370 acres. Since the 2001 to 2005 GWMA data is specific to the Study Area, it was more appropriate for this analysis than the 2004 to 2008 county-average data available from NASS (USDA 2010). To compensate for the difference in acreages, once the percentage split by crop was determined from the GWMA data, it was applied to the Reclamation-specified number of acres in the Study Area.

According to the information provided by GWMA, the primary crops grown in the Study Area from 2001 to 2005 included potatoes, wheat, corn, alfalfa, peas, grass seed, and a catchall category called “other” crops (onions and dry beans). Potatoes accounted for more than 15 percent of these reported acres; wheat acres and grass seed acres 46.7 percent; and “other” crops 17 percent. Cumulatively, these three crop categories form almost 79 percent of groundwater-irrigated acres.

Total wheat acres in the GWMA dataset, both irrigated and dryland, make up 46.7 percent of the total acres. It was decided at the outset that dryland wheat acres in this analysis would be capped at 5 percent of total Study Area acres (approximately 102,600 acres) initially. This assumption came about because the initial number of acres being served by the most undependable wells was set at 5 percent. Capping the number of initial dryland acres therefore simplified the analysis. The remaining 41.7 percent of wheat acres were assumed to be irrigated. Table 3-40 shows the GWMA cropping pattern information that contributed to this analysis.

Table 3-40. GWMA crop acreages for the Study Area, 2000 to 2005.

Crop	2000	2001	2002	2003	2004	2005	Average	Percent of Total Acres
Alfalfa	4,264	4,918	6,526	8,079	N/A	5,608	5,879	5.7%
CRP*	4,254	3,090	3,532	3,090	N/A	0	2,793	2.7%
Corn	4,307	7,908	9,303	5,721	N/A	12,592	7,966	7.8%
Other	24,088	22,756	13,661	12,252	N/A	15,007	17,553	17.1%
Peas	3,364	4,538	3,793	6,647	N/A	6,333	4,935	4.8%
Potatoes	14,711	18,404	14,004	15,215	N/A	14,927	15,452	15.1%
Dryland Wheat	4,403	5,088	9,896	6,189	N/A	3,591	5,833	5.7%
Irrigated Wheat/Grass Seed	42,979	35,668	41,655	45,177	N/A	44,312	41,958	41.0%
Total Acres	102,370	102,370	102,370	102,370		102,370	102,370	
*Conservation Reserve Program (CRP)								

Representative Crops Selected

After examining the GWMA cropping pattern for 2001 to 2005, four representative crops were selected to reflect current farming practices in the Study Area: irrigated potatoes, irrigated wheat, irrigated mixed crops, and dryland wheat/fallow rotation. These representative crops were selected based on communication with and cropping patterns provided by GWMA. It should be noted that grass seed was a prevalent crop during the 2001-to-2005 period; however, the importance of grass seed in the Study Area has since been reduced, because grass seed can no longer profitably compete with irrigated wheat. Therefore, grass seed was not used in the cropping pattern for current conditions.

The category “mixed crops” was used to represent a diverse set of crops that includes corn, alfalfa, conservation reserve program acres, peas, onions, dry beans, and numerous other crops grown in the Study Area. Collectively, the acres of these crops add up to a substantial amount. To expedite the agricultural impact analysis, the acres associated with these crops were categorized as “mixed crops.” Representative costs of production and gross income from “mixed crops” came from a dry beans budget prepared by Washington State University.

Table 3-41 shows the crops reported in Table 3-38 that were combined into the four representative crops.

Table 3-41. The four representative crops, the combined GWMC crops for each representative crop, each crop's acreage and percent of total acres, 2000 to 2005.

Representative Crop Name	Crops Included	Acres	Percent of Total Acres
Potatoes	Potatoes	15,452	15.1%
Mixed Crops	Peas, Corn, Alfalfa, CRP, Dry Beans, etc	39,126	38.2%
Irrigated Wheat	Irrigated Wheat, Grass Seed	42,688	41.7%
Dryland Wheat	Dryland Wheat/Fallow Rotation	5,119	5.0%
Total Acres		102,370	100.0%

Groundwater Irrigation in the Study Area

Irrigated acres in the Study Area are currently served by groundwater. The output and dependability of the wells used by farms in the Study Area were categorized from the most dependable, high-output wells to the least dependable, low-output wells by GWMA. Additionally, GWMA provided information on the rate of decline of well dependability.

One of the base assumptions used in the agricultural impact portion of this study was the classification of existing wells into five levels of dependability. Another base assumption for the agricultural impact analysis was related to the decline in well dependability and how that declining dependability affected the crops grown in the Study Area.

Well Status Levels

Chapter 2, Section 2.3.1.1, describes the status of groundwater wells in the Odessa Subarea. Regarding irrigated agriculture, Level 1 wells (presently serving 5 percent of all Study Area lands) are suitable for meeting the irrigation requirements of high-water-use crops such as potatoes for an entire irrigation season. No decline in dependability or output was assumed for Level 1 wells; therefore, no future change in the cropping pattern for Level 1 wells is expected.

Level 2 wells, currently serving 30 percent of all Study Area lands, are also suitable for meeting irrigation requirements for high-water-use crops. However, Level 2 wells are projected to have reduced output and be less dependable in the future. As Level 2 wells become less dependable, they will be downgraded to be Level 3 wells and a less water-intensive cropping pattern will be assigned to the acres served by those wells. Thus, over time, fewer and fewer acres will be served by Level 2 wells.

Level 3 and Level 4 wells (currently serving 60 percent of all acres in the Study Area) may be able to meet irrigation requirements for part of the year, but would not sustain high-water-use crops for an entire irrigation season. The crops grown on lands served by Level 3 and Level 4 wells are irrigated wheat and mixed crops, which need less water than crops such as potatoes. Level 3 and Level 4 wells are subject to lessened well output and dependability, and 10 percent of lands irrigated with Levels 3 and 4 wells will be taken out of the Levels 3 and 4 cropping pattern each year. Once these lands have lost their ability to pump irrigation water, only a crop such as dryland wheat can be produced, and the well level category will be downgraded to Level 5.

Level 5 wells (5 percent of all wells) are unusable and farmland is assumed to be in a dryland wheat/fallow rotation.

As Level 2, Level 3, and Level 4 wells reduce output, they sink to the next lowest level. Over time, this means fewer acres served by each well level and more and more acres in dryland wheat/fallow rotation. Table 3-42 shows the present number of acres in the Study Area served by each well level, percentage split of acres relative to the total number of acres in the Study Area, and acres affected by reduced well output.

Table 3-42. Well levels, acres served by each well level, and rate of decline by well level.

Well Status Level	Output and Dependability	Acres Served	Percent of Total Acres Served	% of Acres Lost From Each Well Level Annually
Level 1	Highest	5,131	5%	0%
Level 2	High	30,785	30%	10%
Level 3	Low	30,785	30%	10%
Level 4	Low	30,785	30%	10%
Level 5	None	5,131	5%	
Total		102,616	100%	

3.15.1.5 Gross Farm Income

Gross farm income was calculated by multiplying the number of acres of each crop by yield per acre and the price received for each unit of yield. For this analysis, GWMA provided data specific to the Study Area about the number of acres of representative crops grown in the Study Area. Yields, with the exception of irrigated wheat, were county-level averages obtained from NASS. The prices received were obtained from NASS (USDA 2010).

The total gross farm income for the area or region is the sum of the gross farm incomes for each crop. The total average gross farm income for the Study Area is $111.1 million. This income is generated by the approximately 102,600 acres in the Study Area.

The total average gross farm income for the four-county region is $1.6 billion, according to the 2007 Census of Agriculture. Thus, the Study Area's gross farm income accounts for 6.9 percent of the gross farm income generated in the four-county region. The average gross value of production generated on the approximately 102,600 acres in the Study Area is shown in Table 3-43.

Table 3-43. The four representative crops and their average gross value of production in 2010.

Representative Crop Name	Percent of Acres	Study Area Acres	Yield	Price	Gross Value of Production
Potatoes	15.1%	15,496	608.6	$6.63	$62,527,000
Mixed Crops	38.2%	39,198	2,191	$0.2894	$24,854,000
Irrigated Wheat	41.7%	42,791	101.5	$5.23	$23,253,000
Dryland Wheat[1]	5.0%	5,131	35.3	$5.23	$474,000
Total		102,616			$111,108,000
The gross value of production for dryland wheat equals acres X price X yield X 0.5, because dryland wheat is only harvested on one-half the acres listed. The other half of the acres is temporarily fallowed.					

3.15.2 Socioeconomics

3.15.2.1 Analysis area and Methods

The analysis area for socioeconomics encompasses Washington's Adams, Grant, Franklin, and Lincoln counties. The Study Area is located within these four counties. Measurements of regional economic activity were used to characterize socioeconomic conditions in the analysis area.

Economic Activity and Conditions

All regional economic activity was aggregated into eight sectors. Economic activity is commonly measured through industry output (sales), employment, and labor income. The data used to derive these measurements were obtained from the IMPLAN (IMpact analysis for PLANning) model. IMPLAN data files are compiled from a wide variety of sources including the U.S. Bureau of Economic Analysis, the U.S. Bureau of Labor, and Census. Regional economic activity for 2008 is shown in Table 3-44

Table 3-44. The 2008 industry output, employment, and labor income for Adams, Grant, Franklin, and Lincoln counties.

Industry Sectors	Industry Output *	Percent of Total	Employment	Percent of Total	Labor Income*	Percent of Total
Agriculture	2,609	20.3	20,524	23.0	521	15.4
Mining	38	0.3	165.4	0.2	11	0.3
Construction	620	4.8	4,540.7	5.1	240	7.1
Manufacturing	4,435	34.5	8,753.50	9.8	482	14.2
Transportation, Information, and Public Utilities	544	4.2	3,646.9	4.1	192	5.7
Trade	1,040	8.1	10,907.1	12.2	419	12.4
Service	2,375	18.5	24,671.00	27.6	711	21.0
Government	1,200	9.3	16,046.7	18.0	808	23.9
Totals	12,862		89,255.3		3,385	

* Millions of Dollars
Source: 2008 IMPLAN data files, including U.S. Bureau of Economic Analysis, U.S. Bureau of Labor, and Census.

Industry output or sales represent the value of goods and services produced by businesses within a sector of the economy. The manufacturing sector produces the greatest level of output in the analysis area, with 34.5 percent of the total output. A portion of the manufacturing output stems from activities in industries related to food processing. Agriculture ranks second in total industry output at 20.3 percent. Ranking third is the service sector, which makes up 18.5 percent of total industry output.

Employment measures the number of jobs related to each of the industry sectors of the regional economy. In the analysis area, activities related to the service sector generate the largest number of jobs, with 27.6 percent of total regional employment. The agricultural sector ranks second in terms of overall number of jobs in the analysis area, with 23 percent of total regional employment. Government-related employment ranks third making up 18 percent of total regional employment.

Labor income is the sum of employee compensation and proprietor income. The government-related sector generates the largest portion of labor income in the analysis area, at 23.9 percent of the total regional labor income. The service sector ranks second, with 21 percent of the total regional labor income. Ranking third is agriculture, at 15.9 percent of the total regional labor income.

3.16 Transportation

Potential transportation concerns associated with the Odessa Subarea Special Study alternatives focus on the local and regional road/highway and railroad systems. No air or navigable waterway transportation systems or facilities would be involved in or affected by any of the alternatives.

3.16.1 Analysis Area and Methods

The analysis area for transportation focuses on the Study Area, where new irrigation infrastructure would be constructed and operated as part of the action alternatives. The analysis area for transportation includes the following aspects of the existing road and railroad:

1. Systems that could experience increases in car and truck traffic during irrigation system construction and operation for transport of personnel, material, and equipment

2. Systems that could be affected in terms of continuity or disruption because of new canal crossings or development of other facilities such as reservoirs

Transportation resources were evaluated based on existing maps, county and municipal planning documents, and topographic maps and aerial photos.

3.16.1.1 Regional Highway/Road Access

Regional access to the Study Area is provided by the network of interstate and state highways. Described below, this backbone highway system is illustrated on Figure 2-1 in Chapter 2. All interstate and state highways are under the jurisdiction of the WSDOT.

Interstate Highways

Two interstate highways cross the Study Area. These are the only four-lane, divided, limited-access highways providing direct access to the area. I-90 traverses the Study Area east-west, dividing it into northern and southern halves. It connects the area with Moses Lake and Seattle to the west, and Spokane to the east. I-395 enters the Study Area at its southernmost point near the town of Connell and tracks northeast to a connection with I-90 in Ritzville. This highway is the primary connection of the area to the Tri-Cities area to the south (Kennewick, Pasco, and Richland).

State Highways

Two 2-lane state highways traverse the Study Area in an east-west direction: one north and one south of I-90. North of I-90, State Route 28 (SR 28) traverses the northern part of the area east-west, connecting it with local cities such as Ephrata to the west and Odessa to the east. SR 28 ultimately also provides access to cities outside the region (for example, Seattle and Spokane) through connections with I-90 and other highways. South of I-90, SR 26 crosses the Study Area east-west, connecting with Othello to the west and numerous small communities to the east.

No state highways directly traverse the Study Area in a north-south direction. However, two state highways flank the area, one to the east and one to the west. Immediately east of the Study Area, SR 21 provides north-south connections, linking SR 28 and Odessa in the north with Lind and I-395 in the south. The Study Area is flanked on the west by SR 17 and SR 171, linking SR 28 in the north with SR 26 and I-395 in the south. This route provides access to local cities such as Moses Lake and Othello, and ultimately the Tri-Cities area to the south.

In general, all interstate and state highways in the area are in good condition with no significant congestion or safety concerns.

3.16.1.2 Local Road Network

Road access from the interstate and state highways to and within the Study Area is provided by the network of local roads owned and maintained by counties. Much of this road network has been developed to serve the agricultural economy (Photograph 3-8). As a result, road access is relatively well developed in areas under cultivation, and less developed (few roads) in open, uncultivated parts of the counties.

Photograph 3-8. Rural road in the Study Area.

In all involved counties, the local road system is generally a grid. In agricultural areas, the grid is developed with both north-south and east-west roads every 1 to 2 miles. North of I-90, 1 mile spacing is more common in the agricultural areas, with limited instances of 0.5-mile spacing where land subdivisions have occurred.

Because of the rural nature of the Study Area and the general absence of significant population centers, the local road system has no significant congestion or safety issues. However, maintaining open, through access during winter conditions can be a challenge. For example, Grant County publishes a map illustrating all-weather roads (built and maintained so that seasonal load limitations are not normally needed), conditional all-weather roads (normally subject to seasonal limitations but only for short periods), and programmed all-weather roads (identified for improvement to all-weather road status).

3.16.1.3 Railroads

Rail access to and within the Study Area is part of the Burlington Northern Santa Fe Railroad regional system. The primary rail linkages in and around the area are as follows:

- Along the SR 28 and Crab Creek corridor in the northern half of the area, providing transport east-west
- Along the western edge (outside) of the Study Area, in a generally north-south direction, generally following the SR 17 and SR 171 corridor and linking through Coulee City in the north and Connell in the south
- In the southeast portion of the Study Area, from Connell to Lind and points beyond. This line trends northeast-southwest in the area, generally parallel to (and west of) the I-395 corridor.

3.17 Energy

Energy issues associated with the Odessa Special Study action alternatives consist of the potential to impact the regional power system and John W. Keys III Pump-Generating Plant (Keys Pump-Generating Plant). Additional water diversions from the Columbia River would result in more pumping into Banks Lake and less hydroelectric generation, and there may be an increase in load due to increased pumping at Banks Lake. At the Keys Pump-Generating Plant, pump-generation operations would be negatively impacted with respect to unit availability to provide reserves (spinning and non-spinning), generation, and diurnal shaping.

3.17.1 Analysis Area and Methods

The analysis area for energy is an examination of the Pacific Northwest region. Methods include providing an overview of the regional power system and on creating an inventory of local energy utilities. The analysis area for Keys Pump-Generating Plant is the plant and Banks Lake drawdown. To evaluate Keys Pump-Generating Plant impacts, the Banks Lake drawdown tables were reviewed and compared to the generation capability at Keys Pump-Generating Plant against historical drawdowns.

3.17.2 Energy Resources in the Pacific Northwest

The Pacific Northwest power system is managed by a variety of entities, including the BPA, investor-owned utilities, municipal utilities, rural electric associations, and public utility districts. Hydroelectric generation provides approximately 81 percent of the total energy resources in the Federal system and 45 percent of the total energy resources in the Pacific Northwest. The Keys Pump-Generating Plant is owned by Reclamation and funded by BPA and local irrigation districts.

3.17.3 The Pacific Northwest Regional Load and Resources

The regional supply and demand for energy in the Pacific Northwest is evaluated and summarized by BPA in a document titled, Pacific Northwest Loads and Resources Study, commonly referred to as the "White Book" (BPA 2011). The White Book projects energy supply and demand 10 years into the future for planning purposes and is prepared by BPA with input from other Pacific Northwest Federal agencies, public agencies, cooperatives, Reclamation, the Corps, and investor-owned utilities. The 2011 White Book provides a snapshot of both the Federal system and the Pacific Northwest region loads and resources for operating years 2012 through 2021.

Total forecasted regional loads are 22,489 average megawatts (aMW) for 2012 increasing to 25,227 aMW in 2021. Firm resources expected to serve these loads are 26,460 aMW in 2012 and decreasing to 25,890 aMW in 2021. The decrease is mainly due to the closure of several large thermal plants. The regional surplus is 3,961 aMW in 2012 and declines to 652 average megawatts in 2021 under low water conditions. Under average water conditions (the middle 80 percent water conditions) the regional surplus declines from 7,296 aMW in 2012 to 3,855 aMW in 2021.

3.17.4 Energy Resources in the Study Area

3.17.4.1 Energy Supply and Consumption

Energy is provided to customers in the Study Area by several different entities. Table 3-45 summarizes local electric utilities which provide energy to residential, commercial, industrial, and agricultural users who need energy to pump groundwater for irrigation.

Table 3-45. Study area local electrical utilities.

County	Provider Electric Utility
Adams	Avista
Franklin	Big Bend Electric Cooperative
	Franklin County PUD
	Avista
	Inland Power and Light
Grant	Grant County PUD
Lincoln	Avista
	Inland Power and Light

One of the suppliers, Big Bend Electric Cooperative, recorded energy consumption during a series of pump tests for wells supplying water to 11,000 acres of farmland in Franklin and Adams Counties. The wells were located both north and south of I-90 and ranged in depth from 394 feet to 830 feet with pumping rates from 500 gallons per minute (gpm) to 3,334 gpm. Assuming those results were typical of groundwater irrigation pumping requirements in the Study Area, the annualized amount of energy consumed by groundwater pumping averaged 0.000274 aMW per acre.

3.17.5 John W. Keys III Pump-Generating Plant

3.17.5.1 Modernization of the John W. Keys III Pump-Generating Plant Facility

Reclamation's Grand Coulee Office and BPA are defining the scope of work to be implemented at the Keys Pump-Generating Plant to modernize the facility encumbering significant investments. Approximately $4.2 million will have been invested by the end of 2012. Projected spending based on preliminary estimates over approximately the next 10 years range from about $100 million to $370 million dollars. BPA is interested in making this investment to increase both the reliability and flexibility of the existing Keys Pump-Generating Plant. Doing so would provide BPA with additional within hour reserves during critical operational periods as well as facilitate the integration of additional renewable resources into BPA's Balancing Authority.

3.18 Public Services and Methods

Public services in the Odessa Special Study Area include law enforcement, fire protection, and emergency medical services. Utilities providers include electricity, natural gas, water supply (domestic and irrigation), telecommunications, and wastewater management.

3.18.1 Analysis Area and Methods

The analysis area for public services and utilities consists of Adams, Franklin, Grant, and Lincoln counties, within which public service or utility providers could be affected by the No Action Alternative or any of the action alternatives. Primary sources of information for existing public services in the area included city and county documentation and individual service provider websites.

3.18.2 Public Services in the Analysis Area

Table 3-46 presents law enforcement, fire protection, and emergency medical services available in the Analysis Area.

Table 3-46. Public services in the analysis area by county.

	Law Enforcement	Fire Protection	Emergency Medical Services
Entire Analysis Area	Washington State Patrol	None	None
Adams County: Cunningham, Hatton, Lind, Othello, Ritzville, Schrag, Washtucna	Adams County Sheriff Othello Police Department Ritzville Police Department	Ritzville Fire Department Lind Town Fire Department Othello Fire Department	Othello Community Hospital, Othello Ritzville Medical Clinic, Ritzville
Franklin County: Connell, Kahlotus, Mesa, Pasco	Franklin County Sheriff Connell Police Department Pasco Police Department	Connell Fire Department Kahlotus Fire Department Pasco Fire Department Washtucna Fire Department	Franklin County Public Hospital, Eltopia Lourdes Medical Center, Pasco

	Law Enforcement	Fire Protection	Emergency Medical Services
Grant County: Coulee City, Ephrata, Hartline, Krupp, Moses Lake, Quincy, Stratford, Soap Lake, Warden, Wheeler, Wilson Creek, Royal City	Grant County Sheriff Coulee City Police Department Ephrata Police Department Moses Lake Police Department Quincy Police Department Soap Lake City Police Department Warden City Police Department Royal City Police Department	Grant County Fire Department Hartline & Grant Fire Department Coulee City Fire Department Ephrata Fire Department Quincy Fire Department Soap Lake Fire Department Warden City Fire Department Moses Lake Fire Department	Columbia Basin Hospital, Ephrata Quincy Valley Medical Center, Quincy Samaritan Healthcare, Moses Lake
Lincoln County: Almira, Irby, Lamona, Odessa, Sprague	Lincoln County Sheriff Odessa City Police Department Sprague Police Department	Almira Fire Department Sprague City Fire Department Odessa Fire Department	Odessa Memorial Healthcare Center, Odessa
Source: Mapquest 2009			

County and local law enforcement officers and fire officials work within their jurisdiction and work cooperatively. Many of the fire protection services are provided by volunteers. Medical services vary among the facilities, with the following services available within the area:

- Emergency room services
- Non-emergency medical services
- Surgical services
- Medical specialists
- Laboratory and pharmacy

3.18.3 Utilities in the Analysis Area

3.18.3.1 Electricity

Electrical utilities are listed in Table 3-46 in Section 3.17 – *Energy*.

3.18.3.2 Natural Gas

Avista Utilities provides natural gas to portions of the area within Adams and Lincoln counties (Avista Utilities 2007 Gas IRP). Cascade Natural Gas Corporation, an investor-owned utility, builds, operates, and maintains natural gas facilities in Franklin County (Franklin County 2008). Within Grant County, Cascade Natural Gas provides natural gas service only to Moses Lake, Othello, Quincy, and Wheeler. Avista Utilities provides natural gas to the city of Warden in Grant County (Grant County 1999).

3.18.3.3 Telecommunications

CenturyTel provides internet service, broadband television, digital television, local and long distance telephone service, and home security service in Adams and Lincoln counties (CenturyTel 2009). T Mobile also provides cellular telephone service in Adams County (T Mobile 2009). Qwest Communications provides internet service and local and long-distance telephone service in Lincoln County (Qwest Communications 2009).

Verizon, Sprint, Cingular, T-Mobile, Qwest Communications, and Nextel provide cellular telephone service in Franklin County. Cable television is provided by Charter Communications. Internet service is provided by over a dozen internet service providers (City of Pasco 2007).

Five companies provide internet service in Grant County: Quicksilver Online Services, Inc., GEMNET, At.Net, Northwest Internet, and Corkrum. Telephone service for Grant County is provided by U.S. West Communications and GTE. Grant County is served by six cellular telephone companies: AT&T Wireless, Consumer Cellular, Inland Cellular, Mirage Cellular, Nextel, and U.S. Cellular Wireless Communications. The two primary providers of cable television service in Grant County are Northland Cable Television and Sun Country Cable.

3.18.3.4 Water Supply

Groundwater is the primary source of water for domestic, municipal, and industrial uses in the four counties that comprise the Study Area. Cities, towns, and rural areas within the four counties are served by public water supply systems and individual wells.

3.18.3.5 Wastewater Management

People and businesses rely mostly on onsite septic disposal systems, such as septic tanks, disposal units, and drain fields in rural areas and smaller towns. Wastewater within the incorporated cities and larger towns within the four counties is handled through connections to public or private wastewater treatment systems.

3.19 Noise

Noise-sensitive land uses are generally defined as locations where people reside or where the presence of unwanted sound could adversely impact the designated use of the land. Typically, noise-sensitive land uses include residences, hospitals, places of worship, libraries, schools, nature and wildlife preserves, undeveloped native habitats, and parks. Noise-sensitive locations in the Study Area include several small communities as well as scattered residences.

3.19.1 Analysis Area and Methods

The analysis area for potential noise impacts is the Study Area. The analysis focuses on areas area where new facilities would be constructed (short-term impacts) and operated (potential long-term impacts) in the action alternatives.

Noise impacts were evaluated based on existing conditions and measurements of additional project induced noise that may adversely impact the designated use of the land.

3.19.2 Noise Measurement

Noise is defined as unwanted sound. Several ways exist for measuring noise, depending on the source of the noise, the receiver, and the reason for the noise measurement. The most common is the overall A-weighted sound level measurement in decibels (dbA) that has been adopted by regulatory bodies worldwide. This measures sound similar to how a person perceives or hears sound, achieving very good correlation in terms of how to evaluate acceptable and unacceptable sound levels. A-weighted sound levels are typically measured or presented as the equivalent sound pressure level (Leq), which is defined as the average noise level over a given period of time.

Table 3-47 shows the relative A-weighted noise levels of common sounds measured in the environment and in industry for various sound levels.

The general human response to changes in noise levels that are similar in frequency content (for example, comparing increases in continuous traffic noise levels) are summarized below:

- A 3-dB change in sound level is considered a barely noticeable difference.
- A 5-dB change in sound level will typically be noticeable.
- A 10-dB change is considered to be a doubling in loudness.

Table 3-47. Typical sound levels measured in the environment and industry.

Noise Source At a Given Distance	A-Weighted Sound Level in Decibels (dBA)	Qualitative Description
Heavy truck (50 feet)	90	Very annoying Hearing damage with 8 hours of continuous exposure
Pneumatic drill (50 feet)	80	Annoying
Freight train (50 feet) Freeway traffic (50 feet)	70 to 80	
	70	Intrusive (telephone use difficult)
Air conditioning unit (20 feet)	60	
Light auto traffic (50 feet)	50	Quiet
Living room, bedroom	40	
Library, soft whisper (5 feet)	30	Very quiet
Broadcasting/recording studio	20	
	10	Just audible
Source: Adapted from New York Department of Environmental Conservation 2001		

3.19.3 Existing Noise Conditions in the Analysis Area

The existing environment in the Study Area consists of noise sources typically found in a rural setting. Noise from farm machinery, irrigation pumps, and traffic on local roadways are indicative of the agricultural nature of the area. No ambient noise surveys have been conducted in the Study Area. However, it is expected that existing noise levels in much of the area range between 45 and 50 dBA because of the rural or undeveloped nature of the area. Undeveloped lands north of the Study Area, where the East High Canal would be constructed, have very few noise sources.

3.20 Public Health

The public health resource focuses on the current environment related to, and the potential for increasing or reducing, threats to human health from hazardous materials or mosquito-borne illness.

A potential public health and safety concern that has been considered, but found not to be significant is canal safety (that is, potential increase in risk of drowning or injury associated with expanded and new canal systems). None of the Special Study alternatives would introduce new types of hazards in this regard, and existing construction standards and safety programs adequately address questions of canal safety. Therefore, this potential concern is not addressed further in this document.

3.20.1 Analysis Area and Methods

The analysis area for public health is the Study Area and the shoreline zones of Lake Roosevelt and Banks Lake. The analysis includes any properties that could be disturbed during construction or exposed by additional reservoir drawdowns, which would have a potential of exposing existing hazardous sites resulting from historic misuse. Historic misuse may be related to historic agricultural uses, mining and smelting, or prior construction activities (including CBP facilities). The shoreline zones of Lake Roosevelt and Banks Lake are included in the Public Health analysis area to determine if reservoir drawdowns would modify existing shorelines and create an area that would foster mosquitoes and mosquito-borne illnesses. Methods for conducting these studies included database surveys, aerial photography analysis, and field visits.

3.20.2 Hazardous Materials

Reclamation's policies require that an environmental site survey be completed whenever residential, agricultural, or industrial property is acquired. Through historic use, any of these property types could potentially contain hazardous or toxic substances. An Environmental Site Survey, as described in Manual, Directives, and Standards (Reclamation 1999) will be conducted after the preferred alternative is selected and prior to construction. The potential of such discoveries is evaluated in this EIS to compare the action alternatives.

3.20.2.1 Odessa Special Study Area

The agricultural environment of the Study Area, where proposed project water delivery systems and reservoirs would be located, may have been subjected to misuse or mismanagement of hazardous materials and other materials commonly used in the production of crops and the maintenance of farm equipment. A database search of local, State, and Federal records was conducted by Environmental Data Resources, Inc. (EDR) to identify any known hazardous sites in the Study Area that might potentially be encountered during excavations in the project footprint.

EDR's report indicated that approximately 30 hazardous materials sites are listed on Federal and State inventories within 1.5 miles of facility sites related to one or more of the action alternatives. Most of these are related to agricultural operations, such as fertilizer, propane, and fuel, not to mention farm service materials and chemicals. Many of these operations and businesses also have underground storage tanks (USTs). Residential properties were identified within the facility easements and in a 0.5-mile buffer from the boundary of facilities such as reservoirs associated with the action alternatives to determine the potential for encountering spills or leaks from USTs. During final design and construction of a preferred alternative, these locations would be further analyzed in accordance with Reclamation policies to determine specific risks.

Another potential source of hazardous materials is the mishandling or spills of fuel or other materials during construction. Construction BMPs would be applied to minimize or avoid such issues.

Application of fertilizer and other agricultural chemical use can result in nitrogen and phosphorus entering surface water and groundwater (*Banks Lake Resource Management Plan, Section 2.7, Hazardous and Toxic Materials Summary*, Reclamation 2001). The EPA has set the Maximum Contaminant Level (MCL) of nitrate as nitrogen (NO_3 N) at 10 mg/L (or 10 parts per million) for the safety of drinking water. Nitrate levels at or above this level have been known to cause a potentially fatal blood disorder in infants under six months of age called methemoglobinemia, or “blue-baby” syndrome, in which there is a reduction in the oxygen-carrying capacity of blood. When nitrogen fertilizers are used to enrich soils, nitrates may be carried by rain, irrigation, and other surface waters through the soil into groundwater. In Franklin County, agricultural practices have been linked to elevated levels of nitrates in drinking water (Benton Franklin District 2009).

3.20.2.2 Shoreline of Banks Lake

A database search was conducted for listed hazardous sites on lands adjacent to Banks Lake that would be exposed if the lake level elevation was lowered. The analysis was based on Banks Lake Resource Management Plan, 2001 (Reclamation 2001). No Federal- or State-listed hazardous sites were found (Reclamation 2001). However, as reported in the Banks Lake Resource Management Plan (RMP) (Reclamation 2001), a total of 12 leaking underground storage tanks (LUSTs) are present in the general area. All sites have contaminated soil, and one also has contaminated groundwater.

3.20.2.3 Shoreline of Lake Roosevelt

The potential for public health impacts focuses on whether the Lake Roosevelt drawdown might expose contaminated sediments, resulting in public health concerns to swimmers using shoreline beaches and to those exposed to wind-blown particulates. Sediment exposures are expected to occur during occupational, recreational, and subsistence activities on beaches and exposed shorelines, and potentially also during wading or swimming in shallow waters of the reservoir. Human health exposures focus on ingesting or dermal contact of contaminated soils or sediment. In addition, these exposed areas of exposed fine-grained sediment particles may become airborne as a result of atmospheric disturbances.

As a result, several studies were performed by the EPA, testing beach and riverbank sediments to assess risk to human health. These studies are summarized in *Lake Roosevelt Remedial Investigation and Feasibility Study: A Public Guide* (Lake Roosevelt Forum 2009), which was reviewed for this evaluation.

3.20.2.4 Risks from Direct Contact

Beach sediment data was collected at 15 beaches in 2005, providing an initial finding that exposure to contaminated sediment was safely below human health-based risk standards. The EPA contracted another study of 34 beaches from the Canadian Border to Grand Coulee Dam. Sampling began in September 2009 and continued through spring of 2010. This study addressed data gaps identified in previous studies and was combined with the 2005 study results. Additional sampling is expected to provide data for areas of importance for human use and to allow for beach-specific exposure evaluations.

Preliminary risk estimates suggest that risks from skin contact exposures to sediment are low and appear to be minor, relative to incidental ingestion exposures. Risks from incidental ingestion of metals in sediment have the potential to contribute substantially to total risks; therefore, future data collection efforts will be designed to address uncertainties in this exposure scenario. In addition, the Washington Department of Health (WSDOH) has concluded that future sampling should have additional surface sediment samples, which provide measured data on the list of chemicals of interest for radionuclides and polybrominated diphenyl ethers.

Meanwhile, WSDOH concluded in a draft 2009 Health Consultation that there is “no apparent public health hazard” related to Lake Roosevelt exposed sediments, which was based on children or adults being exposed for 2 days per week for 4 months, or 24 days per year for area residents.

3.20.2.5 Risks from Airborne Sediments

Based on available data from the WSDOH, potential risks from inhalation of sediment-derived chemicals of interest (COIs) in outdoor air under routine conditions are likely to be low. WSDOH concluded that additional data collection under routine (ambient) conditions is not likely to be necessary to address this exposure scenario. However, measured levels of metals in background air are needed to determine the potential contribution of sediment-derived particulates to outdoor air concentrations. Therefore, future data collection efforts will focus on locations where there are large expanses of exposed contaminated sediments and the potential for windblown erosion and transport during high wind conditions. WSDOH and USGS are continuing to conduct studies regarding airborne contaminants.

3.20.3 Mosquitoes

Vegetated reservoir shorelines can provide habitat suitable for breeding mosquitoes (*Culex tarsalis*) that can carry diseases such as the West Nile virus. Conditions that foster mosquito habitat are shallow, warm, stagnant water in conjunction with emergent vegetation. Resident birds in high densities that can fulfill the mosquito's biological cycle would need to be present for the transmission of the West Nile virus. Project features that might leave wet shorelines during the summer when temperatures are warm were evaluated for each alternative.

For this analysis, water level management conditions that potentially create mosquito habitat were examined, with slopes from 0 to 3 percent considered as areas conducive to shallow water pooling and mosquito habitat. Other considerations were proximity of roosting sites for birds, potential for shoreline vegetation, and water surface disturbance from wind. New water features, such as proposed new reservoir shores, flood storage areas, and coulees used as potential irrigation wasteways, were all examined.

3.21 Visual Resources

Visual Resources associated with the Odessa Special Study include rural and agricultural lands as well as areas surrounding the water bodies of Banks Lake and Lake Roosevelt. Within the Study Area itself (see Figure 1-1 in Chapter 1), potential for visual changes and impacts relate to both the general transition over time of all or part of existing groundwater-irrigated lands to dryland agriculture and also introduction of significant new irrigation infrastructure. In the viewsheds of both Banks Lake and Lake Roosevelt, the primary potential for visual resource changes are related to additional reservoir drawdowns associated with the action alternatives.

3.21.1 Analysis Area and Methods

The analysis area for visual resources encompasses three distinct landscapes:

1. The Study Area, including the areas currently irrigated with groundwater and areas where new facilities would be developed as part of the action alternatives

2. Banks Lake and its surroundings

3. Lake Roosevelt and its surroundings

For each of these landscapes, the analysis area includes all locations from which visual changes caused by one or more of the action alternatives would be seen by the general public or nearby residents (that is, all locations within the viewshed).

Visual resources were evaluated based on changes in land or agricultural use patterns, the introduction of new developed facilities and infrastructure in the Study Area, and changes in reservoir drawdown patterns at Banks Lake and Lake Roosevelt.

3.21.2 Study Area

3.21.2.1 Setting

The general visual setting of the Study Area can be described as a mosaic of irrigated agriculture, dryland agriculture, and remnants of sagebrush that once covered the region. Overall, although it is predominantly rural and characterized by open landscapes and vistas, it is heavily influenced by human activity. Irrigation has allowed a wide variety of crops to be grown, introducing large areas of summertime green fields in contrast to the browns and grays of native vegetation or the yellow-golds of dryland farms. In addition to the farm fields themselves, irrigation infrastructure is widely evident and contributes significantly to the Study Area's agricultural character (e.g., center pivots, storage structures, distribution lines, farms, pumping plants, and canals).

Both native and introduced vegetative cover is predominantly low-lying, allowing long viewing distances through most of the area. Few trees occur naturally. Most trees in the area were likely introduced by residents for windbreaks, shade, or crops, or by the WDFW for wildlife habitat improvement. Drainage and seepage from agricultural irrigation combine with natural runoff to form scattered small lakes, sloughs, streams, wet meadows, and marshes along channels, wasteways, and in coulees. The presence of water in this arid landscape has encouraged the growth of woody shrubs and trees around and near these locations. This increase in woody plants, along with the proliferation of irrigated fields, has resulted in many parts of the Study Area being more lush and green than was the case prior to the CBP.

Because most of the area is relatively flat, features such as canals are often difficult to see except in areas where roads pass over them or the occasional elevated area where they can be seen below the viewer. More visible than the canals, in many locations, are the long linear areas of excavated spoiled materials that parallel them. Along the East Low Canal, for example, these features can be as high as 20 feet.

Other large-scale, human-made features are present in the Study Area and are part of the viewed landscape. These include interstate and state highways such as I-90, SR 28, and SR

26, as well as a grid of paved and unpaved county roads. Multiple electrical transmission and distribution lines pass through the area and are quite visible from many locations.

Despite the large areas of irrigated and dryland fields in the Study Area, scattered tracts of land have retained a largely natural appearance. Some of these areas are private lands that have not been developed. Others are owned and managed by various governmental entities. Most publicly-owned land in the Study Area is under the jurisdiction of the WDNR (State Trust lands) or Reclamation. Many WDNR tracts are leased for agriculture, while others are open and serve as livestock grazing land. Most of the Reclamation land in the area is managed by the WDFW to protect and enhance wildlife and fish resources under agreements signed in 2003 as part of the CBWA. Most of the lands managed by WDFW have a natural, undeveloped character to the general public, although changes in vegetation communities have occurred generally with the presence of water from the CBP and the spread of invasive species over the past 50 years.

3.21.2.2 Viewers and Viewing Locations

People viewing the landscape in the Study Area are generally either residents involved in agriculture or motorists (both local and those passing through).

Residents are much more sensitive to changes in the viewed landscape because of presence and longevity in the area. Most residences in the area are widely scattered and are associated with farm operations and a rural environment. However, several small communities have multiple residences, such as Warden and Wheeler. In all cases, the normal visual environment for residents is dominated by agriculture and all associated infrastructure.

Aside from residents, the majority of motorists visiting or passing through the area are likely travelling I-90 or one of the state highways. However, county roads also provide viewing corridors. Motorists have views of the landscape that are of short duration, and they generally have lower viewer sensitivity (or level of concern) to changes in the landscape.

3.21.2.3 Management Directives

No county or other agency plan or policy documents address visual resources in the Study Area. In the case of county comprehensive plans, intent for long term agricultural land use is expressed, as discussed in Section 3.13 – *Land Use and Shoreline Resources*, but no goals, objectives, or policies specifically relate to visual resources. On public lands, the WDFW management plan for the CBWA contains policies and directives for recreation resources, but not for visual resources (WDFW 2006).

3.21.3 Banks Lake

3.21.3.1 Setting

Banks Lake is located in the upper Grand Coulee in an area characterized by towering basalt cliffs as high as 800 feet above the reservoir, headwalls, terraces, and talus slopes. The walls of the upper Grand Coulee are widest near the southern and northern parts of the reservoir and narrow in the middle to as little as 0.75 mile. Unique landforms, such as Steamboat Rock and Castle Rock, are dominant visual features and focal points throughout much of the area. Native vegetation communities are found near Banks Lake and contribute to its character.

Under current conditions, the reservoir is generally at full pool throughout the year except in August and September, when the water level is drawn down and refills as part of overall Columbia River and CBP operations (see Chapter 2, Section 2.2.3 – *Water Management Programs and Requirements Common to All Alternatives*). Since many areas of the reservoir shore—especially the eastern shore—are characterized by shallow, low-gradient shorelines, the extent of drawdown area exposed (the amount of visible "bathtub ring") can be impacted by even small fluctuations in water level (Ecology 2008). Drawdowns of Banks Lake can also impact the appearance of shoreline recreation areas by exposing reservoir bottom and leaving facilities such as boat launches and swimming areas unusable.

The large-scale and wide-open nature of the Grand Coulee area, in combination with low-lying vegetation, allow for open and expansive views towards the reservoir from much of the adjacent shoreline and many upland areas. Most of the Banks Lake setting is undeveloped and has a natural character. The Banks Lake Wildlife Unit of the CBWA encircles much of reservoir and contributes to its largely undeveloped character.

SR 155, which follows the eastern shoreline of Banks Lake, is part of the Coulee Corridor National Scenic Byway. The Coulee Corridor was designated as a Washington State Scenic Byway in 1997 and a National Scenic Byway in 2005 (Otak 2009). SR 155 is the primary human-made feature along much of the reservoir shore.

Developed areas in the Banks Lake environment are concentrated at the north and south ends of the reservoir near the dams, with Steamboat Rock State Park located along the upper central shoreline (see Figure 3-14 and Figure 3-15 in Section 3.14 – *Recreation*).

At the north end is North Dam, Electric City, and environs (including shoreline resorts), and shoreline recreational businesses and facilities in Osborn Bay Lake (an inlet of the main reservoir). At the south end are Dry Falls Dam, Coulee City, and the rural residential area of Fordair. Steamboat Rock State Park is located on a peninsula approximately 8 miles southwest of Electric City. It is accessed from SR 155, and the developed part of Park can be seen from many locations along SR 155. Facilities are concentrated on the east side of the peninsula.

The unique scenery of Banks Lake and other areas in Coulee County has resulted in sightseeing being one of the popular recreational activities in the general area. Sightseeing by motor vehicle is especially popular at Banks Lake because several features at the reservoir are identified as places of interest in a brochure and map developed for the Scenic Byway (Coulee Corridor 2006). These locations include but are not limited to Coulee City and Marina Park, the reservoir itself along much of SR 155, and Steamboat Rock State Park.

3.21.3.2 Viewers and Viewing Locations

Banks Lake is visible from a range of viewing locations that include developed and dispersed recreational facilities, SR 155, residences, and local roads. For the purposes of this analysis, viewers at Banks Lake can be classified into the following four general viewing types:

- Residents in the immediate areas of Coulee City and Electric City as well as the surrounding local area who visit the reservoir. Residents' sensitivity to changes in the visual environment of the reservoir is generally very high because of their familiarity with and appreciation of the visual quality of the area.
- Active water-oriented recreationists assumed to be highly sensitive to changes related to the appearance of the reservoir and shoreline.
- Non-active water-oriented recreationists and sightseers including overnighters, sightseers, and people who engage in land-based activities such as relaxing, picnicking, hiking, wildlife viewing and hunting. These viewers are considered moderately sensitive to changes in the appearance of the reservoir and shoreline.
- Motorists passing through the area on SR 155 at relatively high speeds. In general, motorists traveling SR 155 would not be closely attuned to the "normal" visual environment of the reservoir, and only moderately sensitive to the visual impact of changes in reservoir water level.

3.21.3.3 Management Directives

Two resource management planning documents address visual resources at Banks Lake: Reclamation's Banks Lake Resource Management Plan (Reclamation 2001) and Grant County's Shorelines Management Master Program (Grant County 1975). As noted earlier, WDFW's management plan for the CBWA addresses recreation but not visual resources.

Banks Lake Resources Management Plan (RMP)

The Banks Lake RMP identifies a number of visually distinctive areas of Banks Lake, including the middle and much of the upper reservoir, Steamboat Rock, and Old Devil's

Lake (north shore, north of Steamboat Rock State Park). Most relevant to present study, the RMP calls for preservation of the natural landscape throughout the management area.

Grant County Shorelines Management Master Program

Prepared in response to Washington's Shoreline Management Act (RCW 90.58), Grant County's Shorelines Management Master Program designates Banks Lake as conservancy environment, with the associated objective to maintain existing character.

3.21.4 Lake Roosevelt

3.21.4.1 Setting

The landscape character of Lake Roosevelt and the LRNRA is greatly influenced by topography, vegetation, and operations. Human-made structures and development are less evident than at Banks Lake because of the remote nature of much of reservoir environment. In the southern part of the reservoir, canyon walls rise from the shoreline and viewing distance is frequently restricted because of the twisting nature of the reservoir. Road access is limited in this part of the reservoir, with no parallel roads along the first 50 miles upstream from the Grand Coulee Dam. Views of the southern part of the Lake Roosevelt are available from the communities of Grand Coulee, Seven Bays, Lincoln, and scattered residences on the hillsides overlooking the reservoir.

In contrast to the lower half of the reservoir, the upper half is generally narrower, less twisting, and with more moderate terrain along the shore. Visitors to the reservoir environment or people driving through on roads such as SR 25 have many opportunities and locations to view the reservoir and mountains beyond. Views are also available from numerous small communities or rural residential areas.

As with Banks Lake, reservoir elevations (and thus the "bathtub ring" around the shore) vary up to 80 feet during the year. Typically, the lowest pool elevations occur in April. The reservoir level generally reaches approximately 1280 feet amsl (10 feet below full pool) by mid-June, which corresponds with the start of the heaviest part of the summer recreation season (NPS 2008). Levels then generally fluctuate between 1280 feet amsl and full pool through September.

Most of the land-based human-made elements in the landscape of Lake Roosevelt are concentrated in several areas that contain recreational or residential developments. The greatest number is at the southern part of the project near the Grand Coulee Dam. These developments influence the character of the areas near them, but have little influence on the overall character of most of the reservoir.

3.21.4.2 Viewers and Viewing Locations

Categories of viewers at Lake Roosevelt are essentially the same, with the same relative sensitivity to changes in the visual environment, as those described above for Banks Lake. One additional category at Lake Roosevelt would be visitors to the Grand Coulee Dam complex. These viewers can be assumed to be focused more on the dam and the complex of infrastructure surrounding it, rather than being sensitive to fluctuations in reservoir level.

3.21.4.3 Management Directives

The LRNRA has been managed under the Lake Roosevelt National Recreation Area General Management Plan since 2001. The plan addresses goals and policies related to a number of resources including recreation, but contains no policies or directives concerning visual or aesthetic resources.

3.22 Cultural and Historic Resources

Cultural resources can encompass a wide range of manmade or man-modified resources. Cultural resources include pre-contact, ethno-historic, and historic archaeological resources (below-ground), historic structures, sites, and objects (above-ground), and traditional cultural places. Included among cultural resources are human remains and associated funerary objects as protected under Native American Graves Protection and Repatriation Act (NAGPRA) and state laws, as well as artifacts protected under the Archaeological Resources Protection Act (ARPA) or which are subject to curation requirements if collected/ recovered. If identified in the Study area, cultural resources would be evaluated in terms of their significance and also in terms of project impacts. A significant cultural resource, also called a historic property, is a resource that is found to meet criteria for eligibility for listing in the National Register of Historic Places (NRHP). In addition, significant cultural resources must possess integrity relative to their original historical features and characteristics.

3.22.1 Analysis Area and Methods

The Area of Potential Effect (APE) is the geographic area where the character or use of historic properties (significant cultural resources) may directly or indirectly be affected because of a project undertaking (36 CFR 800.16). Because of the magnitude and complexity of the Study action alternatives, a formal APE has not been defined. Instead, for the purposes of the current analysis, a cultural resource probability analysis area has been defined encompassing all action alternatives. If a decision is made to pursue an action alternative to implementation, a formal APE would be defined and targeted studies would be performed specific to the Proposed Action.

The cultural resource analysis area evaluated for this stage of planning and environmental analysis includes the following:

- Study Area: Lands within a 0.5-mile radius of all elements comprising the alternative water delivery systems (including canals, pipelines, reregulating reservoir, pumping plants, and O&M facilities associated with the partial and full replacement alternatives). The 0.5-mile radius is generally accepted as the area of concern among cultural resource oversight agencies for projects with linear components such as those in the action alternatives. This Study Area encompasses approximately 278,300 acres.
- Banks Lake and Lake Roosevelt: Impacts at these reservoirs may result from additional drawdowns, and thus are limited to the area defined by the difference between current drawdowns and those that would occur under the action alternatives.

Cultural and historic resources were evaluated based on archival research, field surveys, and a predictive model to estimate probabilities of cultural resources in the area.

3.22.2 Cultural Setting

3.22.2.1 Pre-contact and Ethnographic Setting

The analysis area is located within the Columbia Plateau region. Human history of this area dates back at least 11,000 years. A generalized chronology is provided in Table 3-48.

Table 3-48. Generalized pre-contact cultural sequence – Columbia Plateau.

Cultural Period	Age in ybp *	Site Types	Artifacts
Paleo-Indian	11,000 and prior	Hunting and game processing sites; tool manufacture sites, and toolstone procurement sites	Large lithic tools, including Folsom and Clovis projectile points and blades
Windust	11,000-8,000 ybp	Hunting and game processing sites; tool manufacture sites, and toolstone procurement sites; not yet documented in the mid-Columbia region	Tool include Windust style projectile points, cobble tools, scrapers, gravers, and burins, hammer stones, groove stones, bone awls, ocher beads, and antler wedges.
Cascade/ Vantage	8,000-4,500 ybp	Hunting and foraging (botanicals) resource processing sites, seasonal encampments, lithic tool sites, petroglyphs, and pictographs	Lanceolate projectile points (often basalt), cobbles, grinding stones, bone tools, large side-notched projectile points

Cultural Period	Age in ybp *	Site Types	Artifacts
Frenchman Springs	4,500-2,500 ybp	Pithouse village sites along rivers, seasonal encampments, resource processing sites, lithic and toolstone manufacture sites, burials, spiritual sites, petroglyphs and pictographs	Stemmed and barbed projectile points, mortars and pestles; weights and tools associated with fishing and netting
Cayuse Phase	2,500 ybp-ethnographic present	Pithouse village settlements, seasonal encampments, resource processing sites, petroglyphs and pictographs, burials, spiritual and ideological sites	Narrow necked projectile points, corner and basal notched projectile points, scrapers, knives, net sinkers and weights, mortars and pestles, cordage and matting, adornment items (for example, beads and decorated bone)
Source: Synthesized from information contained in Gundy (1998), Marceau et al. (2002) and Sharpe (2009) * ybp = years before present			

Native American Resources

Many Native American Tribes have ancestral and traditional ties to the lands within the analysis area. These Tribes are included in the membership of the Confederated Tribes of the Colville Reservation, the Spokane Tribe of Indians, the Confederated Tribes of the Umatilla Indian Reservation, and the Yakama Nation. A nonfederally recognized Tribe that has traditional ties to the area includes the Wanapum Band.

Traditional Cultural Properties (TCPs)

A Traditional Cultural Property (TCP) is a place eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that are both rooted in that community's history and important in maintaining the cultural identity of the community. The Confederated Tribes of the Colville Reservation conducted an inventory-level investigation of the analysis area in 2007. Ethnographic records, oral histories, published works, oral interviews and a field reconnaissance concluded that the Moses-Columbia people and their contemporary descendants are traditionally, but not exclusively, associated with the area. Furthermore, a variety of TCPs were noted adjacent to the western edges of the analysis area near Moses Lake and Crab Creek. A more focused TCP inventory was recommended for specific areas that may be affected by any of the Odessa Special Study action alternatives. Such a TCP inventory would focus on coulees, prominent landforms, escarpments, and natural vegetation breaks (Reclamation 2008 Appraisal).

3.22.2.2 Other Tribal Interests

Sections 3.23 – *Indian Sacred Sites,* and 3.24 – *Indian Trust Assets*, detail other Tribal interests in the analysis area.

Historic Setting

Euro-Americans began exploration of the Columbia River Basin in the U.S. and Canadian "Oregon Country" in the late 1700s. The first major Euro-American settlement began in 1835, when Samuel Parker settled on the Columbia plain. Although the upper basin's prairies were fertile, few settlers made the effort to farm during the early years. Missionaries, on the other hand, were willing to establish missions in the area in efforts to convert native peoples to Christianity. The Whitman and Spaulding missions were established in 1836.

In 1848, Congress established the Oregon Territory, encompassing the Columbia River Basin. Oregon Territory was split in 1853, resulting in creation of the Washington Territory, which included the present state of Washington, as well as portions of Montana and Idaho. In 1854, gold was discovered by a prospector operating near Fort Colville. This discovery resulted in a gold rush to the Pacific Northwest. Sporadic settlement of the area continued from 1854 until the 1880s, and was based in the economy of cattle ranching (Linenberger 2009).

In 1883, the Northern Pacific Railroad laid tracks in the Columbia River Basin. The Great Northern Railroad followed 10 years later. The rail industry created an increase in settlement and population growth in the region. However, a series of hard winters in the 1880s shifted the economic base of the region from cattle ranching to wheat farming. With agricultural development arose the need for increased access to water for crops. The Columbia River seemed a good source and in 1918, Rufus Woods promoted an idea for a dam at Grand Coulee (Linenberger 2009). Another idea for irrigating land in the basin was a gravity plan bringing in water from Idaho through 130 miles of canals, tunnels, aqueducts, and reservoirs. For over 10 years, various studies of the two schemes (Grand Coulee and Idaho) were conducted and debate continued regarding which plan should be pursued.

Beginning in 1929, a drought resulted in crippling power shortages throughout the Pacific Northwest and Dust Bowl conditions. Columbia River Basin topsoil began to blow away. For example, in April of 1931, a huge cloud of fine dust engulfed passengers aboard an ocean liner 600 miles off the coast of Seattle headed for Honolulu. Public demand for additional irrigation projects was renewed.

In 1932, Franklin D. Roosevelt was elected President. Roosevelt's plans for large public works programs designed to increase expenditures and promote economic growth included Grand Coulee Dam in his new Public Works Administration program (Linenberger 2009). Through the next 18 years, the main elements of the CBP irrigation system we see today were constructed, including Grand Coulee Dam itself, the Main, West and East Low Canals, regulating reservoirs at Banks Lake and Billy Clapp Lake, and other elements.

While much of the analysis area had been sparsely settled around the turn of the 20th century, many settlements failed because of droughts. The completion of the main elements of the irrigation system in about 1950 resulted in dramatic changes to the region's settlement. In 1950, 68 irrigated farms benefitted from the project. By 1955, almost 10,000 people lived on farms within the project and nearby towns and cities had become more developed. By 1985, facilities had been constructed to serve over 557,000 acres; in that year almost 11,000 people lived on CBP-served farms and the average farm size was 257 acres. By 1992, the CBP farm population was over 12,500. Overall, the general trend over time has been both an increase in farm population and an increase in the average size of farms (Linenberger 2009).

3.22.3 Analysis Area Characteristics

3.22.3.1 Odessa Special Study Area

Existing data for the Study area at proposed water system features include cultural resource predictive models, as well as written histories and cultural resource reports. At least 29 cultural resource studies have taken place within the Study Area vicinity; however, research performed for the current discussion indicates that less than 1 percent of the area has been inventoried for cultural resources. Based on these previous cultural resource investigations in the region, the potential for pre-contact sites in the Study area for the action alternatives is believed to be generally low (estimated at one site per 1,000 acres), with greater potential within 1 mile of reliable perennial water, and concentrated in areas with rocky soils. The potential for historic site presence is also low for most of the area, although farmsteads are present throughout the area and many may meet the 50-year threshold for documentation in the coming decade. Literature research and a 2009 visual inspection of the locations where select project components would be built imply that most of the Study Area has a low probability for pre-contact and/or historic cultural resources.

Within the locations that were previously inventoried, approximately 32 cultural resource sites have been documented. Pre-contact archaeological sites include lithic scatters, resource processing and procurement sites, seasonal habitation or encampment sites, a game kill and processing site, and isolated artifacts. Other types of pre-contact resources that may be present in the Study area include petroglyphs and pictographs, burial sites, religious or ideological sites (such as cairns), and TCPs.

Documented historic sites in the area tend to be related to early agricultural development in the region and include farmsteads, homesteads, quarries, rock features, refuse scatters, transportation structures, and irrigation-related features. Additional historic resources likely in the Study Area include railroads, roads, trails, historic buildings, and small townsites.

Although historic in age, most of the East Low Canal and other extensive linear components of the CBP have not yet been documented as cultural resources. However, these features are considered to be significant historic cultural resources, eligible for listing on the NRHP. The National Historic Preservation Act (NHPA) process would be carried out independent of the NEPA process.

3.22.3.2 Banks Lake and Lake Roosevelt Reservoir Areas

The Banks Lake and Lake Roosevelt areas have had a considerable amount of cultural resource work conducted around them. These areas, including the land exposed by reservoir drawdowns, are considered to have a high probability for cultural resource presence.

Banks Lake

Numerous cultural resource investigations have been conducted for Banks Lake, dating back to 1947 during the Columbia Basin Archaeological Survey. Since that time, cultural resource investigations have been conducted (Reclamation 2004). There are 673 archaeological sites recorded on Reclamation-managed lands. Of that total, 66 pre-contact sites, 3 historic sites, and 2 multicomponent sites have been identified within the water drawdown area between 1570 and 1565 feet amsl. Banks Lake, from the vicinity of Steamboat Rock southward, is located in the area ceded in the Yakama Treaty of 1855. Native American groups reserve rights and privileges to hunt, fish, and gather roots and berries on open and unclaimed lands. The Colville Confederated Tribes consider Banks Lake and the surrounding area traditional territory for some of the Tribal members (Reclamation 2004).

Lake Roosevelt

Numerous cultural resource investigations have been conducted related to drawdowns of Lake Roosevelt. Most of the cultural resource investigations have focused on elevations between 1220 and 1290 feet amsl. As of 2006, almost 700 archaeological sites had been recorded at the reservoir. Pre-contact sites are diverse and include small and large habitation sites, resource procurement and processing sites, and ritual sites. Historic sites include artifact dumps, structural remains, town sites, mines, missions, forts, cemeteries, and schools (Ecology 2007).

3.22.3.3 Predictive Model

Because of the areal extent and complexity of the action alternatives (the analysis is more than 278,000 acres, excluding Banks Lake and Lake Roosevelt), a Class II cultural resource investigation including pedestrian inventory surveys was not justified at this time. Instead, a cultural resource predictive modeling approach has been employed to aid in understanding the relative potential for encountering cultural resources within the footprint and defined buffer area of delivery system facilities that would be built in one or more of the action alternatives.

A general cultural resource predictive model for the Study area was generated in 2007 (Ives). The model was based on documented cultural resource presence in the region as well as elevation and hydro-geographic spatial data. This predictive model suggests that only 15 percent of the land on which facilities would be built with the action alternatives has a high probability rating for pre-contact archaeological sites, with 32 percent rated as moderate and 53 percent rated as low potential. According to the Ives model, high probability areas are primarily associated with the larger ephemeral drainage channels, such as those in which the Black Rock Coulee Reregulating Reservoir would be sited.

Neither Banks Lake nor Lake Roosevelt are included in the predictive modeling because both locations are known to contain pre-contact and historic cultural resources, and both are considered to have high probability for encountering additional resources if reservoir levels are drawn down below No Action Alternative conditions.

This predictive modeling can be used to compare alternatives as input to project decisionmaking. If the decision is made to proceed to implementation with one of the action alternatives, a formal APE will be defined for the selected alternative and appropriate Class II investigations and pedestrian inventory survey would be conducted.

As part of research for the EIS, field reconnaissance was conducted in spring 2009, targeting portions of the analysis area that are considered to have moderate or high cultural resource probability based on the Ives model. This reconnaissance was intended to generally review cultural resource conditions in the Study Area and support refinement of the Ives predictive model. It also confirmed that the site of the Black Rock Reregulating Reservoir, the alignment of the northern portion of the East High Canal, and the Black Rock Coulee Flood Channel have a moderate potential to contain pre-contact and perhaps historic archaeological resources. These sites and alignments are characterized by talus slopes, exposed basalt outcrops, and open rangeland.

This model incorporates the following data sets:

- Washington Department of Archeology and Historic Preservation
- Government Land Office maps
- Historic topographic maps
- Hydrologic data
- Soils and geology data
- Aerial imagery
- Digital elevation model

To obtain a composite assessment, the data sets are overlaid and a location, zone, or subarea designated as high probability on any data set is considered for an overall or composite rating of high probability. Where applicable, points or areas where resources have previously been encountered are automatically assigned a high probability rating. However, professional judgment is also important in the composite rating process. For example, the soils data do not appear to be a good indicator of cultural resource presence. Under the current soil classification system, the majority of the Study Area falls into the high probability for possessing cultural resources, and this is known not to be the case.

Generalized results of the predictive model analysis are presented on Table 3-49. The probability (high, moderate, or low) for encountering pre-contact and historic archaeological resources is reported for the footprints of the major types and locations of facilities associated with the action alternatives.

Table 3-49. Estimated probability for pre-contact and historic cultural resource presence at major water delivery system sites based on research and available geospatial datasets.

	Canal and Constructed Wasteway Corridors			Distribution Pipeline Routes		
	East Low Canal	**East High & Black Rock Branch Canals**	**Weber Wasteway**	**Northern Study Area (North of I-90)**	**Southern Study Area (South of I-90)**	**Black Rock Coulee Reregulating Reservoir**
Washington Department of Archaeology and Historic Preservation Dataset	High probability for historic (canal itself) and localized areas of pre-contact resources	No known historic or pre-contact resources present	No known historic or pre-contact resources present	Cemetery in vicinity; otherwise, no known historic or pre-contact resources	No known historic or pre-contact resources present	No known historic or pre-contact resources present
Government Land Office Dataset	North half: High probability for pre-contact and moderate probability for historic resources; low probability elsewhere	Northern East High Canal: High probability for pre-contact and historic resources; elsewhere, localized high to moderate probabilities for both	Moderate to high probabilities for pre-contact; low probability for historic resources except at extreme southwestern end	Moderate probability for historic and pre-contact resources at localized areas; high probability for pre-contact resources in eastern area	Low probability for historic and pre-contact resources in general; high probability for pre-contact resources in eastern area	Moderate to high probabilities for pre-contact and historic resources
Historical Map Dataset	Low probability for pre-contact and historic resources	Localized small areas of high historic probability; otherwise, low probability for pre-contact & historic resources	Low probability for pre-contact and historic resources	Localized small areas of high historic probability; low probability for pre-contact and historic resources	Low probability for pre-contact and historic resources; localized small areas of high historic probability	Low probability for pre-contact and historic resources

	Canal and Constructed Wasteway Corridors			Distribution Pipeline Routes		
	East Low Canal	**East High & Black Rock Branch Canals**	**Weber Wasteway**	**Northern Study Area (North of I-90)**	**Southern Study Area (South of I-90)**	**Black Rock Coulee Reregulating Reservoir**
Hydrology Dataset	High probability for historic (canal itself) and moderate probability of pre-contact resources	Majority at low probability for pre-contact and historic resources; limited areas with moderate and high probability	High probability for pre-contact and historic resources at north end; elsewhere, moderate probability	Majority at low probability; localized areas of moderate or high probability for pre-contact and historic resources	Majority at low probability; localized areas of moderate or high probability for pre-contact and historic resources	Majority at high probability for pre-contact and historic resources, except the eastern tip, which is low probability
Soils and Geology Dataset	Majority at high probability for pre-contact resources	Majority at high probability for pre-contact resources	Majority at high probability for pre-contact resources	Majority at high probability for pre-contact resources	Majority at high probability for pre-contact resources	Roughly half high and half low probability for pre-contact resources
Aerial Imagery Dataset	No data	Majority at low with some areas of moderate probability for historic structures	No data	No data for most areas; northernmost are at moderate probability for historic agricultural buildings and utility lines	No data	Portions at moderate or high probability
Digital Elevation Model Dataset	Generally high probability for pre-contact and historic resources	Widely varying probabilities for pre-contact and historic resources	Generally high probability for pre-contact and historic resources	Widely varying probabilities for pre-contact and historic resources; generally high probability for pre-contact and historic resources closer to I-90	Generally high probability for pre-contact and historic resources; generally high probability for pre-contact and historic resources closer to I-90	Moderate pre-contact probability; low historic probability

3.23 Indian Sacred Sites

Executive Order 13007, dated May 24, 1996, instructs Federal agencies to promote accommodation of access and protect the physical integrity of American Indian sacred sites. Executive Order 13007 directs Federal agencies to accommodate access to, and ceremonial use of, Indian Sacred Sites by Indian religious practitioners and to avoid adversely affecting the physical integrity of such sacred sites on Federal lands. The agencies are further directed to ensure reasonable notice is provided for proposed land actions or policies that may restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites. A Sacred Site means any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian Tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion.

Sacred sites may include ceremonial areas and landmarks such as rock formations which are symbolic representations of religious beings. A sacred site is sometimes only identified if the Tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of a site. No sacred sites have yet been identified within the APE. However, the Yakama Indian Nation and the Confederated Tribes of the Colville Reservation have expressed concern in the past about other projects in the general vicinity. Reclamation is consulting with the Yakama Indian Nation and the Confederated Tribes of the Colville Reservation regarding potential cultural resource and sacred site issues.

3.24 Indian Trust Assets

Indian Trust Assets (ITAs) are legal interests in property held in trust by the U.S. Government for federally recognized Indian Tribes or individual Indians. ITAs may include land, minerals, federally reserved hunting and fishing rights, federally reserved water rights, and instream flows associated with trust land. Beneficiaries of the Indian trust relationship are federally recognized Indian tribes or individuals with trust land, the U.S. acting as trustee. By definition, ITAs cannot be sold, leased, or otherwise encumbered without approval of the U.S.

In accordance with the 1994 memorandum “Government-to-Government Relations with Native American Tribal Governments,” Reclamation is responsible for the assessment of study or project effects on Tribal trust resources and federally recognized Tribal governments. Reclamation is tasked to actively engage and consult federally recognized Tribal governments on Government-to-Government level when its actions affect ITAs.

The U.S. Department of the Interior (DOI) Departmental Manual Part 512.2 defines the responsibility for ensuring protection of ITAs to the heads of bureaus and offices (DOI 1995). DOI is required to "protect and preserve Indian trust assets from loss, damage, unlawful alienation, waste, and depletion" (DOI 2000). It is the responsibility of Reclamation to determine if the proposed project has the potential to affect ITAs.

While the majority of ITAs are located on-reservation, ITAs can also occur outside reservation boundaries. Consequently, several Tribes have a historical presence or cultural interest in the project area. These include the Spokane Tribe of Indians, the Yakama Nation, and the Confederated Tribes of the Colville Reservation. Additionally, the Wanapum, a nonfederally recognized Tribe, also has a cultural interest in the project area.

The majority of the area in and surrounding the project area is within lands ceded in the Yakama Treaty of 1855. The treaty established the Yakama Reservation, which lies to the southwest of the project, and reserved:

> The exclusive right of taking fish in all the streams, where running through or bordering said reservation, is further secured to said confederated tribes and bands of Indians, as also the right of taking fish at all usual and accustomed places, in common with the citizens of the Territory, and of erecting temporary buildings for curing them: together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land.

Consultation has been ongoing between Reclamation and the Colville Confederated Tribes and the Yakama Nation. Consultation has focused on these two Tribes because of the presence of ceded lands (Yakama Nation) and potential impacts to the Columbia River (Colville Tribes). Additionally, both Tribes have cultural ties to the Columbia River Basin. Concerns identified during consultation generally focused on impacts to wildlife habitat and cultural resources; no specific issues dealing with ITAs were identified.

Reclamation contacted the Bureau of Indian Affairs (BIA), Yakima Office, to identify the presence of ITAs or trust lands in the Study Area. Trust lands are property held in trust by the U.S. for individuals, sometimes referred to as "allottees." BIA personnel indicated that there are no allotments in the Columbia Basin.

Reclamation also contacted the BIA Colville Tribes Office who also indicated that there are no trust lands in the project area.

Reclamation has determined that the Study Area does not include lands publically withdrawn or held in trust by the U.S. for Tribes or individual allottees, nor does the Study Area include trust land. Reclamation-owned property in the Columbia River Basin was not withdrawn or ever considered open and unclaimed. Instead, property was purchased from private individuals for CBP purposes. However, some Tribes in the past have stated that habitat for fishing, hunting, and gathering located on federally owned land may constitute an ITA. While this is not Reclamation's position, the Government respects and acknowledges this Tribal perspective.

The U.S. DOI Departmental Manual Part 512.2 defines the responsibility for ensuring protection of ITAs to the heads of bureaus and offices (DOI 1995). DOI is required to "protect and preserve Indian trust assets from loss, damage, unlawful alienation, waste, and depletion" (DOI 2000). It is the responsibility of Reclamation to determine if the proposed project has the potential to affect ITAs.

3.25 Environmental Justice

Environmental justice is defined by the EPA Office of Environmental Justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." Fair treatment means no group of people should bear a disproportionate share of negative environmental consequences resulting from industrial, governmental, and commercial operations or policies. Meaningful involvement means (EPA 2008):

1. People have an opportunity to participate in decisions about activities that may impact their environment or health.
2. The public's contribution can influence the regulatory agency's decision.
3. Their concerns will be considered in the decisionmaking process.
4. The decision makers seek out and facilitate the involvement of those potentially impacted.

3.25.1 Analysis Area and Methods

The analysis area for environmental justice consists of the Odessa Subarea plus a 5-mile buffer, to be consistent with the analysis area for Section 3.15 – *Irrigated Agriculture and Socioeconomics*. The environmental justice analysis area is located completely within Adams, Franklin, Grant, and Lincoln counties. Populations of concern such as minorities and low-income populations could be impacted by the No Action Alternative or the action alternatives, either because of facility development, modification, or operation.

According to the Council on Environmental Quality, to be considered a minority population, the population of the impacted area must either exceed 50 percent minority, or the minority population percentage of the impacted area must be meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. To be considered a low-income population, low-income populations in an impacted area should be identified using the annual statistical poverty thresholds from the Census Bureau (CEQ 1997).

The potential for environmental justice impacts was evaluated considering the potential impacts that may be incurred by minority or low-income populations in the area as a result of implementing any of the alternatives.

3.25.2 Race and Ethnicity for the Analysis Area

Table 3-50 lists the population of the counties of Adams, Franklin, Grant, and Lincoln, the State as a whole, and the percent minority for each of those geographies. It also provides the race breakdown for each county, as well as the Hispanic or Latino ethnicity percentages.

As shown in Table 3-50, in 2010, none of the individual minority races for the four counties were above the 50-percent threshold, which would indicate a minority population according to the Council on Environmental Quality or EPA guidelines. However, the percentages for Hispanic or Latino ethnicities categories for Adams, Franklin, and Grant Counties are meaningfully greater than they are for Washington. Therefore, a review of the minority population on a census block group level was conducted using year 2000 data.

Table 3-50. Race and ethnicity in 2010 for Adams, Franklin, Grant and Lincoln counties, and the State of Washington.

Parameter	Adams County	Franklin County	Grant County	Lincoln County	Washington State
Total population	18,728	78,163	89,120	10,570	6,724,540
Racial minorities					
Number	7,025	30,893	24,214	532	1,528,178
Percent	37.5	39.5	27.2	5.0	22.7
Hispanic or Latino (any race)					
Number	11,099	40,004	34,163	239	755,790
Percent	59.3	51.2	38.3	2.3	11.2
Source: U.S. Census Bureau 2010					

Forty-two block groups are located within the environmental justice and socioeconomic analysis area. Six of these block groups have a 50.1- to 75-percent minority population. These block groups are located in and around the town of Warden, between Warden and Othello, and directly south of Warden in northern Franklin County. While only two of these block groups are within the defined Study Area, all are considered in this analysis because of the potential for groundwater impacts to occur in those areas and, therefore, for potential affects to minority populations.

Additional potentially impacted minority populations include members of Native American Tribes with ancestral and traditional ties to the lands, as described in Section 3.23 – *Indian Sacred Sites*, and Section 3.24 – *Indian Trust Assets*.

3.25.3 Income, Poverty, Unemployment, and Housing for the Analysis Area

Table 3-51 provides income, poverty, unemployment, and housing data for the counties of Adams, Franklin, Grant, and Lincoln, as well as for the State of Washington.

As shown in Table 3-51, all four counties have a much lower median family income and/or per capita income than the State as a whole. In addition, the percentages of families and individuals that are living below the poverty level are significantly higher in Adams, Franklin, and Grant Counties than in the State. Similarly, the unemployment rate and the percentage of people who are living together in individual rooms are much higher in Adams, Franklin, and Grant counties than in the State. This triggered a block group analysis of year 2000 data to evaluate potential impacts.

Table 3-51. Income, poverty, unemployment, and housing in 2010 for Adam, Franklin, Grant and Lincoln counties, and the State of Washington.

Parameter	Adams County	Franklin County	Grant County	Lincoln County	Washington State
Median family income	$40,829	$51,457	$42,337	$45,582	$55,631
Per capita income	$16,689	$16,715	$18,678	$24,757	$28,364
Families below poverty level					
Number	N/A	N/A	N/A	N/A	N/A
Percent	19.0	17.2	19.4	7.1	9.2
Individuals below poverty level					
Number	3,539	15,674	20,997	1,260	888,718
Percent	21.2	20.1	23.9	12.1	13.4
Percent unemployed	10.7	6.9	12.5	5.2	10.8
Housing percent with 1.01 or more occupants per room (Year 2000)	14.4	18.6	12.4	1.9	5.1
Housing percent lacking complete plumbing facilities (Year 2000)	0.3	0.6	0.8	0.4	0.5
Source: U.S. Census Bureau 2010					

The majority of the block groups within the environmental justice analysis area (38 of the 42 block groups analyzed) have a population in which approximately 25 percent or less are living in poverty. The remaining four block groups have a population in which 25.1 to 33.2 percent are living in poverty. These four block groups are clustered in two locations: directly south of Warden, in the northern part of Franklin County, and a small block north of Moses Lake. All four block groups are located within the 5-mile buffer area and outside the Study Area, and no facilities are proposed to be located in these areas. These four block group areas will continue to be considered in this analysis, though, because of the potential for groundwater impacts to occur in those areas and potential impacts to populations in poverty. Also, the action alternatives for both partial and full replacement would include this area south of I-90.

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CHAPTER 4 ENVIRONMENTAL CONSEQUENCES

Chapter 4 ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This chapter describes the anticipated beneficial and adverse impacts of the action alternatives on the environmental resources described in Chapter 3. The likely consequences of the No Action Alternative are also discussed. The chapter evaluates direct, indirect, and cumulative effects, and quantifies these effects whenever possible. Actions and commitments intended to avoid or minimize environmental impacts are also described. The net impact on the relevant resources is determined by comparing the impacts of the action alternatives to the No Action Alternative.

The base-case analysis and discussion for each action alternative is with the Spring Diversion Scenario in which diversions in April through June would be allowed from the Columbia River when flows exceed 135,000 cfs at Priest Rapids Dam, 260,000 cfs at McNary Dam and when there is adequate pump capacity to pump water from Lake Roosevelt to Banks Lake. This is consistent with limitations in the previous analyses performed for the Draft EIS.

Potential effects from the Limited Spring Diversion Scenario are then analyzed for each action alternative. Under this scenario, Reclamation would limit diversions in the spring (April through June) for direct delivery to the Study Area to periods when the Columbia River outflows from Grand Coulee Dam exceeds 200,000 cfs and there is adequate pump capacity. This discussion is presented under the "Long-term Impacts" under the heading Changes with Limited Spring Diversion Scenario.

For each environmental resource, impact analysis is presented according to the following outline:

- Summary. The key impact considerations and analysis findings for all alternatives are summarized immediately below the main environmental resource heading.
- Methods and Assumptions. This section describes how the alternatives for that resource are compared:
  - Impact Indicators and Significance Criteria: A list of criteria used to determine whether changes to the environment are significant.
  - Impact Analysis Methods: Defines the technical or professional approach to analyzing impacts and the baseline condition against which the impacts of the alternatives are compared.

  - Impact Analysis Assumptions: Describes the applicable State or Federal regulations and policies that would act to avoid or minimize impact, and the Best Management Practices (BMPs) committed to by the lead agencies to further avoid or minimize impacts. Compliance with these regulations, policies, and BMPs is assumed in assessing the potential magnitude of impacts. Where these apply to more than one resource topic, they are described once the first time and are simply referenced in later discussions.

- Impact Analysis for each alternative.
  - Alternative 1: No Action Alternative
  - Alternative 2A: Partial—Banks
  - Alternative 2B: Partial—Banks + FDR
  - Alternative 3A: Full—Banks
  - Alternative 3B: Full—Banks + FDR
  - Alternative 4A: Modified Partial—Banks (Preferred Alternative)
  - Alternative 4B: Modified Partial—Banks + FDR

What Area is Affected?

Distinct geographic areas are involved with analyzing the alternatives, as shown in Figure 1–1, *Location Map*, and described in Figure 1–2, *Common Terms for the EIS*. The Odessa Subarea refers to the Odessa Groundwater Management Area where groundwater levels are declining. Within this is the Study Area that is the focus of this EIS. This Study Area is the part of the Odessa Subarea that is within the CBP and thus eligible to receive CBP surface water. The analysis area for each environmental resource is the area of potential impact for that resource. For example, the analysis area for fisheries includes the Study Area and the Columbia River downstream of Lake Roosevelt. Analysis areas for each resource were described in Chapter 3. The *Glossary* provides more in–depth definitions for these geographic terms.

For some environmental resources, impacts are described particular to Banks Lake and Lake Roosevelt. Additional drawdown at Banks Lake is a part of the water supply solution for all action alternatives. Likewise, use of storage from Lake Roosevelt is incorporated in some of the alternatives. Anticipated impacts associated with drawdowns at these reservoirs are discussed separately for most resource topics.

How are Impacts Described?

Impacts are analyzed assuming that applicable laws, regulations, and BMPs are followed. If significant impacts remain, they may be addressed in the action alternatives through mitigation measures. Any impacts that cannot be fully mitigated are listed in Section 4.28 – *Unavoidable Adverse Impacts*. The following terms are used to describe the level of impact or effect within each of the alternatives:

Neutral or Negative issues (from least to most impact):

No impact or effect

Minimal impact: Influences the resource negatively, but to a barely measurable degree

Adverse impact: Negatively affects the resource more than minimally, but does not meet the significance criteria identified in the Impact Indicators and Significance Criteria table near the beginning of each environmental topic

Significant impact: Exceeds one of the significance criteria

Positive issues (from least to most effect):

Beneficial effect

Important beneficial effect

Within each alternative, impacts are discussed in the following order:

- Short–term Impacts: Generally, impacts occurring during the construction period, with exceptions noted.
- Long–term Impacts: In most cases, permanent impacts, with some being realized progressively through multiple years or decades.
- Mitigation Measures (applicable only to the action alternatives): Measures that may compensate for some or all of the impacts remaining following adherence to regulations and implementation of BMPs.

Applicable legal requirements and, where appropriate, BMPs, are discussed for each resource topic. The analysis of impacts assumes that the legal requirements and BMPs would be successfully implemented, thereby avoiding some impacts and minimizing others. Mitigation measures may be included to partially or fully compensate for impacts that cannot be avoided or minimized through legal requirements and BMPs. A specific BMP is only listed once under the first resource to which it applies and is not repeated for other resource topics. For example, BMPs that would be implemented to avoid impacts to water quality during construction are discussed in Section 4.4 – *Surface Water Quality*. These same measures would be followed to prevent sediment runoff into wetlands, but they are not repeated in Section 4.8 – *Vegetation and Wetlands*.

Where parts of the impact analysis and associated conclusions are the same for two or more alternatives, discussion is presented only for the first alternative and referenced for subsequent alternatives. As described in Chapter 2, the elements of the water delivery system are the same for the two partial replacement alternatives and are focused on expanding the East Low Canal. Likewise, the full replacement alternatives would involve development of the East High Canal system north of I-90. Much like the partial replacement alternatives, the modified partial replacement alternative delivery systems are identical with impacts that would result from implementation discussed with the first alternative presented.

Within these three broad groups of partial, full, and modified partial replacement alternatives, the alternatives vary only in which reservoir reregulates the water during the juvenile fish migration season, the sources were either Banks Lake only, or a combination of Banks Lake and Lake Roosevelt. Therefore, in many environmental topics, the impact analysis related to the water delivery system is presented only for Alternatives 2A: Partial—Banks, 3A: Full—Banks, and 4A: Modified Partial—Banks (Preferred Alternative), with discussions of other alternatives incorporating that analysis by reference. In all cases, differences from previously described impacts are discussed.

Finally, beyond the 25 individual resource topics, this chapter includes the following discussions as required by NEPA and SEPA:

- Cumulative Impacts
- Unavoidable Adverse Impacts
- Relationship Between Short–Term Use and Long–Term Productivity
- Irreversible and Irretrievable Commitments of Resources
- Environmental Commitments

4.2 Surface Water Quantity

The short– and long–term impacts, and mitigation measures, described for each alternative under Surface Water Quantity are related to potential changes to the amount of water available in the following systems:

- Columbia River.
- Banks Lake and FDR.
- Other surface water resources in the analysis area.

The No Action Alternative would have no impact on Lake Roosevelt, Banks Lake, or the Columbia River downstream of Grand Coulee Dam because no additional water would be withdrawn from the Columbia River system, flows would not change in the Columbia River, and Banks Lake and Lake Roosevelt operation would not change.

Reductions of reservoir water surface elevations because of additional drawdowns in the six action alternatives would impact several resources. The significance of those impacts is discussed in Sections 4.4 – *Surface Water Quality*; 4.8 – *Vegetation and Wetlands*; 4.9 – *Wildlife and Wildlife Habitat*; 4.10 – *Fisheries and Aquatic Resources*; 4.14 – *Recreation,* 4.17 – *Energy,* 4.21 – *Visual Resources,* and 4.22 – *Cultural and Historic Resources.*

The Columbia River would experience flow reductions downstream of Grand Coulee Dam under all of the action alternatives. Maximum projected reductions would generally occur in October and there would be no reduction of flows during July, August, or September. The action alternatives were developed with the assumption that the 2010 FCRPS BiOp water management objectives would not be compromised between April and August.

Other surface water features in the analysis area would be impacted to some extent by all of the action alternatives. Flows would increase in many of the major canals, diversions, channels, and wasteways. Areas receiving water from the wasteways would be minimally impacted because increased flows would slightly increase scour and frequency or extent of inundation. Flows, geomorphology, and connectivity of existing drainages being crossed by new canal segments would only be minimally impacted because cross–drainage facilities would be constructed.

4.2.1 Methods and Assumptions

4.2.1.1 Impact Indicators and Significance Criteria

The impact indicators for hydrology and surface water resources help determine how constructing and operating the proposed delivery facilities and shifting from groundwater to surface water supply compare to current conditions. Impact and significance criteria are presented in Table 4-1.

Table 4-1. Surface water resource impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Instream flow	Compliance with the 2010 FCRPS BiOp for conservation of ESA–listed fish and designated critical habitat. If requirements can no longer be met, a significant impact would result.
Reduction of surface water elevations in Banks Lake or Lake Roosevelt	Significance criteria for this indicator are discussed in Sections 4.4 – *Surface Water Quality*, 4.8 – *Vegetation and Wetlands,* 4.9 – *Wildlife and Wildlife Habitat*, 4.10 – *Fisheries and Aquatic Resources*, 4.14 – *Recreation Resources,* 4.17 – *Energy,* 4.21 – *Visual Resources,* and 4.22 – *Cultural and Historic Resources*.
Changes to flows, geomorphology, or connectivity resulting from inundation under a planned reservoir or spillway flow from a reservoir	Inundation or fragmentation of permanent existing surface water features would be significant.
Changes to areas that receive water from the wasteways	Inundation of permanent existing surface water features or increased erosion would be significant.

Other impacts of these changes, such as to water rights, and threatened or endangered species, are addressed in those sections of this Final EIS.

4.2.1.2 Impact Analysis Methods

Changes to surface water features that would occur under each of the alternatives are compared against the current conditions within the Study Area. The net impacts of each action alternative are determined by comparing their effects to those that would occur under the No Action Alternative.

Selection of Representative Water Years

Spreadsheet analysis and modeling were conducted to estimate future reservoir and Columbia River watershed conditions, as described in Chapter 2, Section 2.2.2 – *River and Reservoir Operational Changes and Hydrology under the Action Alternatives*. For the Final EIS, alternatives are compared based on four projected basin–wide precipitation conditions:

- Wet year: 1982 was selected as being representative of these conditions, approximately 10 percent of all water years are this wet or wetter and 90 percent drier.

- Average year: 1995 was selected as being representative of these conditions, approximately 50 percent of water years would be wetter and 50 percent drier.[1]
- Dry year: 1998 was selected as being representative of these conditions, approximately 15 percent of water years would be this dry or drier; the remaining 85 percent of years would be wetter.
- Drought year: 1931 was selected as being representative of these conditions, approximately 5 percent of water years would be this dry or drier; approximately 95 percent of years would be wetter.

Historic hydrologic data were used to evaluate likely future hydrologic and system operation patterns. The use of these data assumes that future hydrologic conditions would be similar to those observed in the past. The 70–year period of record (1929 to 1998) that was used as the basis for modeling in the Columbia Basin includes periods of years that were the driest on record and years that were the wettest on record in the Columbia River Basin. Future water years would not be identical to the four representative years that were chosen for this study. The results are not predictions of all hydrologic conditions over the life of the Odessa Special Study alternatives, but are indicative of possible patterns of water operations and hydrology assuming no major change occurs relative to historic hydrologic patterns. The 1929 through 1998 modeling period covers a variety of hydrologic conditions and it is reasonable to use this information to make assess the likely effects of the alternatives.

The representative years chosen for the analysis are different than years referenced in the Final Supplemental EIS for the Lake Roosevelt Incremental Storage Releases Program prepared by Ecology (2008), which references representative years as recent as 2003. The analyses presented in this document are limited to data from 1929 through 1998 because additional information is not yet available from HYDSIM modeling on the Columbia River.

Water Resources Impacted

For each of the water bodies and features, the impacts analysis describes the seasonal flow regime for the No Action Alternative and each of the action alternatives. Flow conditions are described for a representative wet, average, dry, and drought water year.

[1] Under current (No Action) operations, Lake Roosevelt end of August drawdown is dependent on the water supply forecast at The Dalles. When the July, April through August water supply forecast volume is 92 MAF (99 percent of average) or higher (between 50 and 60 percent of water years), Lake Roosevelt is drawn down to at least 11 feet from full for both flow augmentation and the Lake Roosevelt Incremental Storage Release project. In water years where the forecast is below 92 MAF (approximately 40 to 50 percent of water years), Lake Roosevelt is drawn down at least 13 feet from full.

Lake Roosevelt

A spreadsheet analysis used for comparison of alternatives computes the interaction of Lake Roosevelt, Banks Lake, and downstream Columbia River flows to determine the effects of each alternative on Lake Roosevelt and Banks Lake. The difference in pumping from Lake Roosevelt to Banks Lake between the No Action Alternative and each action alternative was calculated. The amount of pumping was determined by the amount of Columbia River water available and by the elevations at Lake Roosevelt and Banks Lake. When Lake Roosevelt was drawn down significantly in the spring for flood control during wet years, the volume of pumping decreased because of capacity limitations of the pumps at low elevations.

For the "B" alternatives, Banks Lake drawdown was limited to 3 feet below the No Action Alternative. The increase in demand for the Study Area that was not met by direct pumping from the Columbia River or by drawing down Banks Lake was obtained by drawing down Lake Roosevelt to below the No Action Alternative elevations,

Columbia River

The hydrologic modeling analysis is based on the output data from BPA's HYDSIM model for the FCRPS, which includes all major dams on the mainstem Columbia River and its major tributaries. The HYDSIM modeling results were used to determine when water could be diverted from the Columbia River.

Hydrologic modeling of alternatives assumed that water could be diverted from the Columbia River from October through March and would not be diverted in April through June unless flows met the criteria described below for each of the diversion scenarios. Consistent with State water law, hydrologic modeling also assumed that no new diversions would occur in July and August without a replacement water supply. Pumping from the Columbia River was not allowed in September because of concerns raised by the Tribes during the review process of this study.

Two diversion scenarios were evaluated for each alternative:

- ***Spring Diversion Scenario* –**allowed a maximum diversion of 2,700 cfs in October and 350 cfs in November through March regardless of the flow in the Columbia River. In addition, diversions were allowed in April through June when Columbia flows were in excess of 135,000 cfs at Priest Rapids Dam and 260,000 cfs at McNary Dam, which are the ESA flow objectives during this period for anadromous fish identified by NOAA Fisheries (NMFS 2010). Lake Roosevelt elevations also had to be high enough to allow adequate pumping of water into Banks Lake.
- ***Limited Spring Diversion Scenario* –** allowed a maximum diversion of 2,700 cfs in October and 350 cfs in November through March. In addition, water could only be diverted in April through June when ESA flow objectives were met and Grand

Coulee Dam discharges were in excess of 200,000 cfs. The elevation of Lake Roosevelt also had to be high enough to allow adequate pumping. These more restrictive conditions would be expected in less than 10 percent of the years.

Changes in Columbia River Flows

In this Surface Water Quantity section, the decreases in flows on the Columbia River are presented in tables reflecting the change in cubic feet per second (cfs) in monthly time steps. All the cfs values reflect a monthly average flow rate necessary to produce a defined volume of water during that month. The volume is the amount of water that is diverted from the Columbia River to provide the additional irrigation water for the Study Area. This monthly volume can be pumped during the month at different flow rates. For example, a diversion difference of 2,700 cfs in October is approximately 166,000 acre-feet, a difference of 350 cfs in January is approximately 21,500 acre-feet, this volume of water could be pumped during those months in a couple of days, a couple of weeks, or over the whole month. The pumps from Lake Roosevelt to Banks Lake providing the diversions from the Columbia River are generally run at times when electricity is the least valuable, not necessarily at a constant rate. The changes in flow in the Columbia River are presented based on changes in cfs in the tables for comparison purposes between the alternatives and are not intended to imply an exact flow rate over the whole month.

Banks Lake

The effect of each alternative on Banks Lake was calculated using a spreadsheet analysis. The difference between pumping to Banks Lake under the No Action Alternative and the pumping to Banks Lake for each action alternative was calculated. In the “B” alternatives (Banks Lake and FDR), Banks Lake was limited to a drawdown of 3 feet below the No Action Alternatives elevations. In the “A” alternatives (Banks Lake), no limits were set and Banks Lake was drawn down as needed to meet the additional irrigation demand.

Other Surface Water Features

RiverWare software was used to develop a simulation model of the CBP. The model was calibrated using observed reservoir elevation and surface flow data from 1996 to 1998 and was used to simulate a combination of the proposed water conveyance and water supply options. The model was run for the 70-year period 1929 through 1998. It included Crab Creek inflows from the Irby gaging station. Crab Creek and a number of other perennial streams flow into Potholes Reservoir.

The impacts analysis presents a brief overview of waterways, springs, agricultural drains, and wasteways within the Odessa Subarea, including a summary of impacts and comparison of alternatives. Where data are available from RiverWare modeling, the impacts analysis describes and provides comparisons of the seasonal flow regimes for the No Action Alternative and each of the action alternatives.

There is potential for some additional inflow into Potholes Reservoir with the full replacement alternatives. However, Potholes Reservoir would remain within historic operational levels for all of the action alternatives. Implementation of the full replacement alternative will not cause Potholes Reservoir elevations to deviate from the historic operational range. If implementation of the full replacement alternative occurs and results in increased return flows to Potholes Reservoir, feed water to the reservoir will be managed in such a manner as to operate the reservoir within its required and historic operational range. Water levels and operations of Moses Lake would not be expected to change under the action alternatives. Therefore, those systems were not further evaluated.

4.2.1.3 Impact Analysis Assumptions

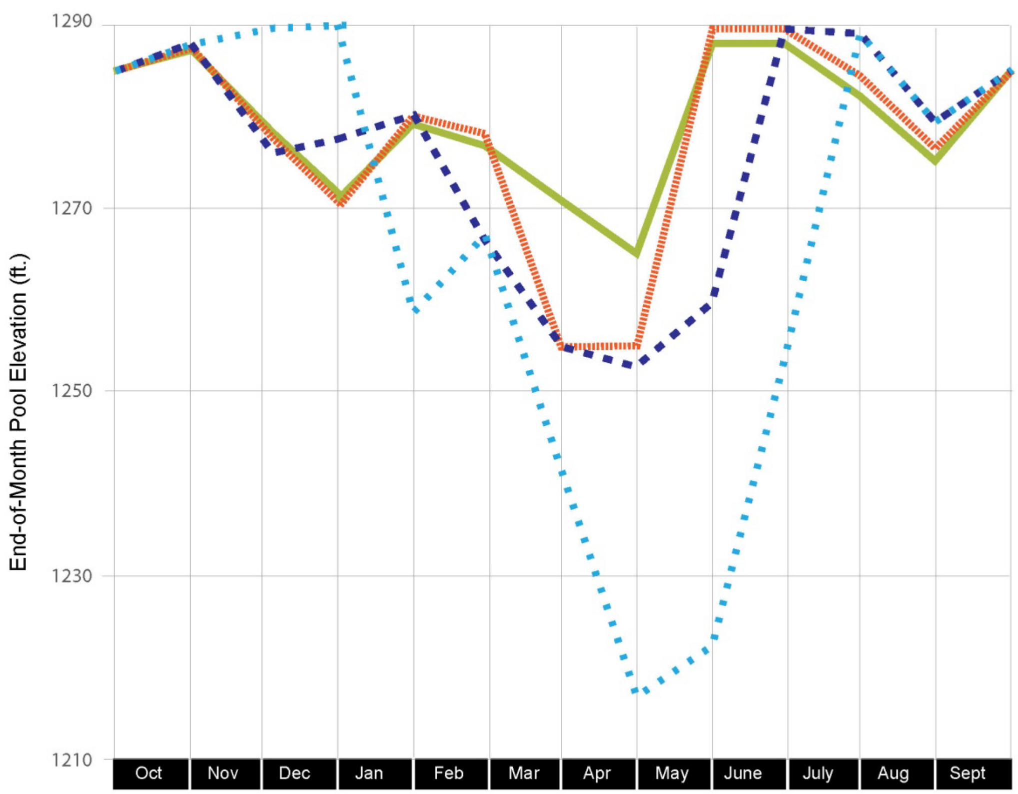
Broadly, applicable legal requirements are described in Chapter 5, *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all regulations would be followed.

Legal Constraints and BMPs for Surface Water Quantity

Flow requirements in the Columbia River are controlled by several regulations. Minimum instream flows for fish protection in the Columbia River are established in WAC 173–563, Instream Resources Protection Program for the Mainstem Columbia River in Washington State. Water management objectives for the Columbia River to aid downstream juvenile salmonid passage are identified in the NMFS BiOp for the FCRPS (NMFS 2010 BiOp). Voluntary regional agreements, established in RCW 90.90.030, limit withdrawals during July and August to mitigate potential instream flow impacts.

4.2.2 Alternative 1: No Action Alternative

For purposes of comparison with the action alternatives, annual operations (reservoir drawdown and refill patterns) under the No Action Alternative at Lake Roosevelt and Banks Lake are illustrated on Figure 4-1 and Figure 4-2. These figures show representative wet, average, dry, and drought watershed conditions.



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

No Action - Average Year
No Action - Wet Year
No Action - Dry Year
No Action - Drought Year

Odessa Subarea Special Study
Columbia Basin Project, Washington

Lake Roosevelt Drawdown (feet) for
No Action Alternative

Figure 4-1. No Action Alternative – Lake Roosevelt drawdown (feet).

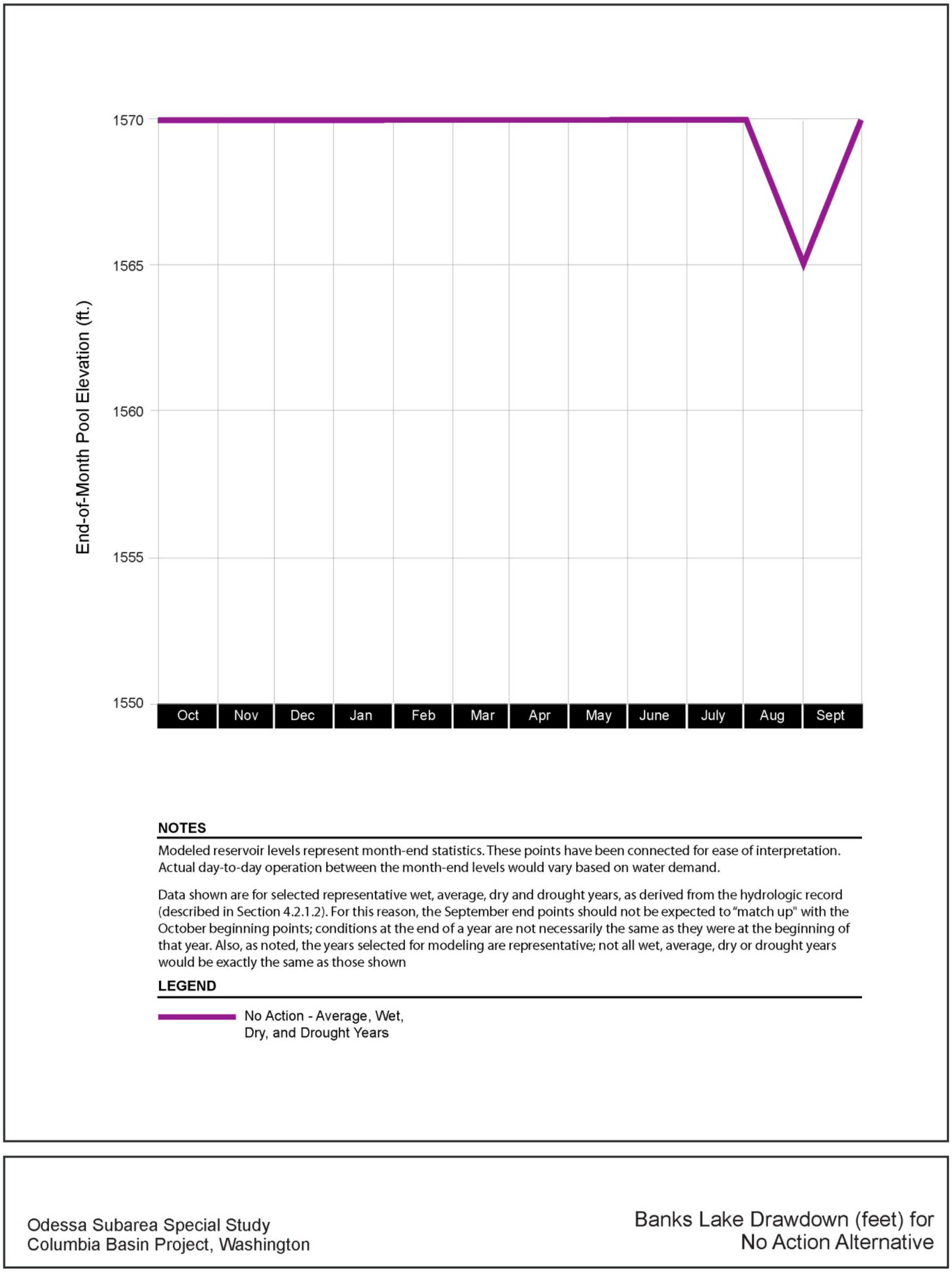


Figure 4-2. No Action Alternative – Banks Lake drawdown (feet).

The annual drawdown pattern for Lake Roosevelt in Figure 4-2 shows a spring drawdown for flood control and a refill in late June and early July depending on the water year volume. The amount of drawdown of Lake Roosevelt at the end of August for flow augmentation in the lower river would also depend on the July final forecast of the April through August runoff volume measured at The Dalles. Years which have an April through August volume greater than 92 MAF at The Dalles would require a drawdown of Lake Roosevelt 10 feet from full (elevation 1280) at the end of August. Years which have a volume less than 92 MAF would require an end of August drawdown of 12 feet (elevation 1278) from full. The Lake Roosevelt Incremental Storage Release Program requires an additional August drawdown of 1.0 foot for most years except the drought years (3 years in the 70-year modeling period, state of Washington criteria[2]) where Lake Roosevelt is drawn down an additional 1.8 feet. Figure 4–1 shows an end of August drawdown of 11.0 feet for 1982 (wet year) and 1995 (average year) which would have volumes higher than 92 MAF. In these years, the Lake would be drawn down 10 feet for flow augmentation plus an additional 1-foot for the Incremental Storage Release Program. Lake Roosevelt would be drawn down 13.0 feet in water year 1988 (dry year) which had a volume lower than 92 MAF, requiring a 12-foot drawdown for flow augmentation, and an additional 1–foot drawdown for the Incremental Storage Release Program. In 1931 (drought year), Lake Roosevelt would be drawn down 13.8 feet, the 12–foot drawdown was for the less than 92 MAF volume and an additional 1.8 feet for the Incremental Storage Release Program.

Water year 1995, which represents an average water year, would have an April through August volume greater than 92 MAF, which would require an end of August 10–foot drawdown for flow augmentation. Other water years within the average category in the 70–year modeling period would have April through August volumes slightly less than 92 MAF. These other water years with less than 92 million acre-feet volumes in the average category would require a 12–foot end of August flow augmentation drawdown at Lake Roosevelt (plus an additional 1 foot for the Incremental Storage Release Program).

The annual drawdown pattern for Banks Lake is shown in Figure 4-2. Figure 4-2 shows Banks Lake at the full elevation of 1570 feet all year except during the month of August when there is a 5-foot drawdown for fish flow augmentation on the lower Columbia River.

4.2.2.1 Short–term Impacts

No short–term impacts are anticipated because no new facilities would be constructed under this alternative.

[2] The by the state of Washington for a drought year is dependent on the March final forecast for April through September. Drought years are years when the April through September volume is less than 60 MAF.

4.2.2.2 Long–term Impacts

No long–term impacts are anticipated for Lake Roosevelt, Banks Lake, or the Columbia River downstream of Grand Coulee Dam because no additional water would be withdrawn from Lake Roosevelt, flows would not change in the Columbia River, and Banks Lake operation would not change.

4.2.3 Alternative 2A: Partial—Banks

This alternative under the Spring Diversion Scenario would cause an additional summer drawdown of Banks Lake. The maximum drawdown of the lake would increase by 2.3 feet in an average year and 4.8 to 4.6 feet in dry and drought years. There would be no change in the drawdown of Lake Roosevelt. Flows would be reduced in the Columbia River in the spring under average year conditions by as much as 500 cfs. In October, Banks Lake would be refilled and flows in the Columbia River would be decreased less than 2,300 cfs.

4.2.3.1 Short–term Impacts

No short-term impacts during construction to Lake Roosevelt, the Columbia River, or Banks Lake are anticipated for this alternative, or for any of the other action alternatives. Therefore, short-term impacts to those features are not addressed further in this analysis.

The following minimal impacts would be anticipated for other surface water features in the CBP:

- Temporary changes to flows, geomorphology, or connectivity would result from crossings of the surface water resources by canals, siphons, or other delivery system components. Construction activities associated with the East Low Canal enlargement would cross 17 unnamed ephemeral drainages. New construction would cross two unnamed ephemeral drainages.
- Diversion structures or pumping plants would be required to bypass short reaches of impacted drainages during construction.

4.2.3.2 Long–term Impacts

Lake Roosevelt

Implementation of this alternative would have minimal impact to Lake Roosevelt storage because the water source for this alternative is from the Columbia River and reregulated through Banks Lake storage. Water will come from Lake Roosevelt storage initially when the pumps to Banks Lake are turned on but only until Grand Coulee discharges are adjusted allowing Lake Roosevelt levels to recover.

Columbia River

Implementation of this alternative with the Spring Diversion Scenario would reduce flow in the Columbia River downstream of Lake Roosevelt during the month of October and in April through June when conditions in the Columbia River met the criteria for the Spring Diversion Scenario described in Section 4.2.1.2. Table 4-2 presents a summary of seasonal changes in flow conditions for this alternative relative to the No Action Alternative for representative wet (1982), average (1995), dry (1988), and drought (1931) years. Water would be withdrawn from the Columbia River and would decrease flow in October by less than 1,400 cfs in 1982 and less than 2,300 cfs in 1995, 1988, and 1931. This water would be used to completely refill Banks Lake by the end of October. In 1982 and 1995, there would also be flow in the Columbia River in excess of flow objectives in April through June in 1982 and May and June in 1995. This additional diversion in the spring months would be used for direct diversion to the Study Area and replacing some Banks Lake storage allowing Banks Lake to remain at a higher elevation during the summer in these wet and average years.

Table 4-2. Differences in Columbia River flows for Alternative 2A: Partial—Banks compared to the No Action Alternative Spring Diversion Scenario.

	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Water Year 1982 (Wet Year)	-1321	0	0	0	0	0	-72	-187	-354	0	0	0
Water Year 1995 (Average Year)	-2267	0	0	0	0	0	0	-500	-459	0	0	0
Water Year 1988 (Dry Year)	-2289	0	0	0	0	0	0	0	0	0	0	0
Water Year 1931 (Drought Year)	-2185	0	0	0	0	0	0	0	0	0	0	0

Banks Lake

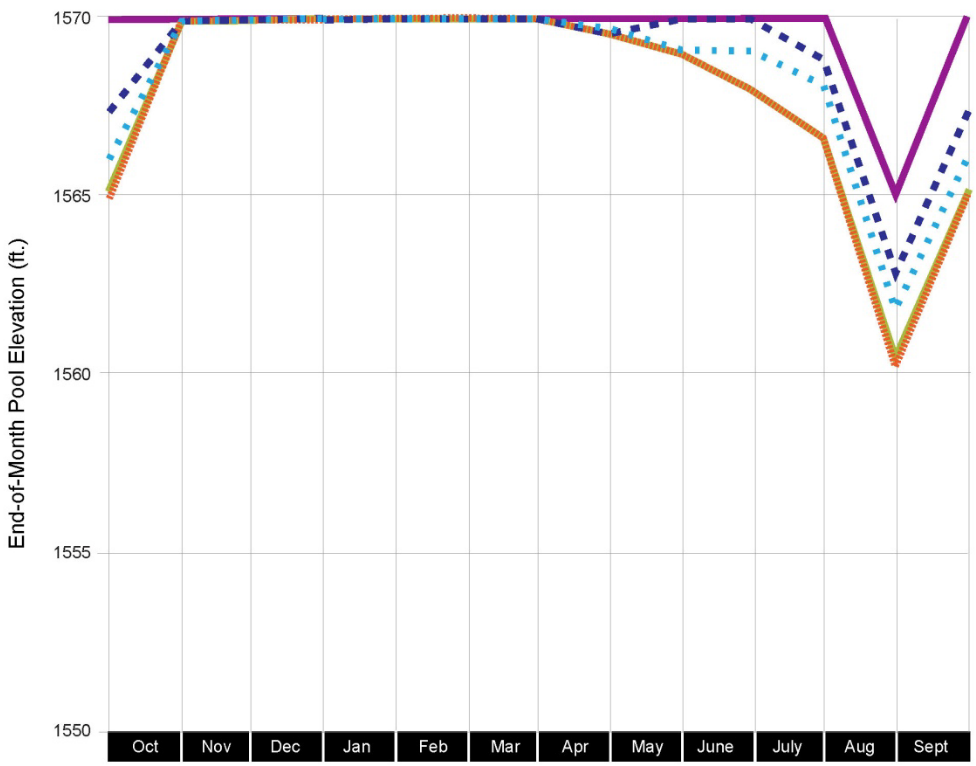
Implementation of this alternative with the Spring Diversion Scenario would result in additional drawdown of Banks Lake. Long-term impacts from drawdown would be a reduction in water levels in the reservoir, as shown in Table 4-2, Table 4-3, and Figure 4-3. The drawdown of Banks Lake would begin in April and continue through September in water years 1988 (dry year) and 1931 (drought year) since no extra water would be diverted from the Columbia River during that period. In water years 1982 (wet year) and 1995 (average year), there would be less of a drawdown in April through September because additional water was diverted from the Columbia River during those years. The maximum drawdown of Banks Lake would take place at the end of August after the flow augmentation water for the Columbia River was provided. Maximum drawdown amounts would range from an additional 2.3 feet (7.3 feet total drawdown) in water year 1995, 3.5 feet (8.5 feet total drawdown) in 1982, 4.6 feet (9.6 feet total drawdown) in 1931, and 4.8 feet (9.8 feet total drawdown) in 1988. Banks Lake would remain below No Action Alternative elevations through the end of September, but return to No Action Alternative elevations by the end of October when additional water is diverted from the Columbia River for refill.

Table 4-3. Banks Lake drawdown (feet) for Alternative 2A: Partial—Banks, Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0*
Water Year 1982 (Wet Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	1.1	2.3	8.5	3.9
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	1.1	2.3	3.5	3.9
Water Year 1995 (Average Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	1.2	7.3	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	1.2	2.3	2.8
Water Year 1988 (Dry Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	3.3	9.8	5.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	3.3	4.8	5.0
Water Year 1931 (Drought Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	3.3	9.6	4.9
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	3.3	4.6	4.9

Drawdowns represent end–of–month levels.

*Reclamation attempts to fill Banks Lake by the end of September during light load hours. Banks Lake may be filled later in the fall if power-marketing conditions warrant it.



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

- Alternative 2A - Average Year
- Alternative 2A - Wet Year
- Alternative 2A - Dry Year
- Alternative 2A - Drought Year
- No Action - Average, Wet, Dry, and Drought Years

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Columbia Basin Project, Washington

Banks Lake Drawdown (feet) for Alternative 2A: Partial - Banks Spring Diversion

Figure 4-3. Banks Lake drawdown (feet) for Alternative 2A: Partial—Banks, Spring Diversion Scenario.

Other Surface Water Features

Implementation of this alternative would be expected to result in the following minimal impacts to other existing surface water resources in the CBP:

- Changes to the flow in wasteways could result in permanent changes to areas that currently receive water from the wasteways. These changes would be small and impacts associated would be minimal.
- Where surface water resources are crossed by canals, siphons, or other delivery system components, there could be permanent changes to flows, geomorphology, or connectivity. New segments of the East Low Canal would cross two unnamed ephemeral drainages. Where the existing East Low Canal currently crosses 17 unnamed ephemeral drainages, cross–drainage facilities are already in place.

Specific long–term impacts as projected by RiverWare modeling were identified for the major canals, diversions, channels, and wasteways. Flows would increase in the Main Canal, East Low Canal, Rocky Coulee Wasteway, Lind Coulee Wasteway, Upper Crab Creek, and Billy Clapp Lake. In each case, the increased flow rate would be within the channel capacity and the impacts associated with the increase would be minimal.

Changes with Limited Spring Diversion Scenario

If limited spring diversions take place with Alternative 2A, the drawdown of Banks Lake would be more uniform for all of the water year types since no additional water is diverted in most years during April through June. The drawdown of Banks Lake under a Limited Spring Diversion Scenario is shown in Table 4-4 and Figure 4-4. The end of August Banks Lake drawdown would be the same as the Spring Diversion Scenario at 4.8 feet (9.8 feet total drawdown) for water years 1988 and 1931 and at 4.6 feet (9.6 feet total drawdown) for water years 1982 and 1995. Figure 4-5 shows the amount of water diverted from the Columbia River with Limited Spring Diversions. The only month that diversions would take place from the Columbia River in these representative years is during October when the diversions are less than 2,300 cfs, no additional water is diverted from the Columbia River during the rest of the year. In less than 10 percent of the years, additional water could be diverted from the Columbia River in April through June if Columbia River flows meet the criteria for the Limited Spring Diversion Scenario as described in Section 4.2.1.2. In these years, there would be some reductions in Columbia River flow (most likely 500 cfs or less) in June and the drawdown of Banks Lake would be decreased about 1 foot.

Table 4-4. Banks Lake drawdown (feet) for Alternative 2A: Partial—Banks, Limited Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Water Year 1982 (Wet Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	3.4	9.6	5.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	3.4	4.6	5.0
Water Year 1995 (Average Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	3.4	9.6	5.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	3.4	4.6	5.0
Water Year 1988 (Dry Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	3.3	9.8	5.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	3.3	4.8	5.0
Water Year 1931 (Drought Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	3.3	9.6	4.9
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	3.3	4.6	4.9
Drawdowns represent end–of–month levels.												

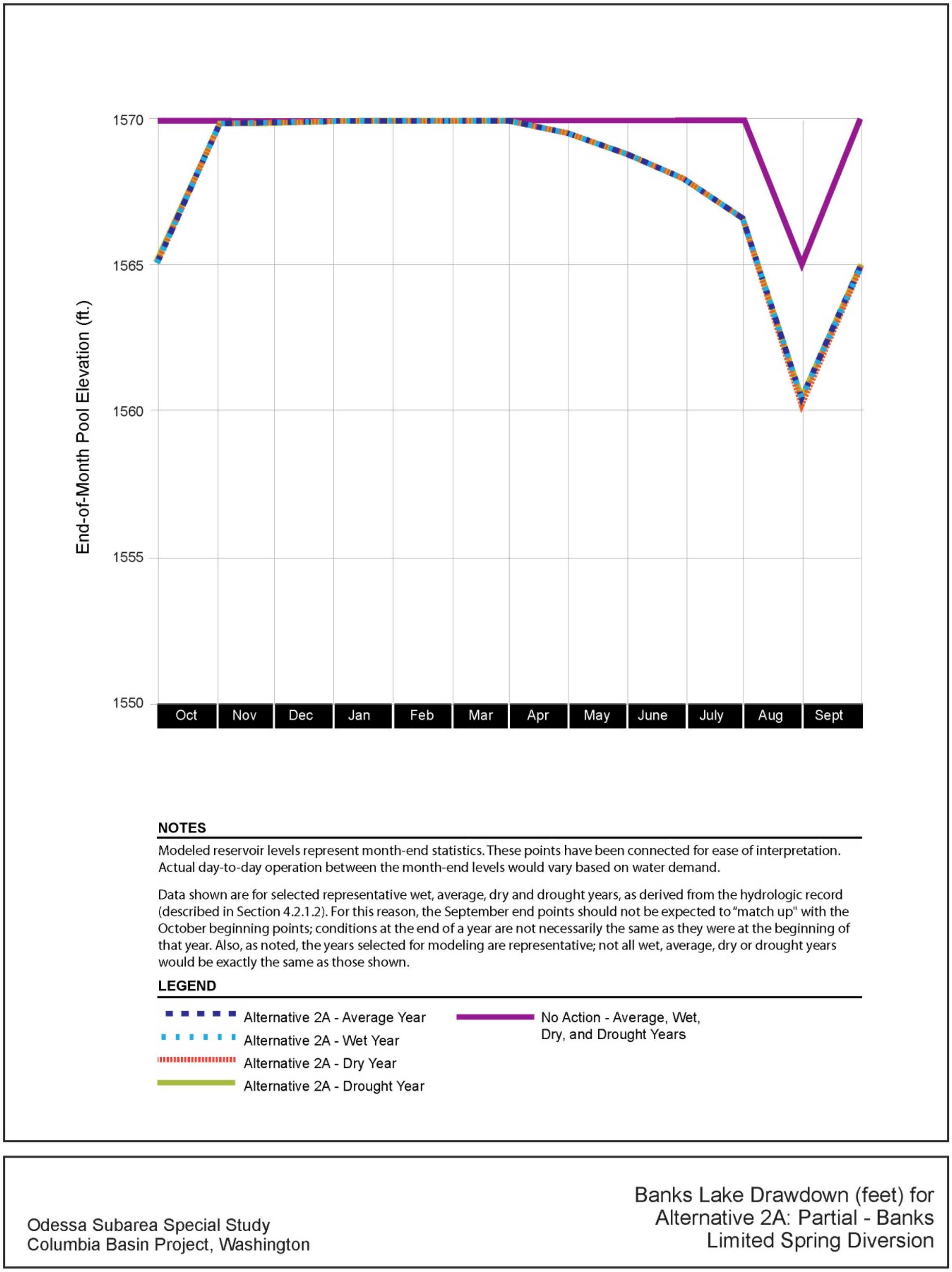


Figure 4-4. Banks Lake drawdown (feet) for Alternative 2A: Partial—Banks Limited Spring Diversion Scenario.

Table 4-5. Differences in Columbia River Flows for Alternative 2A compared to the No Action Alternative, Limited Spring Diversion Scenario.

	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Water Year 1982 (Wet Year)	-2267	0	0	0	0	0	0	0	0	0	0	0
Water Year 1995 (Average Year)	-2267	0	0	0	0	0	0	0	0	0	0	0
Water Year 1988 (Dry Year)	-2289	0	0	0	0	0	0	0	0	0	0	0
Water Year 1931 (Drought Year)	-2185	0	0	0	0	0	0	0	0	0	0	0

4.2.4 Alternative 2B: Partial—Banks + FDR

Alternative 2B under the Spring Diversion Scenario would limit the additional drawdown at Banks Lake to 3 feet. Lake Roosevelt would also be drawn down to provide additional water to the Study Area during the late summer months. In dry and drought years, Lake Roosevelt would be drawn down an additional 0.8 foot by the end of September; average and wet year the additional drawdown is less than 0.5 feet. Flow reductions in the Columbia River are similar to those that would occur under Alternative 2A.

4.2.4.1 Short-term Impacts

Implementation of this alternative would result in the same short-term impacts as described for Alternative 2A: Partial—Banks.

4.2.4.2 Long-term Impacts

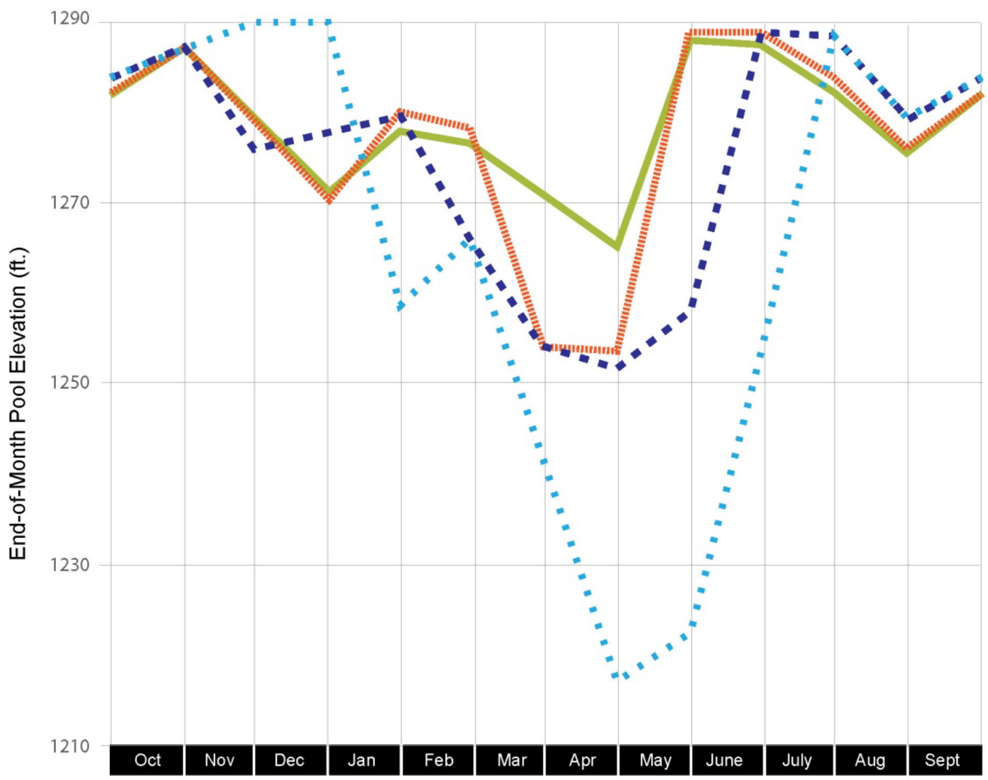
Lake Roosevelt

Implementation of this alternative with the Spring Diversion Scenario would result in additional drawdown of Lake Roosevelt to provide Study Area water during the summer months when the Banks Lake drawdown was limited to 8 feet. Table 4-6 and Figure 4-5 show that the additional drawdown of Lake Roosevelt beyond the No Action Alternative would begin during July in 1988 (dry year) and 1931 (drought year), in August in 1982 (wet year) and in September in 1995 (average year). All years would reach the maximum drawdown at the end of September. The end of August drawdown would range from 0 to 0.6 feet below No Action Alternative elevations and 0.1 feet to 0.8 below No Action Alternative elevations by the end of September. The total end of September elevations would remain above the 1,283-foot elevation for resident fish in these representative water years.

In the 70-year modeled period, the end of September additional drawdown would prevent Lake Roosevelt from being at or above elevation 1283 feet by the end of September in one water year which was no change from the No Action Alternative. Refill of Lake Roosevelt to No Action Alternative levels would be the first priority during October so Lake Roosevelt elevations would be the same as the No Action Alternative at the end of October for the four years representing all water year types.

Table 4-6. Lake Roosevelt drawdown (feet) for Alternative 2B: Partial—Banks + FDR, Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Water Year 1982 (Wet Year)												
Total Drawdown with No Action Alternative	2.1	0.0	0.0	30.1	23.4	47.2	72.4	67.0	36.9	0.5	11.0	5.0
Total Drawdown with Alternative 2B	2.1	0.0	0.0	30.0	23.4	47.2	72.4	67.0	35.9	0.5	11.2	5.4
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
Water Year 1995 (Average Year)												
Total Drawdown with No Action Alternative	2.1	14.0	13.0	10.9	23.6	35.1	37.8	31.9	0.3	0.5	11.0	5.0
Total Drawdown with Alternative 2B	2.1	14.0	13.0	10.9	23.6	35.1	37.8	31.9	0.3	0.5	11.0	5.1
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Water Year 1988 (Dry Year)												
Total Drawdown with No Action Alternative	2.1	12.8	19.7	9.7	12.6	35.1	35.3	0.6	0.6	5.7	13.0	5.0
Total Drawdown with Alternative 2B	2.1	12.8	19.7	9.7	12.6	35.1	35.3	0.6	0.6	6.0	13.6	5.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.8
Water Year 1931 (Drought Year)												
Total Drawdown with No Action Alternative	2.1	12.2	18.4	11.1	13.4	18.9	24.7	1.3	1.1	6.2	13.8	5.0
Total Drawdown with Alternative 2B	2.1	12.2	18.4	11.1	13.4	18.9	24.7	1.3	1.1	6.5	14.3	5.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.8
Drawdowns represent end-of-month levels.												



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

Alternative 2B - Average Year
Alternative 2B - Wet Year
Alternative 2B - Dry Year
Alternative 2B - Drought Year

Odessa Subarea Special Study
Columbia Basin Project, Washington

Lake Roosevelt Drawdown (feet) for
Alternative 2B: Partial - Banks + FDR
Spring Diversion

Figure 4-5. Lake Roosevelt drawdown (feet) for Alternative 2B: Partial—Banks + FDR, Spring Diversion Scenario.

Columbia River

Implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Table 4-7 presents a representation of seasonal changes in flow conditions for this alternative relative to the No Action Alternative for water years 1982 (wet), 1995 (average), 1988 (dry), and 1931 (drought).

Table 4-7. Differences in Columbia River flows for Alternative 2B: Partial—Banks + FDR compared to the No Action Alternative, Spring Diversion Scenario.

	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Water Year 1982 (Wet Year)	-1321	0	0	0	0	0	-72	-187	-354	0	0	0
Water Year 1995 (Average Year)	-2267	0	0	0	0	0	0	-500	-459	0	0	0
Water Year 1988 (Dry Year)	-2289	0	0	0	0	0	0	0	0	0	0	0
Water Year 1931 (Drought Year)	-2185	0	0	0	0	0	0	0	0	0	0	0

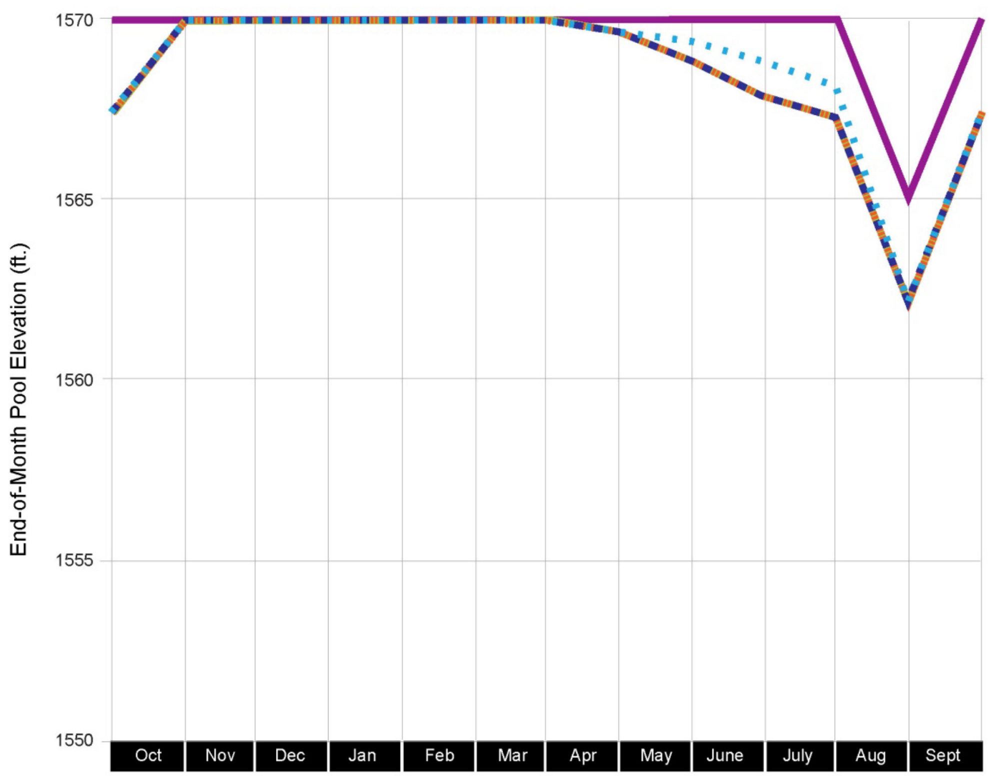
Flow reductions in the Columbia River for this alternative would be the same as for Alternative 2A. The timing and amount of flow reductions would be the same. The difference in this alternative would be that the water was used first to refill Lake Roosevelt and then Banks Lake.

Banks Lake

Implementation of this alternative with the Spring Diversion Scenario would result in an additional end of August drawdown of Banks Lake of 2.3 feet in 1995 (average year) and 3.0 feet in 1982 (wet year), 1995 (average year) and 1931 (drought year) (Table 4-8 and Figure 4-6). Banks Lake would remain 2.8 feet below the No Action Alternative elevation at the end of September for all the representative water years, but would refill completely by the end of October.

Table 4-8. Banks Lake drawdown (feet) for Alternative 2B: Partial—Banks + FDR, Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Water Year 1982 (Wet Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	1.1	2.3	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	1.1	2.3	3.0	2.8
Water Year 1995 (Average Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	1.2	7.3	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	1.2	2.3	2.8
Water Year 1988 (Dry Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	2.8	3.0	2.8
Water Year 1931 (Drought Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	2.8	3.0	2.8
Drawdowns represent end–of–month levels.												

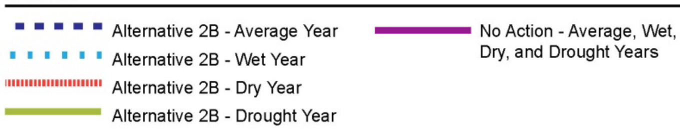


NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND



Odessa Subarea Special Study
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Banks Lake Drawdown (feet) for Alternative 2B: Partial - Banks + FDR Spring Diversion

Figure 4-6. Banks Lake drawdown (feet) for Alternative 2B: Partial—Banks + FDR, Spring Diversion Scenario.

Other Surface Water Features

Implementation of this alternative would result in the same long–term impacts as described for Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

The drawdown of Lake Roosevelt and Banks Lake for Alternative 2B with the Limited Spring Diversion Scenario is shown in Table 4-9, Table 4-10, Figure 4-7, and Figure 4-8. If limited spring diversions take place with this alternative, the drawdown of Lake Roosevelt would begin in July for all water year types and reach a maximum drawdown of 0.8 feet below the No Action Alternative elevations by the end of September. It would refill to No Action Alternative elevations by the end of October. Banks Lake drawdown would be the same for each of the water year types beginning in April and reaching the maximum drawdown at the end of August with a drawdown of 3 feet below the No Action Alternative levels. The amount of diversions from the Columbia River is shown in Table 4-11. The diversions from the Columbia River would be the same as for the Limited Spring Diversion Scenario for Alternative 2A where the diversions occur during the month of October for all of the representative water years. In less than 10 percent of the water years, additional water could be diverted from the Columbia River in April through June if Columbia River flows meet the criteria for the Limited Spring Diversion Scenario as described in Section 4.2.1.2. In these years, there would be some reductions in Columbia River flow (most likely 500 cfs or less) in June and the drawdown of Lake Roosevelt would be decreased by less than half a foot.

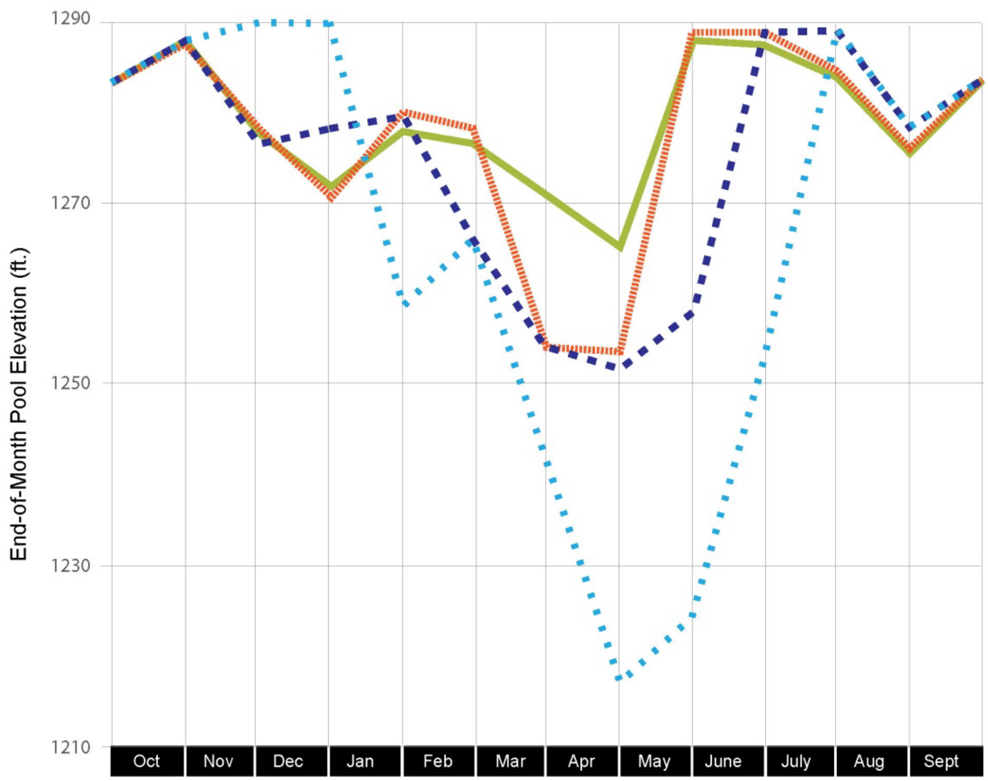
Table 4-9. Lake Roosevelt drawdown (feet) for Alternative 2B: Partial—Banks + FDR, Limited Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Water Year 1982 (Wet Year)												
Total Drawdown with No Action Alternative	2.1	0.0	0.0	30.1	23.4	47.2	72.4	67.0	36.9	0.5	11.0	5.0
Total Drawdown with Alternative 2B	2.1	0.0	0.0	30.0	23.4	47.2	72.4	67.0	35.9	0.7	11.6	5.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.8
Water Year 1995 (Average Year)												
Total Drawdown with No Action Alternative	2.1	14.0	13.0	10.9	23.6	35.1	37.8	31.9	0.3	0.5	11.0	5.0
Total Drawdown with Alternative 2B	2.1	14.0	13.0	10.9	23.6	35.1	37.8	31.9	0.3	0.7	11.5	5.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.8
Water Year 1988 (Dry Year)												
Total Drawdown with No Action Alternative	2.1	12.8	19.7	9.7	12.6	35.1	35.3	0.6	0.6	5.7	13.0	5.0

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Total Drawdown with Alternative 2B	2.1	12.8	19.7	9.7	12.6	35.1	35.3	0.6	0.6	6.0	13.6	5.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.8
Water Year 1931 (Drought Year)												
Total Drawdown with No Action Alternative	2.1	12.2	18.4	11.1	13.4	18.9	24.7	1.3	1.1	6.2	13.8	5.0
Total Drawdown with Alternative 2B	2.1	12.2	18.4	11.1	13.4	18.9	24.7	1.3	1.1	6.5	14.3	5.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.8
Drawdowns represent end-of-month levels.												

Table 4-10. Banks Lake drawdown (feet) for Alternative 2B: Partial—Banks + FDR, Limited Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Water Year 1982 (Wet Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	2.8	3.0	2.8
Water Year 1995 (Average Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	2.8	3.0	2.8
Water Year 1988 (Dry Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	2.8	3.0	2.8
Water Year 1931 (Drought Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	2.1	2.8	3.0	2.8
Drawdowns represent end-of-month levels.												



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

- Alternative 2B - Average Year
- Alternative 2B - Wet Year
- Alternative 2B - Dry Year
- Alternative 2B - Drought Year

Odessa Subarea Special Study
Columbia Basin Project, Washington

Lake Roosevelt Drawdown (feet) for
Alternative 2B: Partial - Banks + FDR
Limited Spring Diversion

Figure 4-7. Lake Roosevelt drawdown (feet) for Alternative 2B: Partial—Banks + FDR, Limited Spring Diversion Scenario.

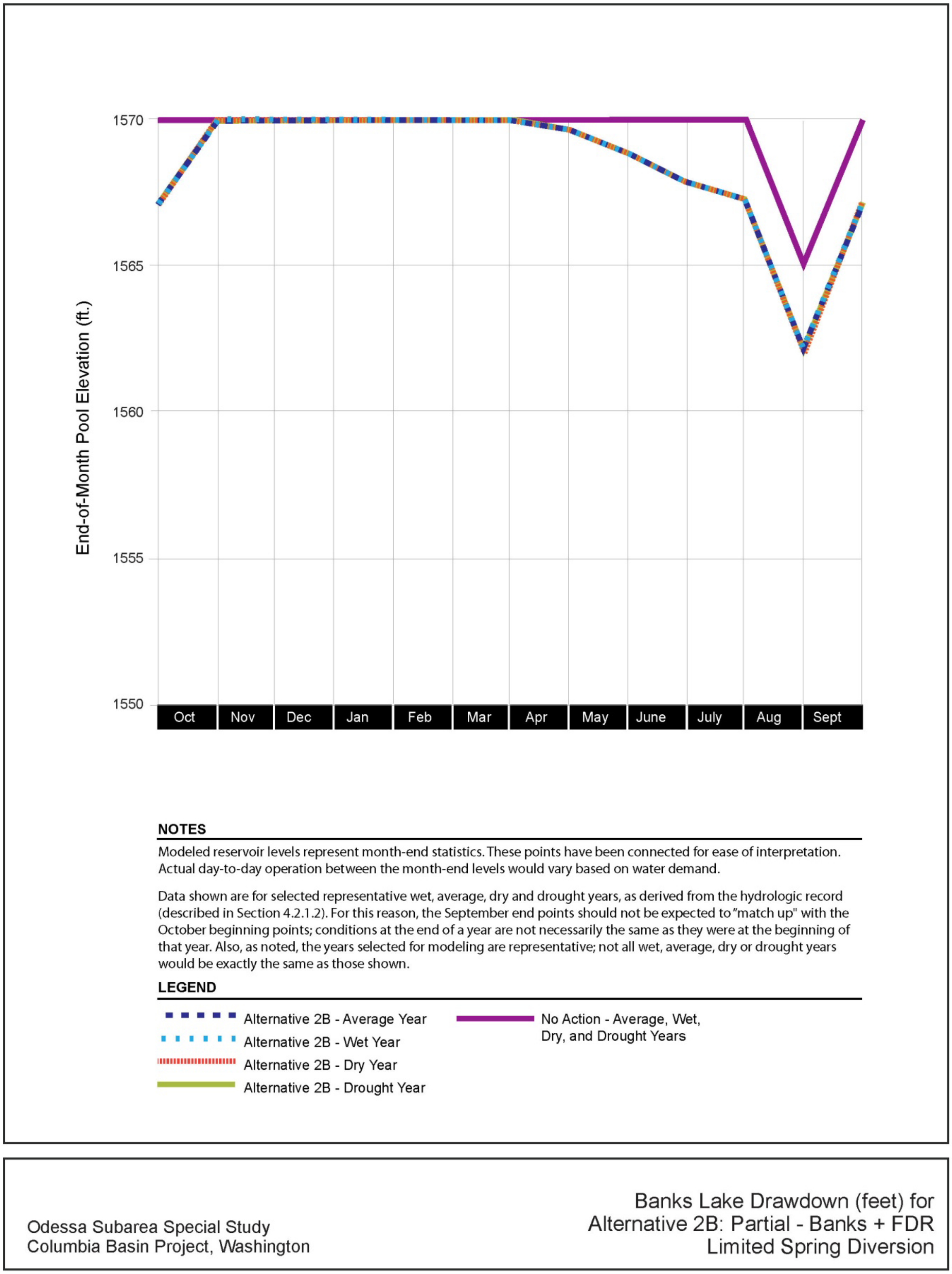


Figure 4-8. Banks Lake drawdown (feet) for Alternative 2B: Partial—Banks + FDR, Limited Spring Diversion Scenario.

Table 4-11. Differences in Columbia River flows for Alternative 2B: Partial—Banks + FDR compared to the No Action Alternative, Limited Spring Diversion Scenario.

	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Water Year 1982 (Wet Year)	-2267	0	0	0	0	0	0	0	0	0	0	0
Water Year 1995 (Average Year)	-2267	0	0	0	0	0	0	0	0	0	0	0
Water Year 1988 (Dry Year)	-2289	0	0	0	0	0	0	0	0	0	0	0
Water Year 1931 (Drought Year)	-2185	0	0	0	0	0	0	0	0	0	0	0

4.2.5 Alternative 3A: Full—Banks

Alternative 3A with the Spring Diversion Scenario would result in an additional drawdown at Banks Lake ranging from 5.6 to 10.2 feet at the end of August. The drawdown would start at the beginning of the irrigation season and continues through the end of the summer. Flows would be reduced in the Columbia River in the spring when there is water available and adequate pump capacity. The maximum amount in the representative water years would be slightly less than 1,200 cfs. Refill of Banks Lake storage would begin after September and flows in the Columbia River would be decreased 2,700 cfs in October and by as much as 350 cfs in November through February or March.

4.2.5.1 Short–term Impacts

Implementation of this alternative would result in the same short–term impacts as described for Alternative 2A: Partial—Banks, but would also have the following additional minimal impacts:

- Temporary minimal impacts would be associated with the construction of the East High Canal, the Black Rock Branch Canal, and new storage facilities. Temporary changes to flows, geomorphology, or connectivity would result from crossings of the surface water resources by canals, siphons, or other delivery system components. Construction activities associated with the East High Canal would cross 11 unnamed ephemeral drainages, Crab Creek, Sand Coulee, and Rocky Coulee. Construction activities associated with the Black Rock Branch Canal would cross 12 unnamed ephemeral drainages and Sand Coulee. Sand Coulee is a dry coulee that conveys runoff only in response to infrequent precipitation events.
- Temporary changes to flows, geomorphology, or connectivity would result from inundation of the area proposed to be occupied by the Black Rock Coulee Reregulating Reservoir.

4.2.5.2 Long–term Impacts

Lake Roosevelt

Implementation of this alternative would have minimal impact to Lake Roosevelt storage because the water source for this alternative is from the Columbia River and reregulated through Banks Lake storage. Water will come from Lake Roosevelt storage initially when the pumps to Banks Lake are turned on but only until Grand Coulee discharges are adjusted allowing Lake Roosevelt levels to recover.

Columbia River

Implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Reductions in flow would be limited to a maximum diversion of 2,700 cfs in October and 350 cfs in November through March. Additional diversions from the Columbia River would be allowed in April through June when flows met the criteria under the Spring Diversion Scenario description in Section 4.2.1.2. No reduction in flows would occur in July through September.

Table 4-12 displays estimates based on model hydrologic conditions recorded from the four water years selected to represent the wet (1982), average (1995), dry (1988), and drought conditions (1931). With this alternative, 1931, 1988, and 1995 diverted the maximum amount allowed in October through January. In water year 1982 (wet year), the preceding water year was wet, allowing for a diversion of Columbia River water during June causing less drawdown of Banks Lake and less water needed to refill Banks Lake in October. In March, the amount of diversion varied between the representative water year types depending on the amount of drawdown required the previous water year. In February of 1988 (dry year), the diversion amount was slightly below the maximum amount. Additional water was diverted in May and June of 1982 and 1995 when water was available. Less water was diverted during May and June of 1982 when compared to 1995 because Lake Roosevelt was drawn down lower for flood control during 1982 and limited the amount of water that could pumped to Banks Lake and diverted to the CBP.

Table 4-12. Differences in Columbia River flows for Alternatives 3A and 3B compared to the No Action Alternative, Spring Diversion Scenario.

	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Water Year 1982 (Wet Year)	-2578	0	0	0	0	0	0	-42	-354	0	0	0
Water Year 1995 (Average Year)	-2700	-350	-350	-350	-350	-162	0	-518	-1184	0	0	0
Water Year 1988 (Dry Year)	-2700	-350	-350	-350	-313	0	0	0	0	0	0	0

	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Water Year 1931 (Drought Year)	-2700	-350	-350	-350	-350	-294	0	0	0	0	0	0

Banks Lake

In this alternative, Banks Lake would be the only source of storage to reshape water diversions from the Columbia River and would be drawn down to the lowest elevations. The additional drawdown of Banks Lake at the end of August would range from 5.6 to 10.2 feet lower than the current 5-foot drawdown for summer fish flow augmentation in the Columbia River (Table 4-13 and Figure 4-9). The total drawdown at the end of August would be 10.6 feet in 1995 (average year), 13.8 feet in 1982 (wet year), 15.0 feet in 1988 (dry year), and 15.2 feet in 1931 (drought year).

The refill of Banks Lake would take place in October in water years 1982 and from October through March in the average, dry, and drought years. In these years, the end of October elevations would remain 3.0 to 3.8 feet from full and gradually refilled to full elevations or 0.0 feet from full by the end of March in all water year types.

Table 4-13. Banks Lake drawdown (feet) for Alternative 3A: Full—Banks, compared to the No Action Alternative, Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Water Year 1982 (Wet Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	2.9	6.0	13.8	8.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	2.9	6.0	8.8	8.8
Water Year 1995 (Average Year)												
Total Drawdown	3.5	2.7	1.9	1.1	0.4	0.0	0.1	0.0	0.0	3.0	10.6	5.7
Additional Drawdown Beyond No Action	3.5	2.7	1.9	1.1	0.4	0.0	0.1	0.0	0.0	3.0	5.6	5.7
Water Year 1988 (Dry Year)												
Total Drawdown	3.0	2.2	1.4	0.7	0.0	0.0	0.3	1.4	4.0	7.1	15.0	9.6
Additional Drawdown Beyond No Action	3.0	2.2	1.4	0.7	0.0	0.0	0.3	1.4	4.0	7.1	10.0	9.6
Water Year 1931 (Drought Year)												
Total Drawdown	3.8	3.0	2.2	1.4	0.7	0.0	0.3	1.4	4.1	7.2	15.2	10.0
Additional Drawdown Beyond No Action	3.8	3.0	2.2	1.4	0.7	0.0	0.3	1.4	4.1	7.2	10.2	10.0
Drawdowns represent end–of–month levels.												

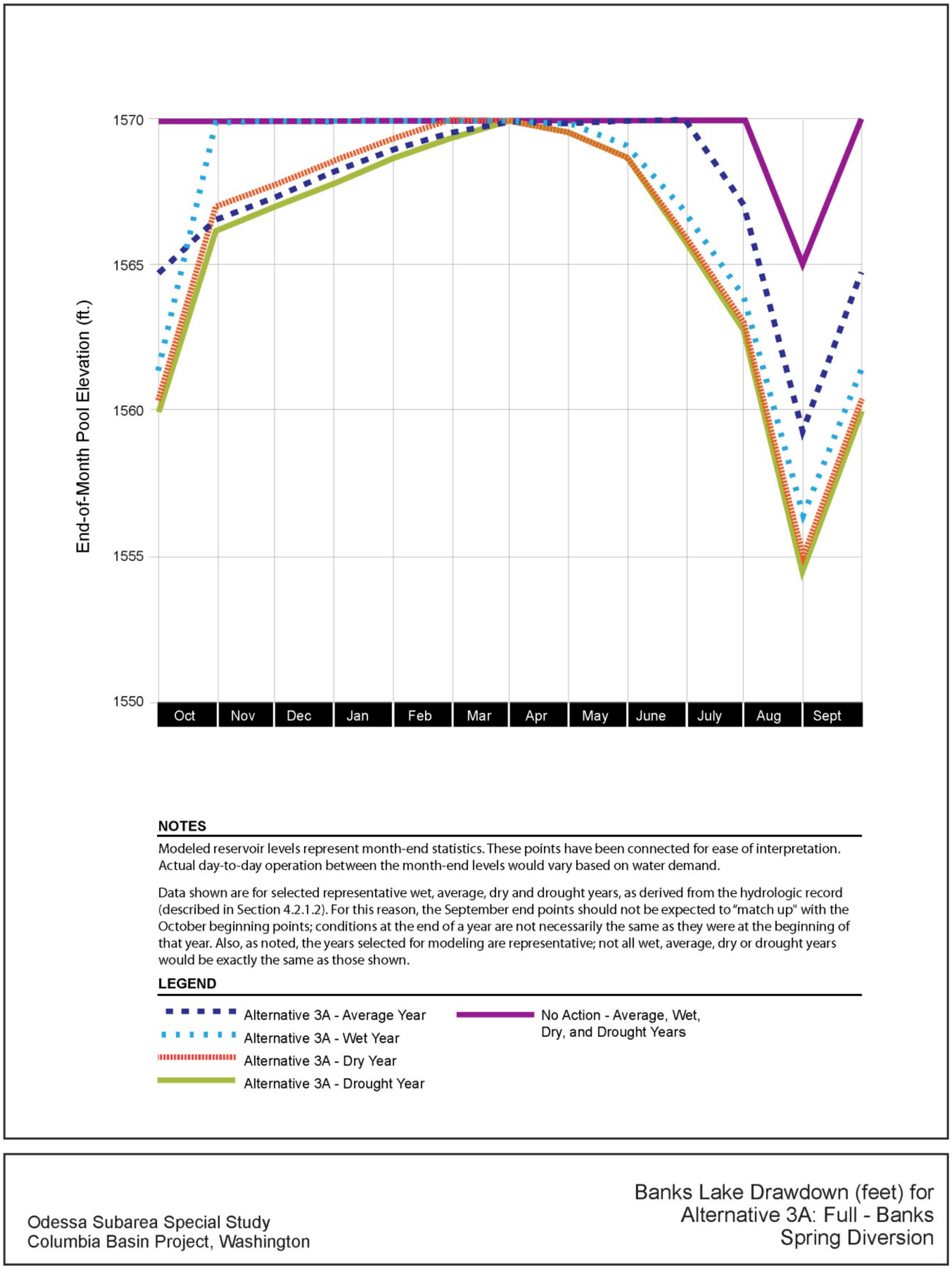


Figure 4-9. Banks Lake drawdown (feet) for Alternative 3A: Full—Banks, Spring Diversion Scenario.

Other Surface Water Features

Implementation of this alternative would result in the same general long–term impacts as described for Alternative 2A: Partial—Banks. In addition, the following minimal impacts are associated with this alternative:

- Permanent changes to flows, geomorphology, or connectivity would result from crossings of the surface water resources by canals, siphons, or other delivery system components. The East High Canal would cross 11 unnamed drainages, Crab Creek, Sand Coulee, and Rocky Coulee. The Black Rock Branch Canal would cross 12 unnamed drainages and Sand Coulee. Except for Crab Creek, all waterways are ephemeral and convey runoff only in response to infrequent precipitation events. Impacts would be minimal, as temporary flows would pass under or over new facilities.
- Construction of the Black Rock Coulee Reregulating Reservoir would create the potential for the dam to breach, resulting in flooding downstream.
- Construction of the Black Rock Coulee Reregulating Reservoir would increase evaporative losses from the irrigation system. These losses would be in proportion to the surface area of the reservoir.
- Permanent changes would occur to flows, geomorphology, or connectivity resulting from inundation of the area under the Black Rock Coulee Reregulating Reservoir. The seep and open water pond (Black Rock Lake) would be permanently eliminated. Although Black Rock Coulee is a dry coulee that conveys runoff only in response to infrequent precipitation events, the reservoir would interrupt natural flow routing.

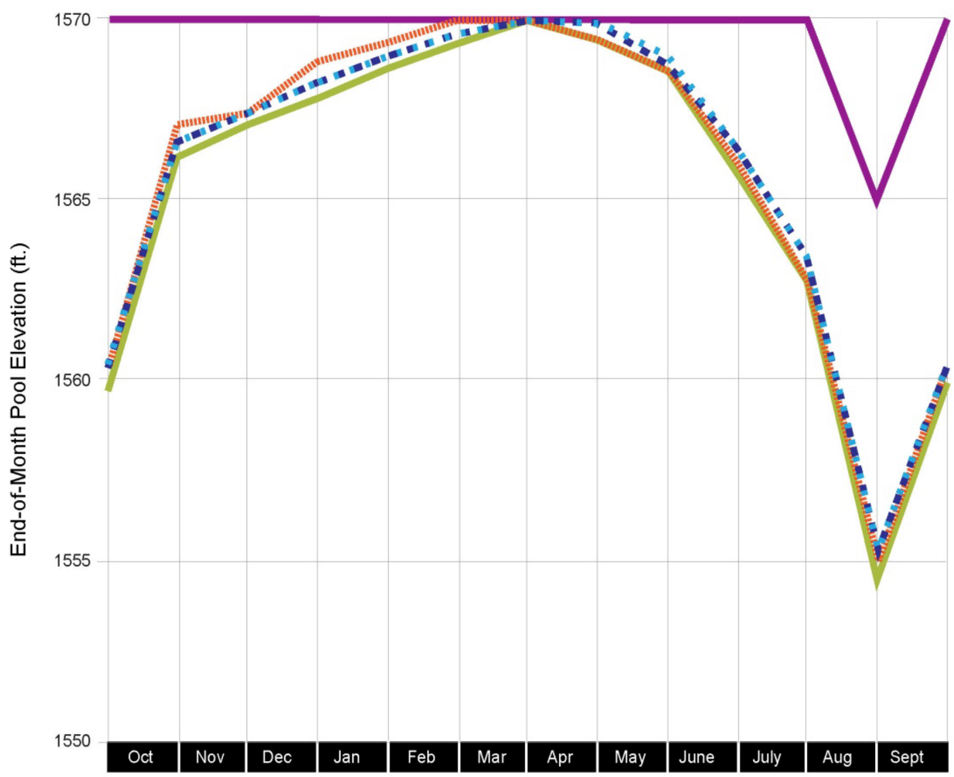
Specific long–term impacts, as projected by RiverWare modeling, were identified for the major canals, diversions, channels, and wasteways. Flows would increase in the Main Canal and East Low Canal, and would decrease in the Rocky Coulee Wasteway. In each case, the increased flow rate would be within the channel capacity and the impacts associated with the increase would be minimal.

Changes with Limited Spring Diversion Scenario

Implementing the Limited Spring Diversion Scenario with Alternative 3A would cause the Banks Lake drawdown to be uniform for all the water year types since no additional water is diverted from the Columbia River in most years during April through June. The drawdown of Banks Lake for Alternative 3A under a Limited Spring Diversion Scenario is shown in Table 4-14and Figure 4-10. The drawdown of Banks Lake would start in April at the beginning of the irrigation season and continues through the end of September. The maximum drawdown would occur at the end of August, ranging from 9.8 to 10.2 additional feet below the No Action Alternative elevations. Banks Lake would not completely refill until the end of March. Table 4-15 shows the amount of water that would be diverted from the Columbia River with the Limited Spring Diversion Scenario. The maximum amount of water would be diverted from the Columbia River in October through January for all the representative water years. In February and March, the amount of diversion would vary between the representative water year types depending on the amount of drawdown required the previous water year. In February of 1988 (dry year), the diversion amount would be slightly below the maximum amount which was the result of water year 1987 operations. In less than 10 percent of the years, additional water could be diverted from the Columbia River in April through June if Columbia River flows meet the criteria for the Limited Spring Diversion Scenario as described in Section 4.2.1.2. In these years, there would be some reductions in Columbia River flow (less than 1,200 cfs) in June and the drawdown of Banks Lake would be reduced by slightly less than 2 feet.

Table 4-14. Banks Lake drawdown (feet) for Alternative 3A: Full—Banks, Limited Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Water Year 1982 (Wet Year)												
Total Drawdown	3.5	2.7	1.9	1.1	0.4	0.0	0.1	1.1	3.8	6.9	14.8	9.7
Additional Drawdown Beyond No Action	3.5	2.7	1.9	1.1	0.4	0.0	0.1	1.1	3.8	6.9	9.8	9.7
Water Year 1995 (Average Year)												
Total Drawdown	3.5	2.7	1.9	1.1	0.4	0.0	0.1	1.2	3.8	6.9	14.8	9.7
Additional Drawdown Beyond No Action	3.5	2.7	1.9	1.1	0.4	0.0	0.1	1.2	3.8	6.9	9.8	9.7
Water Year 1988 (Dry Year)												
Total Drawdown	3.0	2.7	1.4	0.7	0.0	0.0	0.3	1.4	4.0	7.1	15.0	9.6
Additional Drawdown Beyond No Action	3.0	2.7	1.4	0.7	0.0	0.0	0.3	1.4	4.0	7.1	10.0	9.6
Water Year 1931 (Drought Year)												
Total Drawdown	3.8	3.0	2.2	1.4	0.7	0.0	0.3	1.4	4.1	7.2	15.2	10.0
Additional Drawdown Beyond No Action	3.8	3.0	2.2	1.4	0.7	0.0	0.3	1.4	4.1	7.2	10.2	10.0
Drawdowns represent end–of–month levels.												



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

- Alternative 3A - Average Year
- Alternative 3A - Wet Year
- Alternative 3A - Dry Year
- Alternative 3A - Drought Year
- No Action - Average, Wet, Dry, and Drought Years

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Banks Lake Drawdown (feet) for Alternative 3A: Full - Banks Limited Spring Diversion

Figure 4-10. Banks Lake drawdown (feet) for Alternative 3A: Full—Banks Limited Spring Diversion.

Table 4-15. Differences in Columbia River flows for Alternative 3A: Full – Banks, compared to the No Action Alternative – Limited Spring Diversion Scenario.

	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Water Year 1982 (Wet Year)	-2700	-350	-350	-350	-350	-164	0	0	0	0	0	0
Water Year 1995 (Average Year)	-2700	-350	-350	-350	-350	-162	0	0	0	0	0	0
Water Year 1988 (Dry Year)	-2700	-350	-350	-350	-313	0	0	0	0	0	0	0
Water Year 1931 (Drought Year)	-2700	-350	-350	-350	-350	-294	0	0	0	0	0	0

4.2.6 Alternative 3B: Full—Banks + FDR

Alternative 3B with the Spring Diversion Scenario would limit the additional drawdown at Banks Lake to 3 feet beyond the No Action Alternative. Lake Roosevelt storage would be drawn down in the summer to provide additional irrigation for the Odessa Study Area. The maximum drawdown in Lake Roosevelt would occur at the end of September and range from around 1 foot in average years to 2.5 feet in the drier years. Flows reductions in the Columbia River would be similar to those that would occur under Alternative 3A.

4.2.6.1 Short-term Impacts

Implementation of this alternative would result in the same short-term impacts as described for Alternative 3A: Full—Banks.

4.2.6.2 Long-term Impacts

Lake Roosevelt

Long–term impacts from drawdown under this alternative would result in reduced water levels in the reservoir, as shown in Table 4-16 and Figure 4-11. There would be additional drawdown at Lake Roosevelt during the summer, with refill to No Action Alternative levels not occurring until the end of October in 1988 (dry year) and 1982 (wet year) and the end of November in 1995 (average year) and 1931 (dry year).

During water year 1982 (wet year), Lake Roosevelt would refill to No Action Alternative levels at the end of October based on the previous year's drawdown. This would carry over until July, August, and September when additional water was required for the Study Area and drawing down Banks Lake the additional 3 feet did not provide enough water. In 1982, the end of September elevation would be 2.0 feet lower (1,283 feet) than in the No Action Alternative elevation.

Water year 1995 (average year) would start in October at below No Action Alternative levels and refill to No Action Alternative levels by the end of November. Lake Roosevelt would be drawn down in July through September to provide water for the Study Area. Lake Roosevelt's elevation would be 1284 feet at the end of September.

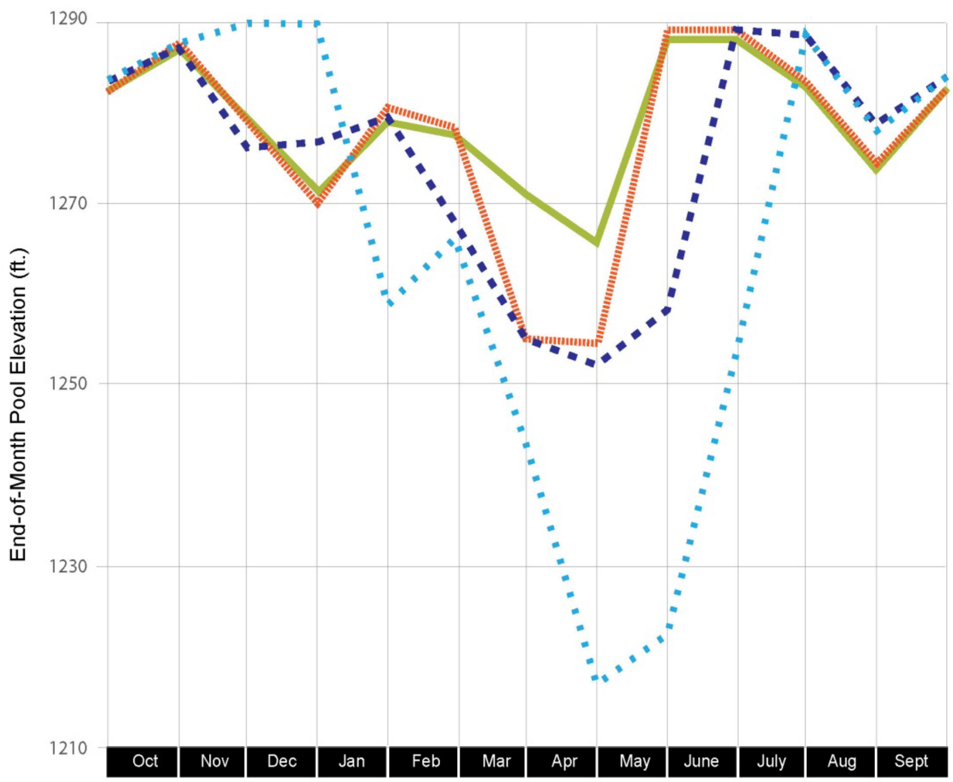
During water year 1988 (dry year), Lake Roosevelt elevations would be at No Action Alternative levels by the end of October. Lake Roosevelt would be drawn down in June through September to supply water for the Study Area. The Lake elevation would be below 1283 feet (1282.7 feet) at the end of September.

Water year 1931 (drought year) would also be below No Action Alternative levels at the beginning of the water year, but refilled by the end of November. Similar to water year 1988, Lake Roosevelt would be drawn down in June through September to supply water for the Study Area. The end of September elevation would be below 1283 feet at 1282.6 feet, which is 2.4 feet below the No Action Alternative level of 1285.0 feet.

The lack of refill of Lake Roosevelt to elevation 1283 by the end of September in the representative dry and drought years would impact the resident fish in the lake by not allowing them access to upstream spawning sites.

Table 4-16. Lake Roosevelt drawdown (feet) for Alternative 3B: Full—Banks + FDR, Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
Water Year 1982 (Wet Year)												
Total Drawdown with No Action Alternative	2.1	0.0	0.0	30.1	23.4	47.2	72.4	67.0	36.9	0.5	11.0	5.0
Total Drawdown with Alternative 3B	2.1	0.0	0.0	30.1	23.4	47.2	72.4	67.0	36.9	1.5	12.9	7.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.9	2.0
Water Year 1995 (Average Year)												
Total Drawdown with No Action Alternative	2.1	14.0	13.0	10.9	23.6	35.1	37.8	31.9	0.3	0.5	11.0	5.0
Total Drawdown with Alternative 3B	2.3	14.0	13.0	10.9	23.6	35.1	37.8	31.9	0.3	0.6	11.9	6.0
Additional Drawdown Beyond No Action	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.9	1.0
Water Year 1988 (Dry Year)												
Total Drawdown with No Action Alternative	2.1	12.8	19.7	9.7	12.6	35.1	35.3	0.6	0.6	5.7	13.0	5.0
Total Drawdown with Alternative 3B	2.1	12.8	19.7	9.7	12.6	35.1	35.3	0.6	1.0	7.2	15.3	7.3
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.5	2.3	2.3
Water Year 1931 (Drought Year)												
Total Drawdown with No Action Alternative	2.1	12.2	18.4	11.1	13.4	18.9	24.7	1.3	1.1	6.2	13.8	5.0
Total Drawdown with Alternative 3B	2.1	12.2	18.4	11.1	13.4	18.9	24.7	1.3	1.5	7.8	16.2	7.4
Additional Drawdown Beyond No Action	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.6	2.4	2.4
Drawdowns represent end-of-month levels.												



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

- Alternative 3B - Average Year
- Alternative 3B - Wet Year
- Alternative 3B - Dry Year
- Alternative 3B - Drought Year

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Lake Roosevelt Drawdown (feet) for Alternative 3B: Full - Banks + FDR Spring Diversion

Figure 4-11. Lake Roosevelt drawdown (feet) for Alternative 3B: Full—Banks + FDR, Spring Diversion Scenario.

Columbia River

Implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Reductions in flow would be limited to October through March with maximum diversions set at 2,700 cfs in October and 350 cfs in November through March. Additional diversions from the Columbia River would be allowed in April through June when flows met the criteria under the Spring Diversion Scenario description in Section 4.2.1.2. No reduction in flows would occur in July through September.

Table 4-17 displays modeled hydrologic conditions recorded from the four water years selected to represent the wet (1982), average (1995), dry (1988), and drought conditions (1931). Flow reductions in the Columbia River for this alternative would be the same as for Alternative 3A. The amount of water taken from the Columbia River and the timing of withdrawals would be the same as in Alternative 3A except the water was used first to refill Lake Roosevelt to No Action Alternative levels and later to refill Banks Lake.

Table 4-17. Differences in Columbia River flows for Alternative 3B: Full—Banks + FDR compared to the No Action Alternative, Spring Diversion Scenario.

	Change in average monthly flow rate compared to the No Action Alternative for modeled representative water years (cfs)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Water Year 1982 (Wet Year)	-2578	0	0	0	0	0	0	-42	-354	0	0	0
Water Year 1995 (Average Year)	-2700	-350	-350	-350	-350	-162	0	-518	-1184	0	0	0
Water Year 1988 (Dry Year)	-2700	-350	-350	-350	-313	0	0	0	0	0	0	0
Water Year 1931 (Drought Year)	-2700	-350	-350	-350	-350	-294	0	0	0	0	0	0

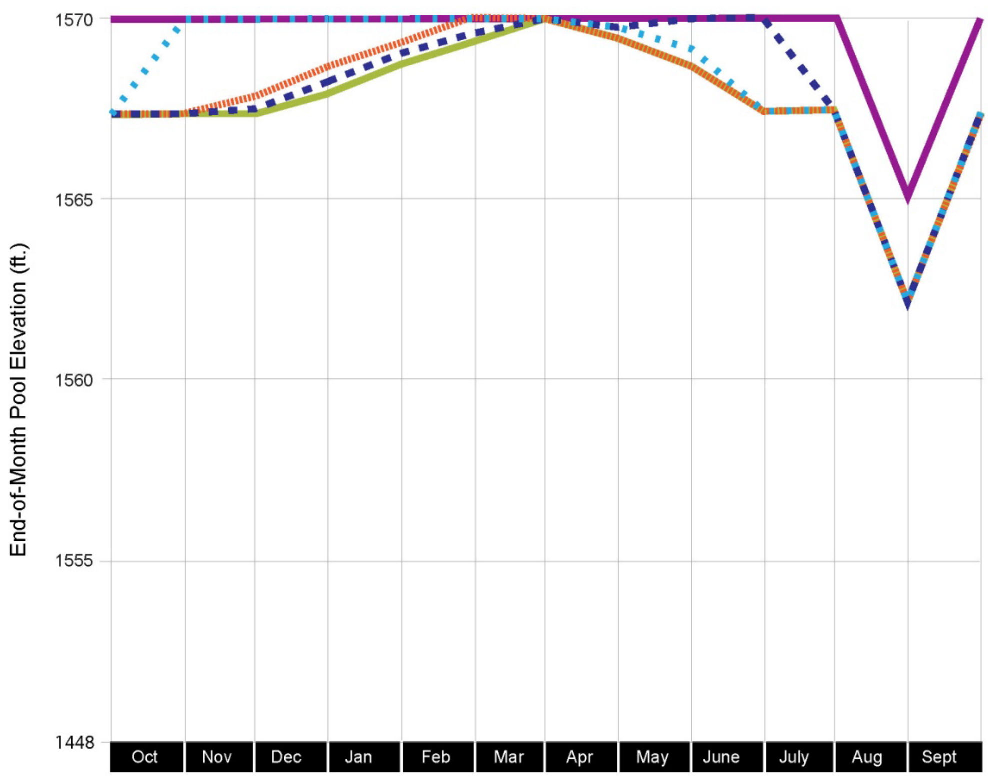
Banks Lake

Implementation of this alternative would result in a maximum additional drawdown of Banks Lake of 3 feet as shown in Table 4-18 and Figure 4-12.

The drawdown limit of a total of 8 feet for Banks Lake would keep the effects of this alternative from being as severe as for Alternative 3A: Full—Banks. The drawdown of Banks Lake at the end of September would remained at 2.8 feet below the No Action Alternative levels for all the water year types. Columbia River water would be diverted to refill Lake Roosevelt and Banks Lake to No Action Alternative levels by the end of March in all the representative water years.

Table 4-18. Banks Lake drawdown (feet) for Alternative 3B: Full—Banks + FDR Lake + FDR, Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Water Year 1982 (Wet Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	2.8	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	2.8	2.8	3.0	2.8
Water Year 1995 (Average Year)												
Total Drawdown	2.8	2.7	1.9	1.1	0.4	0.0	0.1	0.0	0.0	2.8	8.0	2.8
Additional Drawdown Beyond No Action	2.8	2.7	1.9	1.1	0.4	0.0	0.1	0.0	0.0	2.8	3.0	2.8
Water Year 1988 (Dry Year)												
Total Drawdown	2.8	2.2	1.4	0.7	0.0	0.0	0.3	1.4	2.8	2.8	8.0	2.8
Additional Drawdown Beyond No Action	2.8	2.2	1.4	0.7	0.0	0.0	0.3	1.4	2.8	2.8	3.0	2.8
Water Year 1931 (Drought Year)												
Total Drawdown	2.8	2.8	2.2	1.4	0.7	0.0	0.3	1.4	2.8	2.8	8.0	2.8
Additional Drawdown Beyond No Action	2.8	2.8	2.2	1.4	0.7	0.0	0.3	1.4	2.8	2.8	3.0	2.8
Drawdowns represent end-of-month levels.												



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

Alternative 3B - Average Year
Alternative 3B - Wet Year
Alternative 3B - Dry Year
Alternative 3B - Drought Year
No Action - Average, Wet, Dry, and Drought Years

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Banks Lake Drawdown (feet) for Alternative 3B: Full - Banks + FDR Spring Diversion

Figure 4-12. Banks Lake drawdown (feet) for Alternative 3B: Full—Banks + FDR, Spring Diversion Scenario.

Other Water Surface Features

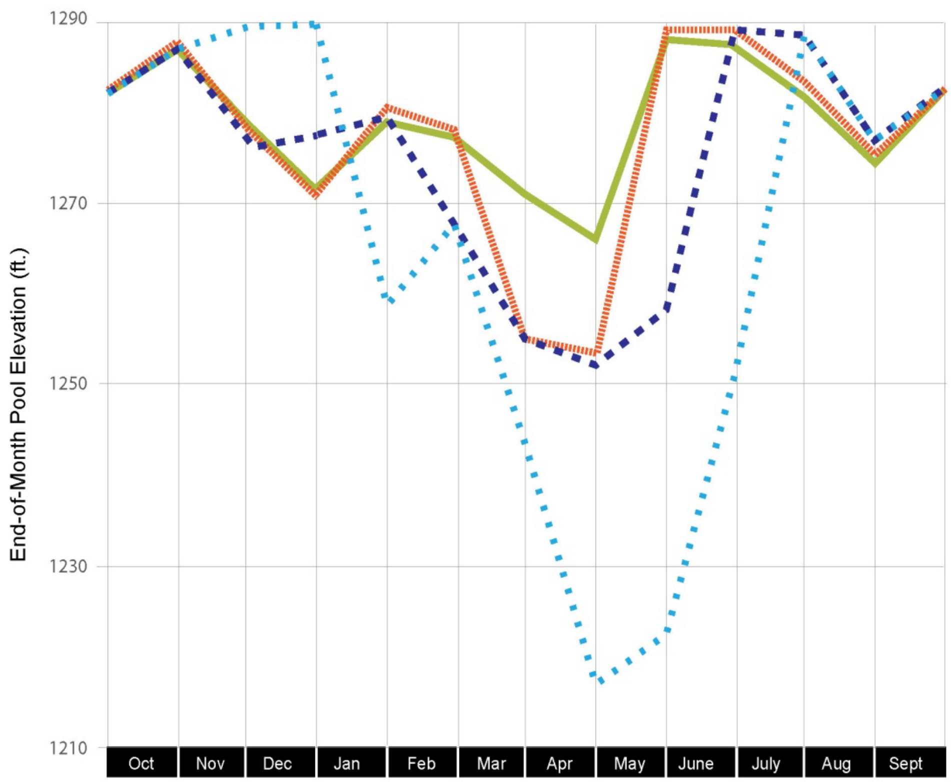
Implementation of this alternative would result in the same long–term impacts as described for Alternative 3A: Full—Banks.

Changes with Limited Spring Diversion Scenario

The drawdown of Lake Roosevelt and Banks Lake for Alternative 3B: Full—Banks + FDR with the Limited Spring Diversion Scenario is shown in Table 4-19 and Table 4-20, Figure 4-13, and Figure 4-14. If limited spring diversions take place with this alternative, the drawdown of Lake Roosevelt would begin in June for all water year types and reach a maximum drawdown of 2.4 feet below the No Action Alternative elevations by the end of September. It would refill to No Action Alternative elevations by the end of November (all operations are a reflection of the previous year's operations). Banks Lake drawdown would be the same for each of the water year types beginning in April and reaching the maximum drawdown at the end of August at 3 feet below the No Action Alternative levels. The amount of diversions from the Columbia River is shown in Table 4-21. The diversions from the Columbia River would be the same as for the Limited Spring Diversion Scenario for Alternative 3A where the diversions are at maximum amounts allowed in October through January and may be slightly reduced in February and March which is a result of the previous water years' operations. The Columbia River diversions would be used first to refill Lake Roosevelt and then Banks Lake. In less than 10 percent of the years, additional water could be diverted from the Columbia River in April through June if Columbia River flows meet the criteria for the Limited Spring Diversion Scenario as described in Section 4.2.1.2. Similar to Alternative 3A with the Limited Spring Diversion Scenario, there would be some reductions in Columbia River flow (less than 1,200 cfs) in June, but in this Alternative, the drawdown at Lake Roosevelt would be reduced by approximately 1 foot.

Table 4-19. Lake Roosevelt drawdown (feet) for Alternative 3B: Full—Banks + FDR, Limited Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Water Year 1982 (Wet Year)												
Total Drawdown with No Action Alternative	2.1	0.0	0.0	30.1	23.4	47.2	72.4	67.0	36.9	0.5	11.0	5.0
Total Drawdown with Alternative 3B	2.3	0.0	0.0	30.1	23.4	47.2	72.4	67.0	37.3	1.8	13.2	7.3
Additional Drawdown Beyond No Action	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.2	2.3
Water Year 1995 (Average Year)												
Total Drawdown with No Action Alternative	2.1	14.0	13.0	10.9	23.6	35.1	37.8	31.9	0.3	0.5	11.0	5.0
Total Drawdown with Alternative 3B	2.3	14.0	13.0	10.9	23.6	35.1	37.8	31.9	0.6	1.8	13.2	7.3
Additional Drawdown Beyond No Action	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	2.2	2.3
Water Year 1988 (Dry Year)												
Total Drawdown with No Action Alternative	2.1	12.8	19.7	9.7	12.6	35.1	35.3	0.6	0.6	5.7	13.0	5.0
Total Drawdown with Alternative 3B	2.1	12.8	19.7	9.7	12.6	35.1	35.3	0.6	1.0	7.2	15.3	7.3
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.5	2.3	2.3
Water Year 1931 (Drought Year)												
Total Drawdown with No Action Alternative	2.1	12.2	18.4	11.1	13.4	18.9	24.7	1.3	1.1	6.2	13.8	5.0
Total Drawdown with Alternative 3B	2.1	12.2	18.4	11.1	13.4	18.9	24.7	1.3	1.5	7.8	16.2	7.4
Additional Drawdown Beyond No Action	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.6	2.4	2.4
Drawdowns represent end-of-month levels.												



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

Alternative 3B - Average Year
Alternative 3B - Wet Year
Alternative 3B - Dry Year
Alternative 3B - Drought Year

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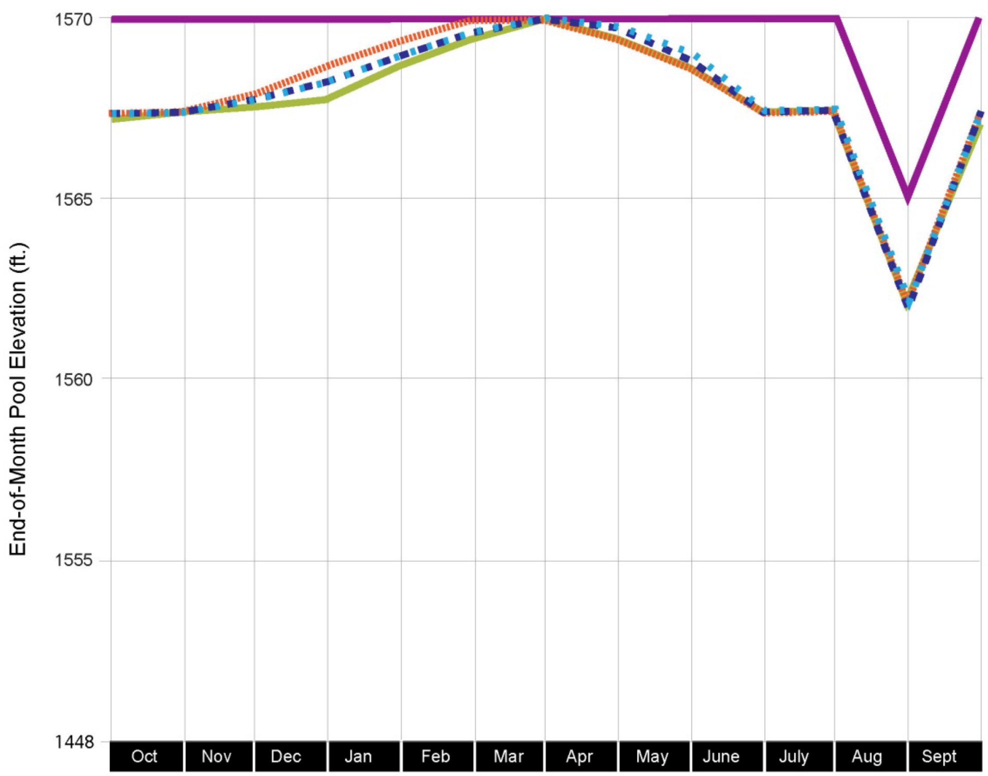
Lake Roosevelt Drawdown (feet) for
Alternative 3B: Full - Banks + FDR
Limited Spring Diversion

Figure 4-13. Lake Roosevelt drawdown (feet) for Alternative 3B: Full—Banks + FDR, Limited Spring Diversion.

Table 4-20. Banks Lake drawdown (feet) for Alternative 3B: Full – Banks + FDR, Limited Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Water Year 1982 (Wet Year)												
Total Drawdown	2.8	2.7	1.9	1.1	0.4	0.0	0.1	1.1	2.8	2.8	8.0	2.8
Additional Drawdown Beyond No Action	2.8	2.7	1.9	1.1	0.4	0.0	0.1	1.1	2.8	2.8	3.0	2.8
Water Year 1995 (Average Year)												
Total Drawdown	2.8	2.7	1.9	1.1	0.4	0.0	0.1	1.2	2.8	2.8	8.0	2.8
Additional Drawdown Beyond No Action	2.8	2.7	1.9	1.1	0.4	0.0	0.1	1.2	2.8	2.8	3.0	2.8
Water Year 1988 (Dry Year)												
Total Drawdown	2.8	2.2	1.4	0.7	0.0	0.0	0.3	1.4	2.8	2.8	8.0	2.8
Additional Drawdown Beyond No Action	2.8	2.2	1.4	0.7	0.0	0.0	0.3	1.4	2.8	2.8	3.0	2.8
Water Year 1931 (Drought Year)												
Total Drawdown	2.8	2.8	2.2	1.4	0.7	0.0	0.3	1.4	2.8	2.8	8.0	2.8
Additional Drawdown Beyond No Action	2.8	2.8	2.2	1.4	0.7	0.0	0.3	1.4	2.8	2.8	3.0	2.8
Drawdowns represent end–of–month levels.												



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

- Alternative 3B - Average Year
- Alternative 3B - Wet Year
- Alternative 3B - Dry Year
- Alternative 3B - Drought Year
- No Action - Average, Wet, Dry, and Drought Years

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Banks Lake Drawdown (feet) for
Alternative 3B: Full - Banks + FDR
Limited Spring Diversion

Figure 4-14. Banks Lake drawdown (feet) for Alternative 3B: Full – Banks + FDR, Limited Spring Diversion Scenario.

Table 4-21. Differences in Columbia River Flows for Alternative 3B: Full – Banks Lake + FDR compared to the No Action Alternative, Limited Spring Diversion Scenario.

	Change in average monthly flow rate compared to the No Action Alternative for modeled representative water years (cfs)											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Water Year 1982 (Wet Year)	-2700	-350	-350	-350	-350	-164	0	0	0	0	0	0
Water Year 1995 (Average Year)	-2700	-350	-350	-350	-350	-162	0	0	0	0	0	0
Water Year 1988 (Dry Year)	-2700	-350	-350	-350	-313	0	0	0	0	0	0	0
Water Year 1931 (Drought Year)	-2700	-350	-350	-350	-350	-294	0	0	0	0	0	0

4.2.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

Alternative 4A differs from the previous alternatives in that the drawdown of Banks Lake falls between the drawdowns in Alternatives 2A and 3A. The maximum additional drawdown would range from about 3 to 6 feet with this alternative. Flows would be reduced in the Columbia River in the spring under average year conditions by up to 650 cfs. In October, Banks Lake would be refilled and flows in the Columbia River would be reduced by approximately 2,700 cfs.

4.2.7.1 Short-term Impacts

The following minimal impacts would be anticipated for other surface water features in the CBP:

- Temporary changes to flows, geomorphology, or connectivity would result from crossings of the surface water resources by canals, siphons, or other delivery system components. Construction activities associated with the East Low Canal enlargement would cross 17 unnamed ephemeral drainages. New construction would cross two unnamed ephemeral drainages.
- Diversion structures or pumping plants would be required to bypass short reaches of impacted drainages during construction.
- Construction of new on–channel facilities would interrupt flow patterns in the various ephemeral drainages.

4.2.7.2 Long-term Impacts

Lake Roosevelt

Implementation of this alternative would have minimal impact to Lake Roosevelt storage because the water source for this alternative is from the Columbia River and reregulated through Banks Lake storage. Water will come from Lake Roosevelt storage initially when the pumps to Banks Lake are turned on but only until Grand Coulee discharges are adjusted allowing Lake Roosevelt levels to recover.

Columbia River

Implementation of this alternative would reduce Columbia River flows during October in all water year types and in April through June when flows in the Columbia River were high enough.

Table 4-22 presents a summary of seasonal changes in flow conditions for this alternative relative to the No Action Alternative for representative wet, average, dry, and drought years. Flows in October would be reduced approximately 2,700 cfs in 1995, 1988, and 1931 and about 1,500 cfs in 1982. In 1982 and 1995, there would be some water available from the Columbia River in May and June and in April of 1982. This additional water would be diverted to the Study Area and replace some Banks Lake storage, causing less drawdown of Banks Lake during the summer months in water years 1982 and 1995 (wet and average years). With less drawdown, there would be less water diverted from the Columbia River to refill Banks Lake the following October. This would be the case in water year 1982.

Table 4-22. Differences in Columbia River flows for Alternative 4A: Modified Partial—Banks (Preferred Alternative)compared to the No Action Alternative, Spring Diversion Scenario.

	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
Water Year 1982 (Wet Year)	-1476	0	0	0	0	0	-70	-42	-354	0	0	0
Water Year 1995 (Average Year)	-2662	0	0	0	0	0	0	-558	-648	0	0	0
Water Year 1988 (Dry Year)	-2666	0	0	0	0	0	0	0	0	0	0	0
Water Year 1931 (Drought Year)	-2620	0	0	0	0	0	0	0	0	0	0	0

Banks Lake

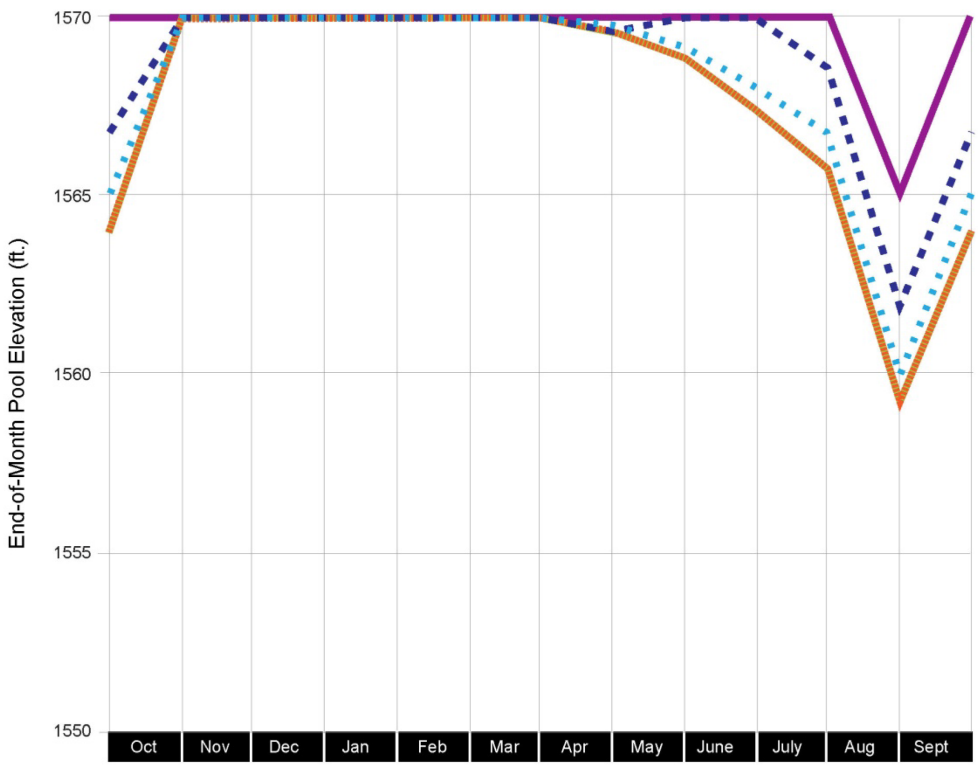
Implementation of this alternative would result in an additional drawdown of Banks Lake. The reduction in water levels from this alternative is shown in Table 4-23 and Figure 4-15. The maximum drawdown of Banks Lake would take place at the end of August when flow augmentation water is supplied to the Columbia River and additional water is supplied to the Study Area. The maximum drawdown of Banks Lake at the end of August would range from

8.1 feet (3.1 feet below the No Action Alternative) in 1995 (average year), 9.9 feet (4.9 feet below the No Action Alternative) in 1982 (wet year), and 10.9 feet (5.9 feet below the No Action Alternative) in 1988 and 1931 (dry and drought years). Banks Lake would refill completely to levels of the No Action Alternative in October of all the representative years.

Table 4-23. Banks Lake drawdown (feet) for Alternative 4A: Modified Partial—Banks, Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Water Year 1982 (Wet Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	1.7	3.3	9.9	5.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	1.7	3.3	4.9	5.0
Water Year 1995 (Average Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	1.6	8.1	3.3
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	1.6	3.1	3.3
Water Year 1988 (Dry Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	4.3	10.9	6.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	4.3	5.9	6.0
Water Year 1931 (Drought Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	4.3	10.9	6.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	4.3	5.9	6.0

Drawdowns represent end-of-month levels.

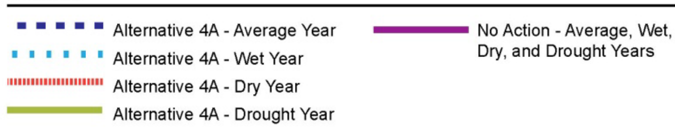


NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND



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Banks Lake Drawdown (feet) for Alternative 4A: Modified Partial (Preferred) – Banks Spring Diversion

Figure 4-15. Banks Lake drawdown (feet) for Alternative 4A: Modified Partial—Banks (Preferred Alternative), Spring Diversion Scenario.

Other Surface Water Features

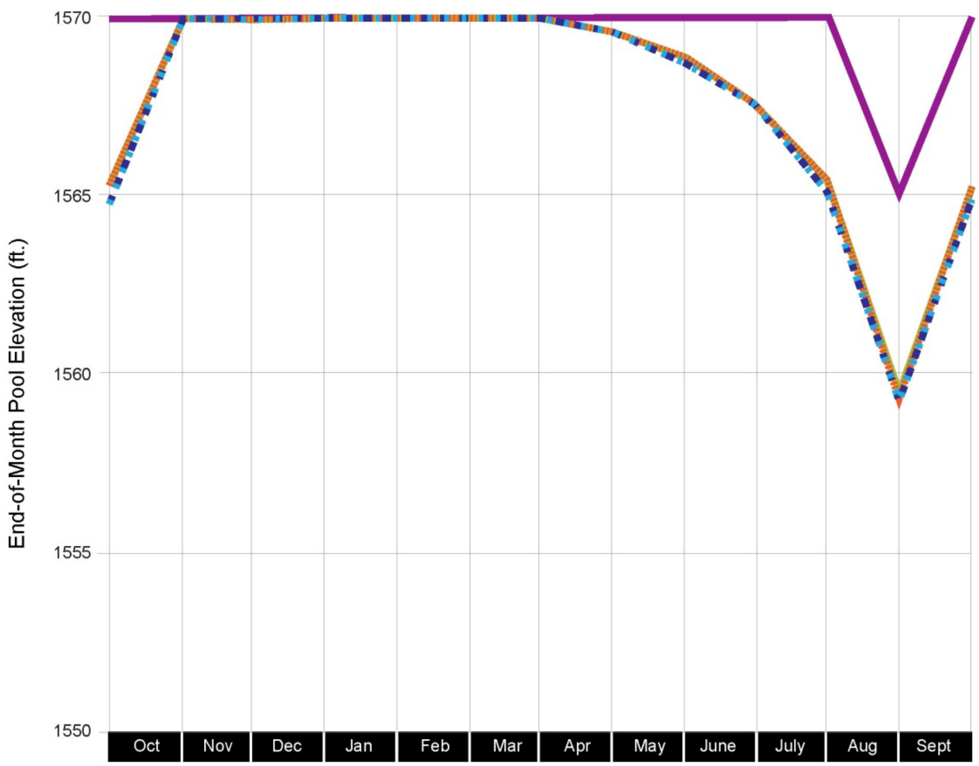
Implementation of this alternative would result in the same long-term impacts as described for Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

The impacts of Alternative 4A: Modified Partial—Banks under the Limited Spring Diversion Scenario on Banks Lake elevations and Columbia River flows are shown in Table 4-24, Figure 4-16, and Table 4-25. Implementation of this alternative with Limited Spring Diversions would cause Banks Lake to be drawn down starting in April and continuing through September to the same elevations regardless of the water year type. The maximum additional drawdown with this alternative would be approximately 6 feet (11 feet total drawdown, end of August) by the end of the summer for all the representative water years. Refilling of Banks Lake would take place in October when slightly less than 2,700 cfs is diverted from the Columbia River. The decrease in flows would only occur in October in these four representative years; no additional diversions for the Study Area would take place during the rest of the year. In less than 10 percent of the years, additional water could be diverted from the Columbia River in April through June if Columbia River flows meet the criteria for the Limited Spring Diversion Scenario as described in Section 4.2.1.2. With this scenario, reductions in Columbia River flow (approximately 650 cfs) would most likely occur in June and the drawdown at Banks Lake would be decreased by 1.5 feet or less.

Table 4-24. Banks Lake drawdown (feet) for Alternative 4A: Modified Partial—Banks (Preferred Alternative), Limited Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Water Year 1982 (Wet Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.7	4.4	11.0	6,1
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.7	4.4	6.0	6.1
Water Year 1995 (Average Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.7	4.4	11.0	6,1
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.7	4.4	6.0	6.1
Water Year 1988 (Dry Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	4.3	10.9	6.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	4.3	5.9	6.0
Water Year 1931 (Drought Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	4.3	10.9	6.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	4.3	5.9	6.0
Drawdowns represent end-of-month levels.												



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

- Alternative 4A - Average Year
- Alternative 4A - Wet Year
- Alternative 4A - Dry Year
- Alternative 4A - Drought Year
- No Action - Average, Wet, Dry, and Drought Years

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Banks Lake Drawdown (feet) for Alternative 4A: Modified Partial (Preferred) – Banks Limited Spring Diversion

Figure 4-16. Banks Lake drawdown (feet) for Alternative 4A: Modified Partial—Banks (Preferred Alternative), Limited Spring Diversion (Preferred Alternative).

Table 4-25. Differences in Columbia River flows for Alternative 4A: Modified Partial – Banks (Preferred Alternative) compared to the No Action Alternative, Limited Spring Diversion Scenario.

	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Water Year 1982 (Wet Year)	-2660	0	0	0	0	0	0	0	0	0	0	0
Water Year 1995 (Average Year)	-2662	0	0	0	0	0	0	0	0	0	0	0
Water Year 1988 (Dry Year)	-2666	0	0	0	0	0	0	0	0	0	0	0
Water Year 1931 (Drought Year)	-2620	0	0	0	0	0	0	0	0	0	0	0

4.2.8 Alternative 4B: Modified Partial—Banks + FDR

Alternative 4B has the same irrigation requirements for the Study Area as Alternative 4A except that the source of water includes Lake Roosevelt storage. The additional drawdown at Banks Lake would be limited to 3 feet under this alternative and the remaining irrigation water would be provided by drawing down Lake Roosevelt. In dry and drought years, the additional drawdown would be about 1.1 feet while in average water years, the additional drawdown would be less than half a foot. Flows reductions in the Columbia River would be similar to those that would occur under Alternative 4A.

4.2.8.1 Short-term Impacts

Short-term impacts would be the same as those for Alternative 4A.

4.2.8.2 Long-term Impacts

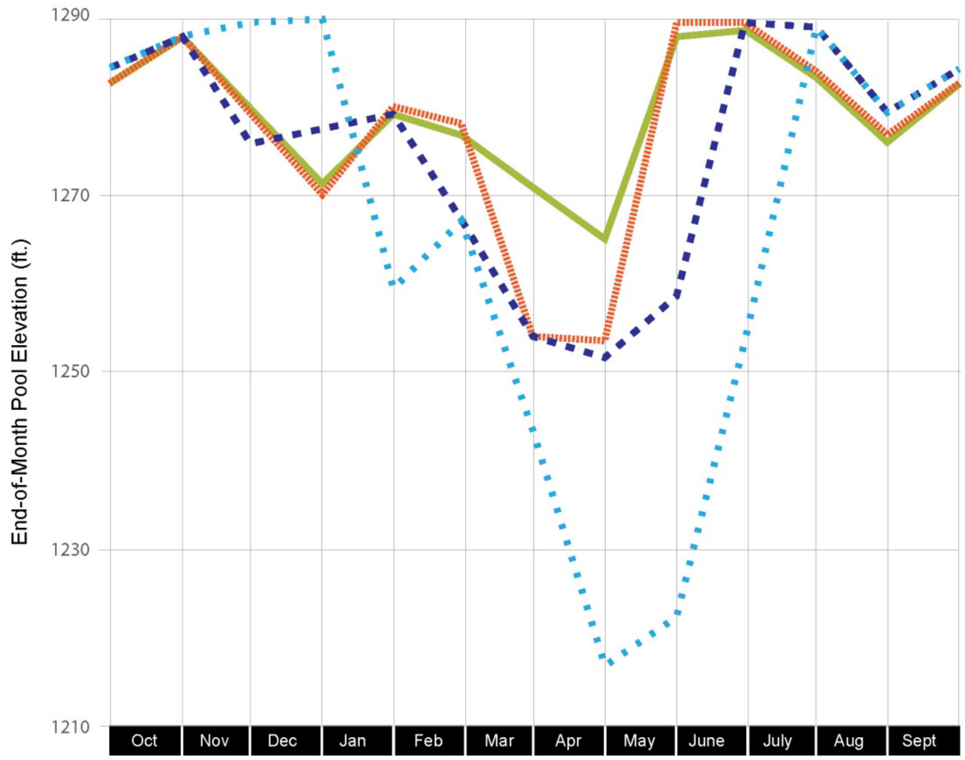
Lake Roosevelt

Implementation of this alternative would cause additional drawdown of Lake Roosevelt during the summer months. As shown in Table 4-26 and Figure 4-17, the drawdown would start in July and continue through September in 1982 (wet year), 1988 (dry year), and 1931 (drought year). In 1995 (average year), the drawdown would not occur until September. The maximum additional drawdown by the end of September would be 0.2 feet in 1995, 0.8 feet in 1982, and 1.1 feet in 1988 and 1931. The drawdown would occur because Banks Lake had been drawn down to 3 feet below the No Action Alternative level which was the lower limit for this alternative and no additional water was available from the Columbia River to meet the Study Area irrigation requirements. End of September elevations would be lower than for the No Action Alternative, but remain above the 1283-foot target elevation for resident fish with this alternative in 69 years out of the 70 years modeled which was the same as the No Action Alternative.

Lake Roosevelt would refill to No Action Alternative levels by the end of October in all of the 70 modeled years.

Table 4-26. Lake Roosevelt drawdown (feet) for Alternative 4B: Modified Partial—Banks + FDR, Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Water Year 1982 (Wet Year)												
Total Drawdown with No Action Alternative	2.1	0.0	0.0	30.1	23.4	47.2	72.4	67.0	36.9	0.5	11.0	5.0
Total Drawdown with Alternative 4B	2.1	0.0	0.0	30.1	23.4	47.2	72.4	67.0	36.9	0.7	11.6	5.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.8
Water Year 1995 (Average Year)												
Total Drawdown with No Action Alternative	2.1	14.0	13.0	10.9	23.6	35.1	37.8	31.9	0.3	0.5	11.0	5.0
Total Drawdown with Alternative 4B	2.1	14.0	13.0	10.9	23.6	35.1	37.8	31.9	0.3	0.5	11.0	5.2
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Water Year 1988 (Dry Year)												
Total Drawdown with No Action Alternative	2.1	12.8	19.7	9.7	12.6	35.1	35.3	0.6	0.6	5.7	13.0	5.0
Total Drawdown with Alternative 4B	2.1	12.8	19.7	9.7	12.6	35.1	35.3	0.6	0.6	6.3	14.0	6.1
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.0	1.1
Water Year 1931 (Drought Year)												
Total Drawdown with No Action Alternative	2.1	12.2	18.4	11.1	13.4	18.9	24.7	1.3	1.1	6.2	13.4	5.0
Total Drawdown with Alternative 4B	2.1	12.2	18.4	11.1	13.4	18.9	24.7	1.3	1.1	6.8	14.4	6.1
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.0	1.1
Drawdowns represent end-of-month levels.												



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

Alternative 4B - Average Year
Alternative 4B - Wet Year
Alternative 4B - Dry Year
Alternative 4B - Drought Year

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Lake Roosevelt Drawdown (feet) for
Alternative 4B: Modified Partial – Banks + FDR
Spring Diversion

Figure 4-17. Lake Roosevelt drawdown (feet) for Alternative 4B: Modified Partial—Banks + FDR, Spring Diversion Scenario.

Columbia River

Implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt during October and during the spring months when the Columbia River water was available. As shown in Table 4-27, there would be some water in excess of Columbia River flow augmentation objectives in May and June of 1995 and 1982 and in April in 1982. Since water would be withdrawn during the spring of average and wet years, the diversions from the Columbia River the following October would be less since there was not as much storage to be refilled at Lake Roosevelt and Banks Lake. This would be shown in water year 1982 where there is less water diverted during October.

The Columbia River water withdrawn in October for this alternative would first be used to refill Lake Roosevelt and then Banks Lake.

Table 4-27. Differences in Columbia River flows for Alternative 4B: Modified Partial—Banks + FDR compared to the No Action Alternative, Spring Diversion Scenario.

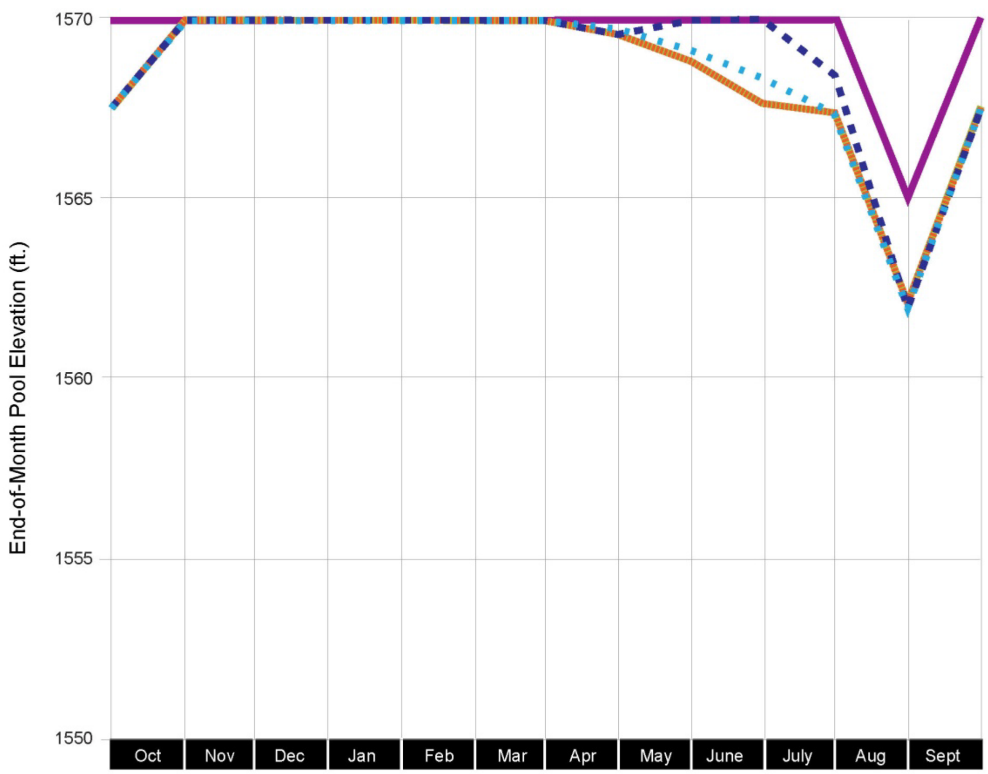
	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Water Year 1982 (Wet Year)	-1476	0	0	0	0	0	-70	-42	-354	0	0	0
Water Year 1995 (Average Year)	-2662	0	0	0	0	0	0	-558	-648	0	0	0
Water Year 1988 (Dry Year)	-2666	0	0	0	0	0	0	0	0	0	0	0
Water Year 1931 (Drought Year)	-2620	0	0	0	0	0	0	0	0	0	0	0

Banks Lake

Implementation of this alternative would limit the additional drawdown of Banks Lake to 3 feet below the No Action Alternative. Long-term impacts from drawdown would be a reduction in water levels in the reservoir, as shown in Table 4-28 and Figure 4-18. The maximum drawdown of Banks Lake would take place at the end of August when flow augmentation water is supplied to the Columbia River. Banks Lake would be drawn down an additional 3 feet below the No Action Alternative for a total of 8 feet at the end of August for all the water year types. Banks Lake would remain below No Action Alternative levels except the drawdown would not be as extreme in the late summer months as Alternative 4A. Banks Lake would completely refill by the end of October in all water year types.

Table 4-28. Banks Lake drawdown (feet) for Alternative 4B: Modified Partial—Banks + FDR, Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Water Year 1982 (Wet Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	1.7	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	1.7	2.8	3.0	2.8
Water Year 1995 (Average Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	1.6	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	1.6	3.0	2.8
Water Year 1988 (Dry Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	2.8	3.0	2.8
Water Year 1931 (Drought Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	2.8	3.0	2.8
Drawdowns represent end–of–month levels.												



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

Alternative 4B - Average Year
Alternative 4B - Wet Year
Alternative 4B - Dry Year
Alternative 4B - Drought Year
No Action - Average, Wet, Dry, and Drought Years

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Banks Lake Drawdown (feet) for
Alternative 4B: Modified Partial – Banks + FDR
Spring Diversion

Figure 4-18. Banks Lake drawdown (feet) for Alternative 4B: Modified Partial—Banks + FDR, Spring Diversion Scenario.

Other Surface Water Features

Implementation of this alternative would result in the same long–term impacts as described for Alternative 2A: Partial—Banks.

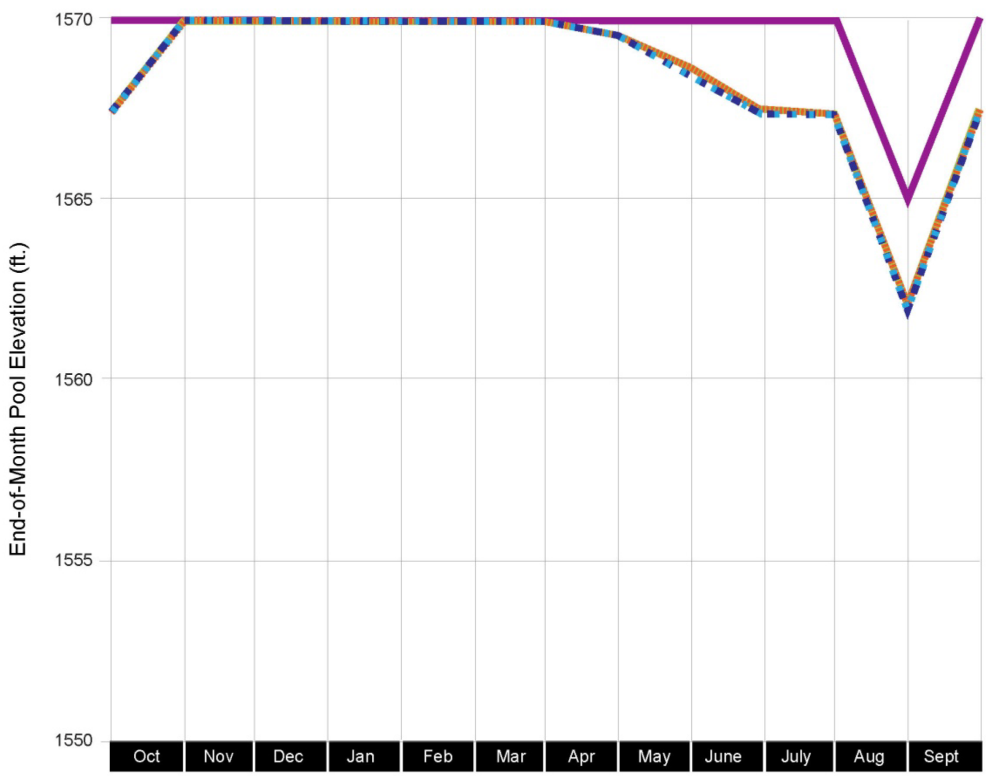
Changes with Limited Spring Diversion Scenario

The impacts of Alternative 4B: Modified Partial – Banks + FDR under the Limited Spring Diversion Scenario on Banks Lake and Lake Roosevelt elevations and Columbia River flows are shown in Table 4-29, Table 4-30, Table 4-31, Figure 4-19, and Figure 4-20. Implementation of this alternative with Limited Spring Diversions would make the drawdown and refill of Banks Lake and Lake Roosevelt more uniform between all the water year types. The diversion of water from the Columbia River would also only take place in October for the four water years presented here and for most other years as well. Banks Lake drawdown would begin in April and would reach the maximum amount of 3 additional feet at the end of August and would not refill until the end of October. Lake Roosevelt would begin the drawdown in July and continued into September, with a maximum additional drawdown of approximately 1 foot. The lake would refill to No Action Alternative elevations by the end of October. Columbia River flows would be decreased only during the month of October when slightly less than 2,700 cfs was diverted in the four representative years. Additional diversions would take place in the spring with the Limited Spring Diversion Scenario when conditions in the Columbia River met the criteria as described in Section 4.2.1.2. If additional water were diverted in the spring, Columbia River flows would be decreased by approximately 650 cfs in June and the drawdown at Lake Roosevelt would be decreased 0.8 feet or less. This would be expected in less than 10 percent of the years.

Table 4-29. Banks Lake drawdown (feet) for Alternative 4B: Modified Partial – Banks + FDR, Limited Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Water Year 1982 (Wet Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.7	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.7	2.8	3.0	2.8
Water Year 1995 (Average Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.7	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.7	2.8	3.0	2.8
Water Year 1988 (Dry Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	2.8	3.0	2.8
Water Year 1931 (Drought Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	2.8	8.0	2.8
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	2.8	3.0	2.8

Drawdowns represent end-of-month levels.



NOTES

Modeled reservoir levels represent month-end statistics. These points have been connected for ease of interpretation. Actual day-to-day operation between the month-end levels would vary based on water demand.

Data shown are for selected representative wet, average, dry and drought years, as derived from the hydrologic record (described in Section 4.2.1.2). For this reason, the September end points should not be expected to "match up" with the October beginning points; conditions at the end of a year are not necessarily the same as they were at the beginning of that year. Also, as noted, the years selected for modeling are representative; not all wet, average, dry or drought years would be exactly the same as those shown.

LEGEND

- Alternative 4B - Average Year
- Alternative 4B - Wet Year
- Alternative 4B - Dry Year
- Alternative 4B - Drought Year
- No Action - Average, Wet, Dry, and Drought Years

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Columbia Basin Project, Washington

Banks Lake Drawdown (feet) for
Alternative 4B: Modified Partial – Banks + FDR
Limited Spring Diversion

Figure 4-19. Banks Lake drawdown (feet) for Alternative 4B: Modified Partial—Banks + FDR, Limited Spring Diversion Scenario.

Table 4-30. Lake Roosevelt drawdown (feet) for Alternative 4B: Modified Partial – Banks + FDR, Limited Spring Diversion Scenario.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Water Year 1982 (Wet Year)												
Total Drawdown with No Action Alternative	2.1	0.0	0.0	30.1	23.4	47.2	72.4	67.0	36.9	0.5	11.0	5.0
Total Drawdown with Alternative 4B	2.1	0.0	0.0	30.1	23.4	47.2	72.4	67.0	36.9	1.0	12.0	6.1
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	1.1
Water Year 1995 (Average Year)												
Total Drawdown with No Action Alternative	2.1	14.0	13.0	10.9	23.6	35.1	37.8	31.9	0.3	0.5	11.0	5.0
Total Drawdown with Alternative 4B	2.1	14.0	13.0	10.9	23.6	35.1	37.8	31.9	0.3	1.0	12.0	6.1
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	1.1
Water Year 1988 (Dry Year)												
Total Drawdown with No Action Alternative	2.1	12.8	19.7	9.7	12.6	35.1	35.3	0.6	0.6	5.7	13.0	5.0
Total Drawdown with Alternative 4B	2.1	12.8	19.7	9.7	12.6	35.1	35.3	0.6	0.6	6.3	14.0	6.1
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.0	1.1
Water Year 1931 (Drought Year)												
Total Drawdown with No Action Alternative	2.1	12.2	18.4	11.1	13.4	18.9	24.7	1.3	1.1	6.2	13.4	5.0
Total Drawdown with Alternative 4B	2.1	12.2	18.4	11.1	13.4	18.9	24.7	1.3	1.1	6.8	14.4	6.1
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.0	1.1
Drawdowns represent end-of-month levels.												

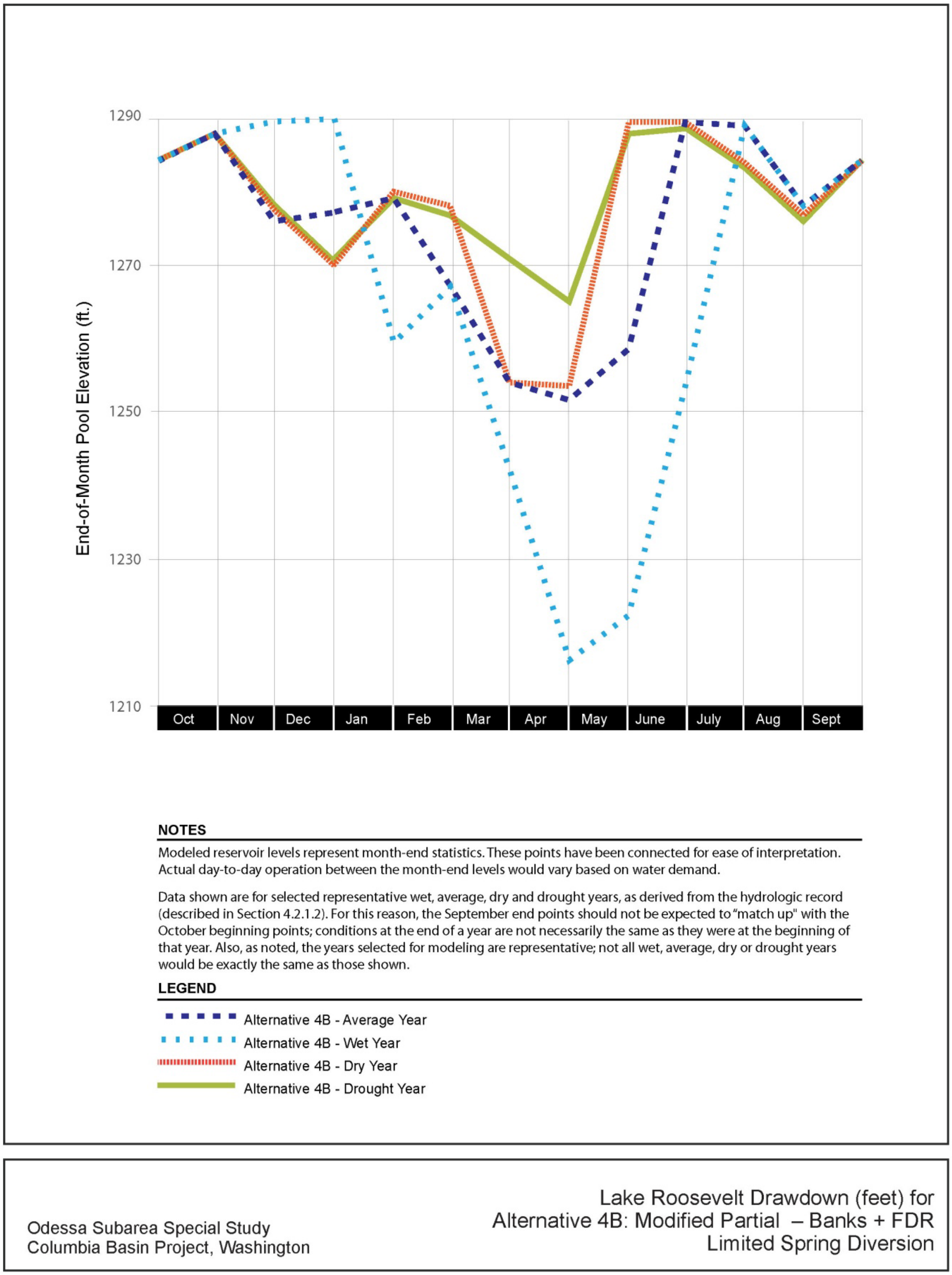


Figure 4-20. Lake Roosevelt drawdown (feet) for Alternative 4B: Modified Partial—Banks + FDR, Limited Spring Diversion Scenario.

Table 4-31. Differences in Columbia River flows for Alternative 4B: Modified Partial—Banks + FDR compared to the No Action Alternative, Limited Spring Diversion Scenario.

	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Water Year 1982 (Wet Year)	-2660	0	0	0	0	0	0	0	0	0	0	0
Water Year 1995 (Average Year)	-2662	0	0	0	0	0	0	0	0	0	0	0
Water Year 1988 (Dry Year)	-2666	0	0	0	0	0	0	0	0	0	0	0
Water Year 1931 (Drought Year)	-2620	0	0	0	0	0	0	0	0	0	0	0

4.2.9 Mitigation

No mitigation is proposed.

4.3 Groundwater Resources

For groundwater resources, the No Action Alternative would have long–term significant impacts related to continued groundwater pumping. These impacts would include continued decline of water levels in the Study Area, which would result in some existing wells going dry, possible pump replacement, increased pumping head, and increased pumping costs.

Groundwater levels would experience an important beneficial effect in some areas from all of the action alternatives. With the partial replacement alternatives, groundwater decline rates in the Study Area south of I-90 would be anticipated to decrease, although groundwater levels north of I-90 would continue to decline and be significantly impacted. With the full replacement alternatives, groundwater decline rates in the Study Area both south and north of I-90 would be anticipated to decrease, an important beneficial effect. Effects with the modified partial replacement alternatives would be similar to the full replacement alternatives except that the beneficial effects would be reduced as the number of acres served with replacement water would be less. Municipal and industrial users would experience a beneficial effect in some areas from all action alternatives as groundwater declines decrease.

Seepage and shallow groundwater recharge associated with the new reservoirs would occur with the full replacement alternatives. Construction of Black Rock Coulee Reregulating Reservoir would have beneficial effects on local shallow groundwater by providing a local recharge area, which would lead to recharging groundwater to the Wanapum Basalt unit.

4.3.1 Methods and Assumptions

4.3.1.1 Impact Indicators and Significance Criteria

Table 4-32 presents impacts indicators and significance criteria for groundwater resources in the Study Area.

Table 4-32. Groundwater resources impact indicators and significance criteria.

Impact Indicators	Significance Criteria
Groundwater level declines	Groundwater becoming too deep or expensive to pump or groundwater quality degrading to the point it becomes unusable for crops would be considered significant.
Recharge or seepage associated with new reservoirs	Adversely impacted local groundwater flow or seepage around dam abutments would be considered significant.
Municipal and industrial users	Groundwater declines and increasing pumping costs for municipal and industrial users would be considered significant.

4.3.1.2 Impact Analysis Methods

Changes in groundwater that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Irrigation Groundwater

The groundwater level declines, along with the associated availability implications for municipal and industrial users, were analyzed using two methods.

The first analysis method used Ground Water Management Area (GWMA) data collected through landowner surveys to evaluate groundwater well conditions and current use (GWMA 2010 Conditions, and 2010 Survey). These data are presented in Chapter 2, Section 2.3 – *Alternative 1: No Action Alternative*.

The second analysis method used existing data from the Ecology groundwater and well database to assess trends in groundwater depths and rates of decline over time. This analysis was done for nine geographic portions of the Odessa Subarea. These portions correspond to the nine replacement alternative construction phases for the full replacement alternatives, and four phases for the partial and modified partial replacement alternatives (see Figures 2-17, 2-24, and 2-30 in Chapter 2).

The GWMA analysis involved interviewing well operators in the Odessa Subarea concerning the current status of well use and performance (GWMA 2010 Conditions). Using this information, GWMA characterized wells into five status levels that are described in detail in

Chapter 2. These range from full–season delivery of permitted flow rates (Status Level 1) to failure and discontinued use of wells (Status Level 5).

The five status levels represent the life cycle of production wells in the Odessa Subarea. Wells were originally constructed for full permit delivery (Status Level 1). Over time as groundwater declines, well yield and irrigation capability progressively diminish. Typically, wells drop from Status Level 1 to Status Level 2, or Status Level 2 to Status Level 3, after the less expensive well changes have been implemented. Well changes include any or all of the following measures:

- Reducing irrigated acreage.
- Rotating to a shorter irrigation season crop.
- Lowering the level of in–well pump intakes (such as pump bowls) to offset groundwater declines through the irrigation season.
- Implementing water conservation measures to increase efficiency.

After these changes, a well could be drilled deeper, if feasible and affordable, to reach additional groundwater resources at a deeper level. GWMA considers wells entering Status Level 5 to have discontinued use permanently.

In January 2010, GWMA (2010 Survey) conducted an additional survey asking well operators in the Odessa Subarea to characterize the current status of their wells relative to the five status levels. This survey also asked well operators if they would deepen their wells, if that were the only solution to water level decline; or, if they instead would reduce system use to shorter season or supplemental use only. Finally, the survey asked well operators to estimate what year current well use would be reduced to shorter season or supplemental use only.

The second method of analysis, based on Ecology data, used reliable groundwater data for wells located within each of the geographic areas that would represent surface water replacement phases under the partial and full replacement alternatives. These are referred to as construction phases in the action alternatives, and are shown on Figures 2-16 and 2-26. Each area, or stage, was evaluated for groundwater depths and rates of historical groundwater level declines. This was done to compare how groundwater in each area would change under the No Action Alternative versus the action alternatives.

Composite hydrographs that show the groundwater level trends for each stage were plotted. Trend lines that represent the minimum, maximum, and average depth to groundwater (below ground surface) and minimum, maximum, and average rates of decline (feet per year) were drawn on the hydrographs and projected into the future. Assuming that observed trends would continue, these trends illustrate how the groundwater levels are expected to change in the future under the No Action Alternative. There would be some influence of groundwater pumping between stages, and also north and south of I–90 depending on when and where the pumping stops.

The groundwater well analysis does not consider the following items, some of which are described in more detail in Chapter 2, Section 2.3 – *Alternative 1: No Action Alternative*:

- The quality of the groundwater is likely to continue to decline as pumping continues, and groundwater quality must be managed. See Section 4.7 – *Soils*, for discussion of the effects of declining groundwater quality on soil productivity, and crop yield.
- As groundwater levels decline, the well yields would decrease because of less water column in the wells.
- Even when total well depth is sufficient to allow access to deeper water levels, pumps cannot always be lowered because of their size (horsepower) and pumping capacity.
- While groundwater levels decrease in linear fashion, pumping costs increase exponentially.
- The future cost of electricity is not known and, therefore, future pumping costs are not considered.
- The future market prices for crops are not known, and it is not known when crops would be switched or rotated to those with a lower water demand.

Other Groundwater Analysis

It appears that the shallow groundwater in the sediments around Banks Lake is not used commercially or domestically, and that groundwater levels mimic the levels of Banks Lake (see Section 4.8 – *Vegetation and Wetlands*). When the reservoir is drawn down, groundwater levels decline. When reservoir levels rise, the groundwater also rises. Therefore, only minimal impacts on shallow groundwater would occur as a result of additional drawdown in Banks Lake and temporary fluctuations in groundwater levels.

Local recharge to shallow groundwater in the coulee walls and floors surrounding Black Rock Coulee was assessed based on geologic conditions and proposed facilities in those areas.

4.3.1.3 Impact Analysis Assumptions

Broadly, applicable legal requirements are described in Chapter 5 – *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all regulations would be followed.

Legal Requirements and BMPs for Groundwater Resources

Uses of groundwater resources in the State of Washington are subject to WAC 173 100, Ground Water Management Areas and Programs; and RCW 90.44, Regulation of Public Groundwaters. BMPs intended to limit groundwater level declines and their impact on municipal and industrial users would require irrigation well users to restrict use of wells to temporary emergency situations only, such as during an interruption of the irrigation supply from the Federal delivery system. BMPs and mitigation measures are discussed further in Section 4.31 – *Environmental Commitments*.

A USGS report (SIR2010-5040) has become available since the release of the Draft EIS and data from that study has been incorporated into the groundwater analysis for the Odessa Subarea Special Study to verify previously used water level decline rates and estimate future pumping lifts. The following critical assumptions were used in the groundwater well analysis:

- When existing wells become unproductive most farmers would not bear the cost of re-drilling.
- Non-pumping (static) depths to groundwater from the database were used, and only wells with reliable data were used. This subset of wells is anticipated to represent general groundwater conditions across the Study Area.
- Large-capacity irrigation wells that appear to be pumping from the Grande Ronde aquifer were selected.
- The rates of future expected groundwater level declines are estimates based on past and present trends and are assumed to remain constant.
- The further into the future the water level declines are projected, the less reliable these estimates become.
- The pumping depth to groundwater is the controlling factor, because the deeper the groundwater the more expensive it is to pump, regardless of total well depth.
- After changing to surface water for irrigation, the groundwater decline rates in the Grande Ronde aquifer would decrease based on the assumptions that there is little or no recharge to the deeper aquifer and that the primary groundwater discharge was through pumping.

4.3.2 Alternative 1: No Action Alternative

4.3.2.1 Short–term Impacts

No short-term impacts are anticipated because no new facilities would be constructed under this alternative.

4.3.2.2 Long-term Impacts

Under the No Action Alternative, long-term significant impacts related to continued groundwater pumping include continued decline of water levels in the Study Area, which would result in existing wells going dry, pump replacement, increased pumping head, and increased pumping costs.

Irrigated agriculture in the Study Area that currently relies on groundwater would continue using that source of water. With continued dependence on groundwater, aquifers would further decline in quantity. As groundwater declines, well yield and irrigation capability would progressively diminish.

Several factors would continue to cause disincentive or inability of most well owners and operators to deepen existing wells. These factors include unreliable groundwater quantity from deeper zones, impaired water quality in deeper zones, uneconomical pumping limits reached, and the high cost of deepening existing wells.

Drilling new groundwater wells is not a feasible solution to augment or replace existing irrigation water needs. New wells would be subject to the same future uncertainties as existing wells with declining groundwater levels in Study Area aquifers. In addition, the State is not issuing new water rights that would be required for new wells.

The two methods of analysis—based on the GWMA surveys and Ecology well data, respectively—indicate similar trends regarding the impacts of continued groundwater pumping under the No Action Alternative. In addition, for the Final EIS a review of the groundwater analysis was conducted and information from a USGS 2010 report was used to verify information that was used for the Draft EIS for pumping depths and rate of decline between 1984 and 2009 (Reclamation 2012 Groundwater). Both methods indicate that continued groundwater pumping for irrigation would result in progressive diminishment of groundwater delivery and a high level of discontinued well use over the next 10 to 20 years.

Based on the first analysis method, if no action is taken, GWMA estimates that wells would drop into lower status levels at a rate of 10 percent per year. Based on information provided by GWMA (2010 Conditions and Survey), and the analysis conducted by Reclamation's Economics and Resource Planning team, the consequences of the No Action Alternative over the next 10 years[3]—by approximately the year 2020—would include the following:[4]

- Only about 15 percent of the production wells in the Study Area would continue to support irrigation for valuable high-water crops, such as potatoes.
- About 55 percent of the production wells in the Study Area would cease groundwater

[3] Based on information provided by GWMA, as well as others, Reclamation interpreted the rate at which wells will go out of production to be approximately 26 years (Reclamation 2012 Groundwater).
[4] Assumed percent wells equals percent acres.

output and use of these wells would be permanently discontinued.

- The remaining 30 percent of the production wells in the Study Area would no longer support high water use crops, even on reduced acreage.

Based on the second analysis method using Ecology well data, the estimated groundwater level decline rates, if sustained, would result in approximately 40 percent of the existing wells across the entire Study Area becoming unusable by 2029 (20-year projection). This would result from groundwater levels declining to a point where wells would go dry or the water becomes too deep to pump economically.

These estimated rates of groundwater decline would continue to vary under the No Action Alternative within the Study Area.

Table 4-33 summarizes the percentage of wells estimated to become unusable and broken into geographic areas that represent the surface water replacement construction phases that would occur under the partial and full replacement alternatives. The area south of I-90 that corresponds with the partial replacement alternatives appears to be more likely to have pumping levels in a majority of wells reach a depth where it would be cost-prohibitive to irrigate with pumped groundwater.

Table 4-33. Estimated percentage of wells going out of commission under the No Action Alternative, based on groundwater decline rates, pumping depth, and stated assumptions.

Geographic Area/ Construction Phase	Number of Wells Analyzed in Stage	Percentage of Wells not Usable by Year 2029
1	6	33
2	14	29
3	5	40
4	6	67
5	6	17
6	10	20
7	7	29
8	7	57
9	5	60
	Average	**39**

Source: Ecology groundwater well data
Note: Only wells with reliable groundwater level data in each Stage were analyzed.

The groundwater well analysis also demonstrated that a wide range of depths to groundwater exists throughout the Study Area, and the decline rates vary. Even within each geographic area that represents a proposed construction phase, the depth to groundwater tends to vary approximately several hundred feet. The pumping depths to groundwater from the wells analyzed range from 270 to 896 feet. The average water level decline rates range from 3.1 to 7.5 feet per year.

In addition to irrigation use, municipal and industrial uses in the Study Area would likely be impacted by continued groundwater level declines under the No Action Alternative. Data available for municipal and industrial wells shows that most of these wells exhibit general trends of groundwater level declines. However, most municipal and industrial users are outside of areas experiencing the greatest groundwater level declines. Even so, groundwater levels in municipal and industrial wells would continue to decline under the No Action Alternative, which would result in increased pumping costs and the eventual need to replace pumps and deepen wells.

Although domestic wells are typically completed in the upper aquifer, these wells can be impacted by water level declines in the deeper aquifer. This is because the shallow aquifer and deeper aquifer are hydraulically connected by open boreholes and vertical fracturing, which allows shallow water to drain into the deeper aquifer. Therefore, domestic wells are likely to continue to be impacted under the No Action Alternative, as the deeper groundwater declines.

The ultimate long–term significant impact of the No Action Alternative would be groundwater declining to levels too deep to pump economically, groundwater with poor quality that cannot be used or requires quality management, and the eventual depletion of the aquifers.

4.3.3 Alternative 2A: Partial—Banks

4.3.3.1 Short–term Impacts

No short-term impacts to groundwater resources would be anticipated for this or for any of the other action alternatives.

4.3.3.2 Long–term Impacts

There would be an important beneficial effect on groundwater under this alternative. Groundwater irrigation would be replaced south of I–90 under all partial replacement alternatives. Following cessation of groundwater pumping for irrigation, the groundwater decline rates in the area are expected to decrease (based on the assumptions discussed earlier, including minimal recharge and no discharge besides emergency pumping for irrigation). Table 4-34 shows the average water level at the end of construction of each stage, including both the partial replacement alternatives south of I-90, the modified partial replacement alternatives north and south of I-90, and the full replacement alternatives north of I-90.

Table 4-34. Anticipated levels of groundwater stabilization following implementation of action alternatives.

Alternative	Construction Phase	Years After Initial Construction Begins	Average Groundwater Depth at End of Construction (feet bgs)[a,b]
Partial Groundwater Replacement Alternatives (2A and 2B)	*South of I–90*		
	1	4	472
	2	7	600
	3	8	677
	4	10	597
Additional Area Included with Full Groundwater Replacement Alternatives (3A and 3B)	*North of I–90*		
	5	5	431
	6	8	536
	7	10	518
	8	7	595
	9	10	563
Modified Partial Groundwater Replacement Alternatives (4A and 4B)	*N & S of I–90*		
	1	4	536
	2	7	472
	3	8	595
	4	10	677

Notes:
[a] Groundwater depth is average depth within stage area and is pumping depth minus 50 feet to represent non–pumping conditions
[b] It is assumed that once groundwater for irrigation is discontinued, groundwater decline rates would decrease

For this and all partial replacement alternatives (encompassing construction phases 1 through 4), it is anticipated that groundwater decline rates in the Grande Ronde aquifer would decrease due to less pumping stress on the aquifer, and groundwater levels in the higher Wanapum aquifer have the potential to rise because of infiltration from additional percolating irrigation water.

In these areas, average groundwater levels would be anticipated to remain at levels between 470 and 680 feet bgs. Groundwater levels at specific locations within these areas would vary several hundred feet and complete water level data is not available.

The important beneficial effect on groundwater under this alternative would occur because up to approximately 138,000 acre-feet of groundwater could potentially be conserved each year south of I-90 if pumping is discontinued on approximately 57,000 acres. Groundwater decline rates would be anticipated to decrease in the deeper aquifer, and the groundwater resource would be conserved for future temporary emergency use in the event of an interruption in surface water from the Federal delivery system.

Alternative 2A: Partial—Banks would have a beneficial effect on groundwater use for municipal and industrial purposes in the Study Area, primarily wells in the Warden, Connell, and Othello area. The groundwater decline rates south of I-90 would be anticipated to decrease after implementation of this alternative; thus, municipal and industrial users would not have to pump from increasingly deeper groundwater levels.

North of I-90, long-term significant impacts to irrigation use and other groundwater uses would be the same as under the No Action Alternative because the groundwater levels in that area would continue to decline and, eventually, the groundwater resource would be depleted.

Domestic wells in some localized areas may still experience water level declines as the groundwater in the shallow aquifer continues to drain downward into the deeper aquifer through open boreholes and vertical fractures, even after pumping is discontinued in the deeper aquifer. At this time open boreholes would not be required to be capped under State law; they would only be required to be placed on standby status. The State will pursue shutdown authority, but does not have such authority at this time.

Minimal impacts to shallow groundwater and sediments around Banks Lake would result from additional seasonal drawdowns.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to groundwater resources are anticipated from the Limited Spring Diversion Scenario.

4.3.4 Alternative 2B: Partial—Banks + FDR

Short- and long-term would be the same as those described for Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or additional impacts to groundwater resources are anticipated from the Limited Spring Diversion Scenario.

4.3.5 Alternative 3A: Full—Banks

Short–term impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.3.5.1 Long-term Impacts

The important beneficial groundwater effects to the area south of I-90 that are discussed under Alternative 2A: Partial—Banks would also occur north of I-90. The groundwater replacement systems south of I-90 would be reconstructed in stages 1 through 4. When the groundwater is replaced by surface water in the area impacted by each stage, the deeper groundwater decline rates are expected to decrease after pumping is discontinued. Ultimately, groundwater decline rates throughout the entire Study Area, including construction phases 1 to 9, are anticipated to decrease in the deeper Grande Ronde aquifer because of the reduction of discharge through pumpage.

Table 4-34 summarizes anticipated average groundwater depths in the Study Area following implementation of the action alternatives. Average groundwater depths are anticipated to be between approximately 430 and 600 feet below ground surface north of I-90, and approximately 470 and 680 feet below ground surface south of I-90.

Because the deep wells would not be decommissioned and abandoned (they would be kept in place for temporary emergency supply in case of an interruption of the Federal delivery system), groundwater in the deeper Grande Ronde aquifer could possibly rise slightly in the vicinity of wells as groundwater continues to flow down through open wells and vertical fractures in the layers of basalt from the shallow to the deeper aquifer. However, no substantial recharge of the Grande Ronde aquifer is expected.

Important long-term beneficial effects to deep groundwater would occur under this alternative, as up to 273,000 acre-feet of groundwater would be conserved each year based on discontinued pumping on approximately 102,600 acres (assuming that 2.5 acre-feet/acre are used each year, but this number varies). The resource would be conserved for future temporary emergency use in the event of a disruption of the surface water supply. Groundwater decline rates in the Grande Ronde aquifer would decrease. The improved quality of the applied surface water would benefit the soils in the vicinity.

Alternative 3A: Full—Banks would have a beneficial effect on groundwater use for municipal and industrial purposes in the Study Area. Groundwater decline rates in the Grande Ronde aquifer are anticipated to decrease throughout the Study Area and municipal and industrial users would benefit by the lack of continued groundwater level decline by having longer-life wells with more stable pumping costs.

Domestic wells in some areas may still experience water level declines as the groundwater in the shallow aquifer continues to drain downward into the deeper aquifer through open boreholes and vertical fractures, even after pumping is discontinued in the deeper aquifer.

Constructing Black Rock Reregulating Reservoir would have beneficial effects on shallow groundwater by providing a local recharge area, which could potentially lead to recharging shallow groundwater in the Wanapum Basalt unit. The Black Rock Reregulating Reservoir would be constructed and operated to manage water delivery and distribute water to both the southern portion of the East High Canal and the Black Rock Branch Canal. When Black Rock Reregulating Reservoir is full (which is anticipated to be most of the time), some water would seep from the reservoir into the coulee walls and floor and become shallow groundwater.

Minimal impacts to the shallow groundwater in the sediments around Banks Lake would include local groundwater levels dropping in response to additional drawdown. However, Banks Lake would be refilled over the winter, and the groundwater would consequently rise back to its original level, which is equal to the lake level. Because of the rapid response of the groundwater to Banks Lake levels, and because no shallow groundwater use occurs, the impacts to groundwater in the Banks Lake vicinity would be minimal.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or additional impacts to groundwater resources are anticipated from the Limited Spring Diversion Scenario.

4.3.6 Alternative 3B: Full—Banks + FDR

Short-term, and long-term, impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or additional impacts to groundwater resources are anticipated from the Limited Spring Diversion Scenario.

4.3.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

Short-term impacts would be the same as Alternative 2A: Partial—Banks.

4.3.7.1 Long–term Impacts

The important beneficial groundwater effects to the area south of I-90 that are discussed under Alternative 2A: Partial—Banks would also occur north of I-90. The groundwater replacement systems north of I-90 would be reconstructed into phases 1 and 2. Two construction phases for delivery south of I-90 would be constructed in phases 3 and 4. When the groundwater is replaced by surface water in the area impacted by each stage, the deeper groundwater decline rates are expected to decrease after pumping is discontinued.

Ultimately, groundwater decline rates throughout the entire Study Area, including construction phases 1 to 4, are anticipated to decrease in the deeper Grande Ronde aquifer because of the elimination of discharge through pumpage.

Table 4-34 summarizes anticipated average groundwater depths in the Study Area following implementation of the action alternatives. Average groundwater depths are anticipated to be between approximately 430 and 600 feet below ground surface north of I-90, and approximately 470 and 680 feet below ground surface south of I-90.

Because the deep wells would not be decommissioned and abandoned (they would be kept in place for temporary emergency supply in case of an interruption of the Federal delivery system), groundwater in the deeper Grande Ronde aquifer could possibly rise slightly in the vicinity of wells as groundwater continues to flow down through open wells and vertical fractures in the layers of basalt from the shallow to the deeper aquifer. However, no substantial recharge of the Grande Ronde aquifer is expected.

Important long-term beneficial effects to deep groundwater would occur under this alternative, as up to 164,000 acre-feet of groundwater would be conserved each year based on discontinued pumping on approximately 70,000 acres (assuming that 2.5 acre-feet per acre are used each year, but this number varies). The resource would be conserved for future temporary emergency use in the event of a disruption of the surface water supply. Groundwater decline rates in the Grande Ronde aquifer would decrease. The improved quality of the applied surface water would benefit the soils in the vicinity.

Alternative 4A: Modified Partial—Banks (Preferred Alternative) would have a beneficial effect on groundwater use for municipal and industrial purposes in the Study Area. Groundwater decline rates in the Grande Ronde aquifer are anticipated to decrease throughout the Study Area and municipal and industrial users would benefit by the lack of continued groundwater level decline by having longer-life wells with more stable pumping costs.

Domestic wells in some areas may still experience water level declines as the groundwater in the shallow aquifer continues to drain downward into the deeper aquifer through open boreholes and vertical fractures, even after pumping is discontinued in the deeper aquifer.

Minimal impacts to the shallow groundwater in the sediments around Banks Lake would include local groundwater levels dropping in response to additional drawdown. However, Banks Lake would be refilled, and the groundwater would consequently rise back to its original level, which is equal to the lake level. Because of the rapid response of the groundwater to Banks Lake levels, and because no shallow groundwater use occurs, the impacts to groundwater in the Banks Lake vicinity would be minimal.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to groundwater resources are anticipated from the Limited Spring Diversion Scenario.

4.3.8 Alternative 4B: Modified Partial—Banks + FDR

Short-term and long-term would be the same as Alternative 4A: Modified Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to groundwater resources are anticipated from the Limited Spring Diversion Scenario.

4.3.9 Mitigation

No mitigation measures are feasible for any of action alternatives.

4.4 Surface Water Quality

The surface water quality analysis addresses the potential effects on temperature, dissolved oxygen, and total dissolved gas in the following systems:

- Lake Roosevelt
- Banks Lake
- Columbia River downstream of Grand Coulee Dam
- CBP irrigation network

In addition, pH, nutrients, turbidity, heavy metals, and pesticides are discussed in general terms for where information or changes are likely.

The No Action Alternative would have no additional adverse impacts on Lake Roosevelt, Banks Lake, or the Columbia River downstream of Grand Coulee Dam. The CBP irrigation network may experience a small beneficial effect from decreased delivery of sediment, pesticides, and nutrients to the canal and drain system over time as the lands go out of irrigated agricultural production and move towards dryland agriculture production. Very limited surface water connections to the CBP's drain system currently exist in the study area. These connections consist of naturally occurring topographic lows and some ephemeral channels. Generally, these channels only carry surface flow during natural runoff events. Very little, if any, irrigation runoff makes its way from the groundwater irrigated lands east of the currently irrigated portions of the CBP to the canal and drain network.

Historically the area was predominantly dryland agriculture, which did not require an extensive drainage network. As groundwater pumping became economical, the dryland agriculture was converted to irrigated agriculture. Highly efficient sprinkler systems aided in this conversion. As a result of the conversion, the use of pressurized sprinkler systems, and the relatively high costs associated with pumping groundwater the farms did not over utilize the available water. Therefore, limited connections to a drainage system were needed. However, these limited connections that do exist may benefit the most under the No Action Alternative as what little irrigation return flows that currently occur diminish as the wells currently used are removed from production. The remainder of the surface flows that currently occur as a result of natural events would continue to flow into the CBP canal and drain network under the No Action Alternative.

Similar beneficial impacts may result from the No Action Alternative and all the action alternatives as the various TMDL's in development or already in place for Lake Roosevelt, the Columbia River downstream of Grand Coulee Dam, as well as their contributing tributaries are implemented and BMPs are implemented throughout the CBP area.

Lake Roosevelt water quality, particularly temperature, dissolved oxygen, and heavy metals, may experience slight impacts from any of the action alternatives, which utilize Lake Roosevelt as a portion of the water supply. Alternative 3B: Full—Banks + FDR, which would result in additional drawdown in Lake Roosevelt of between 0.4 and 2.4 feet in the summer months beginning in June and ending in September. August drawdown, may have the greatest impact on water quality, but is limited to 2.2 to 2.4 feet of additional elevation change. However, Lake Roosevelt's draft could be as little as 7 feet or as great as 82 feet annually to meet flood control objectives. As result, the effects of a 2.4-foot draft for Alternative 3B may not result in a measurable change in the mobilization of sediment or result in a measurable change in the temperature or oxygen profiles of the reservoir.

An additional management scenario investigating limiting spring diversions from the Columbia River during the spring to when flows at Grand Coulee are greater than 200,000 cfs would not change the August drawdown seen in Lake Roosevelt in most years. An additional 0.3 feet of drawdown would occur in August of wet years seen in Lake Roosevelt as a result of Alternative 3B. June drawdown, in wet and average years, under this modification would be similar to the dry and drought conditions and would increase drawdown an additional 0.4 and 0.3 feet, respectively in comparison with the Spring Diversion Scenario originally proposed (Table 4-16 and Table 4-19). This modification may not produce a measurable effect on water quality in Lake Roosevelt.

In 2011, McCulloch et al. (2011 Management) completed a hydrodynamics and water quality model for Banks Lake. The model examined eight management scenarios varying the depth of drawdown in Banks Lake and the source of water from entirely Banks Lake to a mixture of water from Banks Lake, more pumping from FDR, or an alternative storage reservoir. Four of these scenarios were similar to the Odessa Special Study action alternatives 2A, 2B, 3A, and 3B. However, since the report was written Reclamation corrected the depths and timing of drawdown in Banks Lake for each Action alternative to better reflect pump capacities from FDR. As a result, under average hydrological conditions, the modeled scenarios (2011 Management) were between 1.1 and 2.9 feet deeper in August than the final pump capacity corrected action alternatives. Under dry and drought conditions, the adjusted pump capacity conditions remained the same as the modeled action alternatives modeled in 2011, except for Alternative 3A, which resulted in the model using a 3.1-foot deeper draft of Banks Lake during drought conditions.

Under wet conditions, the Banks Lake only (Alternatives 2A and 3A) corrected alternatives resulted in a 1.2 and 3.2 deeper draft of Banks Lake than was modeled. Consequently the effects on temperature and dissolved oxygen reported in McCulloch et al. (2011 Management), while similar will be interpolated between the updated drafting levels and modeled actions.

The results of McCulloch et al. (2011 Management) indicated that there would be minimal deviations in temperature and oxygen profiles because of any of the action alternatives in comparison with the No Action Alternative. Some slight warming may occur during spring months and some slight cooling of the water column may occur during fall months in comparison with the No Action Alternative. Similarly, McCulloch et al. did not identify much change in dissolved oxygen concentrations between the action alternatives and the No Action Alternatives.

Water quality in the Columbia River downstream of Grand Coulee Dam, particularly temperature and potentially total dissolved gas, will likely experience negligible impacts from any of the action alternatives. Flow changes associated with any of the action alternative outside of the spill season for flood control or refill seasons would normally be routed through the power plants and therefore would not change the TDG levels as the power plants simply pass through the TDG from the forebay of FDR. Flow reductions past Grand Coulee, from the action alternatives during months when spill events are likely (May/June/July) would decrease the amount of water spilled. However, spill volumes typically range from 10 kcfs to 100 kcfs while the modeled 70-year average change in flows in these months result in flow reductions of 0.9 to 1.8 kcfs. Flow reductions of this magnitude may not result in a measurable change in TDG production during spill events. Alternatives 3A and 3B would result in the largest in the largest 70-year average flow reductions in the Columbia River of 1.8 kcfs.

The CBP irrigation network water quality would not be change because of the action alternatives. Temperature, nutrients, and pH should not change as a result of changing the source of water from ground water to surface water. There may be a slight beneficial change from the action alternatives because surface water is typically less alkaline than groundwater. The differences between action alternatives and their effects on water quality would be negligible.

4.4.1 Methods and Assumptions

4.4.1.1 Impact Indicators and Significance Criteria

Table 4-35. Water quality resources impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Lake Roosevelt and Banks Lake: temperature [a,b], dissolved oxygen [a,b], heavy metals [a], and turbidity [b]	An exceedance of a state water quality standard or if state water quality standards are already exceeded, statistically significant resource degradation occurs.
Columbia River: temperature and TDG	An exceedance of a state water quality standard or if state water quality standards are already exceeded a statistically significant resource degradation occurs.
CBP irrigation network: temperature, pH, salinity, pesticides, and nutrients	An exceedance of a state water quality standard or if state water quality standards are already exceeded a statistically significant resource degradation occurs.
[a] Lake Roosevelt indicator [b] Banks Lake indicator	

4.4.1.2 Impact Analysis Methods

Changes in surface water quality that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Lake Roosevelt

Although hydrologic models and water quality models exist for portion of Lake Roosevelt exist, a comprehensive water quality model for the entire water body has not been developed to assess impacts for Lake Roosevelt in this EIS, so anticipated impacts resulting from the action alternatives were assessed in a qualitative fashion.

Hydrologic modeling results for wet, average, dry, and drought conditions are presented in detail in Chapter 2, Section 2.2.2 – *River and Reservoir Hydrologic Operational Changes and Hydrology under the Alternatives*. This analysis focuses on the conditions resulting in the greatest late summer drawdown because water quality parameters, like temperature, are particularly sensitive to changes in water depth during warmer times of the year as a result of stratification. Under isothermal conditions (similar or nearly similar temperatures from the top of the water body to the bottom), or no stratification, such as the fall and spring changes in water depth have no effect on water temperature and dissolved oxygen. Differences in the drawdown elevations between the No Action Alternative and the action alternatives were used to establish the anticipated impacts to Lake Roosevelt's target water quality parameters (temperature, dissolved oxygen, and heavy metals).

Banks Lake

A comprehensive CE-QUAL-W2 water quality model has been developed for Banks Lake and incorporated into this Study; the anticipated impacts resulting from the action alternatives were assessed using the model to evaluate the anticipated impacts to the Banks Lake target water quality parameters (temperature and dissolved oxygen). The alternatives evaluated with the model where similar to those presented in the Draft EIS. This Final EIS retains some of those alternatives but generally, the maximum level of drawdown of Banks Lake has been changed for each alternative. Consequently the absolute results of the model runs are not directly transferrable to the alternatives as now constituted. Therefore, some interpretation and interpolation of the results in necessary to draw conclusions about the alternatives in the Final EIS. The following table can be used to help interpret the changes between what was modeled with the CE-QUAL-W2, the final pump capacity rectified action alternatives, and the additional management scenario of using Columbia River diversions in the spring when downstream flow objectives are exceeded. Alternatives 2A, 2B, 3A, and 3B, the modeled August additional drawdown, and the August pump capacity adjusted additional drawdown is presented in Table 4-36.

Table 4-36. Differences between modeled and final action alternatives for August in four water year types.

Action Alternative	August Modeled Drawdown (feet)	August Corrected Drawdown (feet)	August Corrected Drawdown with Limited Spring Diversion (feet)	Difference Between Model and Action Alternative (feet)	
				Spring	Limited Spring
2A Average	8.4	7.3	9.6	1.1	-1.2
2A Dry	9.8	9.8	9.8	0	0
2A Wet	7.3	8.5	9.6	-1.2	-2.3
2A Drought	9.6	9.6	9.6	0	0
2B Average	8.0	8.0	8.0	0	0
2B Dry	8.0	8.0	8.0	0	0
2B Wet	8.0	8.0	8.0	0	0
2B Drought	8.0	8.0	8.0	0	0
3A Average	13.5	10.6	14.8	2.9	-1.3
3A Dry	15.0	15.0	15.0	0	0
3A Wet	10.6	13.8	14.8	-3.2	-4.2
3A Drought	18.3	15.2	15.2	3.1	3.1
3B Average	8.0	8.0	8.0	0	0
3B Dry	8.0	8.0	8.0	0	0
3B Wet	8.0	8.0	8.0	0	0
3B Drought	8.0	8.0	8.0	0	0
4A Average		8.1	11.0		
4A Dry		10.9	10.9		
4A Wet		9.9	11.0		
4A Drought		10.9	10.9		
4B Average		8.0	8.0		
4B Dry		8.0	8.0		
4B Wet		8.0	8.0		
4B Drought		8.0	8.0		

Columbia River Downstream of Grand Coulee Dam

A temperature TMDL for the Columbia River is under development, but no model is currently available that could be used to accurately characterize potential temperature impacts based on small flow changes resulting from the action alternatives. Total dissolved gas concentrations are largely dictated by background concentration, season, dam operations, and meteorological conditions. Hydrologic modeling results and spreadsheet analyses were used to evaluate relative flow changes between the No Action Alternative and the action alternatives at four dams (Grand Coulee, Chief Joseph, Priest Rapids, and Bonneville Dams) on the Columbia River. Based on available data, only relative flow changes with a representative average year were evaluated for this analysis.

CBP Irrigation Network

Under the No Action Alternative, the amount of land irrigated with groundwater in the Odessa Special Study would decrease over time and be converted to dryland agriculture. Under the action alternatives, surface water from Lake Roosevelt and Banks Lake would be supplied to those lands offsetting the use of groundwater where it is used and providing a source of irrigation water where groundwater use has ceased. The action alternatives would not alter land use practices or the amount of water used on the farms for agricultural purposes. Little, if any, surface return flow exists under the current the groundwater irrigation operations and this would not be expected to change under any of the alternatives, including the No Action Alternative. Consequently, the only reason water quality would be altered is if the new surface water supply is of better or poorer quality than the existing groundwater source. This impact analysis compared the representative surface water and groundwater quality data presented in Section 3.4.5 – *CBP Irrigation Network*, Table 3-7).

4.4.1.3 Impact Analysis Assumptions

Broadly, applicable legal requirements are described in Chapter 5, Consultation and Coordination. Specific water quality laws and requirements are explained in Chapter 3, Section 3.4 – *Surface Water Quality*. For the alternative impact analysis, it is assumed that all regulations would be followed and that the BMPs listed in Section 4.31 – *Environmental Commitments*, would be applied.

Legal Requirements and BMPs for Surface Water Quality

Projects impacting water resources in the State are required to file a Joint Aquatic Resource Permit Application, which includes applications for Corps Section 404 permits, Ecology 401 Water Quality Certifications, and WDFW Hydraulic Project Approvals. Additionally, projects must adhere to WAC 220–110, Hydraulic Code. Water quality standards are intended to protect specific designated uses, such as water supply, salmonid spawning, and contact recreation. These water quality standards are explained in Chapter 3, Section 3.4 – *Surface Water Quality*.

The goal of surface water quality BMPs is to prevent and minimize erosion and siltation during construction and site restoration. Actions such as minimizing soil exposure, restoring disturbed sites promptly, and applying proper construction techniques to keep silt out of lakes and drainages are intended to protect both water quality and watershed function, and are described further in Section 4.31 – *Environmental Commitments.*

Traditional water quality BMPs are aimed at avoiding or minimizing water pollution during or after construction. Because the action alternatives do not involve construction activities near Lake Roosevelt, Banks Lake, or the Columbia River downstream of Grand Coulee Dam, BMPs are unwarranted. However, construction activities will take place near the Study Area irrigation network. These BMPs are described in Section 4.31 – *Environmental Commitments*.

4.4.2 Alternative 1: No Action Alternative

4.4.2.1 Short-term Impacts

No short-term impacts are anticipated because no new facilities would be constructed under this alternative.

4.4.2.2 Long-term Impacts

No long-term impacts associated with this study are anticipated for Lake Roosevelt, Banks Lake, or the Columbia River Downstream of Grand Coulee Dam because no additional water would be withdrawn from Lake Roosevelt or Banks Lake and flows would not change in the Columbia River.

As it becomes infeasible to pump groundwater for irrigation use, the currently irrigated lands would not be able to sustain high water demand crops. Initially, as the groundwater supply decreases, a smaller area would be irrigated or less water demanding crops would be grown. Later, as groundwater supplies decline further, irrigated lands would be converted to dryland crops. Surface water quality in the CBP irrigation network would improve slightly, a beneficial effect, because pesticides and fertilizers would not be as easily conveyed to the limited surface water connections. Natural runoff which can also carry pesticides and fertilizers and makes up the bulk of the surface flow would continue under the No Action Alternative.

Water quality standards for some of the target parameters in Lake Roosevelt, Banks Lake, the Columbia River Downstream of Grand Coulee Dam, and the CBP irrigation network are currently exceeded under the existing condition. The No Action Alternative would have no effect on these and exceedances would likely continue into the future.

4.4.3 Alternative 2A: Partial—Banks

4.4.3.1 Short-term Impacts

No short-term impacts to Lake Roosevelt, Banks Lake, and the Columbia River below Grand Coulee Dam would occur because no new facilities would be constructed near these features. Short-term impacts to the CBP irrigation network resulting from construction activities would include localized turbidity plumes when canal operations are resumed, bank erosion prior to revegetation, introduction of oil and grease from heavy equipment into the canal system, and delivery of additional sediment to the canal system from runoff over temporarily exposed embankments or roadways. These impacts would be minimal, for this or any of the action alternatives.

4.4.3.2 Long-term Impacts

Lake Roosevelt

No long-term impacts are anticipated for this alternative because no additional water would be withdrawn from Lake Roosevelt during the critical summer months. Flow diversions of up to 2,289[5] cfs in October will not impact the temperature or oxygen profiles of the reservoir.

Banks Lake

Projected Banks Lake drawdowns for the No Action Alternative and the action alternatives are presented in Chapter 2 under each alternative description. The modeling results (McCulloch et al. 2011 Management) indicate that the impacts will be minor for temperature and dissolved oxygen under this alternative. Banks Lake is not currently listed as a temperature or dissolved oxygen-impaired by the State, but criteria exceedances have occurred under existing conditions and would be expected to continue. The model results of a drawdown scenario similar to that for Alternative 2A shows no statistically significant difference in the shape of the seasonal temperature profiles. This indicates that the drawdown levels modeled will not change the thickness of the stratified layers. Action alternative 2A does result in slightly warmer spring temperatures in comparison with the No Action alternative. The mean temperature profile difference across all the water year types was 0.38 °C. Mean summer change in profile temperature was 0.01 °C warmer, and slightly

[5] Modeled 70-year maximum change in flows.

cooler temperatures in the fall (-0.07° C). Changes in dissolved oxygen were similarly small to nonexistent, most consisted of slight time-averaged volume shifts in oxygen concentration (McCulloch et al. 2011 Management).

Model results should be indicative of the action alternative, as there were no depth changes with the model to final in dry and drought years, while average years resulted in less drawdown (1.1 feet), and in wet years drawdown was increased by approximately 1.2 feet but was still in the range modeled for this alternative. The slight modification of Alternative 2A as a result of the diversion of Columbia River water in the spring only alters the action alternative from the model by increasing the drawdown of Banks Lake by 1.2 feet in average years and 2.3 feet in wet years. These differences are less than the deepest modeled difference (3A) for all action alternatives which were not statistically different from the No Action Alternative (i.e., Alternative 2A = No Action Alternative = Alternative 3A).

Surface heating and a reduction in mixing processes as water density gradients develop at depth drive temperature stratification in a reservoir. In Banks Lake, the stratification regime observed under the No Action Alternative would not be likely to change regardless of the action alternatives as pumping from Lake Roosevelt remains the only source of water for all alternatives including the No Action Alternative. In addition, the fixed discharge location (from Dry Falls Dam at the south end of Banks Lake) remains the same depth. The modeling results confirmed that drawdown depths from 0.00 to 16.60 feet do not change the temperature or oxygen stratification of Banks Lake.

Columbia River Downstream of Grand Coulee Dam

Projected Columbia River flows for the No Action Alternative at four dams (Grand Coulee, Chief Joseph, Priest Rapids, and Bonneville) are presented in Section 4.2 – *Surface Water* Quantity. The projected reductions in flow are anticipated to be very small and would have negligible impacts on water temperature and TDG in the Columbia River.

Alternative 2A: Partial—Banks would generally feature slightly reduced flows compared to the No Action Alternative. Flow changes in relation to the No Action Alternative would range from a monthly average of 0 cfs to a monthly average decrease approximately 2,300 cfs (Table 4-2), with no projected change to flows during the temperature-critical summer months. The largest flow change would occur in October.

These small reductions in flow are anticipated to have a negligible impact on water temperature during the fall when air temperatures are relatively cooler and the reservoirs are isothermal. The flow reductions resulting from this alternative would also have an indiscernible impact on TDG which is generated from spill events in the spring and early summer on the Columbia River. Since the Project would divert water from the river, primarily in October, it would not add to any TDG conditions, which may develop during the high flow periods in the spring and early summer.

The potential impacts that decreased flows have on water quality decreases with distance downstream of the diversion because other tributaries add flow to the river. Consequently, impacts to the Columbia River beyond Bonneville Dam, including estuarine conditions where the river enters the Pacific Ocean, were considered negligible at most and were not evaluated further.

CBP Irrigation Network

Within the irrigation network, no impacts would be anticipated for temperature or nutrients, a negligible impact would be anticipated for pH, and a beneficial effect would be anticipated for salinity under this alternative. The temperature of the irrigation water sent to the CBP through a bottom release at Dry Falls Dam would not be likely to change significantly, because water temperatures near the bottom of the reservoir tend to be uniform across all action alternatives (McCulloch 2011 et al. Management).

Relative to No Action, this alternative would feature conversion of the irrigation water source from groundwater to surface water on lands south of I-90 or the use of surface water for irrigation on previously irrigated lands that have reverted to dryland farming. Where groundwater continues to be used, the new irrigation water source would change from groundwater quality characteristics (primarily from the deeper Grande Ronde aquifer) to the surface water quality characteristics presented in Chapter 3, Table 3-7. The following discussion compares the surface water and groundwater quality observations reported in Table 3-7, and it identifies anticipated impacts to water quality standards and agricultural productivity.

Average surface water temperatures are similar to the shallower Wanapum aquifer and are slightly cooler than the deeper Grande Ronde aquifer. However, following application of irrigation water to crops by sprinkler, the water, regardless of source, likely equilibrates with the environment as it percolates through the soil and eventually returns to the shallow aquifer or surface drain system. The groundwater to surface water conversion would be likely to have no impact on surface water temperature.

The pH of the surface water is slightly higher (more basic) than that of the groundwater. Average surface water pH ranged from 7.9 to 8.3 and average groundwater pH ranged from 7.4 to 8.1. Both pH ranges fall within the state standard (Chapter 3, Table 3-4), and the slightly basic trend resulting from the groundwater to surface water conversion would not be likely to impact agricultural productivity, so this alternative would be anticipated to have an indiscernible impact on surface water pH.

Dissolved solids (measured as TDS) and specific conductance serve as surrogates for salinity. An increase in salinity would represent an adverse impact to agricultural productivity because some crops cannot tolerate highly alkaline water. However, surface water TDS and specific conductance are roughly three times lower than in the groundwater.

Specific conductance observations suggest the surface water falls into the low salinity hazard category (below 250 µS/cm; Lewis 1998) while the groundwater exceeds the low hazard threshold. Decreased TDS and specific conductance in return flows in the drain system would represent a beneficial effect to surface water quality.

Nutrients, especially phosphorus and nitrogen, are often applied to fields as fertilizer to stimulate crop growth, but excess nutrients can lead to algal blooms and dissolved oxygen depletion in receiving streams. Nitrogen concentrations, reported as nitrate plus nitrite, are approximately an order of magnitude lower in the surface water than in the groundwater. Phosphorus concentrations, though not reported for groundwater, likely follow a similar trend. The reported nitrogen concentrations for both sources of water are well below the MCL for drinking water (10 mg/L or 10,000 µg/L), and the decrease in nitrogen that would be experienced because of the groundwater to surface water conversion would essentially have no impact because the nutrient concentrations found in agricultural return flows are due primarily to fertilizer application practices, which are not anticipated to change.

Where groundwater irrigation ceases prior to surface water being provided for irrigation few water quality impacts are anticipated. Currently there is little, if any, surface runoff from the groundwater irrigated lands except that which occurs under natural conditions as a result of precipitation generated runoff events. This would also be the case if the lands reverted to dryland farming under the No Action Alternative. Under Alternative 2A, surface water runoff as a result of irrigation is not expected to be any greater than that that occurs under current conditions with groundwater irrigation. As such converting from either groundwater irrigation to surface water irrigation or from dryland farming to surface water irrigation is not expected to generate any increase in surface flows that reach the CBP irrigation network. Since no additional surface flows are anticipated no changes in surface water quality conditions are anticipated except where surface water replaces groundwater as previously discussed.

Changes with Limited Spring Diversion Scenario

The Limited Spring Diversion Scenario would not alter the effects on Lake Roosevelt or the Columbia River downstream from Grand Coulee Dam significantly. Water diversion in the spring would rarely be available from the Columbia River under this scenario. However, when available water would be diverted to refill Banks Lake. As a result, the loss of water diverted in the spring under the normal scenario would increase the amount of drawdown of Banks Lake during all but the wettest spring months. Since additional water would not be diverted in the spring months except during the wetter water years, the amount of diversion the following October would be increased to 2,700 cfs. Under this scenario, the water that would be diverted in under the Spring Diversion Scenario would remain in the Columbia River system. This change in flow is generally a few hundred cfs (500 cfs maximum). The impact to TDG below Grand Coulee from this slight change in flow between spring diversions and limited spring diversion is likely not measurable.

In comparison with the modeled scenarios, this scenario would result in a slightly deeper draft of Banks Lake in average and wet years (Table 4-4). Consequently, the drafts for the diversions with the Limited Spring Diversion Scenario would be more similar to the depths for the modeled Alternative 2A drought conditions. The modeled Alternative 2A drought conditions may represent drawdown of Banks Lake in all water year types with the Limited Spring Diversion Scenario. With respect to temperature, the differences between these scenarios results in a slightly cooler hypolimnion in the spring (-0.08°C), a very slight cooling in the critical summer period (−0.31°C) and relatively no change in the fall (0.02°C) when the reservoir is again uniform temperature. Consequently, with the Limited Spring Diversion Scenario, Alternative 2A is not statistically different from the No Action Alternative. No changes are expected for dissolved oxygen for Alternative 2A with the Limited Spring Diversion Scenario.

Photograph 4-1. Uses adjacent to waterways could potentially contribute to water quality issues in the CBP irrigation network, but these impacts would be governed by Federal and State water quality regulations.

4.4.4 Alternative 2B: Partial—Banks + FDR

4.4.4.1 Short-term Impacts

Short-term impacts would be the same as Alternative 2A: Partial—Banks.

4.4.4.2 Long-term Impacts

Lake Roosevelt

Minor changes in the operation of Lake Roosevelt creating a small decrease in the water column would result in impacts to temperature, dissolved oxygen, and re-suspension of heavy metals too small to measure. Additional impacts in Lake Roosevelt are not anticipated for total dissolved gas. This alternative would feature slightly greater drawdown than the No Action alternative. Maximum projected late summer drawdown (when additional drawdown is most likely to impact temperature, dissolved oxygen concentrations, as well as other water quality parameters) would occur during August of the representative dry and drought year simulations, when drawdown would increase from 0.6 to 0.5 feet, respectively in relationship with the No Action alternative. If the reservoir was stratified, the vertical temperature profile would shift downward approximately 0.5 feet (eliminating the bottom 0.5 feet of the hypolimnion from the No Action alternative profile). The reservoir has an average depth of approximately 118 feet at full pool (Johnson et al. 1990), so average water depth during August would decrease from 104.2 feet for the No Action alternative to 103.7 feet for this alternative during drought years; a relative decrease of approximately 0.5 feet. In wet and average year conditions, August drawdown is 0.2 and 0.0 feet respectively. Again, the relative decrease in water column depth is not significant. The loss of 0.0 to 0.6 feet of hypolimion may result in a breakdown of the stratification of the reservoir and a return to isothermal conditions days earlier than the No Action Alternative. However, Lake Roosevelt only weakly stratifies in most years and the thermocline break down is highly variable because of the very short retention time of the reservoir (12 to 45 days depending on water year) and the high volume of water moving through the reservoir (Underwood et al. 2004). In general, the reservoir acts more like a run-of-river reservoir than a storage reservoir. A shift of a few days in stratification break down is likely not measurable within the year-to-year variation caused by annual differences in atmospheric heating and cooling. Operation of Lake Roosevelt because of this alternative will not change the stratification dynamics of the reservoir.

Additional re-suspension of sediment-bound metals (zinc, lead, copper, arsenic, cadmium, and mercury), which were primarily derived from Tech Cominco Ltd. smelting operations in British Columbia (Ecology 2001), is not anticipated. Since only minimal additional drawdown would occur in this alternative, very little, if any, previously protected sediments would be exposed to erosive wave forces. Furthermore, only a negligible impact from re–suspension of sediment–bound heavy metals would occur.

Banks Lake

Water quality impacts at Banks Lake under this alternative would be relatively small, when compared to the No Action alternative. The impacts of this alternative would be similar to Alternative 2A: Partial—Banks, except that reduced drawdown for this alternative would result in smaller increases in temperature and smaller decreases in dissolved oxygen relative to the No Action alternative. The model prepared for this study indicates that charges in temperature and dissolved oxygen in Banks Lake are relatively small across all the action alternatives and are not statistically significant. The model results of a drawdown scenario similar to that for Alternative 2B shows no statistically significant difference in the shape of the seasonal temperature profiles. Graphically Alternatives 2A and 2B are nearly indistinguishable. The mean spring temperature profile difference across all the water year types was 0.38°C at the pelagic (deep open water) location. Mean summer change in profile temperature was 0.19°C warmer, and slightly cooler temperatures in the fall (-0.05°C). Changes in dissolved oxygen were similarly small to nonexistent, most consisted of slight time-averaged volume shifts in oxygen concentration (McCulloch et al. 2011 Management). Model results should be indicative of the action alternative, as there were no depth changes with the model to final in dry, wet, and drought years, while average years resulted in less drawdown.

Turbidity in the reservoir results from the concentration of erosive forces from wind and boat waves on a particular bank elevation, so this alternative would have a negligible impact on turbidity and erosive forces would be distributed over a range of bank elevations. For most months, the drawdown is within the 5-foot operating window currently used in Banks Lake. Additional drawdown in excess of this 5-foot window only occurs in August.

Columbia River Downstream of Grand Coulee Dam

Alternative 2B: Partial—Banks + FDR would generally feature slightly reduced flows compared to the No Action Alternative. Flow changes in relation to the No Action alternative would range from a monthly average of 0 cfs to a monthly average decrease of approximately 2,300 cfs (Table 4-5); with no projected change to flows during the temperature-critical summer months. The largest flow change would occur in October when flows from this alternative would decrease between -2,185 to -2,289 cfs relative to the No Action Alternative flows and water year type.

This alternative would feature maximum projected flow reductions ranging from 2.2 percent (at Bonneville) to 3.0 percent (at Grand Coulee) for the representative average year compared to the No Action Alternative, and only minimal impacts are anticipated for this alternative, as described for Alternative 2A: Partial—Banks.

Study Area Irrigation Network

Impacts and benefits would be the same as described in Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

The Limited Spring Diversion Scenario would not alter the effects on Lake Roosevelt or the Columbia River downstream from Grand Coulee Dam significantly. Water diversion in the spring would rarely be available from the Columbia River under this scenario. However, when available water would be diverted to refill Banks Lake. As a result, the loss of water diverted in the spring under the normal scenario would increase the amount of drawdown of Banks Lake during all but the wettest spring months. Since additional water would not be diverted in the spring months except during the wetter water years, the amount of diversion the following October would be increased to 2,700 cfs. Under this scenario, the water that would be diverted in under the Spring Diversion Scenario would remain in the Columbia River system. This change in flow is generally a few hundred cfs (500 cfs maximum). The impact to TDG below Grand Coulee from this slight change in flow between spring diversions and limited spring diversion is likely not measurable.

The modeled results, Alternative 2B combined with the Limited Spring Diversion Scenario have the same maximum summer drawdown depth across all water year types. The model indicated no statistical difference with the No Action Alternative. Consequently, the drafts for the diversions with the Limited Spring Diversion Scenario should have no statistical difference from the No Action Alternative. No changes are expected for dissolved oxygen for Alternative 2B with and without the diversions with the Limited Spring Diversion Scenario as well.

4.4.5 Alternative 3A: Full—Banks

4.4.5.1 Short-term Impacts

Short–term would be the same as Alternative 2A: Partial—Banks.

4.4.5.2 Long-term Impacts

Lake Roosevelt

No long-term impacts are anticipated for this alternative because no additional water would be withdrawn from Lake Roosevelt during the critical summer months. Flow diversions of up to 2,700 cfs in October will not impact the temperature or oxygen profiles of the reservoir.

Banks Lake

Banks Lake modeling indicates that impacts due to relatively large drawdowns (10.6 to 18.3 feet) such as Alternative 3A (10.6 to 15.2 feet) are going to have the greatest effect on temperature and dissolved oxygen, but are still going to relatively small compared to the No Action Alternative, and are not statistically different than the other model scenarios and action alternatives.

The modeled drawdowns were consistently cooler when comparing the August temperature profiles to the No Action Alternative. Although unusual, the drop in temperature during the summer months was not a significant drop in comparison with the No Action Alternative. Additionally, the deep drawdown modeling scenario resulted in the lowest overall water temperature for all flow years, and contains the largest single month drop in water surface elevations. A typical July to August decrease in water surface elevation would range from

2.0 feet to 3.0 feet. Such a change in water surface elevation may draft differentially from the stratified layers of the reservoir system and thus reducing either the warmer epilimnetic waters or the cooler hypolimnion waters depending on the outlet works depth. This alternative showed the lowest overall water temperature for all flow years. This may indicate that the outlet works draw more from the warmer surface layers than the deeper hypolimnion. The model results of a drawdown scenario similar to that for Alternative 3A shows no statistically significant difference in the shape of the seasonal temperature profiles. Graphically, Alternatives 3A and 3B are nearly indistinguishable, with 3A showing a slightly cooler profile. The mean spring temperature profile difference across all the water year types was 0.37°C at the pelagic (deep open water) location. Mean summer change in profile temperature was -0.61°C cooler, and slightly cooler temperatures in the fall (-0.18°C). The average dissolved oxygen concentrations showed slightly more variability between alternatives, but still relatively little overall change. Consistently the wet flow year had the highest overall dissolved oxygen concentrations, while the average flow year produced the lowest average concentrations for the action alternatives. However, management scenarios for the dry and drought flow years in this alternative showed less dissolved oxygen within the 9 mg/l temporal and volume weighted average range than other management scenarios within the same flow years (McCulloch et al. 2011 Management).

More shoreline would be exposed to waves and other erosion during the deep drawdowns during July, August, and September (Table 4-13). However, the reservoir would generally begin refilling by October and would remain at higher elevations for the winter and spring when wind events that would generate waves are more common. Drawdown in excess of the 5-foot operating window currently used in Banks Lake is more common for this action alternative. Additional drawdown in excess of this 5-foot window occurs in nearly every month under drought and average water year conditions, and in July, August, and September of each water year type.

Columbia River Downstream of Grand Coulee Dam

Alternative 3A: Full—Banks would generally feature slightly reduced flows compared to the No Action Alternative. Flow changes in relation to the No Action Alternative would range from an average of 0 cfs to an average decrease of 2,700 cfs (Table 4-15), with no projected change to flows during the temperature-critical summer months. The largest flow change would occur in October when flows from this alternative would decrease 2,700 cfs relative to the No Action Alternative flows and water year type.

This alternative would feature maximum projected flow reductions at other downstream control points (Grand Coulee, Chief Joseph, Priest Rapids, and Bonneville) similar to Alternative 2A (2,289 cfs versus 2,700 cfs). Compared to the No Action Alternative, only minimal impacts are anticipated for this alternative.

CBP Irrigation Network

No impacts would be anticipated for temperature and nutrients, a minimal impact would be anticipated for pH, and a beneficial effect would be anticipated for salinity under this alternative. Discussion related to groundwater-irrigated land south of I-90 provided under Alternative 2A: Partial—Banks would apply to all parts of the Study Area (both north and south of I–90).

Changes with Limited Spring Diversion Scenario

The Limited Spring Diversion Scenario would not alter the effects on Lake Roosevelt or the Columbia River downstream from Grand Coulee Dam significantly. Water diversion in the spring would rarely be available from the Columbia River under this scenario. However, when available water would be diverted to refill Banks Lake. As a result, the loss of water diverted in the spring under the normal scenario would increase the amount of drawdown of Banks Lake during all but the wettest spring months. Since additional water would not be diverted in the spring months except during the wetter water years, the amount of diversion the following October would be increased to 2,700 cfs. Under this scenario, the water that would be diverted in the spring would remain in the Columbia River system. This change in flow in June would keep up to 1,184 cfs in average years and less than 354 cfs in wet years in the Columbia River. The impact to TDG below Grand Coulee from this slight change in flow between spring diversions and limited spring diversion is likely not measurable.

The model drawdowns ranged from 10.6 to 18.3 feet and indicated no statistical difference with the No Action Alternative. The Final EIS action alternative contains August drawdowns ranging from 10.6 to 15.2 feet (Table 4-13), while the Limited Spring Diversion Scenario of Alternative 3A contains August drawdowns ranging from 14.8 to 15.2 feet (Table 4-14). Consequently, the drafts for Alternative 3A with the Limited Spring Diversion Scenario are within the modeled drawdown and should have no statistical difference from the No Action Alternative. No changes are expected for dissolved oxygen for Alternative 3A with the diversions with the Limited Spring Diversion Scenario as well.

4.4.6 Alternative 3B: Full—Banks + FDR

4.4.6.1 Short-term Impacts

Short–term would be the same as Alternative 2A: Partial—Banks.

4.4.6.2 Long-term Impacts

Lake Roosevelt

Minor changes in the operation of Lake Roosevelt creating a small decrease in the water column would result in impacts to temperature, dissolved oxygen, and re-suspension of heavy metals too small to measure. Additional impacts in Lake Roosevelt are not anticipated for total dissolved gas. This alternative would feature slightly greater drawdown than Alternative 2B and the No Action Alternative. Maximum projected late summer drawdown (when additional drawdown is most likely to impact temperature, dissolved oxygen concentrations, as well as other water quality parameters) would occur during August of the representative dry and drought year simulations, when drawdown would increase from 2.3 to 2.4 feet, respectively in relationship with the No Action Alternative. If the reservoir was stratified, the vertical temperature profile would shift downward approximately 2.3 feet on average (eliminating some of the hypolimnion). In wet and average year conditions, August drawdown is 2.2 feet. Again, the relative decrease in water column depth is likely not significant. The loss of 1 to 2 feet of hypolimion may result in a breakdown of the stratification of the reservoir and a return to isothermal conditions a few days earlier than the No Action Alternative. However, Lake Roosevelt only weakly stratifies in most years and the thermocline break down is highly variable because of the very short retention time of the reservoir (14 to 30 days depending on water year) and the high volume of water moving through the reservoir. In general, the reservoir acts more like a run-of-river reservoir than a storage reservoir in cooler years due to less heat stored in the epilimnion. A shift of a few days in stratification break down is likely to shift the reservoir to be more run-of-river like in warmer years as density gradients would be less with the reduced size of the hypolimnion.

Additional re-suspension of sediment-bound metals (zinc, lead, copper, arsenic, cadmium, and mercury), which were primarily derived from Tech Cominco Ltd. smelting operations in British Columbia (Ecology 2001), is not anticipated. Since only minimal additional drawdown would occur in this alternative in comparison with annual flood control drafting levels, very little, if any, previously protected sediments would be exposed to erosive wave forces. Furthermore, only a negligible impact from re-suspension of sediment–bound heavy metals would occur.

Banks Lake

Water quality impacts at Banks Lake under this alternative would be relatively small, when compared to the No Action Alternative. The impacts of this alternative would be similar to Alternative 2B: Partial—Banks + FDR from July through September (when maximum drawdown occurs), but a greater amount of drawdown (with its corresponding water quality impacts) for this alternative would occur throughout the rest of the year. Temperature and oxygen profile changes during the critical summer months, when temperature and dissolved oxygen are most easily affected, would likely be neglible as described in the Banks Lake modeling prepared for this study.

The model indicates that changes in temperature and dissolved oxygen in Banks Lake are relatively small across all the action alternatives and are not statistically significant. The model results of a drawdown scenario similar to that for Alternative 2B shows no statistically significant difference in the shape of the seasonal temperature profiles. The mean spring temperature profile difference across all the water year types was 0.37°C at the pelagic (deep open water) location. Mean summer change in profile temperature was 0.04°C warmer, and slightly cooler temperatures in the fall (-0.14°C). Changes in dissolved oxygen were similarly small to nonexistent, most consisted of slight time-averaged volume shifts in oxygen concentration (McCulloch et al. 2011 Management). Model results should be indicative of the action alternative, as there were no depth changes with the model to final in all water year types.

Turbidity in the reservoir results from the concentration of erosive forces from wind and boat waves on a particular bank elevation, so this alternative would have a negligible impact on turbidity and erosive forces would be distributed over a range of bank elevations. Drawdown in excess of the 5-foot operating window currently used in Banks Lake is rare for this action alternative. Additional drawdown in excess of this 5-foot window occurs only in August of all water year types (Table 4-12) and extends this an additional 3 feet. This area would be exposed to wave action scour of the previously deposited sediments.

Columbia River Downstream of Grand Coulee Dam

Alternative 3B: Full—Banks + FDR would generally feature slightly reduced flows compared to the No Action Alternative. Flow changes in relation to the No Action Alternative would range from an average of 0 cfs to an average decrease of 2,700 cfs (Table 4-17), with no projected change to flows during the temperature-critical summer months. The largest flow change would occur in October when flows from this alternative would decrease 2,700 cfs relative to the No Action Alternative flows and water year type.

This alternative would feature maximum projected flow reductions at other downstream control points (Grand Coulee, Chief Joseph, Priest Rapids, and Bonneville) similar to Alternative 2A (2,300 cfs versus 2,700 cfs). Compared to the No Action Alternative, only minimal impacts are anticipated for this alternative.

CBP Irrigation Network

Impacts and benefits would be the same as described in Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

Impacts and benefits on Lake Roosevelt or the Columbia River downstream from Grand Coulee Dam would be the same as described in Alternative 3A for the Limited Spring Diversion Scenario.

The modeled results and the Limited Spring Diversion Scenario of Alternative 3B have the same maximum summer drawdown depth across all water year types. The model indicated no statistical difference with the No Action Alternative. Consequently, the drafts for the diversions with the Limited Spring Diversion Scenario should have no statistical difference from the No Action Alternative. No changes are expected for dissolved oxygen for Alternative 3B with and without the diversions with the Limited Spring Diversion Scenario as well.

4.4.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

4.4.7.1 Short-term Impacts

Short-term impacts would be the same as Alternative 2A: Partial—Banks.

4.4.7.2 Long-term Impacts

Lake Roosevelt

No long-term impacts are anticipated for this alternative because no additional water would be withdrawn from Lake Roosevelt during the critical summer months. This is true for action alternative and the modification of the action alternative where additional water is diverted from the Columbia River when downstream flow objectives are met or exceeded during high spring flows. Flow diversions of up to 2,666 cfs in October will not impact the temperature or oxygen profiles of the reservoir.

Banks Lake

The impacts of this alternative would be similar to Alternative 3A from July through September (when maximum drawdown occurs). Impacts outside of the critical summer months, when temperature and dissolved oxygen are most easily affected, would likely be negligible.

Banks Lake modeling indicates that impacts due relatively large drawdowns (10.6 to 18.3 feet) such as this alternative (8.1 to 11.0 feet) are going to have the greatest effect on temperature and dissolved oxygen, but are still going to relatively small compared to the No

Action Alternative, and are not statistically different than the other model scenarios and action alternatives.

The modeled drawdowns for Alternative 3A were consistently cooler when comparing the August temperature profiles to the No Action alternative. Alternative 4A should behave in a similar fashion but may exhibit less summer time cooling. The model results of a drawdown scenario similar to that for Alternative 4A shows no statistically significant difference in the shape of the seasonal temperature profiles. Graphically, Alternatives 2A and 3A are nearly indistinguishable, with 3A showing a slightly cooler profile. The average dissolved oxygen concentrations showed slightly more variability between alternatives, but still relatively little overall change. Consistently the wet flow year had the highest overall dissolved oxygen concentrations, while the average flow year produced the lowest average concentrations for the action alternatives (McCulloch et al. 2011 Management).

More shoreline would be exposed to waves and other erosion during the deep drawdowns during July, August, and September (Table 4-23). However, the reservoir would generally refill in October. Drawdown in excess of the 5-foot operating window currently used in Banks Lake is more common for this action alternative. Additional drawdown in excess of 5-feet occurs in August, and September of each water year type. As a result, lower shoreline elevations would be exposed to erosive forces and some additional turbidity would be generated. For this short period, waves will be able to generate localized turbidity plumes as the newly exposed shoreline and the deposited sediments are reworked at the lower elevations. This process will re-sort the sediments in the newly exposed area, but should be episodic when wind and boat generated waves are generated.

Columbia River Downstream of Grand Coulee Dam

Alternative 4A: Modified Partial—Banks would generally feature slightly reduced flows compared to the No Action Alternative. Flow changes in relation to the No Action Alternative would range from an average of 0 cfs to a maximum decrease of 2,700 cfs (Table 4-23); with no projected change to flows during the temperature-critical summer months. The largest flow change would occur in October when flows from this alternative would decrease to a monthly average of approximately 2,700 cfs relative to the No Action Alternative flows and water year type.

This alternative would feature maximum projected flow reductions at other downstream control points (Grand Coulee, Chief Joseph, Priest Rapids, and Bonneville) similar to Alternative 2A (2,300 cfs versus 2,700 cfs). Compared to the No Action Alternative, only minimal impacts are anticipated for this alternative.

CBP Irrigation Network

No impacts would be anticipated for temperature and nutrients, an inconsequential impact would be anticipated for pH, and a beneficial effect would be anticipated for salinity under this alternative. Discussion related to groundwater-irrigated land south of I-90 provided under Alternative 2A: Partial—Banks would apply to all parts of the Study Area (both north and south of I-90).

Changes with Limited Spring Diversion Scenario

Impacts and benefits on Lake Roosevelt or the Columbia River downstream from Grand Coulee Dam would be the same as described in Alternative 2A for the Limited Spring Diversion Scenario.

Alternative 4A and the Limited Spring Diversion Scenario have the similar maximum summer drawdown depths across all water year types (10.9 versus 11.0 feet) (Table 4-24). The modeling completed indicated no statistical difference between Alternative 3A and the No Action Alternative. Consequently, the drafts for Alternative 4A and the Limited Spring Diversions should have no statistical difference from the No Action Alternative, as they are less than the maximum drawdown modeled for Alternative 3A. No changes are expected for dissolved oxygen for Alternative 4A with and without the Limited Spring Diversions as well.

4.4.8 Alternative 4B: Modified Partial—Banks + FDR

4.4.8.1 Short-term Impacts

Short-term impacts would be the same as Alternative 2A: Partial—Banks.

4.4.8.2 Long-term Impacts

Lake Roosevelt

This alternative would feature slightly greater drawdown than Alternative 2B and the No Action Alternative. Maximum projected late summer drawdown (when additional drawdown is most likely to impact temperature, dissolved oxygen concentrations, as well as other water quality parameters) would occur during August of the representative dry and drought year simulations, when drawdown would increase from 1.0 feet in relationship with the No Action Alternative. If the reservoir was stratified, the vertical temperature profile would shift downward eliminating some of the hypolimnion. In wet and average year conditions, August drawdown is 0.6 and 0.0 feet respectively. Again, the relative decrease in water column depth is likely not significant. The loss of 0 to 1 foot of hypolimion may result in a breakdown of the stratification of the reservoir and a return to isothermal conditions a few days earlier than the No Action Alternative.

Additional re-suspension of sediment-bound metals (zinc, lead, copper, arsenic, cadmium, and mercury), which were primarily derived from Tech Cominco Ltd. smelting operations in British Columbia (Ecology 2001), is not anticipated. Since only minimal additional drawdown would occur in this alternative in comparison with annual flood control drafting levels, very little, if any, previously protected sediments would be exposed to erosive wave forces. Furthermore, only a negligible impact from re-suspension of sediment–bound heavy metals would occur.

Banks Lake

The impacts of this alternative would be similar as Alternative 2B and 3B from July through September (when maximum drawdown occurs). Impacts outside of the critical summer months, when temperature and dissolved oxygen are most easily affected, would likely be minimal. Alternatives 2B and 3B were not statistically different from the No Action Alternative.

Columbia River Downstream of Grand Coulee Dam

Alternative 4B: Modified Partial—Banks + FDR would generally feature slightly reduced flows compared to the No Action Alternative. Flow changes in relation to the No Action Alternative would range from an average of 0 cfs to a maximum decrease of 2,700 cfs (Table 4-31), with no projected change to flows during the temperature-critical summer months. The largest flow change would occur in October when flows from this alternative would decrease to a monthly average of approximately 2,700 cfs relative to the No Action Alternative flows and water year type.

This alternative would feature maximum projected flow reductions at other downstream control points (Grand Coulee, Chief Joseph, Priest Rapids, and Bonneville) similar to Alternative 2A (2,300 cfs versus. 2,700 cfs). Compared to the No Action Alternative, only minimal impacts are anticipated for this alternative.

Study Area Irrigation Network

Impacts and benefits would be the same as described for Alternative 4A: Modified Partial—Banks (Preferred Alternative).

Changes with Limited Spring Diversion Scenario

The limited Spring Diversion Scenario would not alter the effects on Lake Roosevelt or the Columbia River downstream from Grand Coulee Dam significantly. Water diversion in the spring would rarely be available from the Columbia River under this scenario. However, when available water would be diverted to refill Banks Lake. As a result, the loss of water diverted in the spring under the normal scenario would increase the amount of drawdown of

Banks Lake during all but the wettest spring months. Since additional water would not be diverted in the spring months except during the wetter water years, the amount of diversion the following October would be increased to 2,700 cfs. Under this scenario, the water that would normally be diverted in the spring would remain in the Columbia River system. This change in flow between the scenarios is less the 648 cfs. The impact to TDG below Grand Coulee from this slight change in flow between spring diversions and limited spring diversion is likely not measurable.

There is no difference between Alternative 4B and the Limited Spring Diversion Scenario of Alternative 4B. Both scenarios have the same maximum summer drawdown depth across all water year types. The model indicated no statistical difference with the No Action Alternative and Alternatives 2B or 3B. Consequently, the drafts for the Alternative 4B diversions with the Limited Spring Diversion Scenario should have no statistical difference from the No Action Alternative. No changes are expected for dissolved oxygen for Alternative 4B with and without the diversions with the Limited Spring Diversion Scenario as well.

4.4.9 Mitigation

No water quality mitigation measures are recommended for Lake Roosevelt, the Columbia River downstream of Grand Coulee Dam, or the CBP irrigation network for any of the action alternatives because the long-term impacts are not considered significant. The long-term impacts to Banks Lake as shown in the CE-QUAL-W2 model are not considered significantly different from the No Action Alternative.

4.5 Water Rights

The water rights issues associated with the Odessa Special Study alternatives consist of two primary areas of concern:

- Surface water withdrawal and storage rights related to the Columbia River
- Changing from State-based groundwater rights to surface water delivered by the CBP under Reclamation’s Federal reserved water rights

No short– or long–term impacts to water rights are anticipated for any of the alternatives. If surface irrigation water is provided, existing groundwater rights would be eclipsed by a superseding permit that provides new rules for use. It does not change the groundwater water right, but essentially does not allow its use except in temporary emergencies, as described below.

4.5.1 Methods and Assumptions

Anticipated impacts to water rights were evaluated in this Final EIS by reviewing existing laws pertaining to water rights (both codified and in case law), interviews conducted with Reclamation and Ecology, and review of GIS databases of existing water rights and claims pertaining to the Columbia River and Odessa Subarea.

4.5.1.1 Impact Indicators and Significance Criteria

The indicators used for analyzing adverse impacts associated with the Study alternatives focus on:

- The validity of the required water rights.
- The extent to which senior water rights would be impaired.
- The extent to which existing certificates or permits would be altered.
- The ability to withdraw groundwater under currently held rights would be reduced.

These indicators have been organized into two main study areas: the Columbia River and Lake Roosevelt, and water rights potentially impacted by changes in the source of irrigation water available in the Odessa Subarea. Table 4-37 lists the significance criteria for each of the study indicators.

Table 4-37. Water rights impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Columbia River and Lake Roosevelt Tribal Water Rights	If minimum reservoir levels during the irrigation season make access infeasible.
Loss or curtailment of groundwater rights	If any operations would no longer be functional or possible because of a loss of groundwater rights, this would represent a significant impact.

4.5.1.2 Impact Analysis Methods

Effects on water rights that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Columbia River and Lake Roosevelt Water Rights

To evaluate the anticipated impacts to water rights in Lake Roosevelt, it is assumed that intakes currently in use are designed to withdraw water at all periods of the irrigation season during normal operations. Although water could remain available within Lake Roosevelt under each of the action alternatives, the ability to feasibly access the water could be impacted (e.g., pumping or intake locations). This analysis compares modeled water levels under each action alternative to the No Action Alternative during the representative wet, average, dry, and drought years.

Odessa Subarea

Impacts to groundwater rights in the Odessa Subarea were evaluated through review of State water law, interviews with Ecology staff, and spot review of existing permit conditions. Determination of specific rights that would be required to convert would require a detailed review of more than 450 permits, certificates, and change documents, and because of the variability in the language in each permit, such an analysis would remain speculative.

Therefore, to estimate the approximate quantity of water rights that would be required to revert to standby or reserve rights, GIS analysis was conducted using databases provided to Reclamation by Ecology that associate water rights documents with individual irrigated agricultural fields in the Odessa Subarea. All fields associated with a water rights document with a priority date of 1967 or later were assumed to be conditioned in part on the delivery of CBP water.

4.5.1.3 Impact Analysis Assumptions

Certain broadly applicable legal requirements are described in Chapter 5, Consultation and Coordination. Other State and Federal legal requirements applicable to water rights were described in Section 3.5 – *Water Rights* for the affected environment. No specific BMPs have been developed to address concerns associated with water rights.

4.5.2 Alternative 1: No Action Alternative

4.5.2.1 Short-term Impacts

No short-term impacts are anticipated because under the No Action Alternative no curtailment of groundwater pumping or loss of water rights is likely during the short term.

4.5.2.2 Long-term Impacts

Under the No Action Alternative, the likelihood is high that groundwater levels would be drawn down to the point where it would be economically infeasible for many irrigators to withdraw that water. However, because of provisions in the RCW that allow rights to revert to standby or reserve rights, existing groundwater rights in the Odessa Subarea would not be impacted. These rules require that water right holders choosing not to exercise a water right provide written notice to Ecology, that reductions or non-use be the result of certain conditions such as unavailability of water or conservation practices, and that withdrawal facilities be maintained in good operating condition. The RCW includes provisions that allow Ecology to enforce priority rules to protect senior groundwater right holders.

However, because of limited recharge to the lower aquifers, such protective measures would likely not prolong the duration where pumping remains feasible.

4.5.3 Alternative 2A: Partial—Banks

4.5.3.1 Short-term Impacts

No short-term impacts to water rights are anticipated for this or any of the other action alternatives.

4.5.3.2 Long-term Impacts

Columbia River and Lake Roosevelt Water Rights

Water required for the proposed replacement of groundwater irrigation supply is already withdrawn from appropriation by the CBP and has an existing water right; however, a secondary use permit would be required to use the withdrawn water. No significant impacts would be associated with the exercise of the existing water right. This alternative would result in additional drawdowns of storage from Banks Lake where there are no competing senior water rights. Therefore, no water rights would be affected at Banks Lake.

Odessa Subarea

The State does not have legal authority to shut down groundwater wells at this time. The presumption is that the authorizing legislation for construction of the Odessa Subarea Special Study would include such authority. At this time, the State can only require that the wells go on standby status.

Within the Odessa Subarea, approximately 45,000 acres (44 percent of the groundwater irrigated area within the Study Area) would have their groundwater rights revert to standby rights for temporary emergency use only. If there was interruption in the surface water supply from the Federal system, this would be considered an emergency and groundwater wells could be used on a temporary basis during this period.

The primary impact of Alternative 2A: Partial—Banks would be involuntary conversion to surface water required by provisions in existing groundwater permits and certificates. However, it appears that the majority of permits issued or amended after development of the Odessa Subarea in 1967 contain some form of provision that condition the groundwater rights on delivery of surface water through the CBP. Under these conditions, if surface irrigation water is provided, existing groundwater rights would be eclipsed by a superseding permit that provides new rules for use. It does not change the groundwater water right, but essentially does not allow its use. This would not be considered a significant impact.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to water rights are anticipated from the Limited Spring Diversion Scenario.

4.5.4 Alternative 2B: Partial—Banks + FDR

Short-term impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.5.4.1 Long–term Impacts

Columbia River and Lake Roosevelt Water Rights

Water required for the proposed replacement of groundwater irrigation supply is already withdrawn from appropriation by the CBP and has an existing water right; however, a secondary use permit would be required to use the withdrawn water. Under normal operations during average to wet years, Lake Roosevelt is typically drafted deeper (19 to 82 feet below full pool elevation) early in the irrigation season. According to the reservoir modeling, Alternative 2B: Partial—Banks + FDR would not increase these early season drawdowns compared to the No Action Alternative. Thus, there would be no impact to senior water rights.

Odessa Subarea

Impacts within the Odessa Subarea would be the same as those described for Alternative 2A: Partial—Banks.

4.5.5 Alternative 3A: Full—Banks

Short-term would be the same as those described for Alternative 2A: Partial—Banks.

4.5.5.1 Long-term Impacts

Columbia River and Lake Roosevelt Water Rights

Long-term impacts related to the Columbia River and Lake Roosevelt water rights would be the same as Alternative 2A: Partial—Banks.

Odessa Subarea

Within the Odessa Subarea, approximately 76,000 acres (74 percent of the groundwater irrigated area within the Study Area) would have groundwater rights that revert to standby rights for temporary emergency use only. If there was interruption in supply from the Federal system, this would be considered an emergency and groundwater wells could be used on a temporary basis during this period.

The primary impact of Alternative 3A: Full—Banks would be involuntary conversion to surface water required by provisions in existing groundwater permits and certificates. However, as previously stated, the majority of permits contain a provision that conditions the groundwater rights on delivery of surface water through the CBP. As is the case with Alternative 2A, under these conditions, if surface irrigation water is provided, existing groundwater rights would be eclipsed by a superseding permit that provides new rules for use. It does not change the groundwater water right, but essentially does not allow its use. This would not be considered a significant impact.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to water rights are anticipated from the Limited Spring Diversion Scenario.

4.5.6 Alternative 3B: Full—Banks + FDR

Short-term impacts would be the same as those described for Alternative 2A: Partial—Banks.

4.5.6.1 Long-term Impacts

Columbia River and Lake Roosevelt Water Rights

Long-term impacts related to the Columbia River and Lake Roosevelt water rights would be the same as Alternative 2B: Partial—Banks + FDR. According to the reservoir modeling, Alternative 3B: Full—Banks + FDR would not increase these early season drawdowns compared to the No Action Alternative. Thus, there would be no impact on existing water rights.

Odessa Subarea

Impacts within the Odessa Subarea would be the same as those described for Alternative 3A, Full—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to water rights are anticipated from the Limited Spring Diversion Scenario.

4.5.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

Short-term impacts would be the same as those described for Alternative 2A: Partial—Banks.

4.5.7.1 Long-term Impacts

Columbia River and Lake Roosevelt Water Rights

Long-term impacts related to the Columbia River and Lake Roosevelt water rights would be the same as Alternative 2A: Partial—Banks.

Odessa Subarea

Within the Odessa Subarea, approximately 43,976 acres (63 percent of the groundwater irrigated area within the Study Area) would have groundwater rights that revert to standby rights for temporary emergency use only. If there was interruption in the surface water supply from the Federal system, this would be considered an emergency and groundwater wells could be used on a temporary basis during this period.

The primary impact of Alternative 4A: Modified Partial—Banks (Preferred Alternative) would be involuntary conversion to surface water required by provisions in existing groundwater permits and certificates. However, as previously stated, the majority of permits contain a provision that conditions the groundwater rights on delivery of surface water through the CBP. As is the case with Alternative 2A: Partial—Banks, under these conditions, if surface irrigation water is provided, existing groundwater rights would be eclipsed by a superseding permit that provides new rules for use. It does not change the groundwater water right, but essentially does not allow its use. This would not be considered a significant impact.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to water rights are anticipated from the Limited Spring Diversion Scenario.

4.5.8 Alternative 4B: Modified Partial—Banks + FDR

Short–term impacts would be the same as those described for Alternative 2A: Partial—Banks.

4.5.8.1 Long-term Impacts

Columbia River and Lake Roosevelt Water Rights

Water required for the proposed replacement of groundwater irrigation supply is already withdrawn from appropriation by the CBP and has an existing water right; however, a secondary use permit would be required to use the withdrawn water. Under normal operations during average to wet years, Lake Roosevelt is typically drafted deeper (19 to 82 feet below full pool elevation) early in the irrigation season. Thus, there would be no impact on existing water rights.

Odessa Subarea

Impacts within the Odessa Subarea would be the same as those described for Alternative 4A, Modified Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to water rights are anticipated from the Limited Spring Diversion Scenario.

4.5.9 Mitigation

No mitigation is proposed.

4.6 Geology

The geologic setting of the Study Area has a major influence on the topography, groundwater occurrence, erosion potential, and availability of resources to construct the facilities associated with the Study alternatives. The No Action Alternative would have no impact on geologic resources because no new facilities would be constructed.

Some geologic resources would be committed to build the facilities proposed in the action alternatives. Materials such as steel, concrete, durable rock for aggregate, various earthfill materials to construct embankments, rock for riprap slope protection, and petroleum products would be consumed during the modification of the East Low Canal or construction of the East High Canal and Black Rock Branch Canal, but excess spoil materials would be generated during excavation. Construction of the Black Rock Coulee Reregulating Reservoir Dam would require earthen materials, but borrow materials are anticipated to come from within the reservoir inundation areas. Impacts associated with the depletion of geologic resources are anticipated to be minimal for all action alternatives.

Geologic hazards, such as earthquakes, volcanic eruptions, landslides, and subsidence, are unlikely to affect the proposed facilities because of the stability of the geologic terrain underlying the Study Area. Geologic hazards are anticipated to have no impact under any of the action alternatives.

Unique geologic features have not been identified during preliminary geologic site investigations, so the action alternatives are anticipated to have no impact on those features.

4.6.1 Methods and Assumptions

4.6.1.1 Impact Indicators and Significance Criteria

Table 4-38 presents impact indicators and significance criteria for geological resources in the Study Area.

Table 4-38. Study area geological resources impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Commitment of geologic resources	Depletion of material for the construction of facilities would be considered significant.
Geologic hazards	High potential for a geologic hazard that could impact a proposed facility would be considered significant.
Unique geologic features	Loss of unique features because of construction of facilities would be considered significant.

Impacts could also include reservoir erosion, undercutting, and sedimentation at the proposed reservoirs. The proposed reservoir areas were evaluated for potential soil erosion and sedimentation at reservoir rims by examining erosion potential and thickness of soils. Because reservoir rim erosion is primarily a soil erosion issue, this potential impact is discussed in Section 4.7 – *Soils*.

4.6.1.2 Impact Analysis Methods

Changes in geology that would occur under each of the action alternatives are compared against the current conditions within the Study Area. Preliminary geologic site investigations have been conducted by Reclamation to identify appropriate construction materials to build the dams, canals, and associated facilities. Comparison of the findings from those investigations with anticipated material quantities needed to construct the facilities were used to estimate the impact of depleted geologic resources.

Geologic hazards that could potentially impact the proposed facilities associated with the action alternatives include earthquakes, volcanic eruptions, landslides, and subsidence. However, the geologic terrain that underlies the Study Area is generally low topographic relief and not susceptible to landslides, underlain by stable soils and bedrock, not underlain by active faults that could pose a seismic hazard, and is a large distance from active volcanoes. Therefore, no geologic hazards are anticipated to impact or influence construction or operations, and thus are not considered further in this impact analysis.

Preliminary geologic site investigations have not revealed unique geologic features, so impacts to those features are not considered significant and not considered further in this impact analysis.

4.6.1.3 Impact Analysis Assumptions

Broadly, applicable legal requirements are described in Chapter 5 – *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all regulations would be followed, along with the BMPs listed in Section 4.31 – *Environmental Commitments*.

Legal Requirements and BMPs for Geologic Resources

To protect resources and ensure that safe working conditions are maintained, the State requires permits for the development or rock quarries and borrow material pits. Dam construction for the reservoirs would be required to adhere to Ecology dam safety guidelines.

BMPs to limit construction impacts would include designing facilities to minimize disturbance, using local materials for construction to minimize impacts beyond the reservoir, and designing gravel pits and rock quarries with stable side slopes to ensure safety and minimize erosion, as described in Section 4.31 – *Environmental Commitments*.

4.6.2 Alternative 1: No Action Alternative

4.6.2.1 Short-term Impacts

No short-term impacts are anticipated because no new facilities would be constructed under this alternative.

4.6.2.2 Long-term Impacts

No long-term impacts would occur under the No Action Alternative.

4.6.3 Alternative 2A: Partial—Banks

4.6.3.1 Short-term Impacts

No short-term impacts to geologic resources resulting from canal expansion or extension are anticipated.

4.6.3.2 Long-term Impacts

Depletion of geologic resources is not expected to be an issue. Long–term impacts would include permanent use of non-replaceable resources for expansion (43.3 miles) and extension (2.1 miles) of the East Low Canal and construction of the associated facilities. These materials would include steel, concrete, durable rock for aggregate, various earthfill materials to construct embankments, rock for riprap slope protection, and petroleum products. The canal excavations would actually generate an excess of spoil materials, therefore impacts because of depletion of resources are considered minimal. No other long-term geologic impacts are anticipated.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to geology are anticipated from the Limited Spring Diversion Scenario.

4.6.4 Alternative 2B: Partial—Banks + FDR

Short-term and long-term impacts would be the same as Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to geology are anticipated from the Limited Spring Diversion Scenario.

4.6.5 Alternative 3A: Full—Banks

4.6.5.1 Short-term Impacts

In addition to the impacts of Alternative 2A: Partial—Banks, constructing the East High Canal, Black Rock Branch Canal, and the Black Rock Coulee Reregulating Reservoir and associated facilities would require clearing and grubbing the canal and dam footprints, excavating the canals and dam abutments, and excavating and hauling materials to build the canals, dam and facilities. Minor impacts on geology are anticipated.

4.6.5.2 Long-term Impacts

Long-term minimal impacts from canal rehabilitation and construction would include permanent use of non–replaceable resources and disturbance of the canal alignment, as described under Alternative 2A: Partial—Banks. In addition, similar impacts would occur because of new construction of the East High Canal and the Black Rock Branch Canal.

Much of the borrow materials would be taken from the proposed Black Rock Coulee Reregulating Reservoir area, which would later be flooded. Construction materials are not anticipated to be in short supply. Fill materials for dam construction would be obtained from within the proposed reservoir inundation area and the surface of the plateau immediately east of the proposed reservoir. Stockpile areas would be located in the proposed reservoir area. Therefore, when the reservoir is full, the impact of the excavations would be inundated annually and impacts would be minimal.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to geology are anticipated from the Limited Spring Diversion Scenario.

4.6.6 Alternative 3B: Full—Banks + FDR

Short-term and long-term impacts would be the same as Alternative 3A: Full—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to geology are anticipated from the Limited Spring Diversion Scenario.

4.6.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

4.6.7.1 Short-term Impacts

No short-term impacts to geologic resources resulting from canal expansion are anticipated.

4.6.7.2 Long-term Impacts

Depletion of geologic resources is not expected to be an issue. Long–term impacts would include permanent use of non–replaceable resources for expansion (43.3 miles) of the East Low Canal and construction of the associated facilities. These materials would include steel, concrete, durable rock for aggregate, various earthfill materials to construct embankments, rock for riprap slope protection, and petroleum products. The canal excavations would actually generate an excess of spoil materials, therefore impacts because of depletion of resources are considered minimal. No other long–term geologic impacts are anticipated.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to geology are anticipated from the Limited Spring Diversion Scenario.

4.6.8 Alternative 4B: Modified Partial—Banks + FDR

Short-term and long-term impacts would be the same as Alternative 4A: Modified Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to geology are anticipated from the Limited Spring Diversion Scenario.

4.6.9 Mitigation

No mitigation is proposed.

4.7 Soils

Impacts to soil productivity in the Study Area would result from new facilities that would take current land out of production or construction activities that could increase erosion and compaction of soils.

Under the No Action Alternative, no short–term impacts to soils would occur. However, long-term impacts would occur under the No Action Alternative, specifically related to declining groundwater quality and supplies and a shift from irrigated farmland to dryland farming. These impacts include a loss of productivity and loss of prime farmland classification for soil classified as prime–if irrigated and an increase in long-term erosion rates. These impacts could not be quantified due to the difficulty in projecting rates of groundwater supply reduction and groundwater quality degradation.

Soil productivity and crop yields may continue to decline in parts of the Study Area under the No Action Alternative due to soil sodicity (causing impaired soil structure and infiltration) from disproportionately high sodium in groundwater used for irrigation. Additional decline in crop yields and shifts away from the more profitable but salt sensitive crops could occur under the No Action Alternative due to increasing groundwater salinity over time. Higher quality surface water (with much lower sodium and salinity) that would be provided under the partial and full replacement alternatives would likely reverse any downward trends in productivity or yield over the course of a few cropping cycles.

Short–term impacts to soils from erosion and compaction relative to construction activities would occur under all of the action alternatives. The extent of these impacts would be greater under the full replacement alternatives because of the larger construction footprint. Erosion control legal requirements, BMPs, and mitigation measures would minimize offsite movement of sediment until new vegetation becomes established on temporarily disturbed lands or these lands are put back into production following construction. Considering legal requirements, BMPs, and required mitigation measures, only minimal short–term impacts to soils would occur under any of the action alternatives.

Long–term impacts to soils due to construction of permanent facilities would occur under all of the action alternatives. Prime farmland, State–important farmland, and unique farmland would also be permanently taken out of production under all of the action alternatives. The extent of the impacts would vary for the action alternatives, with more impact occurring under the full replacement alternatives. Implementation of the legal requirements, proposed BMPs, and required mitigation measures would minimize long–term impacts to farmlands.

4.7.1 Methods and Assumptions

4.7.1.1 Impact Indicators and Significance Criteria

Soils over much of the Study Area are productive when irrigated and support the agricultural base of the region. Loss of productive soil acreage or topsoil because of construction or erosion is a concern. Loss of productive soil acreage by conversion from irrigated to dryland farming due to diminishing groundwater supply is also a concern. Table 4-39 presents the resource indicators and significance criteria that have been identified for soils.

Table 4-39. Soils resources impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Farmland Protection Policy Act	Impacts would be significant if: Use of land is changed from farmland to an agricultural non–compatible use. Proposed alternatives encourage non–agricultural uses. Project facilities impact on–farm improvements and protected soils.

4.7.1.2 Impact Analysis Methods

Changes in soils or soil productivity that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Specific activities and methods that were used to identify Study Area soils and evaluate anticipated impacts of the action alternatives on soils and farmland are as follows:

- Site–specific spatial and soil characteristic data, including the Soil Survey

Geographic data set, were obtained from web sites, reports, and geographic information system (GIS) layers, and were then reviewed.

- The types and extent of soils that would be impacted by construction and operation of Odessa Study Area facilities were identified by using the information described above, by using GIS analysis of facility footprints, and by identifying the nature of expected construction and operation that would result in impacts on soils.
- Constraints of soil characteristics within facility construction (temporary impact) and operation (permanent impact) footprints were identified. The extent of soils with constraints that would impede revegetation (e.g., compaction) or result in excessive erosion was quantified.
- The extent of soils with special farmland protections within facility construction (temporary impact) and operation (permanent impact) footprints was quantified. These include State–important, unique, and prime–if irrigated farmland. Because not all impacted acreage was classified for irrigation status, all prime–if irrigated farmland impacted by facility construction and operation was quantified and presented

For the No Action Alternative, methods that were used to evaluate anticipated impacts on soils and farmland are as follows:

- Changes in erosion susceptibility on currently irrigated lands were considered.
- The potential impacts of soil sodicity and salinity were assessed because of substantial differences in the chemical characteristics of the groundwater currently used for irrigation and the surface water that would be used under the partial and full replacement alternatives.
- Impacts to prime–if irrigated farmland were considered.

4.7.1.3 Impact Analysis Assumptions

Broadly, applicable legal requirements are described in Chapter 5, Consultation and Coordination. For the alternative impact analysis, it is assumed that all regulations would be followed, along with the BMPs listed in Section 4.31 – *Environmental Commitments*. After environmental impacts are determined, mitigation measures are applied to compensate for some or all remaining adverse impacts, which are described with the action alternatives and summarized along with the BMPs in Section 4.31 – *Environmental Commitments.*

Legal Requirements and BMPs for Soils

The Farmland Protection Policy Act (FPPA) is intended to minimize the impact Federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. The action alternatives comply with FPPA because they do not change the use of land from farmland to uses that are not compatible with agriculture, as described in Chapter 5 – *Consultation and Coordination*. Furthermore, the purpose of the action alternatives is to sustain and protect productive farmland from the loss of productivity due to diminishing groundwater supplies under the No Action Alternative.

BMPs for reducing impacts on soils are similar to those intended to protect surface water quantity and quality, such as limiting the amount of land disturbed at any one time and restoring vegetation quickly. Additional BMPs, such as using temporary erosion control structures and stockpiling topsoil for re–use, are listed in Section 4.31 – *Environmental Commitments*.

4.7.2 Alternative 1: No Action Alternative

4.7.2.1 Short–term Impacts

No short–term impacts are anticipated because no new facilities would be constructed under this alternative.

4.7.2.2 Long–term Impacts

The potential for soil erosion would be greatest on formerly irrigated lands that are converted to dryland farming. As groundwater–supplied irrigation water quantity and quality declines, irrigated land would be converted to dryland farming. Lands that are dry–farmed have a higher probability of losing soil to wind and water erosion than irrigated cropland because dryland wheat fields would be fallowed during the summer every other year. Increased rates of erosion could impact surface water quality as more sediment is deposited into local waterways during spring run-off events due to snow melt, or periodic heavy rains during the summer or fall.

Under the No Action Alternative, groundwater would continue to be delivered and used for irrigation in locations where it was available. Soil sodicity from disproportionately high sodium in groundwater is already a problem for some irrigated lands within the Study Area, where effects such as impaired soil structure, decreased infiltration, and reduced crop yields have been documented. Groundwater salinity levels are also high enough in some wells to reduce crop yields in salt sensitive crops such as peas and potatoes. Soil salinity and sodicity problems are particularly prevalent where available natural precipitation and applied irrigation water are of insufficient quantities to provide leaching of soils to maintain soil structure and infiltration capacity. If water supply is not sufficient to provide for leaching fractions to counter soil salinity conditions, cropping may shift to crops that are more tolerant of salinity conditions and lower water use crops such as irrigated wheat.

Currently, an unknown number of growers are applying soil amendments to maintain adequate soil infiltration and surface soil structure when using sodic irrigation water. These practices would continue under the No Action Alternative. Based on the distribution of groundwater with relatively high sodium across the Study Area (including the number of wells with an SAR greater than 6), it is estimated that at least one–third of the lands irrigated with groundwater are experiencing problems that require special soils management to maintain productivity. The need to apply soil amendments to maintain land in production would likely become more widespread in the future if continued pumping increases use of deeper, older groundwater of higher sodicity. Even with these practices, growers in the Study Area have reported reduced yields for irrigated wheat, corn, potatoes, and bluegrass seed due to the effects of sodic surface soils resulting from irrigation with groundwater.

Although controlled experiment data are not available, growers interviewed indicated that dryland wheat yields would likely be reduced as they have been under irrigation for lands previously irrigated with high SAR groundwater. Growers also indicated that the profit margins from dryland wheat production in this area would not support the additional costs of soil amendments to control soil sodicity (Gimmestad 2010). Therefore, yields could be reduced for a long period following the transition to dryland wheat until natural rainfall driven leaching could sufficiently lower sodium levels in surface soils to eliminate surface soil structure problems.

4.7.3 Alternative 2A: Partial—Banks

4.7.3.1 Short–term Impacts

Erosion Potential

Lands subject to soil and wind erosion would be exposed to these impacts during construction. Erosion is the result of the detachment and movement of soil particles. Erosion leads to the loss of soil productivity as nutrient rich topsoil horizons are lost and surface horizons change. Factors such as soil texture, surface roughness, vegetative cover, slope length, percent slope, management practices, and rainfall all influence the susceptibility of a soil to erosion. Loose, bare soils on moderate to steep slopes are prone to water erosion during storm events. Locations subject to strong winds and with sparse vegetative cover can experience wind–induced erosion if the soils are silty or composed of fine sands. Approximately 3,255 acres of soil susceptible to wind or water erosion would be temporarily cleared during construction (Table 4-40). Application of erosion control BMPs would minimize offsite movement of sediment until new vegetation becomes established on temporarily disturbed lands. Existing farmland would be put back into production following construction once facilities (mostly pipelines) have been installed.

Table 4-40. Permanent and temporary soil impacts resulting from implementation of partial and modified partial replacement action alternatives.

Impact Type	Alternatives/Impacted Acres over 10 Years							
	2A: Partial—Banks		2B: Partial—Banks + FDR		4A: Modified Partial—Banks		4B: Modified Partial—Banks + FDR	
	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary
Wind or water erosion	566	3,255	566	3,255	469	2,429	469	2,429
Compaction	0	0	0	0	0	0	0	0
Good or very good productivity	160	230	160	230	160	332	160	332
Prime farmland, if irrigated	465	2,668	465	2,668	382	2,149	382	2,149
State–important farmland	247	981	247	981	241	1,161	241	1,161
Note: All impacts would occur incrementally over an estimated 10–year construction period.								

Approximately 2,668 acres of prime–if irrigated land, 981 acres of state–important land, and 60 acres of farmland would be temporarily taken out of production. This loss of production would only occur during the construction period. This land would most likely be placed back into agricultural production following completion of the construction work.

Under the requirements of the FPPA, the impact is classified as significant. However, meeting legal requirements would reduce it to less than significant. For the most part, construction within farmed areas is planned to occur outside of the irrigation season, further avoiding disruption of active farming.

4.7.3.2 Long–term Impacts

Erosion Potential

Approximately 566 acres of soil susceptible to wind or water erosion would be permanently impacted (Table 4-40). However, these areas would lie under facilities for the most part. The small areas not under a permanent facility would be revegetated, thereby avoiding offsite movement of sediment and avoiding potentially significant impacts.

Special Status Soil and Soil Productivity Loss

Approximately 465 acres of prime–if irrigated farmland, 247 acres of state–important farmland, and 49 acres of unique farmland[6], respectively, would be permanently taken out of production (Table 4-40). Soil productivity would be lost when productive land is permanently removed from the agricultural land base. For purposes of this analysis,

[6] "Unique" farmland refers to the heavy volcanic soil that produces potatoes that can be stored longer and allow for processing plants to operate year round (Voigt 2012).

productive land is that with a cation exchange capacity greater than 10. Cation exchange capacity is a measure of how easily soil–adsorbed cations needed for plant growth are made available. Based on the soil limitations analysis, 160 acres of productive land would be permanently lost.

Because of the requirement for irrigation in association with soil productivity and the limited amount of land taken out of production relative to that available in the Study Area, only minimal long–term impacts to farmlands are anticipated to occur. The majority of the Study Area has land use protections and contains prime–if irrigated, unique, or statewide soils of importance. All farmlands in the Study Area are suitable for protection under the FPPA for this and all other action alternatives. Farmlands in the Study Area potentially impacted by this alternative and all other action alternatives are only considered important and productive when irrigated. Under FPPA, the impact assessment is required to assume full implementation of the mitigation measures outlined in Section 4.7.3.3 – *Mitigation*.

Photograph 4-2. Farmlands in the Study Area are only considered important and productive when irrigated.

Salinity and Sodicity Effects on Soil Productivity and Crop Yield

Under Alternative 2A: Partial—Banks, surface water of substantially higher quality (i.e., lower SAR) than current groundwater sources would be delivered to irrigated lands. Evaluation of the primary crops grown within the Study Area and the surface water quality suggests that no special sodicity management practices would be required under this alternative. On lands that have received high SAR groundwater in the past and that have required soil amendments to manage infiltration problems, soil amendments would likely be needed for at least one full crop rotation following the transition to higher quality surface water. Over time as sodium is flushed out of surface soils with higher quality surface water, soil amendment applications could be curtailed thereby reducing the soil management costs relative to the No Action Alternative. Based on grower interviews, yields of some crops under full irrigation would be improved without the sodium impacts currently experienced using high SAR groundwater.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to soils are anticipated from the Limited Spring Diversion Scenario.

4.7.4 Alternative 2B: Partial—Banks + FDR

Short–term and long-term impacts would be the same as Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to soils are anticipated from the Limited Spring Diversion Scenario.

4.7.5 Alternative 3A: Full—Banks

Improvements in soil productivity and crop yield would be the same as Alternative 2A: Partial—Banks.

4.7.5.1 Short–term Impacts

Approximately 6,250 acres of soil susceptible to wind or water erosion would be temporarily cleared during construction over 10 years (Table 4-41). Application of erosion control BMPs would minimize offsite movement of sediment until new vegetation becomes established. Existing farmland would be put back into production following construction.

Table 4-41. Permanent and temporary soil impacts resulting from implementation of full replacement action alternatives

Impact Type	3A: Full—Banks		3B: Full—Banks + FDR	
	Permanent	Temporary	Permanent	Temporary
Wind or water erosion	3,780	6,250	3,780	6,250
Compaction	245	17	245	17
Good or very good productivity	5,279	2,889	5,279	2,889
Prime farmland, if irrigated	1,274	4,413	1,274	4,413
State–important farmland	1,357	3,113	1,357	3,113

Approximately 17 acres of soils susceptible to compaction would be temporarily impacted by construction. If growth–limiting compaction occurs because of equipment traffic, mitigation measures to reduce compaction would be implemented.

Approximately 4,413 acres of prime–if irrigated, 3,113 acres of state–important, and 776 acres of unique farmland would be would be temporarily taken out of production (Table 4-41). This loss of production would only occur during the construction period and would be spread over 10 years. Existing farmland would most likely be placed back into agricultural production following completion of the construction work.

Implementation of BMPs and mitigation measures, in accordance with FPPA, would reduce short–term impacts to non–significance.

4.7.5.2 Long–term Impacts

Impacts associated with Alternative 3A: Full—Banks would include all the impacts associated with Alternative 2A: Partial—Banks, plus impacts associated with implementation of the full replacement alternatives.

Erosion Potential

Approximately 3,780 acres of soil susceptible to wind or water erosion would be permanently impacted from the construction and operation of Alternative 3A: Full—Banks (Table 4-41). However, these areas would be under facilities for the most part. The small areas not under permanent facilities would be revegetated, thereby avoiding offsite movement of sediment.

Special Status Soil and Soil Productivity Loss

Approximately 1,274 acres of prime–if irrigated farmland, 1,357 acres of state–important farmland, and 691 acres of unique farmland, would be permanently taken out of production

(Table 4-41). Based on the soil limitations analysis, 5,279 acres of productive land would be permanently lost.

Same as Alternative 2A: Partial—Banks, with the implementation of the legal requirements, proposed BMP's, and mitigation measures in accordance with FPPA, no significant long–term impacts to farmlands are anticipated under this or any of the full replacement alternatives.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to soils are anticipated from the Limited Spring Diversion Scenario.

4.7.6 Alternative 3B: Full—Banks + FDR

Short–term and long–term impacts would be the same as Alternative 3A: Full—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to soils are anticipated from the Limited Spring Diversion Scenario.

4.7.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

Improvements in soil productivity and crop yield would be the same as Alternative 2A: Partial—Banks.

4.7.7.1 Short–term Impacts

Approximately 2,429 acres of soil susceptible to wind or water erosion would be temporarily cleared during construction over 10 years (Table 4-41). Application of erosion control BMPs would minimize offsite movement of sediment until new vegetation becomes established. Existing farmland would be put back into production following construction.

Approximately 2,149 acres of prime–if irrigated farmland, 1,161 acres of state–important farmland, and 187 acres of unique farmland would be temporarily taken out of production (Table 4-41). Based on the soil limitations analysis, 332 acres of productive land would be temporarily lost. This loss of production would only occur during the construction period and would be spread over 10 years. This land would most likely be placed back into agricultural production following completion of the construction work.

Implementation of BMPs and mitigation measures, in accordance with FPPA, would reduce short–term impacts to non–significance.

4.7.7.2 Long–term Impacts

Impacts associated with Alternative 4A: Full—Banks would include all the impacts associated with Alternative 2A: Partial—Banks, plus impacts associated with implementation of the full replacement alternatives.

Erosion Potential

Approximately 469 acres of soil susceptible to wind or water erosion would be permanently impacted from the construction and operation of Alternative 4A: Modified Partial—Banks (Preferred Alternative) (Table 4-40). However, these areas would be under facilities for the most part. The small areas not under a permanent facilities would be revegetated, thereby avoiding offsite movement of sediment.

Special Status Soil and Soil Productivity Loss

Approximately 382 acres of prime–if irrigated farmland, 241 acres of state–important farmland, and 49 acres of unique farmland, would be permanently taken out of production (Table 4-41). Based on the soil limitations analysis, 160 acres of productive land would be permanently lost.

Same as Alternative 2A: Partial—Banks, with the implementation of the legal requirements, proposed BMP's, and mitigation measures in accordance with FPPA, no significant long–term impacts to farmlands are anticipated under this or any of the full replacement alternatives.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to soils are anticipated from the Limited Spring Diversion Scenario.

4.7.8 Alternative 4B: Full—Banks + FDR

Short-term and long–term impacts would be the same as Alternative 4A: Modified Partial—Banks (Preferred Alternative).

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to soils are anticipated from the Limited Spring Diversion Scenario.

4.7.9 Mitigation

When soil becomes compacted because of construction activity, the compaction would be reduced through ripping followed by chaining or cultivation to break up large soil clods. Ripping is a common and effective method that would be used to reduce compaction. It breaks up soil, thereby encouraging root growth and water infiltration.

To reduce the potential for erosion, soil temporarily disturbed during construction would be revegetated as soon as construction activities have ended in a particular area. Areas that supported native vegetation before disturbance would be revegetated using native species as described in Section 4.8 – *Vegetation and Wetlands*.

Design improvements were implemented to minimize the amount of farmland acquisition. Design measures would include, but are not limited to, reducing the proposed width of facilities such as canals, or realigning the improvement to avoid agricultural lands. Lands with significant statewide value, such as prime farmland, would be avoided when feasible.

The Study is self–mitigating relative to the FPPA because it does not change the use of land from farmland to an agricultural non–compatible use, it does not encourage non–agricultural use, and the proposed structures are designed to improve and encourage agriculture.

The same mitigation measure would be applied to all action alternatives.

4.8 Vegetation and Wetlands

This section describes impacts to vegetation resources that would occur under the alternatives in two main categories: upland vegetation and wetland vegetation. Adverse impacts—many of which would be significant—would occur under all of the action alternatives.

Short–term adverse impacts related to construction activities would occur to both upland vegetation and wetland resources under all of the action alternatives. More extensive impacts would result from the full replacement alternatives because of the increased affected acreage.

Long–term impacts under all of the partial replacement alternatives would be significant relative to wetlands adjacent to the East Low Canal. Impacts to wetlands surrounding Banks Lake under the partial replacement alternatives would primarily result in a shift in community composition and not be significant. Long–term impacts under the modified partial replacement alternatives would be adverse to significant in respect to wetlands around Banks Lake and would range from shifts in community composition to reduced wetland size.

Long–term impacts under the full replacement alternatives would be similar to the partial replacement alternatives, but to a much greater extent. Impacts to native plant communities would be significant and include the area of the proposed Black Rock Coulee Reregulating

Reservoir and the East High and Black Rock canals. Significant impacts to State–listed rare or sensitive plant species would occur under the full replacement alternatives. Significant wetland impacts would occur adjacent to the East Low Canal under all alternatives, along the proposed East High Canal, and in the area of the proposed Black Rock Coulee Reregulating Reservoir for Alternatives 3A and 3B. Adverse to significant impacts to wetlands around Banks Lake would range from shifts in community composition to reduced wetland size.

4.8.1 Methods and Assumptions

4.8.1.1 Impact Indicators and Significance Criteria

The impact indicators and significance criteria for upland vegetation and wetlands are listed in Table 4-42.

Table 4-42. Vegetation and wetlands impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Fragmentation of native plant communities	Fragmentation of high quality native plant communities would be significant
Impacts on special status plants	Loss of any special status plants would be significant
Habitat restoration	Failure of native plant community restoration efforts to meet established success criteria would be significant
Long–term loss of wetland area	Loss of wetland area would be significant
Long–term loss or degradation of wetland function	Loss of wetland function would be significant

4.8.1.2 Impact Analysis Methods

Changes in the extent or condition of native vegetation or wetlands that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Uplands

Uplands within the proposed facility footprints and construction easements were quantified by type and acreage using GIS. Rare plant surveys were conducted to gather information about the affected environment, as described in Section 3.8.1 – *Analysis Area and Methods*.

Wetlands

Wetlands within the proposed facility footprints were quantified by type, acreage, and functional category. To support the wetland impact analysis related to drawdowns at Lake

Roosevelt and Banks Lake, wetlands were quantified by acreage and functional category. Reservoir surface modeling conducted for the action alternatives projected monthly pool elevations and exceedance curves for affected reservoirs, showing drawdown patterns for all alternatives during modeled representative wet, average, dry, and drought years. The analysis indicated that wetlands and riparian communities at Lake Roosevelt would not be impacted under any of the action alternatives. Therefore, Lake Roosevelt is not discussed.

Several of the action alternatives would result in Banks Lake drawdowns that would be greater in both duration and extent than those evaluated in the Banks Lake Drawdown EIS (Reclamation 2004). Given the uncertainty of an analysis based only on countywide soil survey data, soil type data and soil moisture data were collected from wetland soils in representative soil types around Banks Lake during the 2009 summer drawdown.

Piezometers were installed at 17 locations to monitor the depth to standing water. With two exceptions, the bottoms of the piezometers were installed at an elevation corresponding to 10 feet below the normal full pool elevation of Banks Lake. The depth to the top of the saturated soil and the depth to groundwater were noted during installation when possible. Grab samples of the drill cuttings (soil) were periodically collected from each borehole (typically at 5 foot intervals, or at a notable lithologic changes) to assist in field and laboratory characterization of subsurface conditions. Depth to groundwater was measured every 10 days beginning on July 28 and continuing through September 30. This period covered the full drawdown and partial refill of Banks Lake reservoir. Monitoring was stopped after groundwater depths in the wetlands began to rise in response to initial refilling of Banks Lake.

Groundwater response to the reservoir drawdown was plotted for each monitored wetland. Typical macrophyte rooting depths were obtained from the literature and used to estimate the response of wetland vegetation to the proposed Banks Lake drawdown for each alternative.

Wetland Invasive Species

Field observations of invasive species on exposed reservoir banks were made during the September 2009 drawdown of Banks Lake. These observations were used to project anticipated conditions for the action alternatives.

4.8.1.3 Impact Analysis Assumptions

The following assumptions regarding the analysis of short– and long–term impacts were made for plant communities:

- The entire identified easement along linear facilities would be disturbed during construction. This includes a total width of 150 feet along the east side of the East Low Canal expansion, and 100 or 200 feet along distribution pipelines (depending on location and size of pipe needed).

- When rare plant surveys were conducted, pumping plants were planned to be constructed within the canal easement. If the pumping plants would be outside of the easement, additional surveys would need to be conducted.
- Impacts to plant communities during construction are considered short–term impacts because restoration can occur at those locations. However, restoration of native shrub-steppe habitats to pre–construction conditions would be difficult and would require 15 years or more. Adverse impacts that persist after remediation efforts are complete are considered long–term impacts.
- None of the action alternatives would impact wetland, riparian, or upland communities associated with Lake Roosevelt, as the lands that would be exposed by additional drawdown do not support any of these habitat types as discussed in Chapter 3. Therefore, Lake Roosevelt is not discussed.
- Reclamation has not observed aquatic weeds within drawdown areas of Banks Lake over a 20-year period. Observations conducted during the 2009 drawdown of Banks Lake confirmed that aquatic weeds are not present in the drawdown area. Based on these observations, aquatic weeds are not expected to spread or become established under any of the alternatives. Therefore, aquatic weeds are not discussed further.

Applicable legal requirements are described in Chapter 5 – *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all regulations would be followed, along with the BMPs listed in Section 4.31 – *Environmental Commitments*. After environmental impacts are determined, mitigation measures are applied to compensate for some or all remaining adverse impacts, which are described with the action alternatives and summarized along with the BMPs in Section 4.31 – *Environmental Commitments*.

Legal Requirements and BMPs for Vegetation and Wetland Resources

The State requires adherence to the State and Federal statutes intended to avoid or reduce weed expansion during and after construction, as well as to protect wetlands. These statutes and their general requirements are listed in Chapter 5, Consultation and Coordination.

The BMPs listed for surface water quantity and quality would help to minimize degradation of native upland, wetland, and riparian communities outside the rights–of–way. Further actions needed to minimize the spread of noxious weeds include finding and flagging noxious weed populations to keep vehicles from entering infested areas and to facilitate weed control efforts on disturbed lands during and after construction and revegetation. Other actions would include installation of sediment barriers, marking buffer areas and minimizing construction work around wetland and riparian areas, and seeding lands disturbed by pipeline work with native species following construction, as described in Section 4.31 – *Environmental Commitments*.

4.8.2 Alternative 1: No Action Alternative

4.8.2.1 Short–term Impacts

No short–term impacts are anticipated because no new facilities would be constructed under this alternative.

4.8.2.2 Long–term Impacts

There would be no additional long–term impacts to uplands or wetlands under the No Action Alternative.

4.8.3 Alternative 2A: Partial—Banks

4.8.3.1 Short–Term Impacts

Uplands

Construction impacts to shrub–steppe communities would occur during excavation for pipe laying and expansion of the East Low Canal. Direct short–term losses during pipeline construction are estimated as follows:

- 105 acres of sagebrush steppe
- 9 acres of steppe grassland
- 0.24 acres of scabland shrubland

Lands that would be impacted during construction, but that are not required for permanent facilities, are considered short–term impacts because restoration can occur at those locations.

However, restoration of native shrub-steppe habitats to pre–construction conditions would be difficult and would require 15 years or more.

The areas listed above would be reseeded to match pre–construction conditions. Lands with native vegetation impacted during construction would be seeded with local native species following construction with a goal of restoring the impacted community. Restoration or in–kind replacement on private lands would be subject to landowner approval. The success of reseeding depends on timing, precipitation, and many other factors. It is likely that many of the acres of native plant communities disturbed by pipelines would be invaded by weed species, including cheatgrass. If in–kind replacement cannot be done on private lands, another suitable site would be found.

Transmission line construction would include short–term impacts on 1,018 acres. Most of these lines are expected to be located along existing rights–of–way where lands have been previously disturbed.

No short–term direct or indirect impacts to populations of rare plants are expected under this alternative because none were found in areas that would be impacted.

Wetlands

This alternative would have short–term temporary construction impacts to 37.8 acres of the fringe of a palustrine emergent wetland (PEM) that lines the left (east) inner wall of the East Low Canal adverse impacts on wetland resources as follows:

The impacted PEM fringe wetlands, consisting mostly of reed canarygrass, are described as Category IV wetlands that provide low water quality, low hydrologic function, and moderate habitat function. These wetlands would be removed during construction activities associated with enlarging the East Low Canal. Reed canarygrass is a common invasive wetland species frequently found in disturbed wetland sites. These non–significant wetland impacts associated with widening the East Low Canal are considered short term, because the fringe wetland would reestablish in the same place following construction activities or flow disturbances. Adjacent to the East Low Canal, wetlands affected by temporary construction impacts would be seeded with local native wetland species following construction with a goal of restoring the impacted community.

4.8.3.2 Long–term Impacts

Uplands

Long–term significant impacts to upland plant communities south of I–90 would include 112 acres of shrub-steppe and 18 acres of steppe grassland required for expansion and extension of the East Low Canal. These losses cannot be replaced at the location of the impact because the canal would occupy these areas. There would be no impacts to uplands north of I–90. Pumping plants would not impact native upland communities.

Some short–term impacts to shrub-steppe communities that are restored after construction would persist for 15 years or more because of the difficulty or restoring these vegetation types to pre–construction conditions as previously described. Construction vehicles would likely spread weed seeds among construction sites if weeds are present in these areas. If weed infestations occur, Reclamation would implement ongoing weed control measures in accordance with county weed board requirements.

However, weed infestations would likely occur over a long period as an indirect result of construction disturbance. The difficulty of controlling weed infestations suggests that weeds would likely also be a problem in shrub-steppe communities adjacent to construction areas. When weeds become established in native communities, they lower diversity by out–competing native plants and they alter the structure, composition, and successional pathways of ecosystems (Harrod 2001). Weed infestations in shrub-steppe communities also make them more susceptible to large fires, which further degrade species diversity and habitat values for wildlife. All of the shub-steppe adjacent to the East Low Canal where it will be expanded has already been subject to weed infestation when the canal was originally constructed.

Wetlands

Long–term significant impacts to 1.0 acre of PEM wetlands are anticipated adjacent to the East Low Canal because of canal expansion.

Estimating potential littoral zone wetland impacts that would result from deeper and longer duration drawdowns at Banks Lake is a multi–step process that requires interpretation of several data sources. A few key highlights and the findings for each of the alternatives are presented as appropriate. In summary, no long–term impacts to wetland resources are anticipated surrounding Banks Lake.

Banks Lake surface water elevations and corresponding groundwater elevations measured during the 2009 annual drawdown are shown in Figure 4-21. The piezometer data represents conditions at the wetland/upland boundary and are considered a maximum effect of drawdown influence for all alternatives. Based on this data, water levels during average and dry water years would exceed the 3 foot rooting depth and capillary fringe threshold for an additional 7 days beyond current conditions (total of 37 days), as shown in Table 4-43.

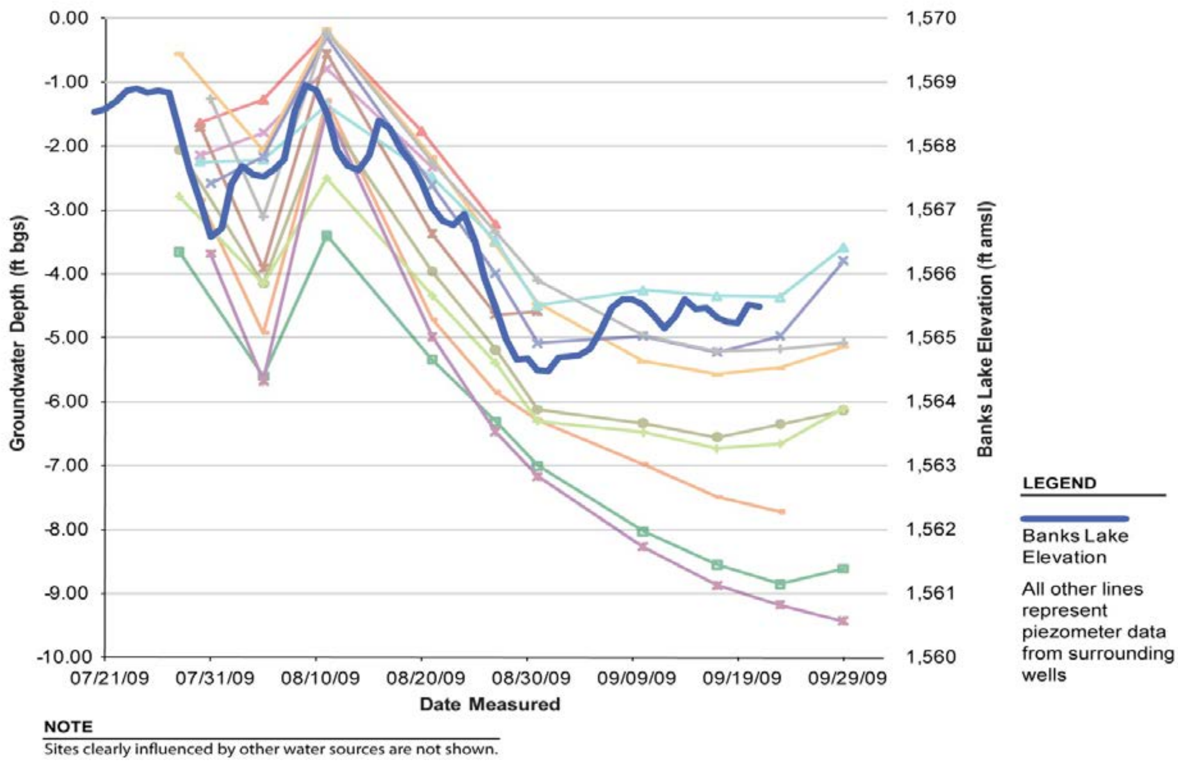


Figure 4-21. Groundwater elevations of Banks Lake fringe wetlands during August 2009 drawdown of the reservoir.

Table 4-43. Responses of wetland plants to groundwater drawdowns near Banks Lake in representative average and dry watershed conditions: partial replacement and modified partial replacement alternatives.

Alternative	Number of Days (on Average) the 3–foot rooting depth and capillary fringe threshold is exceeded		Plant Response and Notes
	Average Year	Dry Year	
No Action	30 days	30 days	Survival without stress
2A: Partial—Banks	37 days	37days	Survival without stress
2B: Partial—Banks + FDR	41 days	41 days	Survival without stress
4A: Modified Partial—Banks	37 days	65 days	Survival without stress for average years. Possible decrease in species diversity through favoring the most drought tolerant emergent species, or the reduction or elimination of subdominant emergent species that would not be as drought tolerant, depending on the number of years in a row that dry conditions persist.
4B: Modified Partial—Banks + FDR	37 days	45 days	Survival without stress for average years and probably also for dry years. Minor stress during dry years if dry conditions persist for many years.

How are Wetland Impacts Estimated at Banks Lake?

Three sets of data were used to estimate potential future impacts to wetlands at Banks Lake:

- Observations of current wetland conditions with a 5–foot annual drawdown in August.
- Results from the 2004 Banks Lake drawdown and studies conducted in anticipation of that event.
- Piezometer studies conducted during the 2009 annual drawdown, which show groundwater response to reservoir drawdown.

Within the Banks Lake Study Area, wetland plants are considered able to access soil moisture or groundwater to a depth of 3 feet below ground surface (bgs). This assumption is based on the approximate rooting depth of plants (2 feet bgs) and the approximate capillary fringe height of 1 foot above the groundwater level. The approximate rooting depths of dominant wetland species surrounding Banks Lake (bulrush species, cattail species, and Baltic rush) is approximated at 2 feet bgs. Cattail is expected to have an approximate root depth ranging from 12 to 14 inches bgs (Bays 2009; Kirkpatrick 2004, respectively), with 27 inch–long rhizomes (Gucker 2008). Bulrush species are expected to have a range of rooting depths from 14 to 23 inches (Kirkpatrick 2004; Bays 2009, respectively). Baltic rush, a dominant species on the west side of Banks Lake, has an approximate rooting depth range of 16 of 20 inches bgs (Hauser 2005; and Kirkpatrick 2004).

Observations of existing wetland conditions surrounding Banks Lake indicate that an August drawdown of 5 feet does not stress the existing vegetation in any community type identified. The existing wetland communities are adapted to the annual 5–foot drawdown during August. Based on recorded groundwater levels, field observations, approximate rooting depth of wetland plants, soil water holding capacity, and anticipated capillary fringe height, wetland communities around Banks Lake are considered to be able to access water to 3 feet bgs and are able to survive without apparent stress for the 30 days during which groundwater is about 5 feet bgs. This benchmark, which represents conditions under the No Action Alternative, is used for comparison throughout the action alternatives to determine impacts.

No long–term direct impacts to wetland resources at Banks Lake are anticipated under the drawdown regime for Alternative 2A: Partial—Banks. Banks Lake wetlands currently exist under an August 5 foot and 30–day drawdown regime (No Action Alternative), and do not exhibit stress under these conditions. Under Alternative 2A: Partial—Banks, wetlands surrounding Banks Lake are not anticipated to be negatively influenced because available soil moisture and groundwater would mimic current threshold conditions. The Alternative 2A: Partial—Banks drawdown regime would be temporally similar to current conditions, albeit deeper in August.

The following mitigation measures are intended to partially compensate for impacts that would not be avoided through adherence to legal requirements or BMPs.

Uplands

Actions that would be implemented to mitigate significant upland impacts include the following:

- Mitigation for impacts to rare, endangered and sensitive plants that may be impacted by project activities would be avoidance, where possible. Relocation of populations and minimization of impacts would be observed where avoidance is not possible. Finally, protection and enhancement of remaining populations would be employed where practicable.
- Construction staging areas would be located within the easement that would be disturbed during construction.
- To reduce long–term habitat alterations and weed encroachment, all temporarily disturbed areas that currently support native vegetation would be reseeded with a local native seed mix that includes native grasses, forbs, and sagebrush species acclimated to site conditions. Restoration goals, success criteria, and monitoring protocols would be developed in cooperation with WDFW. Monitoring would be conducted to measure progress toward meeting goals and determine the need for corrective actions.
- The amount and types of mitigation measures required to compensate for the permanent loss of about 130 acres of shrub-steppe and steppe grassland during expansion and extension of the East Low Canal would be developed to achieve a climax shrub-steepe/grassland site over time. Mitigation would include both restoration of degraded shrub–steppe areas as well as re–establishment of shrub–steppe on sites that formerly supported these vegetation types. Potential locations to implement these mitigation measures have not been identified.
- Weed inventory and weed control of all disturbed lands would be implemented in accordance with county requirements and State and Federal laws, as appropriate.

All revegetation or restoration efforts would require many years of reseeding and weed control to achieve the desired goals. The fact that restoration or in–kind replacement of vegetation on private lands would be subject to landowner approval would limit the replacement of native plant communities on these lands. If in–kind replacement cannot be done on private lands, another suitable site would be found.

Even if reseeding and weed control are successful, it is unlikely that these efforts would fully replicate the species diversity of existing higher quality stands of shrub-steppe. Some of these areas have relatively intact biotic crusts that cannot be restored. A reduction in native plant diversity and a loss of biotic crust are expected to persist for the long term on shrub-steppe areas that are disturbed or restored. This would be less of a problem under this alternative than for some others because the shrub–steppe stands that would be impacted are smaller and of lower quality than in other portions of the Study Area.

Wetlands

Mitigating the 1 acre of expected long–term wetland impacts would be accomplished as described for the East Low Canal under Alternative 3A: Full—Banks. It is described in more detail in that section because more acres are affected.

Changes with Limited Spring Diversion Scenario

Drawdowns at Banks Lake under Alternative 2A with the Limited Spring Diversion Scenario would be similar across all water year types and would look like the drawdown in dry and drought years with spring diversions. These drawdowns were not expected to impact wetlands and Banks Lake so the Limited Spring Diversion would not impact wetlands at Banks Lake to any greater degree than previously outlined for Alternative 2A. No changes to impacts to uplands would be expected with the Limited Spring Diversion Scenario.

4.8.4 Alternative 2B: Partial—Banks + FDR

Short–term and long–term impacts on native upland plant communities would be the same as Alternative 2A: Partial—Banks. Impacts to wetlands would be similar to Alternative 2A and are shown in Table 4-43.

Changes with Limited Spring Diversion Scenario

Changes and impacts would be the same as Alternative 2A.

4.8.5 Alternative 3A: Full—Banks

4.8.5.1 Short–term Impacts

Uplands

Significant impacts on native upland plant communities would be similar to those described for Alternative 2A: Partial—Banks. However, they would occur on a much larger scale (Table 4-44). Impacts would occur from constructing pipelines, the East Low Canal, the East High Canal, and Black Rock Coulee Reregulating Reservoir. Table 4-44 lists the short– and long–term impacts that would occur with Alternative 3A: Full—Banks, as well as Alternative 3B: Full—Banks + FDR. Transmission line construction would include additional short–term impacts on 2,557 acres. Most of these lines are expected to be located along existing rights–of–way where lands have been previously disturbed. Impacts to native communities listed as temporary would persist for many years because of the issues related to weeds, the inability to fully restore high quality shrub-steppe communities, and the long times required to mitigate the losses.

Table 4-44. Short– and long–term impacts on native upland plant communities from Alternatives 3A and 3B full replacement alternatives.

Facility[a]	Upland Vegetation Type and Acres Impacted					
	montane deciduous shrub	steppe grassland	sagebrush steppe	aspen woodland	semi–desert shrub-steppe	basin cliff and canyon[b]
Impacts from Permanent Facilities – Must be Mitigated Elsewhere Because of Permanent Facilities						
East Low Canal	–	18	112	–	–	–
Black Rock Coulee Reregulating Reservoir	–	7	149	1	–	–
East High Canal	–	27	2,145	–	4	4
Pumping Plants	–	–	18	–	–	–
Total Permanent Impacts	**–**	**52**	**2,424**	**1**	**4**	**4**
Additional Temporary[c] Impacts During Construction – These Impacts May Be Mitigated In–Place						
Pipelines for the East Low Canal	–	9	105	–	–	–
East Low Canal	–	11	98	–	–	–
Pipelines for the East High Canal	24	19	405	–	–	–
East High Canal	–	14	1,107	–	2	–
Total Additional Temporary Impacts	**24**	**53**	**1,715**	**–**	**2**	**–**

[a] Permanent and temporary impacts do not include those from substations and transmission lines because their locations are not known at this time. The footprint of the dam at Black Rock Coulee Reregulating Reservoir is also not included.

[b] Basin cliff and canyon is potential habitat for sticky phacelia, a rare plant.

[c] Temporary impacts to mature shrub-steppe communities would persist for many years because of the issues related to weeds, the ability to fully restore high quality shrub–steppe communities, and the long times required to mitigate the losses.

Wetlands

Short–term significant direct impacts to wetland resources associated with this alternative would be limited to the 37.8 acres of fringe PEM wetland that lines the left inner wall of the East Low Canal and temporary construction impacts to PEM wetlands that would occur during excavation for pipe laying and expansion and extension of the East Low Canal. Fringe wetlands would be removed during construction activities associated with enlarging the East Low Canal. The nature of these impacts and their expected re–establishment following construction would be the same as described for Alternative 2A: Partial—Banks.

4.8.5.2 Long–term Impacts

Uplands

As shown in Table 4-44, about 2,485 acres of native plant communities would be directly impacted by permanent facilities under Alternative 3A: Full—Banks; a significant impact. Another 1,794 acres of native plant communities would be impacted during construction, but would not be occupied by permanent facilities. Considering the past losses of shrub–steppe communities in the Columbia Basin, these impacts would be considered significant. Temporary impacts to mature shrub-steppe communities would persist for many years because of the issues related to weeds, the inability to fully restore high quality shrub–steppe communities, and the long times required to mitigate the losses. Rural residential development is expected to occur on private lands around Black Rock Coulee once the reservoir is filled. This would result in an additional indirect permanent loss of native shrub–steppe communities.

As described for Alternative 2A: Partial—Banks, the success of reseeding depends upon the timing and amount of precipitation as well as many other factors. It is likely that many of the acres of native plant communities disturbed by pipelines would be invaded by weed species, including cheatgrass. Long–term minimal to adverse impacts from of weed invasion would be addressed through ongoing weed control. However, weed infestations would likely occur over a long period as an indirect effect of disturbance.

Data regarding the quality of shrub–steppe communities indicates that about 52 percent of the sites along the East High Canal and within the footprint of the Black Rock Coulee Reregulating Reservoir are high quality and 19 percent are good quality, based on species diversity and cheatgrass occurrence. Even if reseeding and weed control are successful, it is very unlikely that these efforts would fully replicate the species diversity of existing high quality shrub–steppe sites that currently exist in many areas that would be impacted by this alternative. These high quality areas have relatively high levels of biotic crust and high species diversity that likely cannot be fully restored by restoration efforts. A reduction in native plant diversity and loss of biotic crust are expected to persist over these areas of high quality shrub–steppe habitat for the long term, a significant impact.

This alternative would also have significant impacts on rare plant populations in Black Rock Coulee. Inundation of this site would result in the direct loss of three populations of Hoover’s umbrellawort and two occurrences of Snake River cryptantha. It would likely result in the indirect loss of another population of Snake River cryptantha from trampling as people use the banks of the reservoir. The construction of the East High Canal would result in the loss of five populations of sticky phacelia and the loss of an additional five populations of Hoover’s umbrellawort. Some of these losses would be avoided during final design of the East High Canal, but some of them cannot be avoided. Rural residential development that is expected to occur around Black Rock Coulee once the reservoir is filled would likely destroy other populations in that area.

Some short-term impacts to shrub-steppe communities that are restored after construction would persist for 15 years or more because of the difficulty or restoring these vegetation types to pre-construction conditions as previously described.

Wetlands

Long–term, significant, direct and indirect wetland impacts under Alternative 3A: Full—Banks would be associated with the loss of high quality wetlands within the Black Rock Coulee Reregulating Reservoir footprint, direct impacts to wetlands within the proposed East High Canal footprint, and wetlands adjacent to the East Low Canal. Indirect adverse impacts to wetlands fringing Banks Lake would also result (Table 4-45). Wetland resources in Black Rock Coulee Reregulating Reservoir are considered high quality wetlands (Category I; including PFO, alkali, and vernal pool wetland components) (Photograph 4-3). Detailed information specific to Black Rock Coulee Reregulating Reservoir wetland characteristics is in Section 3.8 – *Vegetation and Wetlands*.

Table 4-45. Direct and indirect impacts on wetlands expected under the full replacement alternatives.

Location	Acres of Impact	Wetland Type	Category	Wetland Impact Type	Full Replacement Alternative included in this Impact	
					3A	3B
East High Canal	5.2	PEM	IV	Long–term direct impact	X	X
Black Rock Coulee Reregulating Reservoir	21.6	PEM	I	Long–term direct impact	X	X
Black Rock Coulee Reregulating Reservoir	0.1	PEM	III	Long–term direct impact	X	X
Black Rock Coulee Reregulating Reservoir	3.6	PFO	I	Long–term direct impact	X	X
East Low Canal	37.8	PEM	IV	Short–term direct impact	X	X
East Low Canal	1.0	PEM	III	Long–term direct impact	X	X
East Low Canal	3.4	PEM	III	Temporary construction impacts	X	X
Banks Lake	Unquantified	PEM	III	Long–term indirect impact–*Vegetation community composition shift*	X	
Banks Lake	Unquantified	PEM	III	Long–term indirect impact – *During dry year drawdown regimes only, and likely community composition shift.*	X	
Banks Lake	Unquantified	PEM	III	Long–term indirect impact – *During drought year drawdown regime only and community composition shift*	X	
East High Canal	Unquantified	PEM	IV	Long–term indirect impact – *Potential decrease in wetland function*	X	X

Photograph 4-3. PEM/PFO wetland / open water complex at the site of the Black Rock Coulee Reregulating Reservoir.

Indirect minimal impacts would result from change or loss of wetland function based on Hruby (2007) and are not expected to result in long–term changes in wetland area except as noted in Table 4-45 for modeled dry and drought year watershed conditions. It is generally understood that emergent wetland species are more sensitive to decreased water availability than wetland trees or shrubs; however, the degree of susceptibility among emergent plants is not well documented. Emergent species lack the extensive rooting systems typical of most woody plants and as such are likely to have higher susceptibility to water deprivation (Touchette et al. 2008).

Previous studies examining drawdown effects to vegetation along Banks Lake have discussed that significant changes in the seasonal groundwater fluctuation would be expected to affect wetland species composition (Reclamation 2004) through mortality and stress (Reclamation 2004).

How Do Wetlands Respond To Drought Conditions?

Many wetland systems show great plasticity in response to drought events (Touchette et al. 2008). This ability would be largely dependent upon the condition of underground rhizomes and roots, as well as seed bank composition (Touchette et al. 2008). It is well documented that plant community composition and species diversity can change substantially following drought conditions, either eliminating or reducing perennial diversity, or displacing wetland plants by weedy and more drought tolerant species such as reed canarygrass (Touchette et al. 2008). Conversely, some research indicates that short–term dry conditions would increase aboveground biomass production in some species (Touchette et al. 2008), or stimulate germination of seeds (Sodja 1993). Other work on drought tolerance of wetland emergents shows a range of responses. At Banks Lake, the dominant emergent species are considered to be somewhat drought tolerant and include common cattail, hardstem bulrush, and Baltic rush (Reclamation 2004; Kirkpatrick 2004). Common cattail is described as "fairly drought tolerant" (Gucker 2008; Reclamation 2004).

The key difference between the partial replacement alternatives and the full replacement alternatives is how the reservoir would be operated during dry and drought years, as described for each of the alternatives in Chapter 2. For example, the hydrograph for Alternative 2A: Partial—Banks shows that drawdowns under most water conditions (wet, average, dry, and drought) occur in a narrow window between the end of July and the first of September (Section 4.2 – *Surface Water Quantity*, Figure 4–9, Banks Lake Drawdown (feet) for Alternative 3A: Full—Banks). By contrast, the drawdowns for Alternative 3A: Full—Banks occur over a wider period of time, with the water surface during the modeled dry year greater than 3 feet below full pool beginning about May 31 and continuing for the rest of the growing season.

The wetland area that would be affected by functional changes or drought year losses cannot be quantified and can only be determined through monitoring following implementation of a particular alternative. At Banks Lake, about 413.2 acres of PEM fringe wetlands were identified for average and dry year drawdown regimes under Alternative 3A: Full—Banks. The 3-foot rooting depth and capillary fringe threshold and the 5–foot, 30–day threshold of no available soil moisture would be exceeded in July and June, respectively, under this alternative (Section 4.2 – *Surface Water Quantity*, Table 4-13, Banks Lake Drawdown (feet) for Alternative 3A: Full—Banks). It is estimated that groundwater levels under the Alternative 3A: Full—Banks average water year condition would exceed the 3-foot rooting depth and capillary fringe threshold for an additional 36 days, on average, beyond 30–day existing conditions, as shown in Table 4-46. Under dry year conditions, water levels are anticipated to exceed the 3-foot rooting depth and capillary fringe threshold for an additional 50 days, on average. The piezometer data represents conditions at the wetland/upland boundary and are considered a maximum effect of drawdown influence.

Table 4-46. Responses of wetland plants to groundwater drawdowns near Banks Lake in representative average and dry watershed conditions: full replacement alternatives.

Alternative	Number of Days (on Average) the 3–foot rooting depth and capillary fringe threshold is exceeded		Plant Response and Notes
	Average Year	Dry Year	
No Action	30 days	30 days	Survival without stress
3A: Full—Banks	45 days	80 days	Survival without stress for average years. Because of a long drawdown period during dry years, possible decrease in species diversity through favoring the most drought tolerant emergent species, or the reduction or elimination of subdominant emergent species that would not be as drought tolerant, depending on the number of years in a row that dry conditions persist. Possible decrease in wetland area. See footnote for a discussion of drought year effects on wetlands.
3B: Full—Banks + FDR	41 days	41 days	Survival without stress

Note: Representative Drought Year Watershed Effects**:** Projected Banks Lake elevations during drought year watershed conditions would be near or below the 3–foot rooting depth and capillary fringe threshold for much of the growing season for Alternative 3A: Full—Banks. A single drought year preceded or followed by wet or average year watershed conditions would cause some degree of stress and an undetermined but relatively small amount of emergent wetland plant mortality in all PEM wetlands around Banks Lake for all three alternatives. However, wetlands are quite resilient and show great plasticity in response to drought events. The loss of PEM wetlands during successive drought year conditions would likely be reversed over a period of several years by a series of average or wet watershed years. Any changes in species composition toward more drought tolerant species would likely persist at the drier edge of the wetlands in spite of a return to average watershed conditions.

Based on the literature, piezometer data, and species drought tolerance ranges, the average and dry year water level changes are anticipated to alter PEM fringe vegetation composition by decreasing species diversity, through selecting in favor of the most drought tolerant emergent species or producing some emergent mortality within the PEM fringe wetlands (Photograph 4-4). At a minimum, impacts under Alternative 3A: Full—Banks during average and dry years are anticipated to reduce or eliminate subdominant emergent species (cosmopolitan rush and three-square bulrush) that would not be as drought tolerant as the dominant cattail, hardstem bulrush, and Baltic rush. This loss of diversity would be an adverse impact. Wetland losses are possible during a series of dry year watershed conditions and expected during a series of drought year watershed conditions (see footnote in Table 4-46). The loss of PEM wetlands during successive drought year conditions would likely be reversed over a period of several years by a series of average or wet watershed years. Any changes in species composition toward more drought tolerant species would likely persist in spite of a return to average watershed conditions.

Photograph 4-4. PEM/PSS fringe wetland at Banks Lake.

Based on the literature, piezometer data, and species drought tolerance ranges, the average and dry year water level changes are not anticipated to alter PSS or PFO fringe vegetation composition under Alternative 3A: Full—Banks (wet, average, and dry water years). Germination and recruitment of cottonwood seedlings are anticipated to be supported by near bank full elevations in April and May under average and dry year drawdowns, which mimic existing conditions.

Habitat function, as evaluated in the Eastern Washington Wetland Functional Assessment (Hruby 2007), is not heavily weighted in regard to wetland species diversity. As such, under Washington's functional rating system, a lower score reflecting reduced species diversity would be unlikely to decrease the habitat or the overall functional ratings of PEM wetlands adjacent to Banks Lake. However, any relatively large–scale change toward greater dominance of reed canarygrass would have adverse impacts on wildlife, which are discussed in Section 4.9 – *Wildlife and Wildlife Habitat*. No change to the wetland hydrologic and water quality function is anticipated.

The severity of functional impacts proposed for the Category III PEM wetlands adjacent to Banks Lake under wet, average, and dry year drawdown regimes is expected to be minimal.

Except under drought year watershed conditions, any change in species composition in the emergent layer is unlikely to reduce its function to a degree that would lower its functional rating. Under the representative wet and average years, establishment of reed canarygrass (or other invasive species) is not expected to reduce functions of Banks Lake PEM wetlands because the drawdown and refill regime associated with these alternatives would drown reed canarygrass except at the upper (drier) wetland fringes. These drawdown regimes are not anticipated to affect the functional rating of the Banks Lake PEM wetlands over the long term.

Under dry year conditions, colonization of reed canarygrass (or other invasive species) would reduce the current functional scores of Banks Lake PEM wetlands (Category III), but is not anticipated to reduce its functional rating to a Category IV wetland. This is because habitat function as evaluated in the Eastern Washington Wetland Functional Assessment (Hruby 2007) is not heavily weighted concerning wetland species diversity. No change to the wetland hydrologic and water quality function is anticipated.

Conditions that would occur during the drought year drawdown regime would likely result in the loss of PEM fringe wetlands, an adverse impact. In drought years, the 3–foot rooting depth and capillary fringe threshold of available soil moisture would be exceeded early in the growing season (May), and the 5-foot, 30-day threshold of no available soil moisture would be exceeded in early July and would extend through December.

Under the Alternative 3A: Full—Banks drought year drawdown regime, the severity of functional impacts to Banks Lake Category III PEM fringe wetlands largely depends on preceding and following climatic conditions and the duration of drought conditions. If drought year conditions are preceded by one or more dry years, PEM wetland acreage would likely be decreased or eliminated and would represent a moderate to high loss of wetland function, since these wetlands currently provide high water quality function and moderate hydrologic and habitat function. Any loss of PEM area during drought year conditions would likely be reversed over a period of several years by a series of average or wet years. However, changes in species composition would persist at the drier edge of the wetlands in spite of a return to average watershed conditions. As such, following successive wetter years the PEM wetlands would eventually resemble the original community assemblage except at the drier edge of wetlands.

Changes with Limited Spring Diversion Scenario

Vegetative wetland boundaries and zones will take on a more dynamic response to the movement, duration, and function of water levels within the reservoir. Over time, these aquatic plant habitats will migrate to a new equilibrium zones relative to soil moisture as to survive in the summer and not to be completely inundated during periods of high water. Any change in wetlands or aquatic plant communities will be in location, both in elevation and distance to the water edge.

4.8.6 Alternative 3B: Full—Banks + FDR

Alternative 3B: Full—Banks + FDR would have the same short–term and long–term impacts on native upland plant communities and rare plants as Alternative 3A: Full—Banks. For wetlands, short–term impacts would be the same as described for Alternative 3A: Full—Banks. The majority of long–term impacts would be the same as described for Alternative 3A: Full—Banks, with the exceptions for indirect impacts shown in Table 4-44 and the rooting depth and capillary fringe threshold exceedances shown in Table 4-45.

Changes with Limited Spring Diversion Scenario

Changes under Alternative 3B would be very similar to Alternative 3A; however, due to the reduced drawdown under Alternative 3B the dynamic natural vegetation and wetland composition would be less pronounced. Few changes to Banks Lake wetlands would be expected under the Limited Spring Diversion Scenario. The maximum drawdown would be increased and the rate of drawdown would be only slightly affected in average water years. Drawdowns would be more consistent and the development of wetland habitat boundaries will be predicated upon adjacent soil moisture regimes and zones.

4.8.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

4.8.7.1 Short–term Impacts

Uplands

Construction impacts to shrub–steppe communities would occur during excavation for pipe laying and expansion of the East Low Canal. Direct short-term losses during pipeline construction are estimated as follows:

- 87 acres of shrub-steppe
- 6.3 acres of scabland shrubland

Lands that would be impacted during construction, but that are not required for permanent facilities, are considered short-term impacts because restoration can occur at those locations. With the partial replacement alternatives very little shrub-steppe habitat would be disturbed. However, restoration of native shrub-steppe habitats to pre-construction conditions would be difficult and would require 15 years or more.

The disturbed areas would be reseeded to match pre-construction conditions. Lands with native vegetation impacted during construction would be seeded with local native species following construction with a goal of restoring the impacted community. Restoration or in-kind replacement on private lands would be subject to landowner approval. The success of reseeding depends on timing, precipitation, and many other factors. It is likely that many of the acres of native plant communities disturbed by pipelines would be invaded by weed species, including cheatgrass. If in-kind replacement cannot be done on private lands, another suitable site would be found.

Transmission line construction would include short-term impacts on 1,018 acres. Most of these lines are expected to be located along existing rights-of-way where lands have been previously disturbed.

No short-term direct or indirect impacts to populations of rare plants are expected under this alternative because none were found in areas that would be impacted.

Wetlands

Short–term significant direct impacts to wetland resources associated with this alternative would be limited to the 37.8 acres of fringe PEM wetland that lines the left inner wall of the East Low Canal and temporary construction impacts to PEM wetlands that would occur during excavation for pipe laying and expansion and extension of the East Low Canal. Fringe wetlands would be removed during construction activities associated with enlarging the East Low Canal. The nature of these impacts and their expected re–establishment following construction would be the same as described for Alternative 2A: Partial—Banks.

4.8.7.2 Long–term Impacts

Uplands

Expected impacts on native upland plant communities from Alternatives 4A and 4B are shown in Table 4-47. Long–term significant impacts to upland plant communities north and south of I–90 would include 112 acres of shrub-steppe and 18 acres of steppe grassland required for expansion and extension of the East Low Canal. These losses cannot be replaced at the location of the impact because the canal would occupy these areas.

Table 4-47. Short and long-term impacts on native upland plant communities from Alternatives 4A and 4B: modified partial replacement.

Facility	steppe grassland	sagebrush steppe
East Low Canal	18	109
Pumping Plants	-	4
Total Permanent Impacts	**18**	**113**
Pipelines for the East Low Canal	6	87
East Low Canal	10	93
Total Additional Temporary Impacts	**16**	**180**

Some long–term impacts to patchy shrub-steppe communities that are restored after construction would persist for 15 years or more because of the difficulty or restoring these vegetation types to pre–construction conditions as previously described. Construction vehicles would likely spread weed seeds among construction sites if weeds were present in these areas. If weed infestations occur, Reclamation would implement ongoing weed control measures in accordance with county weed board requirements.

However, weed infestations would likely occur over a long period as an indirect result of construction disturbance. The difficulty of controlling weed infestations suggests that weeds would likely also be a problem in shrub-steppe communities adjacent to construction areas. When weeds become established in native communities, they lower diversity by out–competing native plants and they alter the structure, composition, and successional pathways of ecosystems (Harrod 2001). Weed infestations in shrub-steppe communities also make them more susceptible to large fires, which further degrade species diversity and habitat values for wildlife. As previously noted, all shrub-steppe adjacent to the East Low Canal was subject to weed infestation during original canal construction.

Wetlands

Long-term impacts to wetlands under Alternative 4A and 4B would be similar in nature dynamically in regards to composition and movement to available reservoir water levels. Weed infestations, Canary Reedgrass, would be a concern; however, with the movement of water levels under both alternatives this would provide a challenge for this species life cycle. Given the range of drawdown under both of these alternatives, 8 to 11 feet, there will be an extended period of recharge and depletion for associated lakebeds that support these plant communities. Once this period of adjustment equalizes then the boundaries and habitat zones should sustain themselves. The one exception will be during dry years and particularly if these periods exist for more than one year at a time.

Changes with Limited Spring Diversion Scenario

Upland habitat will be disturbed during construction; however, restoration is planned for this disturbance. The complete restoration will take upwards of 15 years to regain a self-supporting shrub-steppe/grassland ecosystem. The control and reduction of invasive weeds will be an ongoing process that will aid in the re-establishment of this nature habitat. Wetlands, particularly at Banks Lake will be challenged to re-establish their habitat within the movement of the reservoirs water level and subsurface hydrological zone. This new scenario will place move stress upon wetland communities due to the possibility of consecutive naturally dry/wet years depending the composition of the associated lakebed within these plant communities.

4.8.8 Alternative 4B: Partial—Banks + FDR

Short–term and long–term impacts on native upland plant communities would be the same as Alternative 4A: Partial—Banks. Impacts to wetlands would be the same as Alternative 4A and as shown in Table 4-47 for Banks Lake.

Changes with Limited Spring Diversion Scenario

Changes under this Alternative 4B will be similar to Alternative 4A; however, not as pronounced due to the reduced level of reservoir drawdown.

4.8.9 Mitigation

Alternative 2A

Wetlands

The specific mitigation approach would change based on the final determination of impacts. Mitigation for unavoidable impacts to wetlands and riparian areas would require both passive and active measures and could be implemented. For example, construct water turnouts within irrigation delivery systems within the Odessa Subarea Study area for all action alternatives to facilitate, where ecologically appropriate, wetland establishment and/or expansion to existing wetlands to promote wildlife use and recreational opportunities. WDFW would be required to manage these lands for Reclamation under an existing management agreement.

An increase in both cost and acreage of mitigation would be seen for Alternative 2A with the Limited Spring Diversion Scenario due to the increased level of construction and project operations. Monitoring expenses and operations would also increase.

Alternative 2B

Changes and impacts would be the same as Alternative 2A, therefore, mitigation is the same.

Alternative 3A and 3B

Changes and impacts under this scenario would be extensive and require much habitat mitigation, improvement, invasive weed control, re-establishment of aquatic plant communities, and wildlife habitat restoration due to the loss of terrestrial habitat with the establishment and development of both the East High Canal and Black Rock Coulee Reservoir.

Alternative 4A and 4B

Mitigation for Alternatives 4A and 4B would have similar acreage, processes, and areas of concern. The primary mitigation would be focused on Banks Lake drawdown and the construction site of facilities and buried irrigation pipelines. Mitigation would need to be performed upon uplands and wetlands. The uplands would be primarily concerned with the control of invasive weeds and the restoration of native shrub-steppe ecosystems. This restoration program would concentrate upon the establishment of native grasses, forbs, and shrubs with an annual review of invasive weeds and cheatgrass. Follow-up herbicides could be used to help with the re-establishment of these species and the reduction of ever-present cheatgrass. The build-up of cheatgrass is not only an invasive and less desirable species, it elevates the danger and hazard of fire. As previously stated, this process will take on average 15 years to successfully establish the preferred plant community and composition.

Wetlands, will respond to the newly established moisture band and thresholds, which will occur after the lowering and continued operation of the reservoir under the specific Limited Spring Diversion Scenario. Plant communities are quite dynamic and do have the ability to re-establish themselves through seed dispersion and germination upon favorable habitat. If after monitoring it is determined that wetland communities are not responding favorable to the movement of reservoir levels and local soil characteristics plants and/or seedlings can and should occur to promote and maintain the health of the wetland ecosystem.

4.9 Wildlife and Wildlife Habitat

No short–term impacts to wildlife and wildlife habitat would occur under the No Action Alternative. Long–term impacts to wildlife using wetlands would not occur under the No Action Alternative. However, a shift from irrigated agriculture to dryland farming would cause adverse impacts to wildlife that use irrigated croplands because dryland wheat would be fallowed every other year, thereby removing forage and cover for some wildlife species.

Short–term impacts to wildlife would occur under all of the action alternatives. The extent of the impacts would be greater in duration and degree under the full replacement alternatives where construction would occur in native habitats.

Under both the partial and full replacement alternatives, long–term significant impacts to all wildlife would occur as a result of lost shrub–steppe habitat. Additional long–term significant impacts would occur on special status species and migratory birds under all of the action alternatives as a result of drawdowns at Banks Lake reservoir and reduced nesting habitat. The extent of these impacts would last longer and occur over a greater area under the full replacement alternatives. The East High Canal and Black Rock Branch Canal would result in significant impacts to wildlife under all of the full replacement alternatives. The canals would create barriers to animal movements, fragment native shrub–steppe habitat, and isolate small populations of some species.

4.9.1 Methods and Assumptions

4.9.1.1 Impact Indicators and Significance Criteria

The impact indicators and significance criteria for wildlife are listed in Table 4-48.

Table 4-48. Wildlife and wildlife habitat impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Impacts to shrub-steppe habitat	A long–term loss of more than 100 acres of high quality shrub–steppe habitat would be significant
Impacts on special status species, including migratory birds	Direct or indirect impacts on special status wildlife or occupied habitat would be significant
Barriers to movement to wildlife	Construction of linear facilities that substantially restrict wildlife movement would be significant
Habitat fragmentation and population viability	Reduced long–term viability of small populations isolated from larger ones would be significant

4.9.1.2 Impact Analysis Methods and Assumptions

Impacts on wildlife or changes in the extent or condition of wildlife habitat that would occur under each of the alternatives are compared to the current conditions within the Study Area.

Analyses described in Sections 4.2 – *Surface Water Quantity*, and 4.8 – *Vegetation and Wetlands*, were used to determine impacts on upland and wetland wildlife habitats within the analysis area. This includes the effects of projected changes to the operation of Banks Lake on fringe wetland and riparian habitats. WDFW studies, along with existing literature, botanical studies, and PHS database observations, were used in this analysis.

Wildlife Studies Conducted by WDFW for this EIS

WDFW (2010) conducted a series of investigations within the analysis area to determine wildlife use of the area and to estimate impacts of the action alternatives. Specific studies are as follows:

- Inventory of wildlife species of concern and an estimate of avian species richness within the parts of the analysis area where facilities would be constructed.
- Evaluation of effects to species of concern and their habitat from new construction, including conveyances and storage and pump facilities.
- Identification of areas where wildlife canal crossings would be most appropriate.
- Inventory of Western and Clark's grebe nesting sites and adults to evaluate anticipated impacts from changing reservoir conditions.
- Habitat Evaluation Procedures (HEP) habitat study to quantify and qualify habitat suitability and habitat value in parts of the analysis area that would be impacted.

WDFW studies identified special status species within portions of the analysis area that would be affected by facilities. The HEP study results were used to estimate general habitat values for the HEP evaluation species and to represent the habitat quality of specific habitats. HEP results are presented as habitat units that would be lost as a result of construction of facilities. Habitat units are calculated by multiplying the habitat value rating (the HSI value) for each evaluation species by the area of habitat for that species that would be impacted. For example, an area of 100 acres with an HSI score of 0.67 would represent 67 habitat units. WDFW's HEP analysis did not distinguish between short– and long–term impacts so the number of habitat units that would be affected likely over estimates the actual number.

Construction of facilities would result in disturbance and displacement of wildlife near construction areas because of noise and human presence. These effects were assessed based on existing literature and are discussed as they relate to wildlife and especially to special status species, which tend to be more sensitive to the effects of human disturbance than other species. Facility footprints and easement areas were used to estimate the acres of wildlife habitat types that would be directly impacted under each of the alternatives.

Potential fragmentation or isolation of patches of native habitats from existing relatively large continuous blocks of native habitat by new canals or other facilities were evaluated. The effects of this habitat fragmentation on wildlife were assessed by evaluating the long–term viability of small populations that would be physically isolated from larger ones.

Importance of Wildlife Population Size

A minimum viable population (MVP) size is an estimate of the number of individuals required for a high probability of survival of the population over a given period (often 20, 50, or 100 years). A commonly used, but somewhat arbitrary definition is greater than 95 percent probability of persistence over 100 years (Traill et al. 2007). Survival risks for small populations that become physically isolated from larger ones of which they were part result from a variety of processes such as inbreeding depression, density dependence, catastrophes, and environmental and demographic stochasticity (random variation).

Population viability analysis (PVA) models are often used to analyze data, project population trends, make policy decisions regarding management of rare species, and assess the genetic impacts of isolation or reduced habitat connectivity on low mobility species. PVA analyses require vital statistics including survival rates and reproduction statistics for resident and emigrant animals, dispersal rates, and the timing of mortality that can only be obtained through several years of field research and do not exist for species that occur in the analysis area. WDFW and Ecology have entered into a mitigation agreement concerning shrub–steppe losses due to Office of Columbia River projects. This agreement would apply to the Odessa Project to the extent it is implemented by the Office of the Columbia River. Reclamation is not a party to the agreement or bound by it.

For the purpose of this analysis, a population is defined as an interacting collection of animals of the same species occupying a defined geographic area. Movements and interactions by individuals are relatively continuous over the population area even though the habitat would vary in quality somewhat from place to place. Individuals may or may not move long distances within the geographic area. On a landscape scale, isolation of patches of vegetation occurs when small patches of habitat are cut off from larger, more contiguous blocks of habitat by a physical barrier that prevents movements of organisms and processes within or among previously connected landscapes (Hilty et al. 2006). Isolation of populations occurs when a physical barrier prevents or severely hinders normal movement of animals across the barrier.

GIS was also used to evaluate the extent to which the proposed East High Canal and Black Rock Branch canals would bisect or isolate existing stands of native shrub–steppe and Columbia Plateau steppe grassland vegetation. Polygons of existing shrub–steppe and steppe grassland vegetation that would be crossed by these canals were identified and the area of each polygon within 1 mile of the canals was determined. Klein (2005) studied Washington ground squirrel dispersal over a 2-year period and found that about 90 percent of 67 dispersing squirrels moved 1 mile or less. Therefore, a 1-mile distance was chosen for the analysis of changes in shrub-steppe and steppe grassland polygon size.

Changes in the size of these polygons that would result from construction of the East High Canal and Black Rock Branch canals and from the Black Rock Coulee Reregulating Reservoir were then determined using GIS. Existing shrub-steppe and steppe grassland polygons were grouped by size class for analysis. Introduced annual grassland areas were not included in the analysis because Washington ground squirrels are more likely to persist in a diverse and native grass forb community, which is missing in annual grasslands.

Potential long-term population effects of the East High and Black Rock Branch canals on low mobility species were estimated based on life history information for selected species collected from the literature. Published MVP estimates for a wide range of species (Brook et al. 2006; Traill et al. 2007) were compared to density estimates to identify the number of habitat polygons that would not support the selected species over a long period of years because of their small size and the fact that they would be physically isolated from larger areas of intact shrub–steppe habitats.

4.9.1.3 Impact Analysis Assumptions

All of the analysis assumptions stated in Section 3.8 – *Vegetation and Wetlands,* that relate to calculating the areas that would be directly affected by construction activities and changes in reservoir operations apply to the analysis of impacts on wildlife. The following additional assumptions were made regarding the analysis of short-and long-term impacts on wildlife:

- None of the action alternatives would impact wetland, riparian, or upland habitats or wildlife associated with Lake Roosevelt as the lands that would be exposed by additional drawdown do not support any of these habitat types, as discussed in Chapter 3. Therefore, Lake Roosevelt is not discussed.
- Short–term impacts would occur during construction, and include wildlife disturbance and displacement because of noise, human activity, and the immediate effects of habitat loss.
- The loss of habitat in areas required for construction that are not required for permanent facilities are considered short-term impacts because restoration can occur at those locations. However, restoration of native shrub-steppe habitats to preconstruction conditions would be difficult and would require 15 years or more.
- Long–term impacts would persist for many years following construction, or would be realized over a longer timeframe, such as the effects of permanent facilities or habitat fragmentation on wildlife. These impacts would persist indefinitely.

Broadly, applicable legal requirements are described in Chapter 5 – *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all regulations would be followed along with the BMPs listed in Section 4.31 – *Environmental Commitments*. After environmental impacts are determined, mitigation measures are applied to compensate for some or all remaining adverse impacts, which are described with the action alternatives and summarized along with the BMPs in Section 4.31 – *Environmental Commitments*.

Legal Requirements and BMPs for Wildlife Resources

The Washington PHS Program fulfills one of the most fundamental responsibilities of the WDFW—to provide comprehensive information on important fish, wildlife, and habitat resources in Washington. PHS data are used by many cities and counties to meet the requirements of the Washington Growth Management Act, and are used in this Final EIS. At a Federal level, migratory birds, as well as bald and golden eagles, are protected by international treaties.

WDFW and Ecology have entered into a mitigation agreement intended to address situations where Office of Columbia River projects would result in loss of shrub–steppe habitat. This agreement applies to the Odessa Project; however, since that project is a groundwater replacement project and would not expand irrigated acreage over current levels, any potential loss of shrub–steppe habitat would be limited to relatively small areas associated with construction of pumping plants and pipelines. Reclamation is not a party to the agreement nor is it bound by it.

BMPs that protect water quality and vegetation also help to prevent or minimize wildlife habitat degradation. Reclamation and Ecology would implement BMPs to protect raptors from powerlines and time construction activities to avoid the breeding periods of special status species, as described in Section 4.31 – *Environmental Commitments*.

4.9.2 Alternative 1: No Action Alternative

4.9.2.1 Short–term Impacts

The No Action Alternative would have no short-term direct or indirect impacts on wildlife or habitat.

4.9.2.2 Long–term Impacts

The No Action Alternative would not impact wetland habitats or wildlife using wetlands in the analysis area. The gradual cessation of irrigated agriculture in the Study Area over many years would minimally impact the few wildlife species that depend on irrigated agriculture for food and cover because dryland wheat would be fallowed every other year. Parts of the Study Area currently support large congregations of mule deer that depend on winter wheat during the late fall and winter until they begin migrating back to their summer ranges (Photograph 4-5). These herds would likely retain their current high numbers if irrigated agriculture changed to dryland farming.

Photograph 4-5. Mule deer depend on croplands bordering native habitats in the Study Area.

4.9.3 Alternative 2A: Partial—Banks

4.9.3.1 Short–term Impacts

Pipeline construction associated with the East Low Canal could impact up to 114 acres of sagebrush steppe and 93 acres of steppe grassland. Revegetation following construction would restore an undetermined portion of the lost habitat values, depending on landowner preferences. The success of revegetation efforts depends on a several factors and is not assured. Impacts on wildlife use of revegetated lands would vary by species and successional stage. Shrub–steppe obligates may not use the habitat until shrubs achieve mature stature, which may take may take 15 years or more. The extent to which impacted wildlife would reoccupy revegetated sites would depend upon the success of the revegetation efforts.

Construction activities along East Low Canal would displace wildlife. Most of this work would occur during the non–irrigation season. This corresponds with the nonbreeding season for wildlife. Therefore, while human activity and noise levels near construction could be high, the effects on wildlife would be relatively low compared to the effects if construction occurred during the breeding season. Wildlife near active construction sites would be displaced some distance away from active construction areas. Most of the East Low Canal expansion would impact agricultural lands, so the affected wildlife species would be those associated with cropland. If construction of the East Low Canal extension and associated roads occurs during the breeding season, the associated noise and human activity would displace some wildlife species and could also interfere with breeding activities. Displaced wildlife may or may not find suitable unoccupied habitat to use during construction. Both the East Low Canal enlargement and extension would occur in developed areas where rural roads, highways, railroads, dwellings, and commercial operations (mostly farms) are present. Wildlife present is habituated to the noise associated with these features.

Construction noise impacts wildlife in a variety of ways. Determining the specific effects of noise on wildlife is complicated because responses vary among species and among individuals of a single species. These variable responses result from the characteristics of the noise and its duration, the life history characteristics of the species, habitat type, season, activity at the time of exposure, sex and age of the individual, and level of previous exposure.

Many animals would react to noises, but it is especially troublesome for songbirds because noise interferes with the ability use songs to establish and defend breeding territories, attract females, and hear warning calls and calls by juveniles that can result in higher predation rates. The area of disturbance would vary by species and specific construction.

Additional traffic on local roads, as well as construction traffic, would increase the number of animals struck and killed by vehicles. Small, less mobile species, such as small mammals and reptiles, would be lost as lands are cleared for construction.

The loss of the thin fringe of reed-canary-grass-dominated emergent wetlands along the edge of the East Low Canal would have temporary impacts on a few wildlife species that forage in and along the edge of the canal. Two special status species that would be impacted by this temporary loss of foraging habitat include the black-crowned night heron and great blue heron. This fringe of wetland habitat is expected to redevelop along the widened and lengthened East Low Canal over a period of a few years, thereby replacing the habitat that was created by the original canal construction.

4.9.3.2 Long-term Impacts

Upland Vegetation Types and Species

Construction of the East Low Canal expansion and extension would permanently remove about 112 acres of sagebrush steppe and 18 acres of steppe grassland, and impact a wide range of species; this would be an adverse impact.

The East Low Canal is a barrier to movement by ground-dwelling animals. The East Low Canal also severely restricts or eliminates the ability of some wildlife species to cross the canal, especially since many such movements occur during and just after the breeding season when the canal is full of water. Extension of the East Low Canal would lengthen this movement barrier. However, because of the already patchy nature of the shrub-steppe areas, extension of the East Low Canal is not expected to significantly increase the degree to which wildlife movements are restricted.

Although much quieter than construction activities, noise from the operation of pump stations would displace some wildlife from the immediate vicinity of the station.

Some birds would occasionally be killed by colliding with the 84 miles of new transmission lines. This problem tends to affect larger, slow-flying birds during low light or foggy conditions. Electrocution of raptors is not expected to be a problem because of the design of power lines as described in the BMPs.

The only areas evaluated during the HEP study that would be affected under Alternative 2A are the East Low Canal and the East Low Canal Extension. Because more of the study sites used during the HEP analysis would be affected under the full-replacement alternatives, the HEP study results are presented under Alternative 3A: Full—Banks.

North of I–90, significant impacts related to conversion from irrigated crops to dryland crops would be the same as described under the No Action Alternative.

Banks Lake

No significant long-term impacts on Banks Lake fish populations are anticipated under this or Alternative 2B. Therefore, no long–term impacts on fish–eating birds are expected. Based on the analysis of piezometer data, the data presented in Table 4-4 indicate that emergent wetland plants growing in Banks Lake fringe wetlands would continue to survive without additional stress. However, many species of wildlife, including waterfowl, grebes, and some neotropical migrant songbirds, nest within these emergent wetland communities where they are protected from mammalian predation by standing water in the wetlands.

Grebes nesting at Banks Lake would be impacted be changing water levels. Grebes create floating vegetation mats on which to nest. WDFW (2009 Species) reported that nests were located in emergent wetlands at three locations in Osborne Bay near the north end of Banks Lake during the 2009 nesting season. Bathymetry maps of Banks Lake indicate that the bottom contour elevation of these nesting areas ranges from about 1,565 to 1,570 feet amsl, which corresponds with the top 5 feet of the full pool.

The current operation of Banks Lake generally keeps the reservoir full until August 1, and it drops to about 1,565 feet amsl by August 31 (Section 4.2 – *Surface Water Quantity*, Table 4-3). Operational changes under Alternative 2A: Partial—Banks would begin to drawdown Banks Lake from 1 to 3 months earlier, depending on the amount of snow and rain in the watershed. Drawdowns would begin earliest in the driest years. Based on straight–line projections of modeled month–end elevations, the drawdowns under this alternative would reach 1,565 feet amsl on or about August 20 in a representative wet year, August 15 in an average water year, and August 5 in dry and drought years. These changes would begin to lower the water levels in the nesting colonies 1 to 3 months earlier and remove all water from the colonies 10 to 25 days earlier than under the No Action Alternative. Under all water year types, colonies would not be dry until after most broods have hatched.

Grebe nesting was just beginning on June 22 (WDFW 2009 Species); the peak of nest initiation is about July 7; and most broods would hatch about the end of July. Short (1984) indicates that western grebes need at least 12 inches of water at nest sites to minimize nest predation. Lower reservoir levels earlier in the season would remove the water from under some, but probably not all, nests. Those closer to the reservoir shoreline would be the first to dry out from declining water levels while those near the open water edge would dry later. In average water years drawdowns by the end of July, would be just over a foot by which time most broods have hatched. In dry and drought years drawdown of about 1.5 feet occur by mid-June eliminating some of the nesting habitat. Drawdowns would continue during the nesting period, dropping another 1.5 to 2 feet by the end of July adversely affecting nest success.

WDFW noted that operational changes (lower water levels) in Banks Lake during June through August have the potential to negatively impact grebe nest success by tipping nests, leaving nests on dry ground, or by reducing the ability of grebes to enter nests for incubation. Reduced water levels earlier in the summer would likely reduce nesting success through all of these mechanisms. Reduced grebe nesting success would be a significant impact. All birds nesting in these emergent wetlands would be subject to increasing levels of depredation as water levels decline through the summer.

Special Status Species

Several special status species would be impacted by implementation of this alternative. Special status species identified by WDFW during their surveys of the East Low Canal expansion and extension included badger, black-crowned night-heron, black-necked stilt, burrowing owl, grasshopper sparrow, great blue heron, loggerhead shrike, long–billed curlew, prairie falcon, sage sparrow, sandhill crane, Swainson’s hawk, and turkey vulture. All of these species would likely be directly or indirectly impacted through loss of breeding and foraging habitat and displacement in response to noise and human activities. Badgers would likely retreat at the sign of danger such as approaching people or equipment and be lost during construction. Any burrowing owls that also retreat to their burrows within construction areas would also be killed. Grasshopper sparrows and long-billed curlews would likely be impacted by the loss of shrub-steppe habitats more than the other species. These impacts to special status species would be significant. Loggerhead shrikes and sage sparrows would be displaced if present, but do not likely nest near the East Low Canal. Impacts on prairie falcons, sandhill cranes, Swainson’s hawks, and turkey vultures would be insignificant because of the mobility of these species and the large area of suitable foraging habitat that would not be impacted. Several other special status species listed in Chapter 3, Table 3-20, use shrub–steppe habitats, and would occur in the analysis area. Any of the other special status species that use shrub–steppe habitats and that are present in affected areas would also be impacted by direct mortality or loss of habitat resulting in a significant impact.

Changes with Limited Spring Diversion Scenario

Impacts to nesting Western grebes would be greater and more pronounced with the Limited Spring Diversion Scenario only during wet and average water years. Drawdowns would occur sooner and result in 1 to 2-feet deeper drawdowns by the end of August. Dry and drought water years are not anticipated to have different impacts compared to the Spring Diversion Scenario.

4.9.4 Alternative 2B: Partial—Banks + FDR

Short-term and long-term impacts on shrub-steppe habitats and associated wildlife would be the same as Alternative 2A: Partial—Banks. Impacts to wetland habitats and associated wildlife would be similar to Alternative 2A: Partial—Banks except as described below for long-term impacts on grebes and other birds nesting in emergent wetlands at Banks Lake. Mitigation measures and limitations would be the same as Alternative 2A: Partial—Banks.

4.9.4.1 Long–term Impacts

Banks Lake Reservoir

The Banks Lake drawdown, which would start on April 1 during all of the representative water year types under this alternative, would impact nesting grebes. Compared to the No Action Alternative, water levels in the grebe nesting colony would be lower by about 1 foot by the end of May, 2 feet on July 1, and 3 feet on August 1 (Section 4.2 – *Surface Water Quantity*). This is an earlier and faster drawdown than would occur under average and wet conditions for Alternative 2A: Partial—Banks, resulting in a higher possibility of significant impacts on nesting success. Drawdowns during the nesting season from mid June to late July would be less than 1.5 feet.

Lake Roosevelt

The rationale for concluding that there would be minimal or no impacts on wildlife and wildlife habitat at Lake Roosevelt under all of the alternatives is presented in this section. As described in Chapter 2, Section 2.2.3 – *Water Management Programs and Requirements Common to All Alternatives*, management of Lake Roosevelt includes two annual drawdowns—one during early spring for flood control, and the other during the late summer. Both the winter and summer drawdowns are equal to or greater than the depth of the littoral zone. These semiannual drawdowns expose the littoral zone to regular desiccation and have severely limited the development and extent of submerged and emergent wetland communities along the reservoir shoreline. The rapid annual fluctuation of water levels resulting from reservoir operations limits the establishment of shoreline vegetation and the amount of suitable habitat for nesting waterfowl and breeding amphibians along the edge of Lake Roosevelt. Ecology (2007 CRWMP) acknowledged that nesting waterfowl and breeding amphibians are currently impacted by the rapid springtime fluctuations of water levels.

As cited in Ecology 2008, little aquatic plant community growth and low benthic macroinvertebrate assemblages was observed at Lake Roosevelt because of the lack of stable littoral habitats. For an approximately 3–month period, the reservoir drawdown separates the riparian habitats from the reservoir by an expanse of barren land (Ecology 2008). Since water levels fluctuate dramatically, few perennial wetlands are present along the shoreline of Lake Roosevelt.

Considering the incremental storage release (Ecology 2008), the elevation of Lake Roosevelt currently would be managed at between 10 and about 12 feet below full pool at the end of August, depending on the water year. Comparable figures for the end of September are 5 to 9 feet below full pool. These levels are within about 1 foot of historic operational levels. Preliminary modeling of the surface elevation of Lake Roosevelt indicates that the reservoir surface could be 0.0 to 0.5 feet lower at the end of August and 1.1 to 0.8 feet lower at the end of September, which does not vary much from current conditions. The Final Supplemental EIS for the Lake Roosevelt Incremental Storage Release Program (Ecology 2008) reached a similar conclusion, stating that "the additional changes that would occur to wildlife as a result of the additional drawdown under both non–drought and drought conditions are generally within the range of fluctuations that currently exist." Therefore, the additional incremental drawdown is expected to have minimal, if any, impacts on wildlife or wildlife habitat, including waterfowl nesting.

Section 3.10 – *Fisheries and Aquatic Resources*, notes that the current semiannual drawdowns severely limit littoral zone aquatic productivity for both macrophytes and macroinvertebrates. That analysis indicates that the additional late summer drawdown in the littoral zone should not have more than a minimal impact on any benthic aquatic biota. Furthermore, the additional drawdown would occur during the summer when the majority of the aquatic species' dependence on zooplankton has passed, thus minimizing impacts on forage fish that are consumed by birds or mammals.

Upland plant communities adjacent to the reservoir would not be affected by a greater summer drawdown. Wildlife habitats would essentially not be impacted by any of the alternatives, and the reservoir surface area available for foraging or loafing birds would not change substantially from current conditions. Considering all of these factors, there would be minimal-to–no impacts on wildlife or wildlife habitat at Lake Roosevelt under any of the alternatives. Therefore, wildlife and habitats present at and near Lake Roosevelt are not discussed below.

Changes with Limited Spring Diversion Scenario

No substantive changes are anticipated with the Limited Spring Diversion Scenario impacting wildlife or wildlife habitat.

4.9.5 Alternative 3A: Full—Banks

Short–term and long–term impacts would be the same as Alternative 2A for lands south of I–90. The impacts description in this section for Alternative 3A: Full—Banks, focuses on the additional facilities north of I-90 required for the full replacement alternatives.

4.9.5.1 Short–term Impacts

Short–term significant impacts would include clearing about 1,800 acres of shrub–steppe and steppe grassland that would not be required for permanent facilities (Table 4-44). The 1,800 acres would be reseeded as described under Alternative 2A: Partial—Banks, but impacts on habitat quality would persist for many years following restoration efforts.

All of the impacts on wildlife associated with construction noise, displacement, and road kill that were described under Alternative 2A: Partial—Banks would occur on a larger scale and affect much more area and more wildlife under this alternative.

Some birds would be killed by colliding with the 211 miles of new transmission lines. This problem tends to affect larger, slow–flying birds during low light or foggy conditions (Barrientos et al. 2011).

4.9.5.2 Long–term Impacts

Banks Lake

Grebes nesting at Banks Lake would be significantly impacted by implementation of this alternative. All of the nesting areas used by the grebe colony would be dry, or nearly so, during much of the entire nesting season in dry and drought years. This would eliminate nesting in the existing colony at Banks Lake during representative drought years, an adverse impact. Operational changes proposed for Banks Lake under Alternative 3A: Full—Banks during representative average would begin to drawdown the reservoir one month earlier than under the No Action Alternative. While Banks Lake would be full at the beginning of the nesting period in average years, it would drop 3 feet by the end of July when most broods have hatches. This would affect nest success.

As described in Section 4.8 – *Vegetation and Wetlands*, a single representative drought year following wet or average year watershed conditions would cause severe stress and an undetermined amount of emergent wetland plant mortality in all PEM wetlands around Banks Lake. Wildlife species that nest or forage in these wetlands would find degraded habitat conditions during representative drought years, likely resulting in reduced nesting habitat quality and success. However, impacts to wetlands during representative drought years would likely be reversed over a period of several years by a series of average or wet watershed years. Any changes in plant species composition toward more drought tolerant species would likely persist in spite of a return to average watershed conditions. Such changes could have undetermined impacts on wildlife if more drought tolerant species provide lower quality habitat or support fewer invertebrates consumed by wildlife. A series of drought years could result in a change in the species composition of emergent wetlands in favor of reed canary grass. This could persist for several years, but is not expected to be permanent because wetland vegetation would respond favorably to a return to average precipitation when the drought ends. However, wildlife habitat values at Banks Lake would be significantly reduced if reed canary grass replaces existing emergent wetland plants.

On the basis of currently available data, significant impacts on Banks Lake fish populations are anticipated under this and Alternative 3B. A decrease in fish abundance would have adverse impacts on fish-eating birds, depending on whether prey availability is a limiting factor for these birds. The overall impact on zooplankton abundance and, subsequently, on the growth of plankton-eating fish, has been evaluated by WDFW and results were incorporated in the Final EIS.

Upland Vegetation Types and Species

About 2,470 acres of shrub–steppe and steppe grassland habitat would be permanently lost as a result of constructing facilities under Alternative 3A: Full—Banks (Table 4-45). This represents a significant impact. The effects of the short- and long-term loss of about 4,290 acres of shrub-steppe and steppe grassland under this alternative would persist for many years and impact a wide range of species. Many of these affected areas were rated as very high or high quality habitat based on native species diversity, low occurrence of cheatgrass, and HSI values.

A large area of steppe grassland and sagebrush steppe habitat would be lost under this alternative. For nonlinear features, it is very unlikely that individuals of the more mobile species that would be displaced would find suitable unoccupied habitat. Displaced animals would likely be lost as part of the local populations of affected species over a period of a few years. Given the linear nature of the East High Canal, it is unknown if displaced animals would find suitable unoccupied habitat nearby. Less mobile species, such as small mammals and reptiles occupying all affected areas, would be lost during construction. Impacts on this scale would be significant.

Mule deer would be impacted by the canal in several ways. WDFW (2009 Survey) reported well over 100 individual observations of mule deer during their surveys. Many observations were along the East High Canal segment at the site of the Black Rock Coulee Reregulating Reservoir and downstream in Black Rock Coulee and along the upper reaches of the Black

Rock Branch segment. Habitat loss would impact mule deer that use shrub–steppe areas during the winter. While escape ramps would be built into the East High Canal, some deer would still drown in the canal during the irrigation season. The largest numbers of deer are present outside of the irrigation season. A few others might drown while crossing the Black Rock Coulee Reregulating Reservoir, especially in the winter if ice conditions are not stable enough to support deer, but prevent unimpeded swimming. Entrapment in dry canals is not expected to be a significant problem because of the presence of escape ramps. However, entrapment would result in some loss of deer during prolonged periods of snow or ice, which could make use of concrete escape ramps more difficult.

Flooding of the pond, emergent wetland, and riparian area by the Black Rock Coulee Reregulating Reservoir would eliminate the habitats for the geotropically migrant songbirds, wading birds, and waterfowl that use the area. No similar area is known to occur within the analysis area, and loss of this wetland and riparian habitat would be significant.

Rural residential development would result in the permanent loss and degradation of additional shrub-steppe habitat and displacement of wildlife. Such development is expected to occur on private lands around Black Rock Coulee Reregulating Reservoir once the reservoir is filled. There is probably a higher likelihood of this occurring under the full replacement alternatives than under the No Action Alternative because the reservoir would be an attractive feature for owners. Residential development brings other hazards to wildlife, such as dogs and housecats that would kill small birds, mammals, and reptiles. Fertilizer runoff from residential areas also presents a risk to wildlife. Weed infestations would likely increase near residential developments, further degrading shrub–steppe habitat.

The results of the HEP analysis of the East Low Canal, East Low Canal Extension, East High Canal, and Black Rock Coulee Reregulating Reservoir site are presented in Figure 4-22 through Figure 4-26. The acreage of each cover type that would be impacted is constant for each species, but varies for each identified construction feature on each individual figure. For instance, all of the projected habitat unit losses on Figure 4-22 refer to the same number of acres of shrub-steppe habitat for each specie for the East High Canal but the acreage figures are different for Black Rock Coulee Reregulating Reservoir. Therefore, variation in the number of habitat units that would be impacted within a cover type at a feature is a reflection of the overall suitability of the cover type and the amount of cover type present for each species that was evaluated.

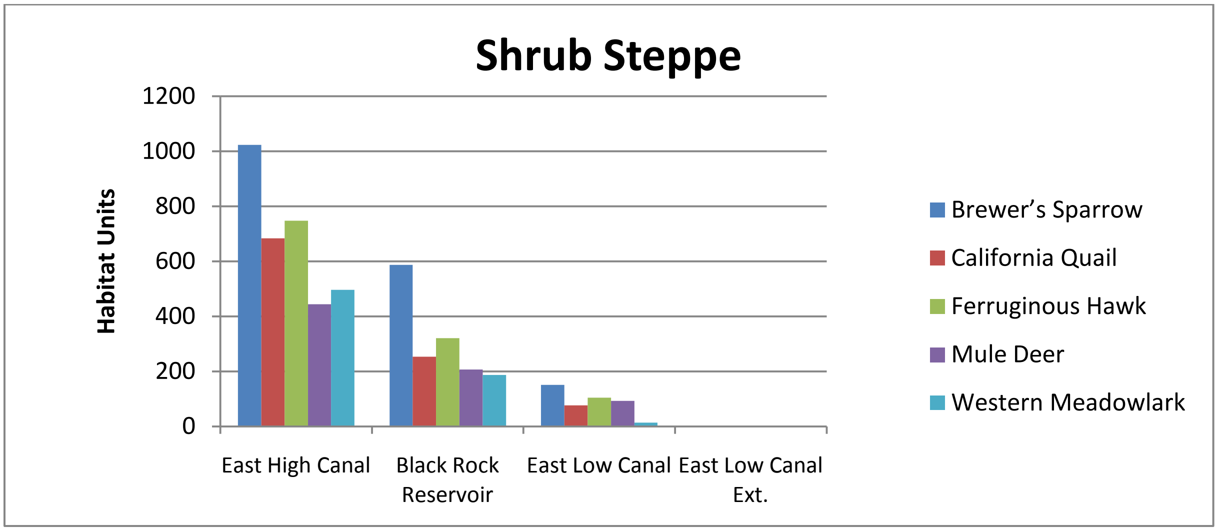


Figure 4-22. HEP results for shrub–steppe evaluation species.

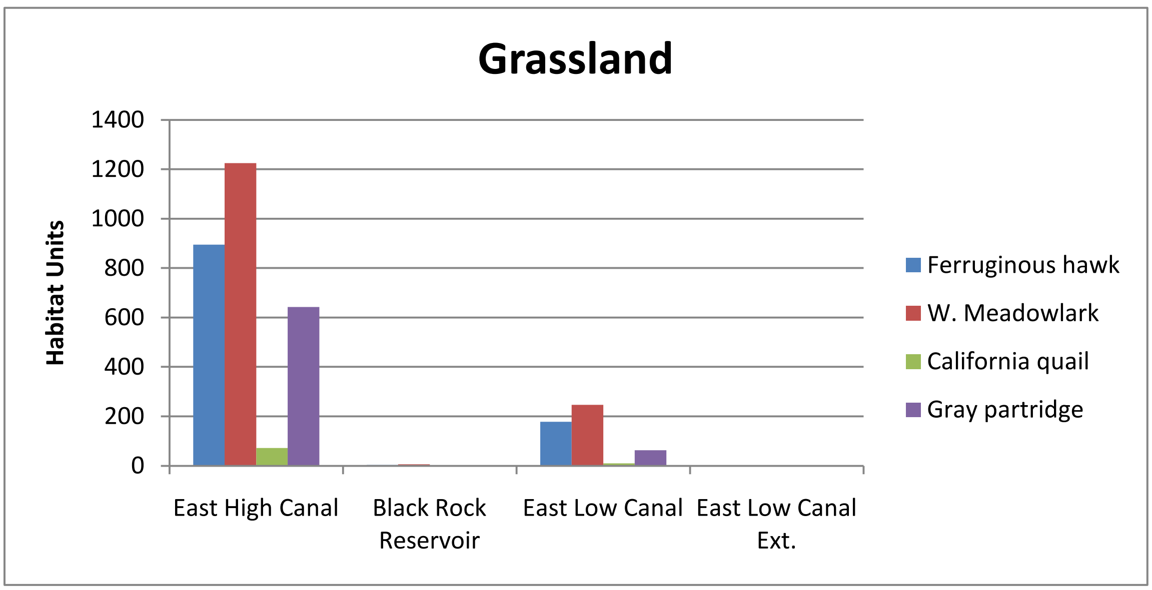


Figure 4-23. HEP results for grassland evaluation species.

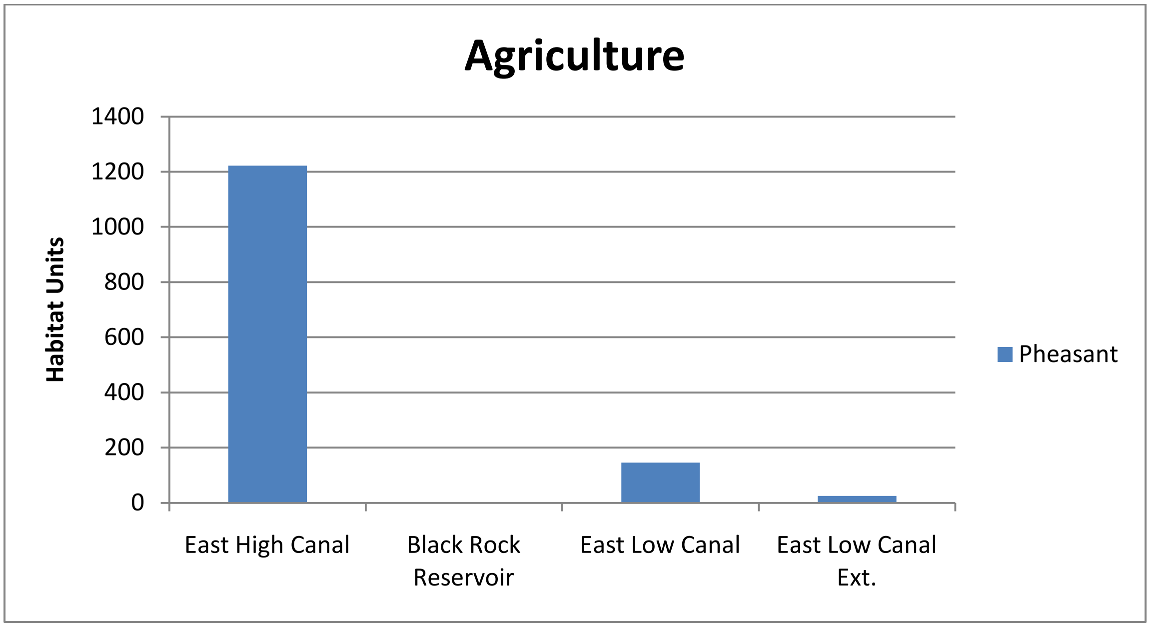


Figure 4-24. HEP results for agriculture evaluation species.

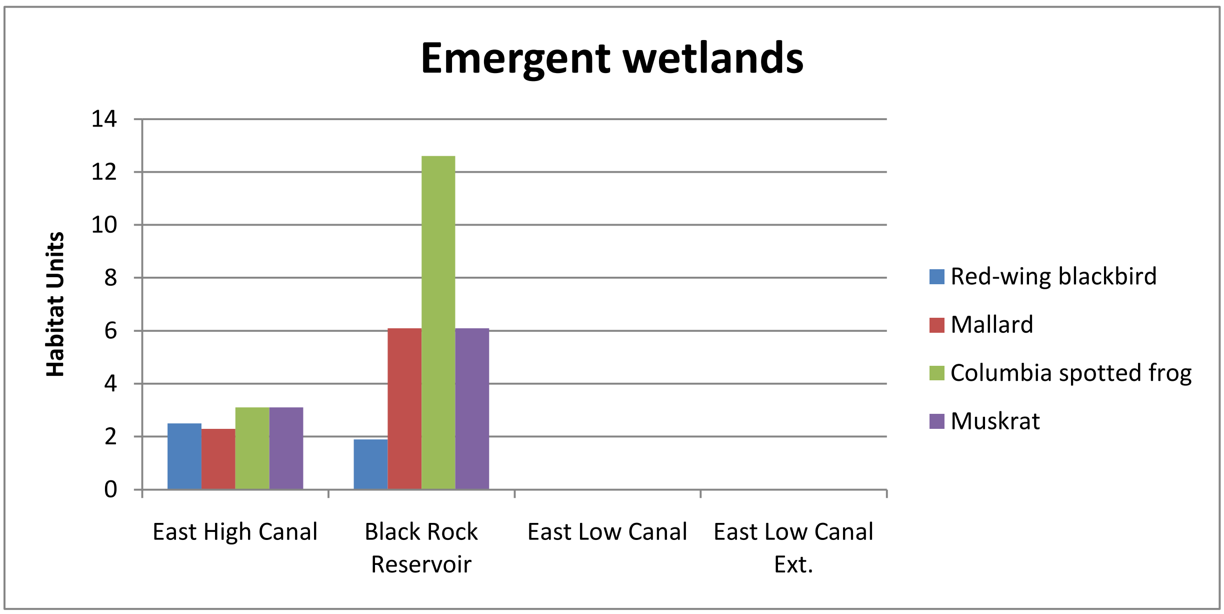


Figure 4-25. HEP results for emergent wetlands evaluation species.

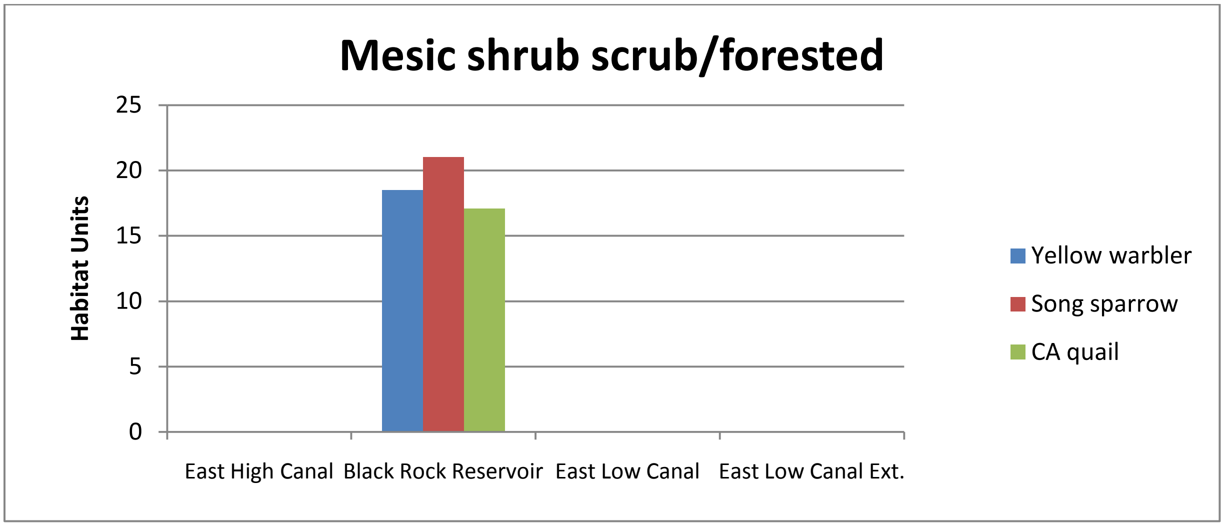


Figure 4-26. HEP results for scrub shrub/mesic shrub/riparian forest evaluation species.

Special Status Species

Several special status species would be impacted by implementation of this alternative. The special status species discussed under Alternative 2A: Partial—Banks would also be affected under this alternative. WDFW (2009 Species) identified an additional 19 special status species during their surveys of the sites where facilities under Alternative 3A: Full—Banks would be constructed, as shown in Table 4-49.

Table 4-49. Special status species observed by WDFW at major facilities of the full replacement alternatives.

Species	East High Canal	Black Rock Coulee Reregulating Reservoir	Black Rock Coulee (below reservoir)	East High Canal Black Rock Branch
American white pelican	X			
Badger	X	X	X	
Bald eagle	X			
Black–necked stilt	X	X		
Grasshopper sparrow	X	X	X	X
Great blue heron	X	X		
Great egret	X			
Loggerhead shrike	X	X	X	X
Long–billed curlew	X		X	
Osprey	X			
Peregrine falcon	X			

Species	East High Canal	Black Rock Coulee Reregulating Reservoir	Black Rock Coulee (below reservoir)	East High Canal Black Rock Branch
Prairie falcon	X		X	
Pygmy short–horned lizard	X		X	
Sage sparrow	X		X	
Sage thrasher	X	X	X	
Sandhill crane	X			
Swainson's hawk	X	X	X	X
Turkey vulture	X			
Washington ground squirrel	X	X	X	
Note: See discussion of special status species for partial–replacement alternatives for other observations. Source: WDFW 2009 Species				

All of these species would likely be directly or indirectly impacted by loss of breeding and foraging habitat and displacement in response to noise and human activities. Badgers, Washington ground squirrels, and pygmy short–horned lizards would likely retreat to their burrows at the sign of danger, such as approaching people or equipment, and be drowned during flooding or lost during construction. Construction in areas occupied by these species during their dormant periods would eliminate affected individuals.

Of particular concern are impacts to Washington ground squirrels in Black Rock Coulee where perhaps the largest contiguous colony in the State occurs. Construction of Black Rock Coulee Reregulating Reservoir would impact a small portion of that colony with individuals in the footprint of the dam and reservoir likely lost if not successfully relocated. Washington ground squirrels using portions of the Black Rock Coulee Flood Storage Area may also be intermittently and temporary affected if flooding of the site occurs. Portions of this area have been inundated in the past by natural events so recolonization of the site would likely occur should flooding occur under any of the full development alternatives.

Badgers, grasshopper sparrows, loggerhead shrikes, sage sparrows, sage thrashers, pygmy short-horned lizards, and shrub-steppe obligates would likely be impacted by the loss of shrub-steppe habitats more than the other species. Impacts on curlews, prairie falcons, sandhill cranes, Swainson's hawks, and turkey vultures would likely be insignificant because of the mobility of these species and the large area of suitable foraging habitat that would not be impacted. Several other special status species listed in Chapter 3, Table 3–20, use shrub-steppe habitats, and would occur in the analysis area. While their presence was not confirmed by WDFW, there is potential for impacts because surveys can only prove presence, not absence, and WDFW surveys were not necessarily species-specific. Any of the other special status species that use shrub–steppe habitats and that are present in affected areas would also be impacted by direct mortality or loss of habitat. Compared to Alternative 2A, the larger blocks of shrub–steppe habitat that would be affected under both the full-replacement alternatives likely provide suitable habitat for some of these other special status species. Therefore, the impacts on special status species would be significant and would occur under the two full replacement alternatives.

If prey availability is a limiting factor for fish-eating birds that are also special status species, reduced fish populations would have an adverse impact on these birds.

Wildlife Movement Barriers and Habitat Fragmentation

In addition to direct habitat loss, construction of the East High Canal and Black Rock Branch would create significant movement barriers for wildlife. The East High Canal, especially north of the proposed Black Rock Coulee Reregulating Reservoir, and parts of the Black Rock Branch that would be constructed through shrub–steppe and steppe grassland habitats, would also fragment blocks of intact habitat into smaller isolated pieces or patches. Habitat fragmentation is the process whereby habitats that were once contiguous become divided into separate fragments. The two components of habitat fragmentation are as follows:

1. Reduction of the total amount of a habitat type in a landscape.
2. Breakup of the remaining habitat into smaller patches of habitat that is separated or isolated from one another.

Both of these outcomes can cause significant impacts on wildlife. Partitioning a population through habitat fragmentation reduces the potential viability of the population over the long term when a minimum viable population size threshold is reached. Small populations are less resilient and less able to adapt to the changes in their environment that may result from random or stochastic events. Small populations have a higher susceptibility to local extinction because of stochastic events.

Habitat Connectivity and Animal Movement

The eight siphons and three tunnels that would be constructed as part of the East High Canal and Black Rock Branch Canal range from 0.1 to 1.3 miles in length. Following construction and site restoration, the siphons and tunnels would effectively act as “crossing structures” for those portions of the canals where they are located. Larger animals such as deer and coyotes would likely use these areas or siphons. Use by small mammals and reptiles would be depend on the success of vegetation restoration efforts and would increase slowly over time for some species following successful restoration.

Importance of Habitat Connectivity

Ecological connectivity is the movement of organisms and the occurrence of ecological processes across an ecosystem over time. Intact ecosystems are structured by dynamic processes that create a shifting mosaic of various habitat patches. The ability of organisms to disperse freely through this mosaic is important to allow genetic exchange, re-colonization of habitats, and maintenance of functioning food webs. Ecological connectivity across a landscape is important for animals because they need to access food resources, migrate to avoid severe weather, find mates, avoid natural events like wildfires, disperse to maintain genetic fitness, and colonize new areas. Young animals also need to access unoccupied areas to set up new territories.

Wildlife movements generally involve one of two factors: seasonal movements between breeding, rearing, and wintering areas; and dispersal, often by juveniles. Dispersal refers to an animal's movement away from an existing local population or away from the parent organism, and is the primary mechanism of movements within large populations or among subdivided populations, both of which allow the populations to better persist over time. Dispersal is fundamental to maintaining populations over the long term through recolonization, the ability to reverse local extinction, and the maintenance of genetic diversity (Lindenmayer and Fischer 2006). The East High and Black Rock Branch canals would present substantial barriers to wildlife movement and isolate or partition some populations.

The width of proposed structures that would allow wildlife to cross the East High Canal and Black Rock Branch Canal are considerably narrower than the dedicated wildlife overpasses that have proven to be successful on highways. Wildlife crossing structures are planned for every 2 miles along the East High Canal. A typical cross section is shown in Chapter 2 (Figure 2-25). As planned, these crossings would be planted with native grasses and forbs. Final planting design would be determined during final design.

The expected effectiveness of these crossing structures in providing connectivity across the movement barrier is unknown. Little research has been done on the use or success of wildlife crossing structures over canals. However, a large body of work exists regarding wildlife crossings over roads, which form a similar, though more permeable barrier to wildlife movements. The word permeable, as used here, describes the ease with which an animal moves across a barrier, with more permeable barriers allowing easier movement. Research on road crossing structures that might indicate the effectiveness of canal crossing structures for getting wildlife across the canals is briefly reviewed in the following text.

Corlatti et al. (2009) recently summarized the research regarding the ability of wildlife overpasses to both provide connectivity across a movement barrier and prevent genetic isolation on either side of a barrier. The likelihood that overpasses would be used by different species depends on a number of factors including the following (Corlatti et al. 2009):

- Locations in relation to migration routes or movement corridors.
- Size, design, and visual appearance.

- Continuity of vegetative cover on both the crossing structure and the approaches to the structure with the surrounding vegetation type.

This summary of crossing structure use by wildlife noted that evidence of the effectiveness of wildlife crossings derived from long-term monitoring programs is very limited for most species (Corlatti et al. 2009), and that virtually no evaluation of dispersal rates before and after construction of roads with overpasses for wildlife has been done. European studies indicate varying levels of use by medium and large mammals including roe deer, red fox, and Eurasian badger. A study in Switzerland using infrared cameras show that dedicated overpasses wider than 200 feet are effective for a wide variety of animals including invertebrates, but that structures narrower than 165 feet are not as effective, especially for larger mammals (Corlatti et al. 2009). The dedicated highway overpasses constructed for wildlife over the Trans–Canada Highway in Banff National Park, Canada, are 165 feet wide, and are effective for a wide range of large mammals, although deer prefer to use underpasses. The Canadian overpasses include wildlife exclusion fences to prevent most animals from crossing the highway except at the crossing structures.

The 14 wildlife-crossing structures planned for the East High Canal and Black Rock Branch Canal would include a 22-foot-wide area planted with native grasses. This is considerably narrower than the dedicated wildlife overpasses discussed above, which would reduce their effectiveness for most wildlife species. The canal, parallel maintenance roads, berms, and spoil pile are estimated to occupy 300 feet of the 600-foot easement, all of which would be cleared of vegetation during construction. Therefore, the easement on both sides of the canals and the approaches to the crossing structures would need to be replanted to provide a degree of continuity with the surrounding native plant communities. Native shrubs planted in the easement would require 15 years or more to achieve the height and structure of the mature big sagebrush that would be replaced. A longer period would be required if the initial revegetation efforts are not successful.

Mule deer that have made traditional seasonal migrations into the analysis area would have a strong memory of past movements and attempt to continue past patterns. Many would likely use the crossings, especially after a few years. Other larger wide-ranging animals, such as coyotes, are much more likely to use these crossings than are smaller species like ground squirrels, small mammals, or reptiles. Crooks and Sanjayan (2006) observed that adaptation to large-scale landscape change, such as a new road, could take several years depending on the species as they experience, learn, and adjust their own behaviors to the wildlife crossings.

Reduced landscape connectivity would result in higher mortality, lower reproductive success, and ultimately smaller populations of small mammals that are vulnerable to local extinction (Crooks and Sanjayan 2006). Dispersal movements by these smaller species tend to be more random, and few individuals may find the crossing structures, especially during the first 15 years following construction. Even after the first 15 years, the rate at which smaller mammals and reptiles would successfully use these structures may continue to be low because of subtle differences in habitat components between native shrub-steppe and restored areas.

Ramps

For animals that accidentally fall into the canal, the feasibility designs include escape ramps constructed into the sides of the proposed canals. Ramps will be constructed with a 4:1 slope and would be surfaced with unreinforced concrete. The concrete surface would be roughened to provide a nonslip surface for adequate footing. A visual and audible barrier would be suspended across the canal immediately downstream of the ramp. The barrier would be angled upstream such that the animals would be directed to the ramp. A ramp will be located 500 feet upstream of all intakes for siphons, tunnels, and check structures. For intakes, a deer-proof fence would be constructed on both sides of the canal from the intake to the visual and audible barrier. Intakes for turnouts and pumping plants do not require a ramp 500 feet upstream of the structure because these intakes are protected by trashracks, which would prevent animals from being drawn into the intake. For canal sections constructed through rock or concrete lined, ramps would be constructed in the side of the canal every mile. Ramps would alternate between each side of the canal. For canals constructed through soil, ramps are not required. It is assumed that the flatter slopes of these sections of canals plus the fact that the slopes are soil animals would have adequate footing to make their escape from the canal.

Gravel access roads are not likely to restrict movements of most wildlife species. Power lines would also not restrict movements, although some bird collisions would be expected during low visibility conditions. Power line poles would provide perches for raptors, perhaps benefitting their foraging success rates at the expense of their prey species.

Species-Area Relationship

Given equal quality, area is a primary determinant of the number of species that occur and numbers of individuals in a block or patch of habitat. The size of the patch would influence the number of species and the number of individuals of each species that are present in an area. In ecology, a species-area curve is a relationship between the area of a habitat, or of part of a habitat, and the number of species found within that area. Larger areas tend to contain larger numbers of species and more individuals of each species (Morrison et al. 2006). Reducing habitat area reduces species diversity and the number of members within a species. Strong positive relationships between the size of an area and species richness (number of species) have been documented in numerous studies for a wide range of species (Lindenmayer and Fischer 2006).

For those species that either would not cross the structures or would do so less often than if the structures were not there, the presence of the canals effectively cuts off dispersal, isolates individuals on either side of the canal, and effectively reduces the size of shrub-steppe blocks or patches in the vicinity of the canals. Fewer species would likely be supported on smaller patches of habitat.

Table 4-50 contains the results of an analysis of shrub-steppe block or patch size within 1 mile of the East High and Black Rock Branch canals. This analysis was conducted to evaluate the extent to which these canals would bisect or isolate existing stands of native shrub-steppe vegetation. The existing, largest shrub-steppe patches would be the ones most severely affected by construction of the canals. Four large patches, each over 4,000 acres, would be bisected by the East High Canal resulting in only one patch larger than 4,000 acres. There would be more than twice as many very small isolated patches of shrub-steppe and steppe grassland habitat within 1 mile of these canals after construction than before construction. One of the main reasons for the large number of smaller patches is the fact that the canals follow topographic contours and therefore meander across the landscape.

Table 4-50. Number and size of shrub–steppe and steppe grassland patches within 1 mile of canals before and after construction.

	Shrub–steppe Patch Size (acres)							
	Greater than 4,000	**1,000 to 4,000**	**500 to 1,000**	**250 to 500**	**100 to 250**	**50 to 100**	**25 to 50**	**Less than 25**
East High Canal								
Number of patches without canals	2	0	3	2	4	7	5	52
Number of patches with canals	1	4	3	4	7	10	15	109
Black Rock Branch								
Number of patches without canals	1	0	1	1	3	1	3	8
Number of patches with canals	0	0	0	1	4	0	6	30
Total for the East High Canal System								
Number of patches without canals	3	0	4	3	7	8	8	60
Number of patches with canals	1	4	3	5	11	10	21	139

Smaller patches of shrub-steppe habitat would likely result in a reduction in both the number of species and number of individuals, because smaller patches would cease to function as habitat for a species if patch size and the area of resources are small in relation to key life history requirements (Morrison et al. 2006). At some point, as the size of isolated habitat patches declines, it would become too small to support certain species because of limited available resources. However, determining this point for an individual species is difficult because of variations across the landscape, including food supplies, density of animals of the same species, competition with other species, patch shape, predators, and landforms (Morrison et al. 2006).

Minimum Viable Population Analysis

Brook et al. (2006) predicted MVP estimates for 1,198 species using several recognized approaches. Based on the MVP estimates for 1,198 species (Brook et al. 2006), populations of two small mammals, a ground squirrel, and a rabbit that are confirmed to occur in the analysis area would be much less likely to survive for 100 years compared to the No Action Alternative. Similar results on other ground–dwelling resident species would be expected and these impacts would be significant. Buried siphons and tunnels would avoid impacts related to fragmentation at those locations.

The median MVP estimate for the 1,198 species was 1,377 individuals based on a 90 percent probability of persistence over 100 years (Brook et al. 2006). Based on this assessment, the minimum patch size needed to sustain small isolated populations of the four species that occur in the analysis area for 100 years are presented in Table 4-51. The number and area of isolated patches that would not meet this minimum patch size after construction of the canals are also shown.

Survival risks for small isolated populations result from a variety of processes such as inbreeding depression, density dependence, catastrophes, and environmental and demographic stochasticity (random variation) (Traill et al. 2007). The relatively large number of patches that are estimated to be too small to support MVPs before construction (Table 4-51) reflects that portions of the canals would be constructed through areas where most of the native shrub–steppe has already been converted to agricultural uses.

Table 4-51. Minimum viable population (MVP) analysis of small patches of shrub–steppe and steppe grassland habitat that would be isolated by the East High Canal and Black Rock Branch Canal.

Species	Density (number per acre)	Estimated Area Required to Sustain the Population for 100 years (acres)	Number of Isolated Shrub–steppe Patches within 1 mile of the Proposed Routes of the East High Canal and Black Rock Branch that are Smaller than the Estimated Area Required to Sustain Populations		
			Number of Shrub–steppe Patches Along Proposed Route Before Canal Construction*	Number of Shrub–steppe Patches Along Proposed Route After Canal Construction	Area of Additional Fragmented Habitat After Canal Construction (acres)
North American deer mouse (*Peromyscus maniculatus*)	1.3 to 2.7	510 to 1,059	81 to 85	186 to 189	610 – 2,806
Western harvest mouse (Reithrodontomys megalotis)	0.5 to 1.5	918 to 2,754	80 to 81	189 to 193	1,589 – 9,539
Washington ground squirrel (*Spermophilus washingtoni)*	2.5 – 9.7	142 to 550	78 to 85	175 to 186	1,789 – 3,499
Nuttall's cottontail (*Sylvilagus nuttallii)*	0.1 to 1.0	1,377 to 13,770	64 to 67	189 to 194	611 – N/A

*Current fragmentation has resulted from past agricultural development.
Sources: Brook et al. 2006; Klein 2005; NatureServe 2009; and Parmenter et al. 2003; and Watson unpublished

Isolation of habitat fragments from one another can ultimately lead to population declines (Hilty et al. 2006). Researchers have documented local extinctions of species in small habitat patches where access to large core habitat areas or other habitat fragments have been cut off (Hilty et al. 2006). Even maintaining a population above this threshold does not assure long–term survival because the number of individuals required to carry out ecological functions would be much bigger than the minimum required for the species to persist (Soule et al. 2003). Similar effects would be expected for other ground–dwelling animals on small isolated habitat patches.

Buried siphons and tunnels would avoid impacts related to fragmentation at those locations. However, the siphons and tunnels would not be expected to offset the impacts of the canals because they are widely spaced relative to the low mobility of the affected species.

Benefits for Wildlife

Some wetland and riparian habitat would develop along the shoreline of Black Rock Coulee Reregulating Reservoir because the water level would be kept relatively stable. However, the relatively steep topography and erosive forces would likely limit this development. The reservoir would provide loafing habitat for waterfowl but nesting habitat would be limited be the shoreline topography. Leaks in the new canals would probably allow a small amount of wetland habitat to develop at a few locations on the west side of the canals.

Changes with Limited Spring Diversion Scenario

Changes to this analysis for Alternative 3A with the Limited Spring Diversion Scenario would impact Western grebe in that the average year is similar to dry and drought years as grebe nesting is completely lost or adversely affected.

4.9.6 Alternative 3B: Full—Banks + FDR

Except for Banks Lake, short-term and long-term impacts on shrub–steppe habitats and associated wildlife would be the same as Alternative 3A. Impacts to wetland habitats and associated wildlife would be similar to Alternative 3A, except as described below for long-term impacts on grebes and other birds nesting in emergent wetlands at Banks Lake. Mitigation measures and limitations would be the same as Alternative 3A.

4.9.6.1 Long–term Impacts

Banks Lake

Grebes nesting at Banks Lake would be significantly impacted by implementation of this alternative. Under this alternative, the reservoir would be about 2 feet below full pool at the start of the grebe nesting season in dry and drought water years (Section 4.2 – *Surface Water Quantity*, Table 4-18). This would reduce the amount of grebe nesting habitat at the beginning of the nesting season. Further drawdowns during the nesting season would not occur in these water year types so nesting success would not be impacted. In average years, the reservoir would be full at the beginning of the nesting period, but drop nearly 3 feet by the end, affecting nest success.

Changes with Limited Spring Diversion Scenario

Impacts anticipated with the Limited Spring Diversion Scenario would be that average water years look like dry and drought years resulting in lost nesting habitat prior to nest habitation but no affects on nest success.

4.9.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

4.9.7.1 Short–term Impacts

Short-term impacts for this alternative would be similar to those discussed for Alternative 2A. These impacts would involve lands both north and south of I-90 serving approximately 70,000 acres of eligible cropland. The only shrub–steppe loses would occur south of I-90; all facilities north of I-90 would be located on previously disturbed land. Consequently, impacts to native vegetation would be similar to that described for Alternative 2A. The necessary infrastructure would closely mirror the areal impacts as described for Alternative 2A with the exception of the distribution of CBP water both north and south of I-90.

4.9.7.2 Long–term Impacts

Upland Vegetation Types and Species

Construction of the East Low Canal expansion would permanently remove about 112 acres of sagebrush steppe and 18 acres of steppe grassland, and impact a wide range of species; an adverse impact.

The East Low Canal is a barrier to movement by ground-dwelling animals and has been for many years. The East Low Canal also severely restricts or eliminates the ability of some wildlife species to cross the canal, especially since many such movements occur during and just after the breeding season when the canal is full of water. However, because of the already patchy nature of the remaining wildlife habitat, expansion of the East Low Canal is not expected to increase the degree to which wildlife movements are restricted.

Although much quieter than construction activities, noise from the operation of pump stations would displace some wildlife from the immediate vicinity of the station.

Some birds would occasionally be killed by colliding with the 84 miles of new transmission lines (Barrientos et al. 2011). This problem tends to affect larger, slow-flying birds during low light or foggy conditions. Electrocution of raptors is not expected to be a problem because of the design of power lines as described in the BMPs.

The only area evaluated during the HEP study that would be affected under Alternative 4A is the East Low Canal. Because more of the study sites used during the HEP analysis would be affected under the full replacement alternatives, the HEP study results are presented under Alternative 3A: Full—Banks.

North of I-90, wildlife impacts would be temporary as revegetation and continuation of current farming practices would be little changed from current conditions. The lands that may receive Project water under the infill concept would be limited to those parcels that are currently farmed or have been previously disturbed and offer little to no wildlife habitat benefits.

Banks Lake

No significant long-term impacts on Banks Lake fish populations are anticipated under this or the other partial replacement alternatives. Therefore, no long-term impacts on fish-eating birds are expected. Based on the analysis of piezometer data, the data presented in Table 4-43) indicate that emergent wetland plants growing in Banks Lake fringe wetlands would continue to survive without additional stress. However, many species of wildlife, including waterfowl, grebes, and some neotropical migrant songbirds, nest within these emergent wetland communities where they are protected from mammalian predation by standing water in the wetlands.

The current operation of Banks Lake generally keeps the reservoir full until August 1, and it drops to about 1,565 feet amsl by August 31 (Section 4.2, Figure 4-3). Operational changes under Alternative 4A: Partial—Banks would begin to drawdown Banks Lake from 1 to 3 months earlier, depending on the amount of snow and rain in the watershed. Drawdowns would begin earliest in the driest and wettest years. Based on straight–line projections of modeled month–end elevations, the drawdowns under this alternative would reach 1,565 feet amsl sometime in August in all water year types after most grebe broods have hatched. In average water years, Banks Lake would be full at the beginning of the nesting season and drop about an additional 1.5 feet by the end of July when most broods have hatched. Nesting habitat would not be eliminated prior to the nesting season but nest success would be adversely affected. In dry and drought years, nesting habitat would be reduced as the reservoir would be drawn down about 2 feet at the start of the nesting period in mid-June. Nest success would also be adversely impacted as the reservoir drops an additional 2 to 2.5 feet during the nesting period

All of the impacts on wildlife associated with construction noise, displacement, and road kill that were described under Alternative 2A would occur on a slightly larger scale and affect more area and more wildlife under Alternative 4A.

Special Status Species

The East Low Canal enlargement that is part of Alternative 2A would be identical under this alternative but the extension of that canal would not occur. The lateral pipelines south of I–90 would be similarly located under both Alternatives 2A and 4A, but they would be shorter in length under Alternative 4A. North of I-90, only Alternative 4A would involve the construction of pipelines but these would be located on previously disturbed lands or within existing utility corridors. Alternative 4A does include an infill component that would allow some lands not currently irrigated by groundwater to be served with Project water. The infill component would be limited to those lands that are currently farmed or previously disturbed. Consequently, impacts to special status species would be similar under this alternative relative to the impacts described for Alternative 2A.

Changes with Limited Spring Diversion Scenario

Impacts anticipated with the Limited Spring Diversion Scenario would be that average water years look like dry and drought years giving rise to loss in nesting habitat prior to nest habitation and impact on nest success during the nesting season.

4.9.8 Alternative 4B: Modified Partial—Banks + FDR

Short-term and long-term impacts to habitats and associated wildlife are the same as Alternative 4A, with the exception of potential impacts to grebes and other birds nesting in emergent wetlands at Banks Lake. Drawdowns of Banks Lake reservoir would be less under this alternative compared to Alternative 4A but the differences are relatively small during the primary nesting period. In dry and drought years, drawdowns early in the summer would limit the availability of nesting habitat but stable elevations during the nesting period would eliminate impacts to nest success compared to Alternative 4A.

Changes with Limited Spring Diversion Scenario

Impacts anticipated with the Limited Spring Diversion Scenario would be that average water years look like dry and drought years giving rise to loss in nesting habitat prior to nest habitation but little no affect on nest success due to static water levels at this time.

4.9.9 Mitigation

Alternative 2A/2B:

WDFW and Ecology have entered into a mitigation agreement intended to address situations where Office of Columbia River projects would result in loss of shrub-steppe habitat. This agreement applies to the Odessa Study; however, since that project is a groundwater replacement project and would not expand irrigated acreage over current levels, any potential loss of shrub-steppe habitat would be limited to relatively small areas associated with construction of pumping plants and pipelines. Reclamation is not a party to the agreement nor is it bound by it.

Mitigation measures for vegetation and wetlands are intended to revegetate native habitats that would be impacted by construction activities. Habitat restoration goals, success criteria, and monitoring protocols would be developed in cooperation with WDFW and would include measures in addition to those for vegetation and wetlands. Mitigation would include both the restoration of degraded shrub-steppe areas, as well as re-establishment of shrub-steppe on sites that formerly supported shrub-steppe habitat types. Potential locations to implement these mitigation measures have not been identified.

All restoration or in-kind replacement of impacted habitat on private lands would be subject to landowner approval. Vegetation types disturbed during pipeline construction would be restored in-kind. About 112 acres of shrub-steppe habitat and 18 acres of steppe grassland types that would be lost during expansion and extension of the East Low Canal could not be replaced at the site of the impacts because the canal would occupy these areas. If in-kind replacement cannot be done on private lands, another suitable site would be found.

The success of revegetation efforts depends on a several factors and is not assured, as described in Sections 4.8 – *Vegetation and Wetlands*, and 4.31 – *Environmental Commitments*. Full restoration of native shrub-steppe habitats to preconstruction conditions would not be possible, and would not fully replicate the plant species diversity of existing higher quality stands of shrub-steppe and steppe grassland. Impacts on wildlife use of revegetated lands would continue at least until planted shrubs achieve mature stature in perhaps 15 years or more. The extent to which impacted wildlife would reoccupy revegetated sites would depend on the success of the revegetation efforts. These limitations apply to restoration of shrub–steppe habitats under all of the alternatives.

Some portions of rocky spoil piles would be configured to provide predator–proof artificial nesting structures for burrowing owls.

Proposed mitigation measures for grebes involving the installation of nesting platforms have been developed with input from WDFW's 2010 Final Wildlife Report, as well as outlined in the *Intermountain West Waterbird Conservation Plan for Aechmophorus grebes in Washington State* (Ievey and Herziger 2006).

Alternative 3A/3B

Mitigation measures and limitations described for Alternative 2A: Partial—Banks would be implemented. About 1,800 acres of shrub-steppe impacted during pipeline and canal construction would be reseeded as described in Section 4.8 – *Vegetation and Wetlands*. The success of revegetation efforts depends on a several factors and is not assured. Impacts on wildlife use of revegetated lands would continue at least until planted shrubs achieve mature stature in perhaps 15 years or more. The extent to which impacted wildlife would reoccupy revegetated sites would depend on the success of the revegetation efforts. About 2,470 acres of shrub-steppe habitat types that would be lost during construction cannot be replaced at the site of the impacts because canals and reservoirs would occupy these areas. Mitigation of these losses would have to be implemented at one or more offsite locations.

The effectiveness of the wildlife crossing structures would likely be improved by implementing the following actions:

- A triangular-shaped area of native vegetation within the canal easement on both sides of each wildlife crossing would be preserved during construction. Each area would taper from 300 feet wide at the outside edge of the easement to the width of the crossing structure adjacent to the canal. This preserved vegetation would encourage a higher level of use of the crossing structures immediately after construction because it would match the existing habitat type outside of the easement.
- Adaptive management actions would be implemented to improve the effectiveness of crossing structures.

Alternative 4A/4B

Mitigation measures for this alternative would be the same as for Alternative 2A.

4.10 Fisheries and Aquatic Resources

Fisheries and aquatic resource health are strongly linked to water quality conditions and ecosystem function (Postel and Richter 2003). Changes in fish assemblages are influenced by variables such as water flow and temperature, dissolved oxygen, predation, competition for food resources and habitat, and entrainment in regulated systems. Changes in water surface elevations or flow, as proposed in the various study alternatives, can alter temperature, dissolved oxygen, fish movement and distribution, and habitat availability, which in turn can impact the health and overall sustainability of fish assemblages.

Under the No Action Alternative, no short- or long-term impacts on fisheries and aquatic resources would occur. However, under all of the action alternatives, long-term reductions in Columbia River flows and reduced water surface elevations in Banks Lake would occur. Slight reductions (up to 2-1/2 feet) in water surface elevation at Lake Roosevelt would occur during the summer under the three alternatives that include Lake Roosevelt (Alternatives 2B, 3B, and 4B).

Impacts to fisheries and aquatic resources at Banks Lake under the partial replacement Alternatives 2A and 2B and modified partial replacement Alternatives 4A and 4B would be similar, with relatively minor drawdowns ranging from 0 to 7 feet drawdown over the No Action Alternative. The full replacement Alternative 3A would have significant drawdowns during dry and drought years, ranging from 9.5 to 10.0 feet during peak drawdown periods as well as extended drawdown periods during portions of the rest of the year. The full replacement Alternative 3B has only moderate drawdowns May through June but has additional drawdowns that occur October through February. These drawdown impacts would include the potential for reduced habitat availability for various life stages of fish, changes in fish distribution, shifts in zooplankton production, increased exposure of littoral zones, and increased fish and zooplankton entrainment.

For the Columbia River, the largest reduction in flows would occur in October when adult fall Chinook salmon and steelhead trout are migrating up the lower and mid-Columbia River for all action alternatives. These flow reductions, however, are a small fraction of the overall Columbia River flows. No impacts to minimal impacts to these adult migrating fish are anticipated. No flow reductions would occur in November when fall Chinook spawn in the free-flowing Hanford Reach of the Columbia River and chum salmon spawn below Bonneville Dam. The slightly lower October flows under all alternatives would be managed within the flexibility of FCRPS operations to avoid adversely impacting spawning success. During the salmonid smolt downstream migration season from mid-April through September, flows would be slightly reduced under all of the action alternatives in April, May, and June under wet and average years. These relatively minor flow changes would occur only when the flow objective at McNary Dam and Priest Rapids Dam, established for ESA-listed salmonids, are exceeded. No impacts to minimal impacts on salmonid smolt survival during the spring months would be expected in some years for those alternatives not using Lake Roosevelt storage.

No impacts would occur to fisheries and aquatic resources in the broader central Washington and CBP area under the No Action Alternative or any of the action alternatives.

4.10.1 Methods and Assumptions

4.10.1.1 Impact Indicators and Significance Criteria

The impact indicators and associated criteria for determining significance, summarized in Table 4-52 were used to evaluate impacts to fisheries and aquatic resources. These criteria and the methods used to analyze them are described for each of the affected water bodies following the table.

Table 4-52. Fisheries and aquatic resource impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Columbia River	
Downstream migration of salmonid smolts	From mid–April through August, delay of the downstream migration of smolts through reduced flows would be a significant impact in drier years.
Upstream migration of adult salmon and steelhead	If upstream migration of adult salmon and steelhead is delayed by flow reductions, particularly in September and October when flow differences would be greatest, this would be a significant impact.
Chum salmon spawning below Bonneville Dam	Tailwater elevations below Bonneville Dam should be maintained at target elevations (approximately 11.5 feet) from early November to mid–April to provide water coverage of chum eggs and fry. Tailwater elevations below this would be considered significant.
Lake Roosevelt	
Zooplankton production	Impact would be indicated by summer lake elevations and associated water particle travel time. An adverse impact on zooplankton production that would result in a measurable decline in the growth potential of important fish species would be significant.
Rainbow trout net pen program	Impact indicated by lake levels during the maximum annual drawdown period resulting in an impact on operations of the net pen program would be a significant impact.
Kokanee salmon spawner access to San Poil River	Impact indicated by the frequency and duration that lake levels exceed 1283 feet amsl by the end of September. Lake levels below 1283 feet amsl may impede kokanee spawner access to the San Poil River.
Banks Lake Reservoir	
Fish and zooplankton entrainment	An increase in fish and zooplankton entrainment that would cause a decline in the growth potential or abundance of fish greater than 100 mm in length in Banks Lake would be a significant impact.
Surface areas of littoral habitat temporarily exposed during drawdowns	An increase in littoral area exposure and duration that results in measureable and significant decreases in invertebrate production would be a significant impact.
Overall condition of the fishery	Measurable and significant reductions in fish reproduction, growth rates (based on bioenergetics modeling), survival, or fish community composition would be significant impacts.

4.10.1.2 Impact Analysis Methods

Impacts on fisheries or changes in the condition of fish habitat that would occur under each of the alternatives are compared against the current conditions within the Study Area, which are the same as those that would persist under the No Action Alternative.

Columbia River

The analysis of impacts of the alternatives on Columbia River anadromous salmonids is based primarily on the flow changes that would occur in the river. Because anticipated impacts of flow reductions are most evident in the drier years, the predicted changes with the base case are depicted using the same categories of water year types used by NMFS in their recent BiOps. These year-type categories, based on ranking of the annual water volume at The Dalles Dam, are described in Table 4-53. The frequency of occurrence of these water years varies somewhat from those presented in Chapter 2 and used in this EIS because of different modeling approaches.

Table 4-53. Description of water year categories.

Water–Year Category	January to July Water Volume Runoff at The Dalles Dam
Dry	Average of less than 72 MAF (8)
Dry–Average	Average of 73 – 100 MAF (21)
Wet–Average	Average of 101 – 120 MAF (26)
Wet	Average of greater than 120 MAF(15)
Numbers in parenthesis are the number of years out of 70 (1929–1998) under the Base Case that these conditions occurred.	

Flow changes in the Columbia River were developed by applying the results of the RiverWare model (used to develop the alternatives and described in Section 3.2 − *Surface Water Quantity*) to the HYDSIM model through a spreadsheet model, which then predicted monthly average changes to Columbia River flows. Model results have been revised to reflect more current information. These flow changes were assumed concurrent in the same month at each Columbia River dam from Grand Coulee to Bonneville. In the way that the system is operated, flow response time (different from water particle travel time) from Grand Coulee Dam to Bonneville Dam is about 2 days. Thus, in a monthly model, the flow changes would appear to be concurrent at all dams. Base flows (that is, flows under the No Action Alternative) at Grand Coulee Dam for the 1929 through 1998 water years were used as the starting point for computing monthly flow changes (delta flows) on the Columbia River that would result from implementing each of the six action alternatives.

Monthly delta flows for each alternative were categorized into the four water-year types. The flow changes for mid-April through June are highlighted because this period corresponds to the downstream smolt migration of most anadromous salmonid populations in the Columbia River. The exceptions are upper Columbia summer/fall Chinook salmon and Snake River fall Chinook salmon, both of which exhibit a protracted migration from early June through mid-August. July, August, and September flow changes are not highlighted because it was assumed during alternative development that additional water would not be diverted during these 3 months.

Lake Roosevelt

The impact analysis for Lake Roosevelt is based on simulated monthly changes in water surface elevations derived by a spreadsheet model that computed changes based on the RiverWare and HYDSIM modeling results. The end-of-period elevations for the 70-year period (1928 to 1998) are compared to those for the No Action Alternative. This approach to assessing anticipated impacts on fish resources of these water surface elevation changes is similar to that presented in the Final Supplemental EIS for the Lake Roosevelt Storage Release Program prepared by Ecology in August 2008 (Ecology 2008).

Banks Lake

The impact analysis for Banks Lake is based on simulated changes in month-end water surface elevations for each alternative compared to the No Action Alternative. Model results have been revised using more current data. These data combined with bathymetric information were used to assess resultant impacts on littoral habitat. The Banks Lake Drawdown Final EIS prepared by Reclamation (2004) provided a guideline for assessing impacts to fisheries and aquatic resources in Banks Lake. A number of studies contracted by Ecology and under the oversight of WDFW, as well as ongoing studies conducted by the WDFW as part of the BPA-funded Banks Lake Fishery Evaluation Project were ongoing during the preparation of the Draft EIS and were not completed in time for publication of the Draft EIS. These studies are now completed and are incorporated into this Final EIS.

Shoreline Habitat and Fish Community Studies

Ecology contracted Central Washington University (CWU) with oversight by WDFW to evaluate shoreline exposure and habitat losses that would occur at varying lake elevation changes. CWU used GIS to quantify the exposure of littoral habitat through an 18-foot lake level drawdown for each shoreline habitat type using topographic and bathymetric information digitized from Reclamation maps. The estimates of littoral habitat exposure were quantified by habitat type and mapped on a Banks Lake shoreline GIS map created in their previous study. CWU also linked georeferenced, seasonal fish community data collected by WDFW from 2002 to 2006. Fish data was collected using a combination of electro-fishing, gill nets and fyke nets in various shoreline types. Aquatic vegetation and substrate were characterized for each shoreline habitat type.

Fish Habitat, Fish Bioenergetics and Zooplankton Entrainment Studies

Ecology contracted with Portland State University (PSU) with oversight by WDFW to develop a hydrological model for Banks Lake. This model, CE-QUAL-W2, was used to assess the effects of alternatives in the Draft EIS on optimal fish growth habitat using temperature and dissolved oxygen criteria for 4 popular Banks Lake game fish: rainbow trout, kokanee, walleye and smallmouth bass. Results of water quality modeling associated with this model is discussed in Section 4.4 – *Water Quality*. PSU also used the CE-QUAL-W2 model to calculate zooplankton entrainment for the Draft EIS alternatives. PSU (McCulloch et al. 2011 Management) examined the effects of the Draft EIS alternatives on fish growth and consumption using a fish bioenergetics model developed for Lake Roosevelt in association with the CE-QUAL-W2 model.

The PSU studies were conducted with modeling and alternatives using values from the Draft EIS. Since that time, the alternatives have been modified and the hydraulic model has been updated. Table 4-54 below shows the equivalent alternatives. While such comparisons are not exact, it does allow the information from these PSU studies to be applied to the analysis in this Final EIS.

Table 4-54. Equivalent alternatives for purposes of comparing results of PSU studies to the revised flow model and revised alternatives in the Final EIS.

Draft EIS Alternatives	Final EIS Alternatives	Differences, if any
2A	2A	Nearly identical.
2B	2B	Nearly identical.
3A	3A	Both versions of 3A are similar, but the Draft EIS version has more drawdown December through April in drought conditions. Alternative 3A Final EIS has no or low drawdown in February, March, and April compared to Draft EIS version.
3B	3B	Both versions are similar, but Alternative 3B Final EIS has more October to January drawdown for average and dry conditions. Alternative 3B Final EIS also has little winter drawdown compared to consistent winter drawdown in drought conditions in the original Alternative 3B Draft EIS version.
2A	4A	Alternative 4A Final EIS is similar to Alternative 2A Draft EIS except Alternative 4A has higher September drawdowns for drought and dry conditions.
2B	4B	Alternative 4B is comparable to Alternative 2B in the Draft EIS.

Fish Entrainment Studies

Hydroacoustic Technology, Inc. (HTI) was contracted to identify the magnitude and timing of fish entrainment at the powerhouse intake over two annual water irrigation cycles. A hydroacoustic monitoring system was installed and operated 24 hours per day 7 days/week during the sampling period. The hydroacoustic fish entrainment data was collected concurrently with gill netting efforts conducted by WDFW upstream of the intake. The concurrent netting served as complementary information to the hydroacoustic fish entrainment estimates, and provided fish species composition and fish size information.

Overall Study Area and Broader Central Washington/CBP Area

No existing water bodies in the overall Study Area other than Lake Roosevelt, Banks Lake, and the Columbia River are anticipated to be impacted by the alternatives.

4.10.1.3 Impact Analysis Assumptions

Broadly, applicable legal requirements for aquatic resources are described in Chapter 1, Section 1.6 – *Relationship of the Proposed Action to Other Projects or Activities*, as well as in Chapter 5 – *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all regulations would be followed, along with the BMPs listed for water quality in Section 4.31 – *Environmental Commitments*.

Legal Requirements and BMPs for Fisheries and Aquatic Resources

Reclamation is to operate Grand Coulee Dam, Lake Roosevelt, and Banks Lake in a manner that helps meet Columbia River flow objectives for conservation of ESA–listed anadromous salmonids under the obligations of the 2010 FCRPS BiOp (NMFS 2010 BiOp). In addition to these Federally established flow objectives for the Columbia River, minimum flow requirements at various locations in the Columbia River must also be met under WAC 173 563, Establishment of Instream Flows for Instream Uses.

No BMPs are recommended under this EIS to reduce adverse impacts on fish and aquatic resources beyond those developed for water quality, listed in Section 4.31 – *Environmental Commitments*.

4.10.2 Alternative 1: No Action Alternative

4.10.2.1 Short–term Impacts

No short-term impacts are anticipated because no new facilities would be constructed under this alternative and no changes to water surface elevations or water retention times would occur under this alternative.

4.10.2.2 Long–term Impacts

No long-term impacts are anticipated for fish and aquatic resources in the Columbia River, Lake Roosevelt, Banks Lake, or the Study Area and broader central Washington/CBP area for the No Action Alternative because no additional water would be withdrawn and no changes to water surface elevations or water retention times would occur.

4.10.3 Alternative 2A: Partial—Banks

4.10.3.1 Short–term Impacts

Assuming full compliance with all of the legal requirements, no short–term impacts to fisheries and aquatic resources in the Columbia River, Lake Roosevelt, or Banks Lake are anticipated because no construction activities would occur near these water bodies. Short-term impacts to water quality in the Study Area and broader central Washington/CBP area resulting from construction activities would occur, but are not anticipated to impact fish and aquatic resources.

4.10.3.2 Long–term Impacts

Columbia River

The analysis of effects for the Columbia River consists of evaluating impacts of the alternatives on: (1) downstream salmon and steelhead smolt migration; (2) upstream salmon and steelhead adult migration, and (3) chum spawning below Bonneville Dam. To help understand the effects of alternatives on these three criteria, the analysis is divided into three time periods: September - October, November through mid April and mid-April through August.

September – October

Columbia River flows during the September through October period effect adult fall Chinook upstream migration. The primary adverse effect to look for is whether flow reductions can result in migration delays. In general, adult salmon and steelhead are known to pass through the reservoirs on the Columbia River quite rapidly. Migration rates are believed to be similar to or faster in the slower currents of the reservoirs compared to pre-dam riverine conditions (Naughton et al. 2005). However, migration delays have been documented to occur at some dams as a result of fall back (adult fish passing back down through the dams they had just ascended) and difficulties finding fishway entrances. Both of these observed delay factors are more pronounced during periods of greater flow and higher spill rates at the dams, primarily during the spring and early summer (Dauble and Mueller 1993).

Anticipated impacts of Alternative 2A: Partial—Banks and the other action alternatives are related to changes in Columbia River flows. Figure 4-27 illustrates the monthly decreases in flows when compared to No Action for each action alternative. The largest flow reductions occur during October for all of the alternatives including Alternative 2A, which corresponds to the primary refill period for Banks Lake. There are no flow decreases for September under any action alternative. During the September through October period, the peaks of the fall Chinook salmon and steelhead trout adult migrations occur in the lower and mid-Columbia River. While flow decreases for Alternative 2A range from 2,185 to 2,289 cfs for the average, dry and drought years and 1,321 cfs for wet years, the flows in the Columbia River below Bonneville Dam average 112,493 cfs in October. These decreased flows range from 1.2 percent to 2.0 percent of the Columbia River flows, which is a small amount. These October flow decreases resulting from Alternative 2A are not expected to cause any delay in the upstream migration of fall Chinook salmon or steelhead trout.

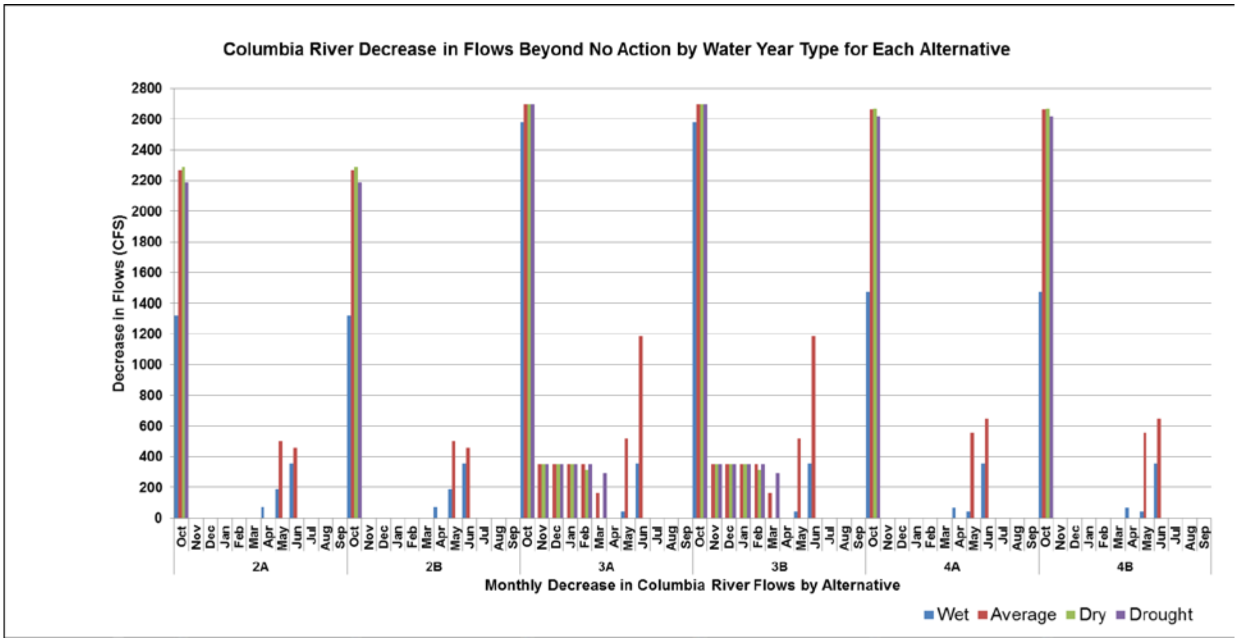


Figure 4-27. Columbia River flow decreases beyond No Action by water year type for each alternative.

November – Mid-April

Columbia River flows during the November through mid-April period can potentially effect fall Chinook spawning in the Hanford Reach, as well as chum spawning conditions below Bonneville Dam. The primary adverse effect to look for is whether flow reductions affect the ability of Grant County PUD to meet its flow obligations outlined in the Hanford Reach Fall Chinook Protection Program (HRFCPP); and whether target elevations for chum salmon spawning can be met in the tailrace below Bonneville Dam.

The Hanford Reach of the Columbia River is the 44-mile long free-flowing reach between Priest Rapids Dam and McNary Reservoir. The fall Chinook population that spawns in the Hanford Reach is considered the healthiest inland stock of Chinook salmon in the Pacific Northwest (Huntington et al. 1996). Annual spawning escapement to the Hanford Reach since 1993 has averaged approximately 50,000 (Geist et al. 2006). The productivity of this population has improved considerably since the late 1980s, because of reduced harvest and implementation of the mitigation and protection measures outlined in the Vernita Bar Settlement Agreement and the revised HRFCPP, which have provided for more stable spawning flows and ensures that subsequent minimum flows keep a high percentage of the spawning redds covered with water through fry emergence in the spring. These protective flow measures require close coordination among the FCRPS agencies and the three mid-Columbia PUDs.

The HRFCPP stipulates certain flow targets during the spawning and egg incubation period and limits flow fluctuations during the post-emergent fry period. More specifically, during the fall Chinook spawning period, which peaks in November (Dauble and Watson 1997), flows from Priest Rapids Dam are manipulated by Grant County PUD No. 2 (licensee for Priest Rapids Hydroelectric Project) to the extent possible to minimize the formation of spawning redds above the 70 kcfs water surface elevation. Because daily average flows are usually higher than 70 kcfs, the spawning flow objective is accomplished primarily by reducing flows during the daytime when most Chinook tend to initiate spawning.

The HRFCPP also restricts how much and how often flows can be reduced or fluctuated within a day from Priest Rapids Dam during the several months after fall Chinook have spawned. These limitations are intended to protect incubating eggs and newly hatched fry from desiccation and stranding. The allowable flow changes vary by the amount of daily average flow entering Priest Rapids pool. When inflows are lower, the allowable fluctuation tends to be less.

Chum salmon need stable spawning flows to keep redds covered from November through fry emergence in spring. The target elevation of the tailwater at Bonneville Dam is to be maintained at 11.5 feet.

Alternative 2A: Partial—Banks would not change November flows, and thus would not impact the ability of Grant County PUD to meet its target flow obligations outlined under the HRFCPP. There would be no impact to fall Chinook spawning on the Hanford Reach.

Additionally, Alternative 2A: Partial—Banks Lake would not impact chum salmon spawning or incubation flows downstream of Bonneville Dam because there are no appreciable flow changes in the Columbia River under this alternative during the November to December spawning season or during subsequent egg incubation months.

Mid-April – August

Columbia River flows during the mid-April through August period can potentially affect downstream migrating salmon, steelhead, and smolts. The primary adverse effect to look for is whether flow reductions can result in migration delays. The blue box below discusses the factors that must be considered in understanding the relationship between streamflows and smolt survival. Following the blue box is further discussion of the influence of snowpack conditions on the Columbia River, managed releases of cold water and local adaptations of salmonid populations to temperature and hydrological patterns.

What is the Relationship Between Streamflows and Fish Survival?

Flow objectives and augmentation have been central components of the Columbia River salmon management program since the early 1980s (ISAB 2003, ISAB 2004). This was based on the hypothesis that higher flows result in higher smolt survival, because faster water velocities result in shorter downstream migration times and therefore lower exposure to predators and optimal time of ocean entry. Recent studies have helped to clarify mechanisms responsible for individual mortality of juvenile fish, and their relationship with river conditions. A key insight is that smolt survival through Columbia reaches and reservoirs can be represented as a function of distance traveled, as migrating smolts pass through a gauntlet of relatively stationary birds and piscivorous fish (Zabel et al. 2005, Anderson 2005). Several factors correlated with flow may independently influence the predator encounter rate and efficiency, including temperature, turbidity, and dam operations and configuration (Williams et al. 2005; Zabel et al. 2008). Additional mechanisms related to river flow may influence survival during later life stages, including access to floodplain habitat at critical flow thresholds and timing of arrival in the ocean.

Within years, there is typically a relatively high statistical correlation between migration distance and travel time, and travel time and survival rates (Raymond 1968, Schaller et al. 2007). However, fish residence time at the dam is not a simple function of mean water travel time. Speed of dam passage can be influenced by flow, spill, powerhouse operations (Goodwin et al. 2006), and smolt species, condition or level of smoltification (Zabel et al. 2005). When dam operations have not been optimized for efficient passage, smolts can potentially spend hours in the forebay searching for a successful passage route. Likewise, unfavorable tailrace conditions may cause smolts to circulate in eddies for extended periods, because complex circulation creates confusing signals about the overall direction of river flow. In turn, predators are abundant and move in these eddies, so the number of encounters between a predator and a smolt depends on the residence time before ultimately clearing the area (Ward et al. 1995). Some projects have attempted to optimize spill patterns to achieve rapid clearance from the tailrace where predators may congregate. Total flow volume, balance of spillway and powerhouse operations, and river bathymetry influence the circulation pattern (Rakowski et al. 2010). The installation of spillway weirs at most mainstem dams since 2005 has added surface passage routes not provided by the relatively deep entryways for regular spillway and powerhouse routes (Johnson et al. 2005). Spillway weirs provide particularly efficient passage for smolts, particularly steelhead, because the fast surface velocities provide strong attraction flow with a relatively small volume of flow, and survival rates have increased (Muir and Williams 2011).

Survival through reservoir reaches is often greater in high water years compared to low water years because temperatures are typically lower and turbidity is higher, and both factors tend to decrease the efficiency of predators in detecting and catching smolts. Turbidity inhibits visual predators such as cormorants, terns, walleye, northern pikeminnow, and smallmouth bass (Gregory and Levings 1998). Petersen and Kitchell (2000) estimated substantially higher rates of predation by northern pikeminnow during climate periods when peak summer water temperatures were up to 2°C higher. Finally, physical access to floodplains during spring flows may temporarily offer shelter or food sources unavailable in the main channel (Tomlinson et al. 2011). Most of the mainstem Columbia River lies in a deep canyon with sparse riparian vegetation, however side channel or marsh habitats are occasionally accessible, when flows exceed a minimum threshold.

The mountain snowpack above tributaries of the Columbia River drives the interannual correlation between flow volumes and water temperatures (Mantua et al. 2010). The snowpack determines the volume of the freshet and the rate of warming in spring. After snowmelt has diminished in summer, mainstem water temperatures start to equilibrate with mean daily air temperature.

In considering the relationship between streamflow and fish survival (see blue box), it is also important to bear in mind that the mountain snowpack above tributaries of the Columbia River drives the interannual correlation between flow volumes and water temperatures (Mantua et al. 2010). The snowpack determines the volume of the freshet and the rate of warming in spring. After snowmelt has diminished in summer, mainstem water temperatures start to equilibrate with mean daily air temperature. Modelers are able to accurately represent Columbia River temperatures as a function of air temperatures, snowmelt/upstream temperatures, soil and vegetation type, wind, and humidity; as an isolated variable, flow volume does not influence water temperatures except via the evaporation rate in a shallow vs. deep river channel (Yearsley 2012). Managed releases of cold water stored in deep flood control reservoirs are capable of influencing water temperatures for moderate distances downstream; however, flow augmentation from shallow or well-mixed reservoirs has a small influence on water temperatures. Most mainstem Columbia reservoirs are relatively low head and fall in this latter category, including Lake Roosevelt above Grand Coulee dam, which is only briefly thermally stratified in late summer (Vermeyen 2000). For example, Dworshak is the only high-head reservoir in the Snake River system capable of significantly cooling the downstream reach to Lower Granite dam; in contrast, summer water releases from Brownlee would potentially have a warming effect on downstream reaches (ISAB 2004). At particularly high volumes, total dissolved gas (TDG) may exceed physiological thresholds for smolts, although spill at hydro projects is managed to avoid creating this hazard.

Additionally, salmonid populations become locally adapted to the average temperature and hydrological patterns via selection on the traits of migration timing and cues used for spawning (Quinn et al. 2000; Brannon et al. 2004; Waples et al. 2008). The lower Columbia River only exceeds physiological temperature limit by late July, when most juvenile salmon have already left the river system, or occupy thermal refugia such as Lower Granite reservoir (McCullough 1999; Richter and Kolmes 2005). Juvenile and adult migration timing in rivers at more southern latitudes is seasonally adjusted to avoid adverse temperatures (Waples et al. 2004). Other studies hypothesize that alteration of the timing of peak flow and flood frequency due to changes in snowpack or reservoir management could be a force of contemporary evolutionary selection (Beechie et al. 2006; Wenger et al. 2010). Timing of arrival in the estuary and Columbia plume has been observed to have a significant effect on post-Bonneville return rates, with yearling steelhead and Chinook arriving in May estimated to have substantially higher post-Bonneville survival than those arriving in June (Scheuerell et al. 2009).

Alternative 2A flows during the spring migratory period are similar to those occurring under No Action except for some relatively minor flow decreases ranging from 72 to 500 cfs during wet and average water year types (Figure 4-27 and Table 4 54). There are no flow reductions during this time period for dry and drought water years. As with all alternatives, Columbia River flows would not be reduced in cases where the flow objectives at Priest

Rapids or McNary dams are not met. Under the assumption that in-river smolt survival is largely independent of flow when flows exceed these objectives, Alternative 2A: Partial—Banks would be expected to no to minimal impacts on any of the salmonids migrating downstream in the spring. Juvenile fall Chinook in the Columbia River have a downstream migration period that extends through July and early August. The issue of July and August flows is moot because none of the alternatives would impact Columbia River flows during these 2 months.

Under the assumption that in-river smolt survival is largely independent of flow when flows exceed these objectives, the alternatives are Alternative 2A: Partial—Banks would be expected to no to minimal impacts on any of the salmonids migrating downstream in the spring.

Banks Lake

Projected Banks Lake monthly drawdowns under wet, average, dry and drought conditions for Alternative 2A: Partial—Banks and other alternatives are presented in Section 4.2 – *Surface Water Quantity*, Table 4-3. Figure 4-28 illustrates the monthly drawdown at Banks Lake for each alternative by water year type.

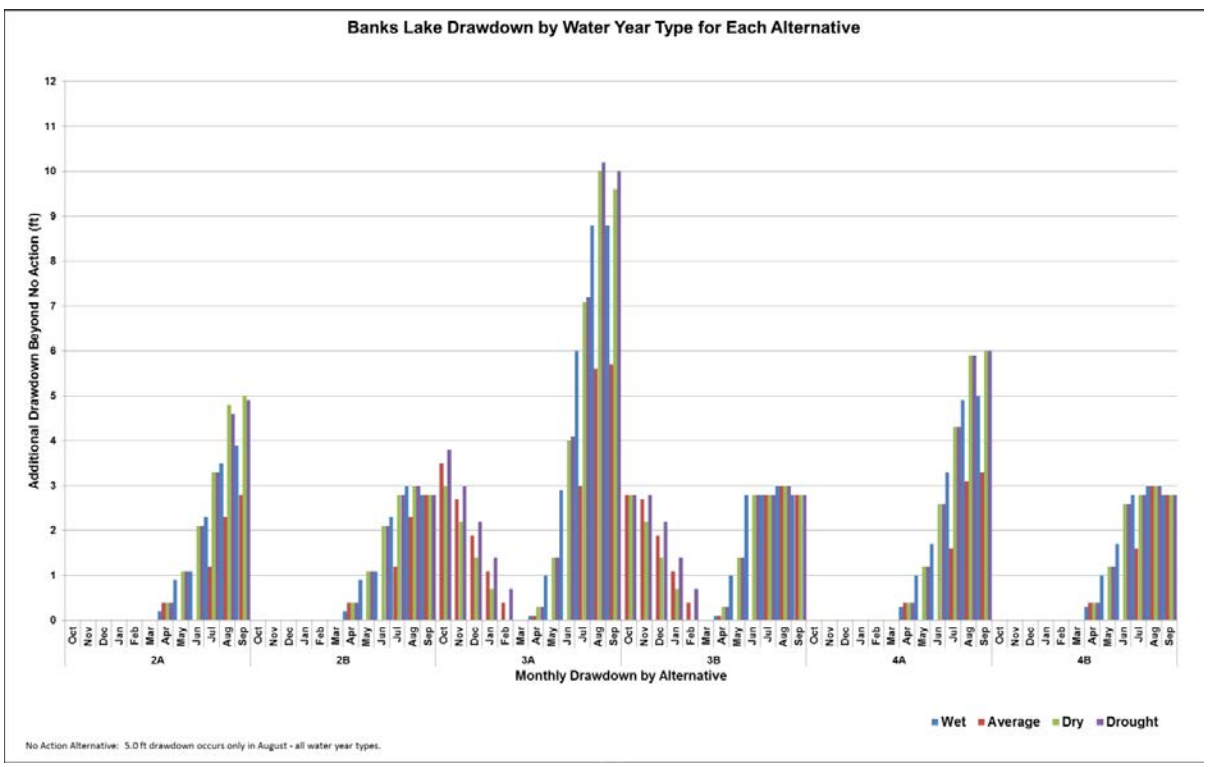


Figure 4-28. Banks Lake additional drawdown beyond No Action by water year type for each alternative.

Water temperatures and dissolved oxygen concentrations in Banks Lake are expected to change only slightly during drawdowns with Alternative 2A: Partial—Banks (Section 4.4 – *Surface Water Quality*). No impacts on warm water species of fish would be associated with the slightly altered water temperature during drawdowns (mostly in August). Cool water species such as trout and kokanee could be adversely affected by warmer waters in shallow embayments, but these species are more typically found in offshore, deeper waters at this time of year. Impacts of altered temperature and dissolved oxygen on fish and aquatic resources are species-specific and can vary depending on the time of year such changes would occur.

In general and across species, spawning fish and small juveniles are most susceptible to such changes. Under Alternative 2A: Partial—Banks, shifts in temperature and dissolved oxygen would be slight and would occur during the late summer/early fall in association with drawdowns. In Banks Lake, most all fish species spawn during the late fall, winter, or especially, early spring. Young fish emerge shortly after this. Under Alternative 2A: Partial—Banks, no changes in water surface elevations and water temperature or dissolved oxygen are anticipated to occur during these times of year, and, in turn, no impacts are anticipated for most fish species related to temperature and dissolved oxygen changes.

Shoreline Habitat

CWU (Gabriel and Cordner 2009) quantified near shore habitat exposure for 5-foot, 10-foot, 15-foot, and 18-foot drawdown scenarios for each of eleven shoreline habitat types. Table 4-55 below summarizes the total shoreline exposed with all habitat types combined for each alternative by water year type. Acreages for specific drawdown amounts were interpolated.

Table 4-55. Estimated total number of acres of shoreline habitat exposed during peak August drawdown by water year type for each alternative based on CWU study (Gabriel and Cordner 2009).

Wet Year			Average Year			Dry Year			Drought Year		
		# Acres			# Acres			# Acres			# Acres
Alt	DD(ft)	Exposed	Alt	DD(ft)	Exposed	Alt	DD (ft)	Exposed	Alt	DD(ft)	Exposed
No Act	5.0	1,204	No Act	5.0	1,204	No Act	5.0	1,204	No Act	5.0	1,204
2B	8.0	1,882	2A	7.3	1,724	2B	8.0	1,882	2B	8.0	1,882
3B	8.0	1,882	2B	8.0	1,882	3B	8.0	1,882	3B	8.0	1,882
4B	8.0	1,882	3B	8.0	1,882	4B	8.0	1,882	4B	8.0	1,882
2A	8.5	1,905	4B	8.0	1,882	2A	9.8	2,289	2A	9.6	2,243
4A	10.9	2,555	4A	8.1	1,905	4A	10.9	2,555	4A	10.9	2,555
3A	13.8	3,266	3A	10.6	2,481	3A	15.0	3,560	3A	15.2	3,703

Shoreline exposure for Alternative 2A (Table 4-55), was intermediate in extent for dry years (9.8 foot drawdown, 2,289 acres exposed); drought years (9.6 foot drawdown, 2,243 acres exposed); and wet years (8.5 foot drawdown, 1,905 acres exposed). The average year exposure was just slightly above the No Action Alternative (7.3-foot drawdown, 17,724 acres exposed). This is compared to the typical 5-foot drawdown under the No Action Alternative of 1,204 acres.

Glacio-lacustrine plains, basalt bedrock knob, and riprap shorelines have the greatest proportions of total near shore exposure at drawdown levels between 5 and 18 feet. Glacio-lacustrine plane shorelines are inhabited by black crappie, bluegill, small and largemouth bass, walleye, and whitefish. Basalt bedrock knob shorelines are dominated by sculpin, yellow perch, and smallmouth bass. Riprap shorelines are primarily composed of rainbow trout, smallmouth bass, and yellow perch. The loss of littoral habitat at these site types will remove multiple fish species from their optimal habitat and displace them into areas with sub-optimal habitat conditions. This creates the potential for multiple fish species to experience increased competition for resources and increased predator-prey interactions (Polacek et al. 2011).

The amount of time that drawdown conditions exist also factor into the type and amount of impacts that can occur to fish communities at Banks Lake. For example, the No Action Alternative has the least amount of drawdown because full pool (zero drawdown) occurs all year except for August). Alternative 2A has slightly more drawdown impact to shoreline habitats and associated fish communities than No Action Alternative because it begins earlier (April instead of July) and extends longer past the peak August drawdown period (October instead of September).

Drawdowns at Banks Lake could create changes in the species composition of emergent aquatic macrophyte communities. However, available shallow aquatic macrophyte communities used by fishes would not likely be reduced over the long term. The emergent aquatic macrophyte communities in the shallow waters of Banks Lake tend to be dominated by species that are somewhat drought tolerant late in the summer (see Section 4.8 – *Vegetation and Wetlands*). These species are less likely to be impacted by the temporary additional dewatering expected with Alternative 2A: Partial—Banks (Section 3.8 – *Vegetation and Wetlands*). However, the less drought tolerant emergent aquatic macrophyte species found at depths greater than 5 feet would likely be impacted and their abundance reduced during the August drawdown. Some regrowth would begin during refill in October prior to the normal winter die-back period. Over time, it is anticipated that the macrophyte species assemblages in these impacted areas would shift toward greater dominance by drought tolerant species. However, the overall area of available shallow aquatic macrophyte communities would not likely be reduced in the long term.

Dewatering macrophyte beds during the late summer may minimally impact juvenile fishes using these areas for rearing and refuge from predators. Juvenile fish species, including yellow bullhead, largemouth bass, pumpkinseed, longnose sucker, largescale sucker, bridgelip sucker, and prickly sculpin are known to use these shallow macrophyte beds in August (Reclamation 2004). During dewatering periods, juvenile fish using these macrophyte beds would be forced out of the protective cover into more open water habitats, thereby increasing their risk of being preyed upon by larger fish and birds. Although this forced movement would adversely impact the individual fish being preyed upon, it would not likely have adverse population-level impacts because of the short duration of the drawdown and the overriding influence of other compensatory factors, such as competition for food or space, controlling the populations of these smaller fish (Myers 2002; Rose et al. 2001). The greater accessibility to forage fish by predatory fish would be expected to temporarily increase the feeding and growth of the predatory fish, most of which are game fish such as walleye and bass (Heman et al. 1969; Ploskey 1983). In fact, late summer and autumn drawdowns have been used successfully in some lakes as a management tool to improve sport fish production because of this increase in vulnerability of forage (Ploskey 1983).

Submerged aquatic plants also are important to benthic invertebrate populations, which in turn provide feed for juvenile fish. Proposed drawdowns in August under Alternative 2A: Partial—Banks would likely adversely impact some invertebrates in the fluctuation zone to a greater extent than what occurs under the No Action Alternative. However, the extensions of the photic zone to new benthic substrates at lower drawdown elevations would tend to compensate for the macroinvertebrate losses in the fluctuation zone. It has been demonstrated in other reservoirs with summer drawdowns, that "macroinvertebrate density and biomass were usually greater in a sample reservoir with 30 years of seasonal drawdowns when compared to a natural lake with little seasonal change in water levels" (Furey et al. 2006). Overall, the temporary dewatering of benthic macroinvertebrates is not expected to be sufficient to significantly affect fish populations in Banks Lake.

Fish Habitat

PSU explored the effects of the proposed action alternative management scenarios on fish habitat availability using a fish habitat algorithm in the CE-QUAL-W2 Model. By specifying the preferred water temperature range and a desired dissolved oxygen concentration for any fish species or group of species, CE-QUAL-W2 calculates a time series of the percent of the total reservoir volume that meets the criteria. This model calculated growth habitat using optimal temperatures and dissolved oxygen concentrations for rainbow trout, kokanee, walleye, and smallmouth bass.

For rainbow trout, Alternative 2A provided slightly less optimal habitat for drought, dry, and average years (approximately 0.5 percent) and an equivalent amount of optimal habitat as the No Action Alternative for wet years. For kokanee, Alternative 2A provides slightly less optimal habitat than the No Action Alternative for the drought, dry and average water years. Wet years provide equivalent amount of optimal kokanee habitat as the No Action Alternative. For walleye, Alternative 2A is similar to the No Action Alternative for dry and average water years. Drought years result in a roughly 0.25 percent decrease in optimal habitat compared to the No Action Alternative. For smallmouth bass, Alternative 2A results in roughly 0.25 percent decrease in optimal habitat during drought years and similar habitat amounts as the No Action Alternative for wet and average year types (McCulloch et al. 2011 Management).

Zooplankton Entrainment

Zooplankton samples collected by WDFW were provided to PSU for incorporation into the CE-QUAL-W2 Model. Zooplankton was divided into two groups: Group 1 consisted of copepods and Group 2 consisted of daphnia. Zooplankton Group 1 was not affected by Alternative 2A and Group 2 showed less mass discharge (entrainment) than the No Action Alternative. This finding likely results from the fact that the reservoir discharge consists of water from the 18- to 30-foot depth strata, whereas zooplankton in Banks Lake are found mostly in the top 12 feet of surface water (Stober et al. 1975). Further tending to offset this potential impact would be the nutrients and zooplankton that would continue to be diverted into Banks Lake from Lake Roosevelt, and which would increase during refill in October compared to the No Action Alternative.

Fish Bioenergetics

PSU used a fish bioenergetics model using zooplankton and water quality data generated by the CE-QUAL-W2 Model and specific metabolic growth functions to calculate kokanee growth. Three sites were modeled in Banks Lake (North, Middle and South) corresponding to the main pools of Banks Lake. Results from the fish bioenergetics model showed that most of the management scenarios evaluated at the Middle and South sites performed as well if not better than the No Action Alternative, whereas the North site was affected more by the different management scenarios. More specifically the North was affected by the average, drought, and dry flow years for Alternative 3A, which produced up to 50 percent less annual average daily growth than the No Action Alternative. Across all management scenarios growth was lowest for dry and drought flow years, especially Alternatives 3A and 3B (McCulloch et al. 2011 Management). Kokanee growth success was shown to be strongly affected by the temporal/spatial availability of zooplankton populations and increased summer water temperatures. Generally, kokanee growth increased when traveling from the North site downlake towards the South site, reflecting the how the effects of Banks Lake hydrodynamics on the transport of zooplankton populations downstream influences kokanee growth. Additionally, kokanee growth was found to spike sharply in parallel to the spring zooplankton bloom and then later retreat when average water temperatures reached approximately 15.5^{o}C. Kokanee growth was typically negative during the warm summer months. The average daily growth for kokanee for Alternative 2A at the north site was slightly more than the No Action Alternative for average water years at about 0.5 grams per day and was slight less than No Action for the average, dry, and drought water years.

Fish Entrainment

Fish entrainment at Dry Falls Dam was assessed by WDFW's contractor HTI during 2009 and 2010 (Sullivan, McFadden, and Nealson 2009). WDFW incorporated the results of the Sullivan, McFadden, and Nealson 2009 report into their assessment of fish entrainment (Polacek et al. 2011). Results from 2009 (Polacek 2009), appear to confirm the findings from 2004 to 2005 that showed most entrained fish to be very small (less than 30 mm). Unlike the 2004 to 2005 study results where yellow perch were found to be the dominant entrained species, the 2009 studies found that cottid species (sculpins) were the dominant entrained fish (73 percent of total) followed by smallmouth bass (19 percent of total). In both 2009 and 2010, the peak entrainment rate occurred between August and October. In 2010 smallmouth bass, yellow perch, and rainbow trout made up the bulk of the entrained species. Lengths ranged from an average of 35 mm for smallmouth bass to 183 mm for rainbow trout. A clear relationship between outflows and entrainment was not established. In 2009, 743,995 fish were entrained from Banks Lake, with peak entrainment occurring in August of an estimated 202,537 fish. In 2010, 878,652 fish were entrained from Banks Lake, with peak entrainment occurring in September (202,537 fish) (Pollacek et al. 2011). In 2009, fish entrainment was positively correlated to discharge, but no relationship was shown in 2010.

While the flow/entrainment relationship remains somewhat unclear, a comparison of total drawdown amounts can provide some useful comparisons of potential fish entrainment among alternatives, assuming the positive relationship in 2009 holds true. Figure 4-28 shows that the overall monthly drawdowns for Alternative 2A are relatively small compared with extensive drawdowns shown in Alternative 3A, and are similar to Alternatives 2B, 3B, 4A and 4B. For Alternative 2A, the most significant drawdowns occur in the average, dry and drought water years during the months of June through September, but these drawdowns are small, ranging from 1.1 to 4.8 feet compared to the No Action Alternative. Only a relatively small amount fish entrainment is likely to occur under Alternative 2A.

Overall Study Area and Broader Central Washington/Columbia Basin Project Area

Water source conversion from groundwater to surface water is anticipated to minimally impact water quality downstream of Banks Lake as described in Section 4.4 – *Surface Water Quality*. Slightly lower surface water temperatures (compared to current groundwater sources) would likely result in decreased maximum temperatures, but would not likely alter average temperatures. These slight changes in maximum water temperatures are not anticipated to impact fish or aquatic resources in Billy Clapp Lake, Moses Lake, Potholes Reservoir, or lower Crab Creek.

Impacts associated with turbidity, pesticides, nutrients, and pH are not anticipated as described in Section 4.4 – *Surface Water Quality*. No impacts to fisheries and aquatic resources in the Study Area and broader central Washington/CBP area would be anticipated under this alternative.

Changes with Limited Spring Diversion Scenario

Figure 4-29 shows the Columbia River decrease in flows beyond no action by water year type for each alternative for the Limited Spring Diversion Scenario. Comparison with Figure 4-27 (Spring Diversion Scenario) shows that the Limited Spring Diversion Scenario for Columbia River flows for Alternative 2A is similar to the Spring Diversion Scenario with the exception that wet year diversions will decrease Columbia River flows in October by slightly over 2,200 cfs. Additionally, the small 42 to 648 cfs decreases in May and June for wet and average years would be eliminated entirely in the Limited Spring Diversion Scenario. Overall, this would have no impact to outmigrating smolts by leaving a small amount more water in the Columbia River during the spring migration period.

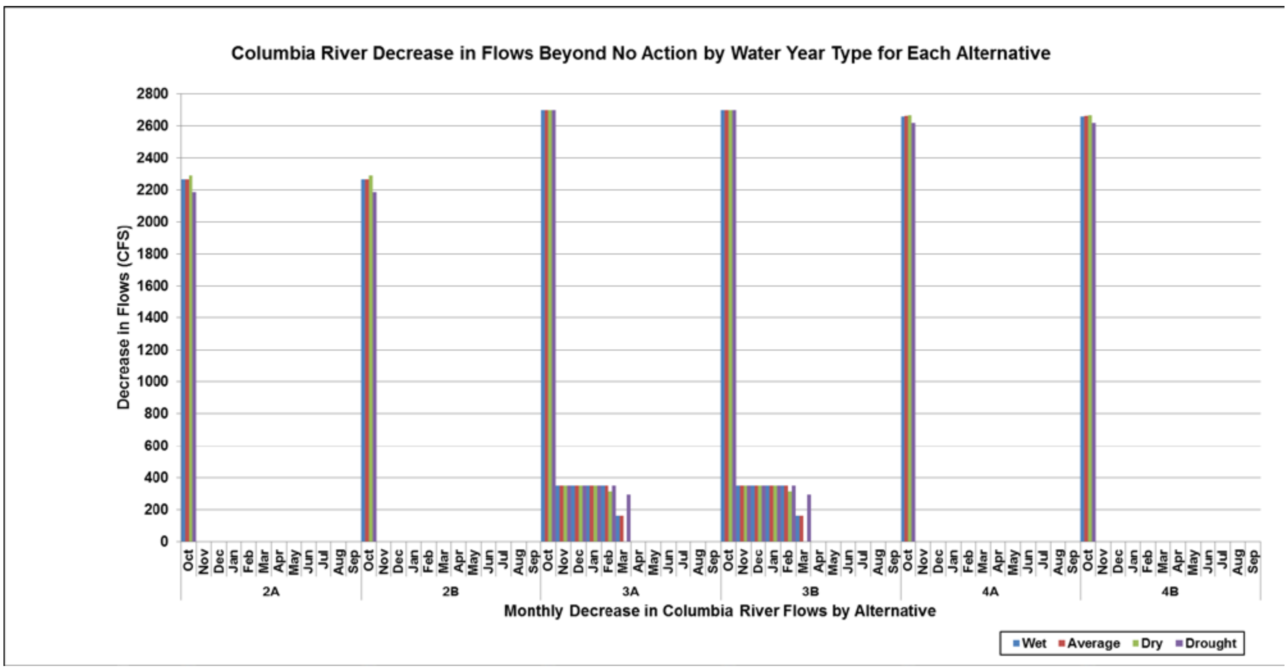


Figure 4-29. Columbia River flow decreases beyond No Action by water year type for all alternatives for the Limited Spring Diversion Scenario.

Figure 4-30 shows the additional drawdown beyond no action for the Limited Spring Diversion Scenario at Banks Lake. Compare with Figure 4-28 for the Spring Diversion Scenario.

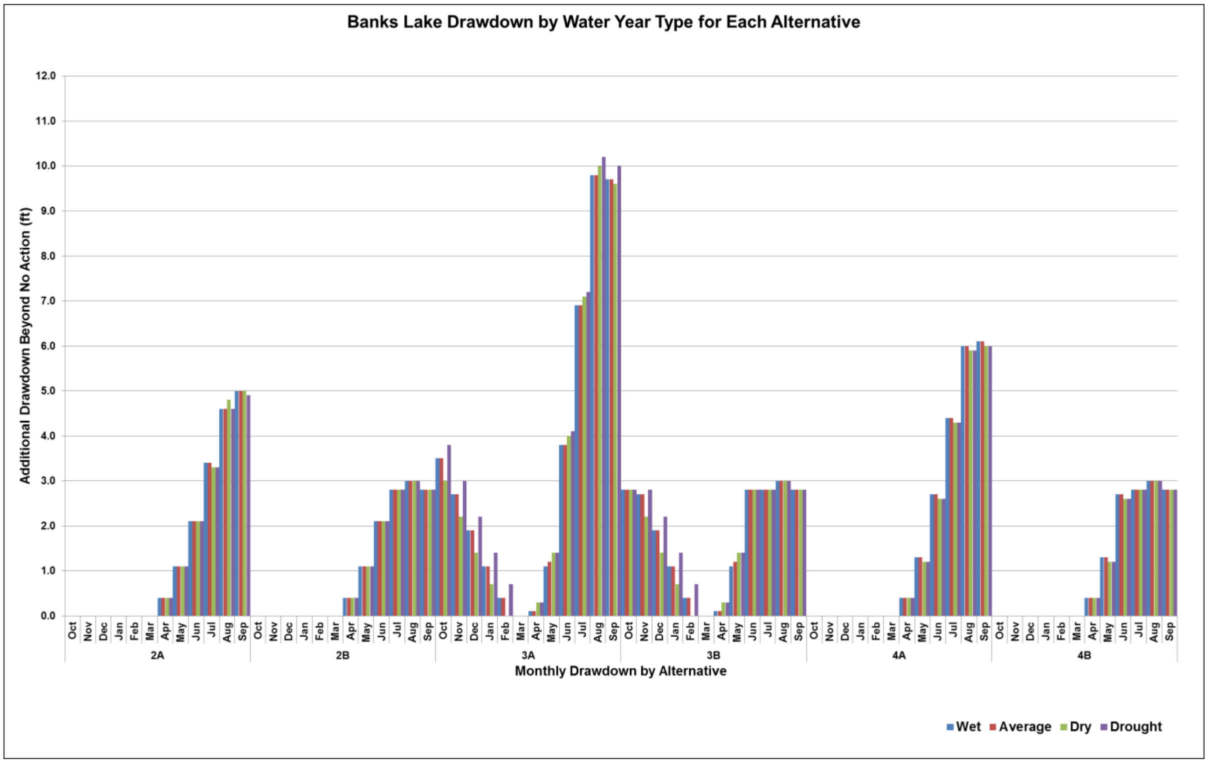


Figure 4-30. Limited Spring Diversion Scenario for Banks Lake drawdown by water year type.

The Limited Spring Diversion Scenario would result in increased drawdown from 1.1 to 2.3 feet for average and wet years during August and September for Alternative 2A at Banks Lake. This slight increase in the extent of drawdown is not expected to adversely impact water quality (Section 4.4 – *Surface Water Quality*). The shoreline exposure for average and wet water years is similar to those in drought conditions with 2,243 acres exposed. Overall, the temporary dewatering of the shoreline and the associated benthic macroinvertebrates and aquatic plants is not sufficient enough to significantly affect fish populations in Banks Lake. The overall impact is minimal.

4.10.4 Alternative 2B: Partial—Banks + FDR

4.10.4.1 Short-term Impacts

Short-term impacts would be the same as Alternative 2A: Partial—Banks.

4.10.4.2 Long-term Impacts

Columbia River

September – October

Impacts to upstream migrating fall Chinook and steelhead adults are the same as Alternative 2A.

November – mid-April

Impacts to fall Chinook spawning and egg incubation flows in the Hanford Reach are the same as described for Alternative 2A. Impacts to chum salmon spawning and egg incubation flows below Bonneville Dam are the same as described for Alternative 2A.

Mid-April – August

Impacts to downstream migrating salmon and steelhead are the same as Alternative 2A.

Lake Roosevelt

Figure 4-31 shows the additional drawdown beyond the No Action Alternative in Lake Roosevelt for Alternatives 2B, 3B, and 4B.

Small additional drawdowns occur during the summer months ranging from 0.2 to 2.4 feet depending on water year for Alternative 2B. These small drawdowns are superimposed on already existing drawdowns. Flood control operations can result in drawdowns in May and June. End of August elevations stay fairly constant (11 to 13 feet from full). There are no drawdowns beyond No Action from October through May. The capacity of the reservoir to support its current fish community and productivity should not be impacted. This is the same conclusion reached for the Lake Roosevelt Incremental Storage Release Program, which entails a similar additional summer drawdown of about 1 foot (Ecology 2008).

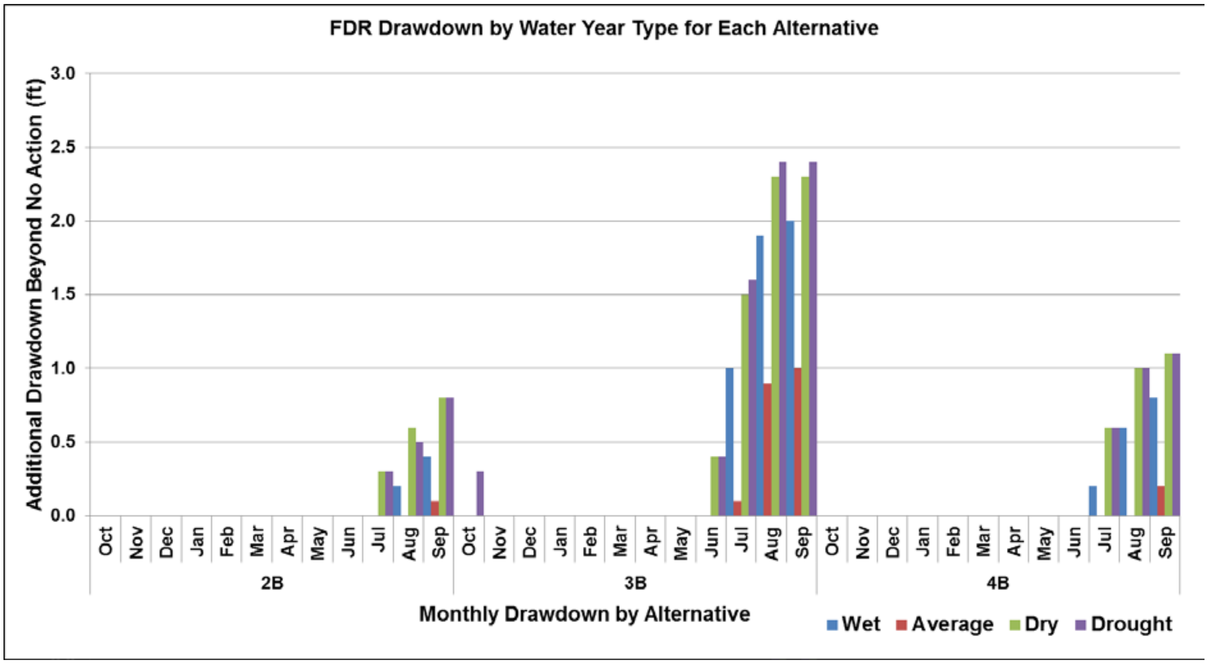


Figure 4-31. Additional drawdown beyond the No Action Alternative for FDR for each alternative for the Spring Diversion Scenario.

Fish Entrainment

Alternative 2B would not be expected to increase the potential for fish entrainment at Grand Coulee Dam or at the nearby pump-generation station. Kokanee and rainbow trout entrainment out of Lake Roosevelt through Grand Coulee Dam has been documented (Spotts et al. 2002; McLellan et al. 2003). The period of greatest entrainment potential is from January through May when seasonally low lake levels combine with high flows to create conditions favorable to entrainment (Underwood et al. 2004). These conditions include low-water retention times (high flushing rate) and lower depth-to-turbine-intakes or the pump generators. Alternative 2B would have no impact on lake elevations compared to the No Action Alternative from October through May in all year-types. Therefore, this action alternative would not be expected to have an impact on fish entrainment at Grand Coulee Dam or at the pump generators used to deliver water to Banks Lake reservoir. The greatest water elevation changes would occur in July, August and September when the lake level is high, flows are low, and resulting water retention times are relatively long (greater than 45 days).

Zooplankton Entrainment

The small changes in water surface elevation are not expected to impact zooplankton production in Lake Roosevelt. As noted above, zooplankton is the primary food of most fish species in Lake Roosevelt. Daphnia are one of the most abundant zooplanktors and are the primary food item for rainbow trout and kokanee salmon in Lake Roosevelt. As such, they have been a primary focus of zooplankton studies in the lake. A number of studies in Lake Roosevelt have concluded that the existing zooplankton production is not limiting fish production (Baldwin et al. 1999; Baldwin and Polacek 2002) or fish growth potential (McKillip and Wells 2007). On the basis of these studies, Alternative 2B: Partial—Banks + FDR is not expected to impact zooplankton production or related fish growth in Lake Roosevelt. The small reductions in lake elevation of about 1 foot would occur in the summer when the lake is nearly full and inflows are relatively low. These conditions produce water particle retention times during the summer of approximately 45 days in an average year. This is above the threshold of less than 30 days known to impact zooplankton production in Lake Roosevelt (Underwood and Shields 1996). The reduction of the August lake level by about 0.5 feet would reduce water retention time by only a fraction of a day (Ecology 2008).

Aquatic Habitat

The aquatic habitat of Lake Roosevelt shoreline areas would not be further degraded by the small additional summer drawdown. The shallow-water littoral habitat in most lakes is where most production of aquatic macrophytes and macroinvertebrates occurs. In these lakes, the macrophyte beds provide important spawning, refuge, and feeding habitat for many fish species. In addition, the macroinvertebrates provide an important food source, especially for small fish. In Lake Roosevelt, however, the large extent of seasonal drawdown, by as much as 82 feet, severely restricts the ability of macrophytes and macroinvertebrates to become established. Therefore, open-water phytoplankton and zooplankton are the primary components of the food web that support nearly all fish species in the lake, including those that are typically benthic macroinvertebrate feeders (Underwood et al. 2004; Black et al. 2003). The operation of Lake Roosevelt as a major storage and release reservoir thus dictates the fish community established in the lake.

Rainbow Trout Net Pens

None of the alternatives would change the annual maximum drawdown occurring in late April or early May. Therefore, none of the alternatives would impact the rainbow trout net pen program.

Kokanee Production

Barnaby Creek

Originally, rule curves for Lake Roosevelt were established to attempt to achieve an elevation of 1283 feet amsl during September when kokanee first start attempt migration runs up Barnaby Creek. In 2012, the Tribes completed major improvements on Barnaby Creek, which were designed to allow the creek to be accessible to spawning kokanee when the Reservoir is below 1283 feet. Kokanee spawner access will be evaluated this year to determine if the San Poil is now the limiting river. Minor changes in water surface elevations that would occur only once in 70 years under Alternative 2B: Partial—Banks +

FDR are not expected to impact the upstream migration of kokanee salmon into Barnaby Creek.

San Poil River

Although most kokanee salmon in Lake Roosevelt originate from artificial production and recruitment of wild fish from upstream Canadian waters, there is a small population that spawns naturally in the San Poil River. Access to the river by upstream migrating kokanee salmon is blocked by shallow water at the river mouth when Lake Roosevelt elevations are less than 1283 feet amsl. Other environmental factors such as water temperature and rainfall events also greatly influence initiation of upstream migration into the river. Minor changes in water surface elevations that would occur only once in 70 years under Alternative 2B are not expected to impact the upstream migration of kokanee salmon into the San Poil River.

Hawk Creek

The Hawk Creek fish trap also operates optimally at 1283 feet amsl. The trap is operated from August through November to collect eggs from returning adult kokanee spawners for use in the Lake Roosevelt Management Team's (LRMT) kokanee hatchery program. Data indicates that the Meadow Creek kokanee stock peak run timing into Hawk Creek occurs from September 15 and 22 (McLellan et al. 2009). Lake Whatcom kokanee stock peak run timing into Hawk Creek is between November 11 and 18. The Meadow Creek stock is preferred for egg collection.

For Alternative 2B, April and May end of month reservoir levels which are important for wild trout spawner access to tributaries, remains drawdown from 24.7 to 72.4 feet in April and from 0.6 to 67.0 feet in May – the same as the No Action Alternative. End of August drawdown ranges from 0 to 0.6 feet below No Action while the end of September drawdown ranges from 0.1 to 0.8 feet below No Action. The total end of September reservoir elevation remains above 1,283 feet elevation for all water year conditions. In the 70-year model period, only one year failed to refill to 1,283 feet by the end of September – which is no change from the No Action alternative. There would be no impact to the Hawk Creek fish trap operations for Alternative 2B (additional details are in the Section 4.2.4 – *Alternative 2B: Partial—Banks + FDR*).

Water Quality Effects on the Lake Roosevelt Coldwater Fishery

Minor changes in the operation of Lake Roosevelt that would result in a small decrease in water column under Alternative 2B are expected to have impacts on temperature and dissolved oxygen concentrations, and re-suspension of heavy metals too small to measure (see Section 4.4.4 – *Alternative 2B: Partial—Banks + FDR*). Additional impacts in Lake Roosevelt are not anticipated for total dissolved gas. Maximum projected late summer drawdown (when additional drawdown is most likely to impact temperature, dissolved oxygen concentrations, as well as other water quality parameters) would occur during August with increases in drawdown ranging from 0.5 to 0.6 feet over the No Action Alternative. This minimal drawdown would expose little if any previously protected sediments to erosive wave action, thus only a negligible amount of re-suspension of sediment-bound heavy metals would occur. There would be no impact to the water quality in Lake Roosevelt for Alternative 2B and as a result to adverse impacts to resident fish.

Water Quality and Quantity Effects on Potential for Reintroduction of Anadromous Fish

Alternative 2B results in very minor drawdowns beyond the No Action Alternative ranging from 0.0 to 0.5 feet for all water year scenarios. Changes in temperature and dissolved oxygen conditions and re-suspension of heavy metals are deemed too small to measure. Thus, it is unlikely that implementation of Alternative 2B would adversely impact habitat conditions above Grand Coulee Dam for future anadromous fish reintroduction efforts.

Small additional drawdowns occur during the summer months ranging from 0.2 to 2.4 feet depending on water year for Alternative 2B. These small drawdowns are superimposed on already existing drawdowns during this period. There are no drawdowns beyond No Action from October through May. The capacity of the reservoir to support its current fish community and productivity should not be impacted. This is the same conclusion reached for the Lake Roosevelt Incremental Storage Release Program, which entails a similar additional summer drawdown of about 1 foot (Ecology 2008).

Banks Lake

For Alternative 2B, Banks Lake would be drawn down a maximum of 3 feet further than currently occurs under the No Action Alternative for all water-year-types. The additional drawdown (on top of the 5 feet under the No Action Alternative) would occur primarily in August. Relatively minor drawdowns (generally 1 to 3 feet from full pool) also would occur during May, June, and July (Section 4.2 – *Surface Water Quantity*, Table 4-55 and Figure 4-28). These drawdowns would be slightly less than those under Alternative 2A: Partial—Banks, but impacts to fish and aquatic resources are anticipated to be similar.

Shoreline Habitat

The total habitat exposed for Alternative 2B ranges from a low of 1,724 acres in average years to 1,882 acres for wet, dry, and drought years (Gabriel and Cordner 2009) (Table 4-55). This is a slightly greater impact than the No Action Alternative. It is similar to Alternatives 3B and 4B.

Proposed drawdowns in water surface elevations during the late summer under this alternative would likely result in the same temporary adverse impact to invertebrates in the fluctuation zone that would occur under Alternative 2A. However, these impacts on invertebrates would not likely be sufficient to significantly affect fish populations in the long term. Impacts to shallow aquatic macrophyte communities (with reduced water surface elevations) under this alternative are slightly less than those that would occur under Alternative 2A and are expected to be minimal. No impacts are expected on fish spawning because of the time of drawdown, but minimal impacts are anticipated for juvenile fish rearing in shallow areas of the lake.

Fish Habitat

Fish habitat (percent volume of optimal habitat) calculated using the CE-QUAL-W2 model for Alternative 2B shows that Alternative 2B is similar to 2A for all four game fish species (McCulloch et al 2011 Management). For kokanee and rainbow trout, habitat in wet years is equivalent to the No Action Alternative, but shows slight declines for drought, dry, and average water years. For walleye, the average water year shows slightly greater optimal habitat than No Action, but slight (about 0.25 percent) decreases in optimal habitat for drought, wet, and dry water years.

Zooplankton Entrainment

PSU modeling shows that Alternative 2B is very similar to Alternative 2A for the annual average mass discharge of zooplankton Group 1 (copepods) and zooplankton Group 2 (daphnia). Zooplankton Group 1 was not affected by either alternative. In general when compared to the No Action Alternative zooplankton group 2 was not negatively affected by any alternative scenario (McCulloch et al. 2011 Management).

Fish Bioenergetics

The fish bioenergetics model developed by PSU for three sites in Banks Lake (North, Middle, and South), indicates that Alternative 2B is similar to all other action alternatives for the Middle and South sites, but shows a very slight decrease in average daily kokanee growth for drought and dry year scenarios when compared to the No Action Alternative. Wet and average year scenarios show a slight increase in daily growth. Overall, kokanee daily growth for Alternative 2B would remain similar to the No Action Alternative when all sites are considered.

Fish Entrainment

Drawdown for Alternative 2B compared to the No Action Alternative ranges from 2 to 3 feet for drought and dry years for the months of July, August, and September (Figure 4-28). This is likely to result in only a slightly increased entrainment of fish if the relationship found in 2009 (Sullivan, McFadden, and Nealson 2009; Pollacek et al. 2011) holds true or no increase in entrainment if the lake of a clear relationship found in 2010 holds true.

Overall Study Area and Broader Central Washington/Columbia Basin Project Area

Only very minimal, if any, impacts to fish and aquatic resources in the Study Area and broader central Washington/CBP area would be anticipated under Alternative 2B: Partial—Banks + FDR for the same reasons as those described for Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

October decreases in Columbia River flows for Alternative 2B range from 2,185 to 2,289 cfs for all water year types in the Limited Spring Diversion Scenario. All of the minor diversions ranging from 72 to 500 cfs during the months of April, May, and June have been eliminated. This provides no minimal beneficial impacts to Columbia River flows for outmigrating salmonid smolts.

Figure 4-32 shows the Limited Spring Diversion Scenario drawdowns at FDR beyond no action are similar to the Spring Diversion Scenario (Figure 4-31). Drawdowns in the Limited Spring Diversion Scenario remain very small, ranging from less than 1 foot to slightly over 2 feet above the No Action Alternative drawdowns. The primary difference is that in the Limited Spring Diversion Scenario average year drawdowns are increased to similar levels as the wet, dry and drought years for all alternatives. There would be no adverse impact to fisheries and aquatic resources at Lake Roosevelt from implementation of the Limited Spring Diversion Scenario.

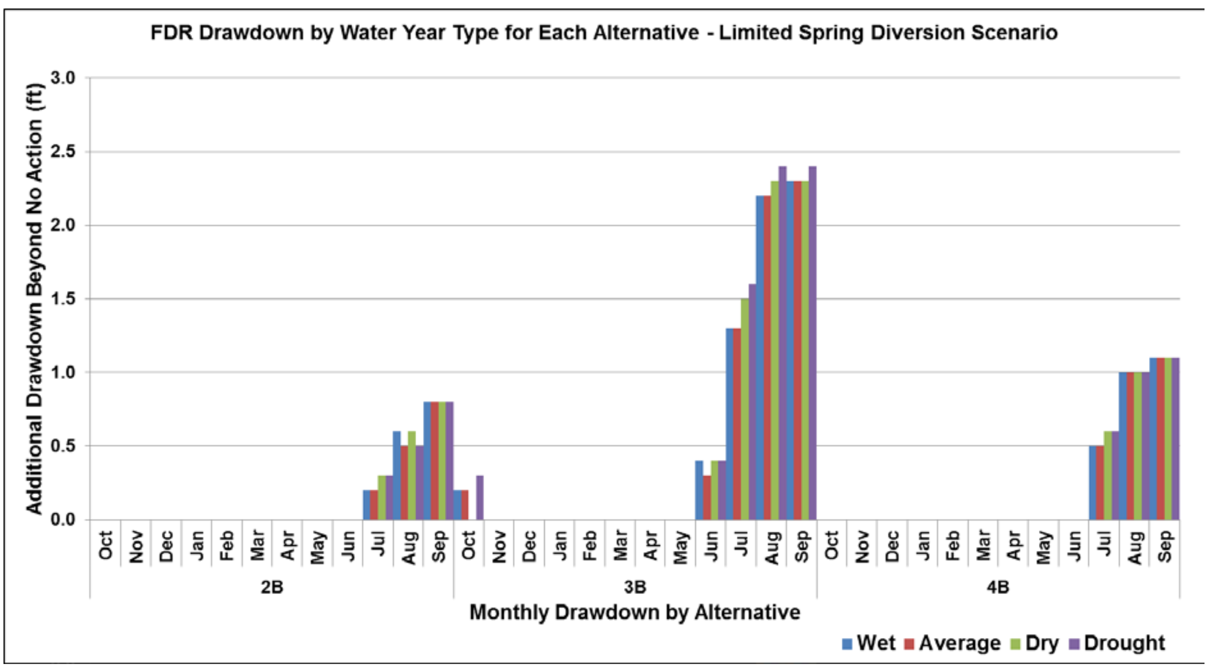


Figure 4-32. Lake Roosevelt drawdown by water year type – Limited Spring Diversion Scenario.

The Banks Lake Limited Spring Diversion Scenario (Figure 4-30) is nearly identical to the Spring Diversion Scenario (Figure 4-28). It would have no adverse impact on Banks Lake fisheries and aquatic resources.

4.10.5 Alternative 3A: Full—Banks

Short-term impacts would be the same as Alternative 2A: Partial—Banks.

4.10.5.1 Long-term Impacts

Columbia River

Alternative 3A results in decreasing Columbia River flows by 2,700 cfs in October during average, dry, and drought water year types, and 2,578 cfs in wet years. Average monthly flow reduction of about 350 cfs also occur consistently for average, dry, and drought year conditions from November through February (Figure 4-27). There are sporadic flow reductions in March, May, and June during average water years ranging from 175 cfs to 1,200 cfs. The 350 cfs is more accurately described as 20,826 acre-feet per month. The pumps are not capable of low-flow pumping. They would have to pump closer to 1,200 to 1,300 cfs. However, FDR would regulate the outflows so differences between 350 cfs and 1,300 cfs or greater would be absorbed in FDR. There are no flow reductions July through September for any water year conditions. Overall flow reductions are the greatest for Alternative 3A as well as 3B; however, they are a small fraction of the overall Columbia River flows.

September – October

Alternative 3A results in decreasing Columbia River flows in October from 2,578 cfs in a wet year to 2,700 cfs in average, dry and drought years. While these flow reductions are higher than Alternatives 2A and 2B, they are still relatively minor (2.3 to 2.4 percent) compared to the overall Columbia River flow below Bonneville Dam (Figure 4-27). These slightly reduced flows are not expected to impact adult fall Chinook or steelhead migration through the lower and mid-Columbia River and would not result in delayed migration.

November – Mid-April

The changes in daily average flow during November at Priest Rapids Dam associated with each alternative are shown in Figure 4-27 and Table 4-15 in Section 4.2 – Surface Water Quantity. Results are presented in ranked order based on November average flows for the base case. None of the partial replacement alternatives would change November flows, and thus would not impact the ability to maintain target flows for Chinook spawning on the Hanford Reach. Chum salmon that spawn downstream of Bonneville Dam would not be impacted by Alternative 2A: Partial—Banks because there would be no appreciable flow changes in the Columbia River under this alternative during the November to December spawning season or during the subsequent egg incubation months.

The changes in daily average flow during November at Priest Rapids Dam associated with each alternative are shown in Table 4-15 and Section 4.2 – *Surface Water Quantity*. Average monthly flow reduction of about 350 cfs would occur November through February during average, dry, and drought conditions; and from 162 to 294 cfs in dry and drought conditions in April. The 350 cfs flow reduction is more accurately described as 20,826 acre-feet per month. These are very minor flow decreases that would not impact the ability of Grant County PUD to meet its flow obligations outlined in the HRFCPP or to meet the 11.5-foot target elevation in the tailrace below Bonneville Dam for chum salmon spawning and incubation flows.

Mid-April – August

Flows for Alternative 3A during the spring downstream smolt migration period are similar to those occurring under No Action Alternative except for some relatively minor flow decreases ranging from 42 to 1,184 cfs during wet and average water year types (Table 4-15). There are no flow reductions during this time period for dry and drought water years. As with all alternatives, Columbia River flows would not be reduced in cases where the flow objectives at Priest Rapids or McNary dams are not met. Under the assumption that in-river smolt survival is largely independent of flow when flows exceed these objectives, Alternative 3A: Partial—Banks would be expected to have no to minimal impacts on any of the salmonids migrating downstream in the spring. The fall Chinook smolt outmigration during July and early August would not be affected because there are no flow decreases during these 2 months.

Banks Lake

Extensive drawdowns occur at Banks Lake June through September for all water year conditions for Alternative 3A with peak August amounts ranging from 10.6 to 15.2 feet total drawdown. Extended drawdowns extend beyond the typical August peak from September through February for average, dry and drought water years. These extended drawdowns may adversely affect aquatic vegetation and associated fish communities.

Shoreline Habitat

Based on the study done by CWU (Gabriel and Cordner 2009) estimates of the near shore habitat exposure for all habitat types for Alternative 3A is significantly greater than all other action alternatives. During wet water years, total drawdown is 13.8 feet with an estimated 3,266 acres of shoreline habitat exposed. Average water years have a total drawdown of 10.6 feet with an estimated 2,481 acres exposed for all habitat types (Table 4-55). During dry water years with a peak drawdown of 15 feet, an estimated total of 3,560 acres is exposed and for drought years with a peak drawdown of 15.2 feet an estimated 3,703 acres is exposed.

Additionally, the total drawdown period of time is greater for Alternative 3A (Figure 4-28). For example, extended drawdowns occur during the fall and winter months (October – February). Such extensive drawdowns in Alternative 3A may result in desiccation and or freezing of aquatic vegetation adversely impacting aquatic macrophytes. Additionally, fish are forced out of the cover of aquatic macrophytes for an extended period of time.

Fish Habitat

Fish habitat (percent volume of optimal habitat) calculated using the CE-QUAL-W2 Model shows Alternative 3A to be similar to all action alternatives for kokanee, with the highest optimal habitat occurring under the wet year scenario, which is slightly greater than the No Action Alternative. Optimal habitat declines about 0.5 percent for drought years compared to No Action.

For rainbow trout, the optimal habitat annual average declines the greatest for drought years, roughly 1.0 percent. Moderate decreases in optimal habitat occur for dry and average water years, approximately 0.5 percent. Wet years show little change in habitat compared to the No Action Alternative.

Zooplankton Entrainment

Alternative 3A was found to discharge on average 4 to 23 percent more zooplankton Group 1 (copepods) during dry and drought years than the No Action Alternative. Zooplankton Group 2 (daphnia) was affected the most by Alternative 3A for all flow years. In general when compared to the No Action Alternative, zooplankton Group 2 was not negatively affected by any alternative scenario including Alternative 3A (McCulloch et al. 2011 Management).

Fish Bioenergetics

Results from the fish bioenergetics model showed that most of the management scenarios evaluated at the Middle and South sites performed as well if not better than the No Action Alternative, whereas the North site was affected more by the different management scenarios. In particular, Alternative 3A affected the North site the most during average, drought and dry years, with up to 50 percent less annual average daily growth than the No Action Alternative scenario (McCulloch et al. 2011 Management).

Fish Entrainment

Drawdown for Alternative 3A compared to the No Action Alternative ranges from 5.6 feet more during wet and average years to 9.6 to 16 feet more for dry and drought years during

August and September (Figure 4-28). This may result in an increased amount of fish entrainment if the relationship found in 2009 (Sullivan, McFadden, and Nealson 2009; Pollacek et al. 2011) holds true or no increase in entrainment if the lake of a clear relationship found in 2010 holds true.

Overall Study Area and Broader Central Washington/Columbia Basin Project Area

No impacts to fish and aquatic resources in the Study Area and broader central Washington/CBP area would be anticipated relative to water quality concerns under this alternative, as described under Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

Columbia River flows under the Limited Diversion Scenario for Alternative 3A are similar to the Spring Diversion Scenario (Figure 4-27) except that the April, May, and June diversions for wet and average years ranging from 42 to 1,184 cfs have been eliminated. In addition, in June Banks Lake would draft deeper in wet and average years although the maximum draft would be similar to what was seen in the dry and drought years for the Spring Diversion Scenario. This results in no flow reductions during the critical smolt outmigration period and therefore, no impact. Overall, there would be no measurable changes to salmonid survival for this Limited Spring Diversion Scenario, compared to the Spring Diversion Scenario.

4.10.6 Alternative 3B: Full—Banks + FDR

Short-term impacts would be the same as Alternative 3A: Partial—Banks.

4.10.6.1 Long-term Impacts

Columbia River

September – October

Impacts to upstream migrating fall Chinook and steelhead adults are the same as Alternative 3A.

November – Mid-April

Impacts to fall Chinook spawning and egg incubation flows in the Hanford Reach are the same as described for Alternative 3A. Impacts to chum salmon spawning and egg incubation flows below Bonneville Dam are the same as described for Alternative 3A.

Mid-April – August

Impacts to downstream migrating salmon and steelhead are the same as Alternative 3A.

Lake Roosevelt

Fish Entrainment

Alternative 3B is the same as Alternative 2B in that the potential for fish entrainment at Grand Coulee Dam or the pump generation station would not increase over the No Action Alternative. As discussed for Alternative 2B, the period of greatest entrainment potential is from January through May when seasonally low lake levels combine with high flows to create conditions favorable to entrainment (Underwood et al. 2004). There is no additional drawdown over the No Action Alternative for any representative water year for Alternative 3B. The greatest water elevation changes would occur in July, August and September when the lake level is high, flows are low, and resulting water retention times are relatively long (greater than 45 days). Thus there would be no additional impact to fish entrainment (refer to Section 4.4 – *Water Quality* for the detailed analysis of water quantity in Lake Roosevelt).

Zooplankton Entrainment

Alternative 3B has small changes to the reservoir surface elevation of less than 1 foot during June for all water year scenarios. July decreases range from 0.1 to 1.0 foot during average and wet water years, with increased drawdown of 1.5 to 1.7 feet for dry and drought year scenarios. August reservoir decreases from 0.9 to 1.9 feet occur during average and wet year scenarios with larger drawdowns from 2.3 to 2.4 feet occurring during dry and drought water years. Reductions of 2.3 or more feet during August could reduce water retention time by slightly more than 1.7 days (Ecology 2008). However, this may result in a slight reduction in plankton biomass of about 2 percent, which should not adversely influence the capacity of the lake to support growth and rearing of kokanee and rainbow trout.

Aquatic Habitat

The aquatic habitat of Lake Roosevelt shoreline areas would not be further degraded by the small additional drawdowns under Alternative 3B, which range from 0.1 to 2.4 feet during July, August, and September. October drawdowns are smaller, ranging from 0.0 to 0.3 feet. The ability of macrophytes and macroinvertebrates to become established in shallow-water littoral habitats in Lake Roosevelt has been severely restricted by the large spring drawdowns, ranging from 24.7 to 72.4 feet, which presently occur under the No Action Alternative.

Rainbow Trout Net Pens

There are no additional drawdowns beyond the No Action Alternative during late April or early May. The rainbow net pen program would not be adversely affected by Alternative 3B.

Kokanee Production

Barnaby Creek

Rule curves for Lake Roosevelt were established originally to attempt to achieve an elevation of 1283 feet amsl during September when kokanee first start attempt migration runs up Barnaby Creek. In 2012, the Tribes completed major improvements on Barnaby Creek, which were designed to allow the creek to be accessible to spawning kokanee when the Reservoir is below 1283 feet. Kokanee spawner access will be evaluated this year to determine if the San Poil is now the limiting river. Reservoir levels during dry years would be 0.3 feet below target elevation in September and drought years would be 0.4 feet below target elevation. Refill to No Action Alternative levels would not occur until the end of October in dry and wet years and the end of November in average and dry water years. The lack of refill of Lake Roosevelt to elevation 1283 by the end of September in dry and drought years would impact kokanee spawners returning to Barnaby Creek.

San Poil River

Alternative 3B results in reduced water levels in the reservoir during the critical September period. The current rule curve target elevation of 1283 feet amsl during September would be met during wet and average water years. However, dry years would be 0.3 feet below target elevation in September and drought years would be 0.4 feet below target elevation. Refill in those water year types to the target elevation of 1283 feet would most likely occur in the first week of October. As discussed above for Alternative 2B, the Tribes will assess whether spawner access to the San Poil River will be limited when reservoir levels drop below 1283 feet amsl. However, it is likely the lack of refill of Lake Roosevelt to elevation 1283 feet amsl by the end of September in dry and drought years would adversely impact kokanee spawners returning to the San Poil River.

Hawk Creek

The Hawk Creek fish trap was originally installed at reservoir level 1282.7 feet (McLellan et al. 2003). Modifications to the trap were made after it was inundated in October 2009 to allow it to be fished at more variable reservoir levels. The trap should be able to function with a 7.3 feet drawdown (elevation 1287.2 feet) that would occur in dry years and a 7.4-foot drawdown (elevation 1282.6 feet) that would occur in drought years.

Water Quality Effects on the Lake Roosevelt Coldwater Fishery

Alternative 3B has a slightly greater drawdown than Alternative 2B and the No Action Alternative. If the reservoir were stratified, maximum late summer drawdown during August in dry and drought years would increase from 2.3 to 2.4 feet over the No Action Alternative. Some of the hypolimnion would be eliminated at the vertical temperature profile shifted downward about 2.3 feet. Wet and average years would result in August drawdowns of 2.2 feet. The loss of 1 to 2 feet of the hypolimnion may result in a breakdown of the weak stratification of the reservoir and a return to isothermal conditions a few days earlier than the No Action Alternative. This shift of a few days in stratification break down is likely to shift the reservoir to be more run-of-river like in warmer years as density gradients would be less with the reduced size of the hypolimnion. The overall result is slight, with neglible overall impacts to the coldwater fishery.

Additional re-suspension of sediment-bound heavy metals derived mostly from Tech Cominco Ltd. smelting operations in British Columbia is not anticipated.

Water Quality and Quantity Effects on Potential for Reintroduction of Anadromous Fish

Alternative 3B results in somewhat greater summer drawdowns beyond No Action ranging from 0.0 to 2.4 feet for all water year scenarios. Small reductions in the hypolimnion (cold water) may result in Lake Roosevelt becoming more run-of-river like. Nevertheless, changes to water temperature are deemed neglible. Thus, it is unlikely that implementation of Alternative 3B would adversely impact habitat conditions above Grand Coulee Dam for future anadromous fish reintroduction efforts.

Banks Lake

Projected Banks Lake monthly drawdowns under wet, average, dry, and drought conditions for Alternative 3B: Full—Banks + FDR are presented in Section 4.2 – *Surface Water Quantity* and in Table 4-18. Banks Lake water levels would be drawn down 3 feet further than currently occurs in August in all water year types. There will also be additional drawdowns starting at 2.8 feet in October and decreasing through February. Leaving the shallow littoral zone exposed during the fall and early winter months will adversely impact aquatic macrophytes, and may expose fish that typically utilize shallow littoral areas exposed to predation.

Shoreline Habitat

Alternative 3B has a lengthy drawdown of 2.8 to 3.0 feet beyond the No Action Alternative (7.8 to 8.0 foot total drawdown) from May through October. This would be approximately

1,882 acres of habitat exposed. This is a slightly greater impact than the No Action Alternative. It is similar to Alternatives 2B and 4B.

Proposed drawdowns in water surface elevations during the late summer under this alternative would likely result in the same temporary adverse impact to invertebrates in the fluctuation zone that would occur under Alternative 2A: Partial—Banks. However, these impacts on invertebrates would not likely be sufficient to significantly affect fish populations in the long term. Impacts to zooplankton communities for this alternative would be the same as anticipated under Alternative 2A: Partial—Banks. The overall abundance and diversity of zooplankton are not anticipated to be impacted significantly.

Fish Habitat

Fish habitat (percent volume of optimal habitat) calculated using the CE-QUAL-W2 model for Alternative 3B shows that Alternative 3B is similar to 3A for all four game fish species (McCulloch et al. 2011 Management). For kokanee and rainbow trout, habitat in wet years is equivalent to the No Action Alternative, but shows slight declines for drought, dry, and average water years. For walleye, the average water year shows slightly greater optimal habitat than the No Action Alternative, but slight (about 0.25 percent) decreases in optimal habitat for drought, wet and dry water years.

Zooplankton Entrainment

Alternative 3B was found to discharge on average 4 to 23 percent more zooplankton Group 1 (copepods) during dry and drought years than the No Action Alternative. Zooplankton Group 2 (daphnia) was affected the most by Alternative 3B for all flow years. In general when compared to the No Action Alternative, zooplankton Group 2 was not negatively affected by any alternative scenario (McCulloch et al. 2011 Management).

Fish Bioenergetics

Alternative 3B, along with Alternative 3A showed the lowest kokanee growth of all the alternatives for dry and drought years (McCulloch et al. 2011 Management).

Fish Entrainment

Drawdown for Alternative 3B compared to the No Action Alternative ranges is consistently 2.8 feet in July, 3.0 feet in August, and 2.8 feet in September for all water year types. Additionally, drawdown continues from October through February for drought and dry water years in this alternative. This is likely to result in some increase in fish entrainment compared to the No Action Alternative, though the exact relationship is ambiguous.

Overall Study Area and Broader Central Washington/Columbia Basin Project Area

Only very minimal, if any, impacts to fish and aquatic resources in the Study Area and broader central Washington/CBP area would be anticipated under this alternative, as described under Alternative 3A: Full—Banks.

Changes with Limited Spring Diversion Scenario

The changes with the Limited Spring Diversion Scenario are the same as that described for Alternative 3A.

4.10.7 Alternative 4A: Modified Partial—Banks

Short-term impacts would be similar to Alternative 2A: Partial—Banks, but with slightly deeper drawdowns of Banks Lake.

4.10.7.1 Long-term Impacts

Columbia River

The changes in daily average flow during November at Priest Rapids Dam associated with each alternative are shown in and Table 4-17 in Section 4.2 – *Surface Water Quantity*. Results are presented in ranked order based on November average flows for the base case.

September – October

Alternative 4A is similar to Alternatives 3A and 3B in overall October Columbia River flow decreases which are approximately 2,600 cfs for average, dry, and drought year conditions. The main difference is a decrease in flows for the wet year condition of 1,465 cfs compared to 2,578 cfs for Alternatives 3A and 3B. Alternative 4A would have no impact to minimal impact to adult fall Chinook or steelhead adults migrating through the lower to mid-Columbia River. There are no September flow decreases.

November – Mid-April

None of the partial replacement alternatives would change November flows, and thus would not impact the ability to maintain target flows for Chinook spawning on the Hanford Reach. Chum salmon that spawn downstream of Bonneville Dam would not be impacted by Alternative 4A: Partial—Banks because there would be no appreciable flow changes in the Columbia River under this alternative during the November to December spawning season or during the subsequent egg incubation months.

Mid-April – August

Alternative 4A flows during the spring migratory period are similar to that occurring under No Action except for some relatively minor flow decreases ranging from 42 to 648 cfs during wet and average water year types (Table 4-17). There are no flow reductions during this time period for dry and drought water years. As with all alternatives, Columbia River flows would not be reduced in cases where the flow objectives at Priest Rapids or McNary dams are not met. Under the assumption that in-river smolt survival is largely independent of flow when flows exceed these objectives, Alternative 2A: Partial—Banks would be expected to have no to minimal impacts on any of the salmonids migrating downstream in the spring. Juvenile fall Chinook in the Columbia River have a downstream migration period that extends through July and early August. The issue of July and August flows is moot because none of the alternatives would impact Columbia River flows during these 2 months.

The relatively minor flow reductions that would occur with Alternative 4A: Modified Partial—Banks during the post-spawning period (November to April) would not impact the ability of Grant County PUD to meet their flow obligations outlined in the HRFCPP. Alternative 4A: Modified Partial—Banks would change November flows in the Columbia River in only 3 of the 70 years and only by 70 cfs to 511 cfs. These minor flow reductions would not impact the ability of Grant County PUD and other coordination parties to provide the desired spawning conditions for fall Chinook below Priest Rapids Dam.

Very minor flow decreases ranging from 70 to 648 cfs from April through June only in wet and average years would have negligible effects to outmigrating salmonid smolts. Overall, there would be no to minimal impacts to downstream smolt migration in the Columbia River. This is the same as Alternative 2A, 2B, 3A, and 3B.

Banks Lake

Shoreline Habitat

Total shoreline habitat exposed for Alternative 4A ranges from a low of 1,882 acres during an 8.1-foot drawdown to 2,555 acres exposed for 10.9-foot drawdowns that would occur under wet, dry, and drought years. This alternative has the second highest amount of shoreline exposure during all water year types, significantly impacting shoreline habitats and associated fish communities. The duration of drawdown is similar to Alternative 2A.

Long-term impacts to shoreline habitat, fish habitat, zooplankton entrainment, fish bioenergetics, and fish entrainment for Alternative 4A are similar to those described for Alternative 2A except the impacts would be somewhat larger because of the more extensive and longer-duration drawdowns with this alternative (Table 4-55) but much less than Alternative 3A. The increased drawdowns in May, June, and July (Figure 4-28), particularly in dry and drought years, would likely have a some impact on the reproductive success (spawning and fry rearing) of many of the fish species using macrophyte beds and substrate (gravel, cobble) at this time of year. There may be some adverse long-term impacts on the fish community.

Overall Study Area and Broader Central Washington/Columbia Basin Project Area

No impacts to fish and aquatic resources in the Study Area and broader central Washington/CBP area would be anticipated relative to water quality concerns under this alternative, as described under Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

Columbia River flows under the Limited Diversion Scenario for Alternative 4A (Figure 4-29) are similar to the Spring Diversion Scenario (Figure 4-27) except that the April, May and June diversions for wet and average years ranging from 42 to 648 cfs have been eliminated. This results in negligible to very slight increase in Columbia River flows for outmigrating salmonid smolts similar to that described for Alternatives 2A, 2B, 3A, and 3B. In addition, Banks Lake water surface elevation would be drafted deeper in wet and average years, similar to the draft for dry and drought years in the Spring Diversion Scenario. Overall, there would be no measurable changes to salmonid survival for this Limited Spring Diversion Scenario, compared to the Spring Diversion Scenario.

The Limited Spring Diversion Scenario for Banks Lake for Alternative 4A is similar to that described for Alternative 2A. Overall, there would be no increased adverse affects to Banks Lake Shoreline exposure, fish habitat, zooplankton, and fish entrainment and fish bioenergetics from implementing the Limited Spring Diversion Scenario.

4.10.8 Alternative 4B – Modified Partial—Banks+FDR

Short-term impacts would be moderately greater than Alternative 4A: Modified Partial – Banks.

4.10.8.1 Long-term Impacts

Columbia River

Under Alternative 4B: Modified Partial—Banks + FDR there would be no impacts to minimal impacts on Columbia River downstream salmonid smolt migration, adult upstream migration, lower river chum salmon spawning success, or on the Hanford Reach fall Chinook the same as described for Alternative 4A.

Lake Roosevelt

Fish Entrainment

Under Alternative 4B, there would be no additional drawdown during the period of greatest entrainment potential from January through May, similar to Alternative 2B. Alternative 4B would not impact fish entrainment at Grand Coulee Dam or the pump generators used to deliver water to Banks Lake reservoir.

Zooplankton Entrainment, Aquatic Habitat, and Rainbow Trout Net Pens

Impacts are the same as discussed for Alternative 2B.

Kokanee Production

Barnaby Creek

End of September elevations were lower than for the No Action Alternative but remained above the 1283-foot target elevation for resident fish with this alternative in 69 years out of the 70 years modeled which was the same as the No Action Alternative. Spawning kokanee would be able to migrate into Barnaby Creek unimpeded, particularly given the habitat improvements designed to improve kokanee spawner access that were implemented in 2012.

San Poil River

End of September elevations were lower than for the No Action Alternative but remained above the 1283-foot target elevation for resident fish with this alternative in 69 years out of the 70 years modeled which was the same as the No Action Alternative. Spawning kokanee would be able to migrate into the San Poil River unimpeded.

Hawk Creek

The 1283-foot elevation rule curve target for September would continue to be met under Alternative 4B. There would be no adverse impacts to operation of this facility.

Water Quality and Quantity Effects on Potential for Reintroduction of Anadromous Fish

Alternative 4B results in very minor drawdowns beyond No Action ranging from 0.0 to 0.5 feet for all water year scenarios. Changes in temperature and dissolved oxygen conditions and re-suspension of heavy metals are deemed too small to measure. Thus it is unlikely that implementation of Alternative 4B would adversely impact habitat conditions above Grand Coulee Dam for future anadromous fish reintroduction efforts.

Banks Lake

Shoreline Habitat

Projected Banks Lake monthly drawdowns under wet, average, dry, and drought conditions for Alternative 4B: Modified Partial—Banks + FDR are presented in Figure 4-28. The minimal spring and summer drawdown levels are similar to those described for Alternative 2B and 3B, (Table 4-55) and impacts to fish and aquatic resources would be similar to those described for that alternative.

Overall Study Area and Broader Central Washington/Columbia Basin Project Area

Only very minimal, if any, impacts to fish and aquatic resources in the Study Area and broader central Washington/CBP area would be anticipated under this alternative, as described under Alternative 4A: Modified Partial—Banks.

Changes with Limited Spring Diversion Scenario

The changes from the Limited Spring Diversion Scenario for Alternative 4B is the same as that described for Alternative 4A for the Columbia River, Lake Roosevelt, and Banks Lake.

4.10.9 Mitigation

Ecology and WDFW agree that there is some degree of uncertainty in the impacts to the Banks Lake fishery. A monitoring and adaptive management plan will be developed by Ecology and WDFW to monitor and evaluate the Banks Lake fishery. The plan elements are outlined in Section 4.31 – *Environmental Commitments*.

4.11 Threatened and Endangered Species

Threatened and endangered species in the analysis area are an important natural resource and are protected under the ESA. Any anticipated impacts on such species must be fully considered in association with all action alternatives.

No short–term impacts to threatened and endangered species would occur under the No Action Alternative or any of the action alternatives. Additionally, there would be no long–term impacts to terrestrial threatened and endangered species under any of the action alternatives.

Long–term impacts to aquatic threatened and endangered species would be relative to changes in Columbia River streamflows. The Columbia River from Chief Joseph Dam to its mouth is designated ESA critical habitat for listed salmonids as a migratory and rearing corridor. Only minimal impacts would occur to some downstream smolt migrants for some alternatives, but no impacts would occur for upstream adult migrants, or spawning under any of the partial or full replacement alternatives.

4.11.1 Methods and Assumptions

The impact indicators and associated criteria for determining significance, summarized in Table 4-56, were used to evaluate impacts to threatened and endangered species. These criteria and the methods used to analyze them are described for each of the affected water bodies below the table.

Table 4-56. Threatened and endangered species impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Wildlife	
Pygmy Rabbits	The presence of pygmy rabbits within 1 mile of facilities that would be constructed in native big sagebrush habitats considered suitable for the species would be a significant impact.
Fisheries	
Downstream migration of salmonid smolts	From mid–April through August, delay of the downstream migration of smolts through reduced flows in dry years would be a significant impact.
Upstream migration of adult salmon, steelhead, and bull trout	If upstream migration of adult salmon, steelhead, and bull trout, especially in September and October when flow differences would be the greatest, is delayed by low flows, this would constitute a significant impact.
Chum salmon spawning below Bonneville Dam	Tailwater elevations below Bonneville Dam should be maintained at target elevations (approximately 11.5 feet) from early November to mid–April to provide water coverage of chum eggs and fry. Lower elevations would be a significant impact.

4.11.1.1 Impact Analysis Methods

Impacts on threatened or endangered species or their habitats that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Wildlife

The Washington PHS database was searched for occurrences of all rare species within 10 miles of the Study Area. WDFW conducted extensive surveys for rare species including pygmy rabbits within parts of the Study Area that support native big sagebrush habitats and that would also be impacted by facilities. Surveys were conducted in 2009 by teams of biologists and survey areas extended 0.25-mile on either side of proposed facilities.

Fisheries

The analysis of effects of the alternatives on ESA-listed anadromous salmonids and bull trout in the Columbia River is based primarily on the flow changes that would occur in the river. Section 4.10.1 – *Methods and Assumptions* for fisheries resources, describes water years and the modeling process used to estimate flow changes in the Columbia River that would occur under the action alternatives.

Base flows at Priest Rapids Dam for the 1929 through 1998 water years were used as the starting point for computing monthly flow changes (delta flows) on the Columbia River that would result from implementing each of the six action alternatives.

4.11.1.2 Impact Analysis Assumptions

Broadly applicable legal requirements, such as the ESA, are described in Chapter 5 – *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all regulations would be followed.

Legal Requirements and BMPs for Threatened and Endangered Species

The pygmy rabbit is listed as an endangered species by both the State of Washington and under the ESA. All ESA provisions regarding "take" apply. No BMPs are recommended for pygmy rabbits because they are no longer known to occur in the Study Area.

State and Federal laws, court decisions, and BiOps that govern actions related to ESA–listed fish species in the Columbia River and Lake Roosevelt are described at length in Chapter 1, Sections 1.6.1 – *Columbia River Basin Water Management Program*, and 1.6.2 – *Prior Investigations and Related Activities in the CBP*, and are not repeated here. These legal requirements cover management of flows on the Columbia River and reservoir releases and refill rates for Lake Roosevelt and Banks Lake. No BMPs are recommended to reduce adverse effects on fish and aquatic resources other than those addressed in Section 4.4 – *Surface Water Quality*. No BMPs are proposed to address anticipated impacts to threatened and endangered fish under any of the action alternatives.

4.11.2 Alternative 1: No Action Alternative

4.11.2.1 Short–term Impacts

No short–term impacts on pygmy rabbits are expected under the No Action Alternative because no populations are located in the Study Area. No short–term impacts would emerge related to ESA–listed fish resources, either, because the water currently used in the Study Area is groundwater. Therefore, its continued and diminishing use would not impact flows in the Columbia River.

4.11.2.2 Long–term Impacts

The expected reduction in irrigated agriculture that would occur under the No Action Alternative would have no long–term impacts on pygmy rabbits or their suitable habitat.

In the long term, the use of groundwater for the Study Area would diminish under the No Action Alternative. However, there would be no change in flows in the Columbia River. Therefore, there would be no long–term changes to fish resources under the No Action Alternative.

4.11.3 Alternative 2A: Partial—Banks

4.11.3.1 Short–Term Impacts

No short–term impacts on pygmy rabbits would result from Alternative 2A: Partial—Banks or from any of the other action alternatives. Therefore, this species is not discussed further.

There would be no short–term impacts of Alternative 2A: Partial—Banks or any of the other action alternatives related to ESA–listed fish species in the analysis area. However, development of the final action would take several years to fully implement. It is expected that the degree of impacts would be proportional to the degree of water development in this interim period before full development. The impacts analyses below assume full development of the alternative and, therefore, all effects would be long term.

4.11.3.2 Long–term Impacts

No long–term impacts on pygmy rabbits would result from Alternative 2A: Partial—Banks or from any of the other action alternatives. Therefore, this species is not discussed further.

Anticipated impacts of Alternative 2A: Partial—Banks on ESA–listed fish would be related to changes in Columbia River streamflows. As described in the Fisheries and Aquatic Resources portion of this Chapter, Section 4.10.3 – *Alternative 2A: Partial—Banks*, there is little correlation between streamflows and fish survival when flows exceed the objectives identified in the 2010 BiOp. Survival relationships with flow vary by species and timing of migration. Therefore, these factors are evaluated in the remainder of the analysis for this alternative.

Downstream Migration

Alternative 2A: Partial—Banks would be expected to have only minimal non–measurable impacts on salmonids migrating downstream in the spring (see previous discussion in Section 4.10.3.2. for Alternative 2A). With Alternative 2A: Partial—Banks, Columbia River flows during the spring migratory period would not differ from the base case in the dry year category (Section 4.2 – *Surface Water Quantity*). Flows in the other year categories would be reduced a minor amount (from 40 to 482 cfs), with the greatest reductions in the wetter years. As with all alternatives, flows would not be reduced in cases where the flow objectives at Priest Rapids or McNary dams are not met. Under the assumption that in–river smolt survival is largely independent of flow when flows exceed these objectives, this alternative would have no impacts to minimal impacts on spring downstream migrants.

No potential exists for impacts under any of the alternatives on Snake River fall Chinook salmon because none of the alternatives would change Columbia River flows during July or August. Juvenile fall Chinook in the Snake and Columbia Rivers have a downstream migration period that extends through July and early August. Although evidence suggests that there is no flow–survival relationship for fall Chinook migrants in the mid– and lower Columbia River (Giorgi et al. 1997; Smith et al. 2002), the issue of summer flow needs remains controversial because some contend that additional summer flow is needed in the lower Columbia River to assist the outmigration of Snake River fall Chinook juveniles. This perceived need for summer flow is largely based on studies conducted in the Snake River where water temperature is a major concern. Complicating the issue is the fact that Snake River fall Chinook appear to be changing their life history strategies in two ways. First, many of the juveniles now successfully overwinter in the lower Snake River reservoirs and outmigrate the following spring (Connor et al. 2005). Second, the juveniles that do outmigrate as subyearlings have shifted their timing progressively earlier by approximately 1 month since 1993 (Reclamation 2007 EA). Encouragingly, while the issue of summer flow needs in the Snake River continues, adult returns of Snake River fall Chinook have increased dramatically since 2000, and record returns (since 1962 at Ice Harbor Dam) occurred in 2008 and 2009.

In summary, there would be no impact to minimal impact to downstream migration for Alternative 2A.

Upstream Migration—Anadromous Fish

Lower flows during September and October in the Columbia River that would result from the alternatives are not expected to cause any delay in the upstream migration of ESA–listed fall Chinook salmon or steelhead trout. The greatest reductions in Columbia River flow for Alternative 2: Partial—Banks, as well as all alternatives, would consistently occur in October (up to 2,200 cfs), corresponding to the primary refill period for FDR, and Banks Lake (see Section 4.10 – *Fisheries and Aquatic Resources*). During this period, the peaks of the fall Chinook salmon and steelhead trout adult migrations occur in the lower and mid–Columbia River.

Adult salmon and steelhead are known to pass through the reservoirs on the Columbia River quite rapidly. Migration rates are believed to be similar to or faster in the slower currents of the reservoirs compared to pre–dam riverine conditions (Naughton et al. 2005). However, migration delays have been documented to occur at some dams as a result of fallback (adult fish passing back down through the dams they had just ascended) and difficulties finding fishway entrances. Both of these observed delay factors are more pronounced during periods of greater flow and higher spill rates at the dams, primarily during the spring and early summer (Dauble and Mueller 1993). If anything, the reduced flows would facilitate faster upstream migration, although very slightly, based on the relatively small change in flow.

In summary, there would be no impact to minimal impact to upstream migrating salmonids under Alternative 2A.

Upstream Migration—Bull Trout

The small flow changes that would occur in the Columbia River as a result of any of the action alternatives would not hinder the upstream migration or otherwise impact bull trout survival. Bull trout of the Columbia Basin DPS reside primarily in tributaries of the Columbia River such as the Methow, Entiat, and Wenatchee Rivers. However, a few juveniles and sub-adults move downstream and rear in the mid Columbia River between Chief Joseph and Priest Rapids dams. These adfluvial fish migrate upstream through the dam fishways (Rock Island, Rocky Reach, and Wells) as adults to return to their natal streams for spawning or overwintering. Adult movement upstream through the dam fishways occurs in May, June, and July. Bull trout are rarely observed in Lake Roosevelt, and no viable populations are known to occur in the reservoir. The few that are observed in Lake Roosevelt are individuals believed to have moved downstream from Canadian waters. Alternative 2B: Partial—Banks would not impact Lake Roosevelt elevation at all compared to the No Action Alternative.

Chum Salmon Spawning below Bonneville Dam

Flow changes under this alternative would not impact chum salmon spawning or egg incubation downstream of Bonneville Dam. Measures to protect chum salmon below Bonneville Dam are intended to encourage fish to spawn at an elevation that would remain wetted during subsequent egg incubation and fry emergence. Generally, this requires that flows and tailwater elevations be constrained from getting too high during the spawning period in November and December (especially during daylight hours). Following completion of spawning, flow should be maintained high enough to keep the chum redds wetted most of the time.

Chum salmon that spawn downstream of Bonneville Dam would not be impacted by Alternative 2A: Partial—Banks because the minor flow changes in the Columbia River with this alternative during the November–December spawning season would tend to produce lower flows consistent with the efforts to keep chum spawning at a lower tailwater elevation at Bonneville Dam. During the subsequent egg incubation and fry emergence period there would be no discernable changes in water surface elevations below Bonneville Dam associated with the relatively minor flow differences with this alternative). In summary, there would be no impact to chum salmon spawning below Bonneville Dam.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to threatened and endangered species are anticipated from the Limited Spring Diversion Scenario.

4.11.4 Alternative 2B: Partial—Banks + FDR

Short–term and long–term impacts would be the same as Alternative 2A: Partial—Banks. There would be no to minimal impact to downstream migration of salmonid smolts, upstream migration of adults or chum spawning below Bonneville Dam.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to threatened and endangered species or ESA-listed fish species are anticipated from the Limited Spring Diversion Scenario.

4.11.5 Alternative 3A: Full—Banks

4.11.5.1 Short–term Impacts

No direct or indirect short–term impacts on pygmy rabbits under this alternative because pygmy rabbits are not known to occupy shrub-steppe habitats that would be impacted by construction of new facilities. Portions of the East High Canal and Black Rock Coulee Reregulating Reservoir would be constructed through the historic range of the pygmy rabbit (Reclamation 2008 Appraisal) and potentially suitable habitat consisting of big sagebrush dominated shrub–steppe occurs in these areas. However, WDFW conducted surveys within these areas of potentially suitable habitat that would be impacted by facilities during 2009 and no pygmy rabbits were detected (WDFW 2009 Species) with additional surveys conducted in select areas in 2010 (WDFW 2010) and no pygmy rabbits were detected.

There would be no short-term impacts related to ESA–listed fish resources for the same reasons as described for Alternative 2A: Partial—Banks.

4.11.5.2 Long–term Impacts

No direct or indirect long–term impacts are expected on pygmy rabbits under this alternative because this species is not known to occupy shrub-steppe habitats that would be impacted by construction of new facilities. Construction of the East High Canal and Black Rock Coulee Reregulating Reservoir through potentially suitable habitat consisting of big sagebrush dominated shrub-steppe would eliminate the possibility of reintroducing captive–bred pygmy rabbits into those areas. However, this is not considered a direct or indirect impact on the species because pygmy rabbits do not occupy these areas and have not been known to do so for many years.

As discussed previously in Section 4.10 – *Fisheries and Aquatic Resources* (subsection 4.10.5.1), there is overall no impact to minimal impact to downstream migrating smolts and adult upstream migration and no impact to chum spawning below Bonneville Dam.

Additionally there would be no to minimal impact on bull trout found in the Columbia River between Chief Joseph Dam and Priest Rapids Dam.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to threatened and endangered species or ESA-listed fish species are anticipated from the Limited Spring Diversion Scenario.

4.11.6 Alternative 3B: Full—Banks + FDR

Short–term and long–term impacts would be the same as Alternative 3A: Full—Banks, except there would be no impact to downstream migrant salmonid smolts in the spring because there would be no changes in flows during this period.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to threatened and endangered species or ESA-listed fish species are anticipated from the Limited Spring Diversion Scenario.

4.11.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

4.11.7.1 Short–term Impacts

No direct or indirect short-term impacts on pygmy rabbits under this alternative because pygmy rabbits are not known to occupy shrub-steppe habitats that would be impacted by construction of new facilities. Portions of the East High Canal and Black Rock Coulee Reregulating Reservoir would be constructed through the historic range of the pygmy rabbit (Reclamation 2008 Appraisal) and potentially suitable habitat consisting of big sagebrush dominated shrub-steppe occurs in these areas. However, WDFW conducted surveys within these areas of potentially suitable habitat that would be impacted by facilities during 2009 (WDFW 2009 Species) with additional surveys conducted in select areas in 2010 (WDFW 2010) and no pygmy rabbits were detected.

There would be no short-term impacts related to ESA-listed fish resources for the same reasons as described for Alternative 2A: Partial—Banks.

4.11.7.2 Long–term Impacts

No direct or indirect long-term impacts are expected on pygmy rabbits under this alternative because this species is not known to occupy shrub-steppe habitats that would be impacted by construction of new facilities.

There would be only minimal impacts on Columbia River downstream smolt migration during the spring, and no impacts on summer downstream migration, and no to minimal impacts on upstream adult migration survival of ESA-listed salmon or steelhead trout originating in the Snake or lower Columbia Rivers under this alternative for the same reasons described for Alternative 2A. Also, there would be no impact on lower Columbia River chum salmon spawning below Bonneville Dam or on bull trout found in the Columbia River between Chief Joseph Dam and Priest Rapids Dam.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to threatened and endangered species or ESA-listed fish species are anticipated from the Limited Spring Diversion Scenario.

4.11.8 Alternative 4B: Modified Partial—Banks + FDR

Short–term and long–term impacts would be the same as Alternative 4A: Modified Partial—Banks (Preferred Alternative).

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to threatened and endangered species or ESA-listed fish species are anticipated from the Limited Spring Diversion Scenario.

4.11.9 Mitigation

No impacts to pygmy rabbits and minimal impacts to ESA–listed fish species would occur under this alternative. Therefore, no mitigation measures are needed.

4.12 Air Quality

Air quality is an important health concern in the Study Area. Non–road construction vehicle engine exhaust emissions have been identified by the EPA as a significant contributor to air pollution throughout the country. This section analyzes the anticipated impacts to air quality in association with construction vehicle engine exhaust and general construction activities that would contribute fugitive dust under each of the alternatives. In addition, the contribution of direct GHG emissions that would be generated during construction is discussed. Direct emissions refer to those that are emitted from sources owned or controlled by the entity completing the project.

An evaluation was also conducted to evaluate impacts to electricity usage as a result of the action alternatives. The evaluation concluded that a minimal amount of additional electricity would be required but that the amount would be supplied by Northwest Regional surplus rather than by new generation (see Section 4.17 – *Energy*).

4.12.1 Methods and Assumptions

4.12.1.1 Impact Indicators and Significance Criteria

Primary air quality standards protect against adverse health impacts, while secondary air quality standards protect against welfare impacts such as damage to crops, vegetation, and buildings. Impact indicators are based on these standards. Table 4-57 presents air quality impact indicators and significance criteria.

Table 4-57. Air quality impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Primary air quality standards	Violation of these standards
Secondary air quality standards	Violation of these standards
Attainment area classification	Degradation to non–attainment

4.12.1.2 Impact Analysis Methods

Impacts on air quality that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Two forms of mobile sources that release air pollutant emissions into the atmosphere are construction vehicle engine exhaust and fugitive dust resulting from construction activities for each of the action alternatives. Construction activities disturb fine dust on the ground (for example, demolition, excavation, drilling and blasting, placing of fill material, grading, onsite and offsite construction equipment and haul truck emissions, onsite processing and concrete batch plants, material hauling, and general construction traffic). Emission factors for construction activity were identified and used to determine the amount of particulate matter released into the atmosphere.

Construction vehicle engine exhaust emissions associated with construction of facilities were calculated based on estimated construction vehicle fuel usage. Emission factors relating engine exhaust to fuel usage were used to determine air pollutant emissions.

The analysis of GHG emissions follows the Council on Environmental Quality (CEQ) draft guidance (CEQ 2010) regarding how agencies of the Federal government should analyze the environmental effects of GHG emissions on climate change of a proposed agency action in accordance with Section 102 of NEPA and the CEQ Regulations for Implementing the Procedural Provisions of NEPA, 40 C.F.R. Parts 1500–1508. The analysis is also consistent with the recently published draft Washington State Department of Ecology State Environmental Policy Act Guidance on Addressing Greenhouse Gas Emissions.

Per the draft SEPA GHG guidance, emission factors from the Climate Registry General Reporting Protocol, Chapter 13, Direct Emissions from Mobile Combustion, May 2008, and the estimated construction vehicle fuel usage were used to develop direct GHG emission estimates for the mobile sources used during construction.

Typically, GHG emissions are reported on tons of carbon dioxide equivalent (CO_2e) basis. To obtain tons of CO_2e emissions, the emissions of each GHG are multiplied by their associated global warming potential (GWP) and then summed. The GWP refers to the ratio of radiative forcing (degree of warming to the atmosphere) that would result from the emission of one unit of a given GHG compared to one unit of carbon dioxide. For example, methane has a GWP of 21 and nitrous oxide has a GWP of 310. GWPs from the Climate Registry Reporting Protocol were used to convert methane and nitrous oxide emissions to total carbon dioxide equivalent emissions.

4.12.1.3 Impact Analysis Assumptions

No legal requirements specifically apply to the alternatives, but rather apply to the manufacturers of construction equipment. For the alternative impact analysis, it is assumed that the BMPs listed in Section 4.31 – *Environmental Commitments*, would be implemented.

Legal Requirements and Best Management Practices for Air Quality

No applicable local, State, or Federal emission standards for fugitive dust exist. Although construction equipment that uses non–road diesel engines would be subject to a 2004 EPA comprehensive rule to reduce emissions, this rule applies to engine manufacturers and not to the users of the equipment. Therefore, no standards are available to compare the emissions projections against the alternatives.

BMPs or reasonable precautions are typically used to control fugitive dust for preventing particulate matter from becoming airborne. BMPs to reduce fugitive dust would focus on measures to stabilize soils during construction, minimize the amount of exposed soil at any given time, and restore areas as quickly as possible, as described in Section 4.31 – *Environmental Commitments*.

4.12.2 Alternative 1: No Action Alternative

4.12.2.1 Short–term Impacts

As a result of the No Action Alternative, aquifer drawdown would continue in the Study Area. With a decline in water availability and quality, some wells may be drilled deeper to maintain irrigated crop production. Engine exhaust from drilling rigs and support equipment would cause a very small and localized increase in air pollutants, fugitive dust, and GHGs. Emissions resulting from the drilling of new deep-water wells would be an extremely small fraction of the emissions that would result from constructing any of the action alternatives. Therefore, No Action Alternative emissions were not estimated.

4.12.2.2 Long–term Impacts

Similar to current conditions, minimal impacts on air quality would occur under the No Action Alternative. As groundwater–supplied irrigation water quantity and quality declines, irrigated land would be converted to dryland farming. Lands that are dry–farmed have a higher probability of losing soil to wind erosion than cropped land, thereby creating airborne fugitive dust emissions. These would be similar to fugitive dust events on existing dryland farmed areas within the Study Area, and would represent a minimal impact.

4.12.3 Alternative 2A: Partial—Banks

4.12.3.1 Short–term Impacts

Air quality standards are not expected to be violated within the four–county analysis area. Air quality impacts associated with constructing the proposed facilities would vary by location and season. Construction activities, including excavation and backfill, would result in the release of fugitive dust into the atmosphere. Table 4-58 summarizes air pollutants that would be released into the atmosphere from engine exhaust during construction of the action alternatives. Table 4-59 summarizes particulate matter emissions from the construction of each of the action alternatives.

Table 4-60 provides background emissions for Adams, Franklin, Grant, and Lincoln counties for comparative purposes. Adverse impacts from combustion byproducts and fugitive dust (PM_{10}) would be temporary in nature and minor. The construction activity BMPs would help maintain PM_{10} emissions compliance with the 24–hour average criterion. Adverse impacts from combustible pollutants and fugitive dust (PM_{10}) would be temporary and minor.

Table 4-58. Estimated average annual air pollutant emission (ton/year).

		Alternatives 2A and 2B	Alternatives 3A and 3B	Alternatives 4A and 4B
Fuel Usage (gal/year)		241,953	922,254	225,946
Criteria Pollutants	Carbon monoxide	54.29	183.97	50.97
	Nitrogen oxides	71.11	272.93	66.40
	Particulate matter	5.00	19.19	4.67
	PM_{10}	5.00	19.19	4.67
	Sulfur oxides	4.66	17.88	4.35
	Volatile organic compounds	7.62	28.12	7.13
Toxic Pollutants	Acetaldehyde	0.001	0.005	0.001
	Acrolein	0.002	0.005	0.001
	Benzene	0.015	0.050	0.014
	1,3–Butadiene	0.001	0.0017	0.0005
	Formaldehyde	0.019	0.063	0.017
	Naphthalene	0.001	0.004	0.001
	Polyaromatic hydrocarbons	0.003	0.009	0.002
	Toluene	0.006	0.021	0.006
	Xylenes	0.005	0.015	0.004
Greenhouse Gas Pollutant	Carbon dioxide	2,785	10,622	2,601
	Methane	0.177	0.665	0.166
	Nitrous oxide	0.072	0.272	0.067
	Total carbon dioxide equivalents	2,811	10,721	2,625

Table 4-59. Total estimated fugitive dust emissions from construction activities (tons).

Alternate	Total Dust Emissions (tons)
2A: Partial—Banks	51,158
2B: Partial—Banks + FDR	51,158
3A: Full—Banks	120,313
3B: Full—Banks + FDR	120,313
4A: Modified Partial—Banks	50,584
4B: Modified Partial—Banks + FDR	50,584
Source: Analysis of facilities, equipment, and transportation requirements	

Table 4-60. Background emission for Adams, Franklin, Grant, and Lincoln counties (tons per square mile).

County	Source	PM_{10}	CO	NO_X	SO_X
Adams	Mobile	124	13,808	3,225	36
	Fuel Combustion	18	124	11	4
	Dust	266			
	Miscellaneous	33	83	5	1
Franklin	Mobile	124	17,327	3,179	42
	Fuel Combustion	69	471	18	5
	Dust	193			
	Miscellaneous	92	418	17	1
Grant	Mobile	168	26,733	3,708	46
	Fuel Combustion	92	626	15	3
	Dust	574			
	Miscellaneous	198	864	38	4
Lincoln	Mobile	120	10,045	2,420	31
	Fuel Combustion	14	99	11	7
	Dust	342			
	Miscellaneous	38	119	7	1
Total		2,465	70,717	12,654	181
Source: EPA National Emissions Inventory, 2008 Data. Accessed May 17, 2012. http://www.epa.gov/air/emissions					

Given the temporary and localized nature of construction activities, emissions are unlikely to endanger Adams, Franklin, Grant, and Lincoln counties' attainment status. NAAQS pollutant criteria would also not be violated within the four–county analysis area. Overall, minimal impact on air quality in the overall analysis area would likely occur. Area agricultural activities and natural events such as wildfires would continue to cause occasional exceedances in fugitive dust ambient air quality standards at a rate of about one occurrence per year.

Emitting carbon dioxide into the atmosphere is not itself an adverse environmental impact. It is the increased concentration of carbon dioxide in the atmosphere, resulting in global climate change and the associated consequences of climate change, that would result in environmental impacts (for example, sea level rise, lower snowpack levels, severe weather events). The largest direct emission of GHGs into the atmosphere would occur during construction of facilities, which occupies a short–term impact time frame. However, any incremental impact on global climate change would occur over a longer time frame and be part of the far greater global GHG emissions.

4.12.3.2 Long–term Impacts

Emissions resulting from maintenance activities would be an extremely small fraction of the short–term impact emissions and were not estimated. Numerous activities are required to maintain irrigation system infrastructure and equipment, provide for efficient operation, and minimize unplanned outages in service. Maintenance activities including routine inspections of delivery lines and pumps, irrigation system repair, removal of debris and vegetation from the irrigation system, and mowing easement rights–of–way. All of these maintenance activities would release very small amounts of air pollutants and GHGs as fugitive emissions. However, all of these emissions would be an extremely small fraction of the short–term impact emissions for Alternative 2A: Partial—Banks. Therefore, no long–term emissions from operations were estimated for this alternative.

Fugitive dust resulting from the Lake Roosevelt and Banks Lake drawdowns are a potential concern for air quality and public health. Exposed banks are susceptible to generating fugitive dust under certain conditions. However, as discussed in Water Quality (Section 3.4.3), Banks Lake receives very little sediment from its large watershed. Most of the sediment from the Columbia River has settled out prior to the intakes of the John W. Keys III Pump-Generating Plant. Furthermore, the local watershed consisted of basalt rocks with a very fine veneer of sediments. Consequently, drawdown events in Banks Lake do not expose large accumulations of sediment nor does the hydrology aid in the recruitment and development of new sediment bars.

Atmospheric dispersion of dust is a function of wind speed, duration, direction, and atmospheric conditions. The small incremental increase in late summer drawdown of Lake Roosevelt is not expected to result in the generation of additional fugitive dust. Banks Lake would be subject to greater late summer drawdowns under Alternative 2A: Partial—Banks. This time corresponds to the period when local atmospheric conditions that are likely to increase dispersion are most common. The prevailing surface winds in the area are from the northwest and occur most frequently during the winter and summer. No data are available for correlating fine–grain particulates with site–specific wind data for Banks Lake and its impacts on air quality.

Changes with Limited Spring Diversion Scenario

The Limited Spring Diversion Scenario would result in additional shoreline being exposed and therefore would increase the potential for fugitive dust. This potential would be minimal because of the short duration and minor amount of the additional drawdown. There would be no significant changes to air quality from this scenario.

4.12.4 Alternative 2B: Partial—Banks + FDR

Short– and long–term impacts for air quality would be the same as Alternative 2A: Partial—Banks (Table 4-58, Table 4-59, and Table 4-61).

Table 4-61. Comparison of Greenhouse Gas Emissions from Construction of the Study Area Facilities to Greenhouse Gas Emissions for Washington and the U.S.

	Greenhouse Gas Emissions (metric tons carbon dioxide equivalent)
	Direct Construction
Alternative 2A	2,811
Alternative 2B	2,811
Alternative 3A	10,721
Alternative 3B	10,721
Alternative 4A	2,625
Alternative 4B	2,625
State of Washington[a]	94,800,000
U.S.[b]	7,260,000,000

[a] Ecology et al. 2007
[b] EPA 2007

Changes with Limited Spring Diversion Scenario

The changes with the Limited Spring Diversion Scenario for air quality would be the same as those described under Alternative 2A.

4.12.5 Alternative 3A: Full—Banks

4.12.5.1 Short–term Impacts

Alternative 3A: Full—Banks construction vehicle fuel usage for full replacement would be substantially greater than for the partial replacement Alternative 2A: Partial—Banks because of construction of the East High Canal system and associated facilities. Vehicle engine exhaust and fugitive dust emissions are presented in Table 4-57 and Table 4-58.

4.12.5.2 Long–term Impacts

Emissions resulting from maintenance activities would be a very small fraction of the short–term impact emissions for Alternative 3A: Full—Banks. Therefore, no long–term emissions were estimated for this alternative.

Changes with Limited Spring Diversion Scenario

The Changes with the Limited Spring Diversion Scenario for air quality would be the same as those described under Alternative 2A.

4.12.6 Alternative 3B: Full—Banks + FDR

Short– and long–term impacts for air quality are the same as those presented for Alternative 3A: Full—Banks, and as shown in Table 4-57, Table 4-58, and Table 4-59 in Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

The changes with the Limited Spring Diversion Scenario for air quality would be the same as those described under Alternative 2A.

4.12.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

4.12.7.1 Short–term Impacts

Alternative 4A: Modified Partial—Banks (Preferred Alternative) construction vehicle fuel usage for this alternative would be moderately greater than for the partial replacement Alternative 2A: Partial—Banks because of construction of more delivery system and associated facilities construction. Vehicle engine exhaust and fugitive dust emissions are presented in

Table 4-60 and Table 4-61.

4.12.7.2 Long–term Impacts

Emissions resulting from maintenance activities would be a very small fraction of the short–term impact emissions for Alternative 4A: Modified—Banks. Therefore, no long–term emissions were estimated for this alternative.

Changes with Limited Spring Diversion Scenario

The changes with the Limited Spring Diversion Scenario for air quality would be the same as those described under Alternative 2A.

4.12.8 Alternative 4B: Modified Partial—Banks + FDR

Short– and long–term impacts for air quality are the same as those presented for Alternative 4A: Modified Partial—Banks (Preferred Alternative), and as shown in Table 4-58, Table 4-59, and

Table 4-60 in Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

The changes with the Limited Spring Diversion Scenario for air quality would be the same as those described under Alternative 2A.

4.12.9 Mitigation

Mitigation is not required because no impacts are expected from any of the action alternatives.

4.13 Land Use and Shoreline Resources

The short– and long–term impacts described for each alternative under land use and shoreline resources fall into three broad categories:

- Land ownership and land status.
- Existing land and shoreline uses, including private land and public land.
- Relevant plans, programs, or policies, such as county comprehensive plans and policies governing state trust lands.

No short–term impacts would occur under the No Action Alternative. Significant long–term impacts under the No Action Alternative would include progressive conversion of all groundwater–irrigated lands in the Study Area to dryland agriculture as the groundwater supply continues to decline. This change would generally not be consistent with the goals and objectives for irrigated agriculture in affected counties.

For the action alternatives, most land use impacts would be long–term. The exception to this would be the acquisition and use of temporary construction staging areas, if they are located outside of lands already owned or newly acquired by Reclamation for long–term use.

The partial replacement alternatives, 2A: Partial—Banks and 2B: Partial—Banks + FDR, would support irrigated agricultural uses in the long term on groundwater-irrigated lands in the Study Area south of I-90 (representing approximately 57 percent of the groundwater irrigated lands in the overall Study Area). North of I-90, significant impacts would be the same as under the No Action Alternative. Development of the water delivery and distribution system south of I-90 would result in significant land ownership and use impacts, including acquisition of over 4,300 acres of land (easement or fee title interest) for facility development and operation. Most of the land that would be acquired is privately owned, and two-thirds is in agricultural use. Existing uses that would be disrupted or changed range from a limited number of residences, through center-pivot irrigated farm parcels, to dryland farms and open land. These alternatives would support the goals and objectives for irrigated agriculture in the comprehensive plans of affected counties south of I-90 and would not support these goals and objectives north of I-90.

The full replacement alternatives, 3A: Full—Banks and 3B: Full—Banks + FDR, would support irrigated agricultural uses on groundwater-irrigated lands throughout the Study Area, consistent with the goals and objectives for irrigated agriculture in affected counties. As with the partial replacement alternatives, development of necessary water delivery and distribution systems would result in significant land ownership and use impacts, but across a broader area. Approximately 19,000 acres of land (easement or fee title interest) would be needed for facility development and operation. Most of the land that would be acquired is privately owned, and approximately 40 percent is in agricultural use. As with Alternative 2A and 2B, existing uses that would be disrupted or changed range from residences, through center-pivot irrigated farm parcels, to dryland farms and open land.

The modified partial replacement alternatives, 4A: Modified Partial—Banks and 4B: Modified Partial—Banks + FDR, would support irrigated agricultural uses in the long term on approximately 70 percent (approximately 70,000 acres) of the groundwater-irrigated lands in the Study Area. Roughly a third of the land provided with CBP water would be north of I-90, and two thirds would be south of that highway. Also, since the replacement water supply (both north and south of I-90) would be provided from the East Low Canal, the lands served would tend to be concentrated at the lower elevations and western portions of the Study Area. In the portions of the Study Area receiving CBP supply, the goals and objectives for irrigated agriculture in the comprehensive plans of affected counties would be supported.

Development of the water delivery and distribution system in these areas would result in significant land ownership and use impacts, including acquisition of over 4,800 acres of land (easement or fee title interest) for facility development and operation. Most of the land/land interest that would be acquired is privately owned, and 59% is in agricultural use. Existing uses that would be disrupted or changed are the same as reported for the other alternatives. In the parts of the Study Area that would not receive replacement CBP water supply, local jurisdiction comprehensive plan goals and objectives related to irrigated agriculture would not be supported, and significant impacts would be the same as under the No Action Alternative.

4.13.1 Methods and Assumptions

4.13.1.1 Impact Indicators and Significance Criteria

The impact indicators and associated criteria for determining significance shown in Table 4-62 were used to evaluate land use and shoreline resources impacts.

Table 4-62. Land use and shoreline resources impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Changes in land ownership and land status	Any potentially involuntary change in land ownership, such as Federal acquisition of land rights through easement or fee title, is considered significant. Because it is not possible to determine the extent to which Federal acquisitions would be voluntary, all such acquisitions are considered significant.
Changes in land or shoreline uses	Short–term or long–term disruption of existing uses (such as agriculture, residential, commercial, industrial, institutional, or designated parks, recreation, and open space) if they cannot continue, either by direct impact or introduction of adjacent incompatible uses, is considered significant.
Consistency with relevant city, county, State, or Federal land use or management plans and policies	Generally, any inconsistency with land or shoreline use designations or relevant goals, objectives and policies of City and County Comprehensive Plans, or applicable State or Federal management plans and programs, is considered significant. Any proposal for substantial development on a shoreline subject to the State Shoreline Management Act could result in significant impacts; within the Land Use and Shoreline Resources analysis area this applies only to Black Rock Lake in Grant County.

4.13.1.2 Impact Analysis Methods

Impacts on land use and shoreline resources that would occur under each of the alternatives (including No Action) are compared against the current conditions within the Study Area.

The land use and shoreline resources impact analysis was conducted using existing published information, supplemented by limited field reconnaissance. Primary sources of information for existing land ownership and use included mapping available at the respective county web sites and available aerial photography.

4.13.1.3 Impact Analysis Assumptions

The following assumptions are made to assess impacts to land use resources:

- The proposed facility locations and sizes, including development sites and conveyance alignments, are derived from Reclamation's preliminary, feasibility–level plans. These facilities and alignments are subject to adjustment based on further study. Thus, the effects reported for these facilities should be viewed as worst case estimates, with site or alignment adjustments considered an important source of mitigation actions.

- Short–term is defined as the roughly 10–year construction period for required facilities, as described in Chapter 2 for each of the alternatives. From the standpoint of direct effects on land use, however, construction at or near any given specific location, such as a farm field, residence, or other use, would generally not exceed 1 year.
- No construction plans have been prepared for facilities associated with the action alternatives. Given this, potential short–term, construction–phase effects on existing land uses during construction cannot be specified (for example, road detours, extent, or duration of construction ongoing at any given location or time, or construction traffic patterns). Such effects are assessed generally, with commitments to further planning and design in coordination with potentially affected parties considered key elements of mitigation.

Broadly applicable legal requirements are described in Chapter 5 − *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all regulations would be followed. No specific BMPs or mitigation measures are required to address land use and shoreline resources.

Legal Requirements and BMPs for Land Acquisition

Under Federal regulations, the process for acquiring land includes appraisal of fair market value and compensation to impacted landowners, as described in Chapter 5, *Consultation and Coordination*. No specific BMPs address land use and shoreline resources.

4.13.2 Alternative 1: No Action Alternative

4.13.2.1 Short–term Impacts

No short–term impacts are anticipated because no new facilities would be constructed under this alternative that would require acquisition of land interests (easements or fee title) by Reclamation.

4.13.2.2 Long–term Impacts

Land Ownership and Land Status

Indirect impacts over the long term could include consolidation of private land ownership into the hands of fewer landowners. As irrigated agriculture declines, assembly of land parcels into the larger ownerships associated with dryland farming would likely become more prevalent.

Existing Land and Shoreline Uses

Private Land

Over the next few decades, as the groundwater resource is depleted, existing agricultural land uses in the Study Area would be transformed. Acreage in irrigated agriculture would progressively decline. It is expected that all currently irrigated farmland would be suitable for dryland agriculture and that the conversion from irrigated to dryland farming would occur on all affected lands within approximately a year after irrigation ceases. It is unlikely that any significant portion of affected lands would be converted to developed uses such as residential, commercial, industrial, or institutional because of the readily available land inventory in and near existing towns and cities.

Public Land

The only impact to public lands in the Study Area as a result of the No Action Alternative would be progressive conversion over the long term of State Trust lands currently leased and used for irrigated agriculture to dryland agriculture, as described above for irrigated private lands. No land use or shoreline impacts would occur related to lands owned by WDFW, WSDOT, Reclamation, or the Towns of Connell and Warden.

Relevant Plans, Programs, or Policies

The No Action Alternative would be broadly inconsistent with the comprehensive plans of all involved counties. These plans recognize the importance of irrigated agriculture to the local economy and seek to promote and protect this use. The de facto termination of irrigated agriculture over time is not consistent with this intent and represents a significant impact.

Given that many tracts of State Trust land in the Study Area are currently leased for irrigated agriculture, the State would experience a decrease in revenues as these tracts transition from irrigated agriculture to dryland agriculture. The potential for the State to convert these lands to a revenue–generating use comparable to or better (higher revenue) than irrigated agriculture is considered low.

The No Action Alternative would involve no inconsistencies with plans, programs, or policies related to the following:

- County critical areas ordinances.
- State Shoreline Management Act and County Shoreline Master Programs.
- WDFW land—CBWA Management Plan (Billy Clapp Unit).
- Towns of Connell and Warden.
- Reclamation land management.

4.13.3 Alternative 2A: Partial—Banks

Land use impacts of the partial replacement alternatives fall into two general categories:

- Direct impacts from construction and operation of the irrigation infrastructure south of I–90: Implementation of this water delivery system would impact land ownership and use conditions predominantly in southwestern Adams County, with relatively limited impacts also occurring in northern Franklin and southeastern Grant counties. Impacts would be associated with Reclamation acquisition of necessary land rights (easements and fee title), as well as construction and operation of the facilities.
- Indirect impacts from not replacing groundwater supply north of I–90: Impacts would be essentially the same as those described for the No Action Alternative.

4.13.3.1 Short–term Impacts

Land Ownership and Land Status

The only potential for significant short–term impacts on land ownership or land status would be any requirements for temporary construction staging areas outside of lands already owned or newly acquired by Reclamation for long–term use. The need for such temporary facilities has not been determined. To the extent that such sites are required, Reclamation would seek voluntary temporary lease arrangements with impacted landowners.

Existing Land Use and Shoreline Resources

All existing uses on lands acquired for construction and operation of Alternative 2A: Partial—Banks (both easements and fee title, as described above) would be disrupted during facility construction. The only exception is the additional easement along Weber Wasteway, where no construction would be completed.

Construction of the enhanced delivery system would be accomplished over roughly a 10-year period as described in Chapter 2. Construction would begin at the northern edge of the Study

Area, immediately south of I–90 in Adams and a small portion of Grant Counties, and proceed south, concluding in Franklin County. Seasonal considerations would dictate timing for some construction activities, while other work could be accomplished at any time.

Significant disruption of agricultural operations would also occur outside of Reclamation easements and fee–owned parcels during delivery system construction. However, most impacts would be temporary. Distribution pipelines would cross numerous irrigated fields, most with center–pivot systems. Where these crossings occur, full–circle operation of the pivot system would be disrupted during installation of the pipeline in the Reclamation easement (likely spanning no more than one growing season in any given instance). After the pipeline is installed, full use of the center–pivot systems could continue in most cases.

Relevant Plans, Programs, or Policies

No short–term impacts would occur related to County Comprehensive Plans or other agency plans, programs, or policies associated with Alternative 2A: Partial—Banks.

4.13.3.2 Long–term Impacts

Land Ownership and Land Status

Construction of the water delivery system for Alternative 2A: Partial—Banks would have a significant land ownership impact, with the following Reclamation acquisitions:

- Easements for the East Low Canal extension, the pipeline distribution system, and required power transmission lines.
- Additional easement width for the 3 mile constructed portion of the existing Weber Wasteway.
- Fee title to land necessary for pumping plants, a gravity turnout, and an O&M facility.

No additional easements would be required for expanding the East Low Canal. Acquisition requirements for each type of facility are listed in Chapter 2 (Table 2–4). Total land interest acquisition requirements in terms of acreage and number of parcels impacted for both private and public land are shown in Table 4-63 for easement acquisition, and Table 4-64 for fee title acquisition.

Table 4-63. Partial replacement alternatives – water delivery system: easement acquisition requirements.

	Canals, Siphons, Wasteways		Pipelines		Transmission Lines	Totals	
	Acres	Parcels Impacted	Acres	Parcels Impacted	Acres	Acres	Parcels Impacted
Private land	356	27	2,729	288	Locations, land status, and parcels impacted undetermined	3,085	315
Public land	—	—	153	12		153	12
School District	—	—	5	1		5	1
State land (WDNR)	—	—	148	11		148	11
Totals	**356**	**27**	**2,882**	**300**	**1,018**	**4,256***	**327**
*Includes totals above plus transmission line acreage at left.							

Table 4-64. Partial replacement alternatives – water delivery system: fee title acquisition requirements.

	Pumping plants, gravity turnout, O&M facility	
	Acres	Parcels Impacted
Private land	39	24
Public land	2	1
State land (WDNR)	2	1
Totals	**41**	**25**

As shown in Table 4-63 and Table 4-64, most land interest acquisition requirements would involve private land, reflecting the predominance of private ownership throughout the Study Area. A total of 3,238 acres of land (327 parcels) would need to be acquired for facility easements (not including transmission line requirements). Approximately 95 percent of this is private land. Of the 84 acres of land necessary in fee title, private land also represents 95 percent. Public lands subject to easement or fee acquisition would include parcels owned by School District 146 and WDNR.

In the Study Area north of I–90, Alternative 2A: Partial—Banks would have minimal impact on land ownership. The trend toward larger private ownerships (fewer owners) described under the No Action Alternative would occur as irrigated agriculture transitions to dryland agriculture in the absence of a replacement water supply.

Existing Land Use and Shoreline Resources

From the perspective of the entire Study Area, Alternative 2A: Partial—Banks would have an important beneficial effect on land use south of I-90 and a significant impact north of I-90.

South of I–90, this alternative would provide CBP water to support the long–term viability of irrigated agriculture on lands now using groundwater for irrigation. However, localized adverse long–term impacts could occur. North of I-90, Alternative 2A: Partial—Banks would have the same adverse long–term impact described for the No Action Alternative.

At a more detailed level, adverse long–term land use impacts would focus south of I-90 and derive directly from Reclamation acquisition of lands and land rights for water delivery system facility development and operation. Impacts would include the following:

- Residential or business displacements.
- Removing land from agricultural production and disrupting existing agricultural operations.
- Introducing major irrigation system infrastructure in currently open land.

In the first two categories, impacts would be significant. Where facilities would be developed on currently open land, land use impacts would generally be considered minimal because none of the impacted open lands are formally designated as open space, recreation, or habitat.

As shown in Table 4-65, five residences would be displaced because of their location within needed facility easements. Actual need for displacement or relocation of these residences is uncertain in some cases. Specifically, three potentially affected residences are within the easement acquisition area associated with conceptual alignments of pipelines. Avoiding these residential displacements may be possible during later design phases.

Of the total land acquired for Alternative 2A: Partial—Banks, 62 percent is used for agriculture (with 73 percent of this in irrigated lands and 27 percent in dryland). Developing the facilities for this alterative would temporarily impact 262 center–pivot irrigated fields with pipeline construction, and permanently restrict full–circle irrigation on 5 fields. Additionally, portions of 66 center–pivot–irrigated fields would be within the easement acquisition area for the facilities; all but three of these would be temporary impacts associated with pipeline installation. The remaining three are associated with the additional easement for Weber Wasteway; full center–pivot operation could continue on these parcels unless or until erosion of the wasteway channel extends into the pivot–irrigated area.

Table 4-65. Partial replacement alternatives – water distribution system: land use impacts.

Proposed Feature County	Occupied Structures (including residences and businesses) within New Easements or Acquisition	Agriculture								Open Land
		Center Pivots		Other Irrigated Farm Parcels		Dryland Farm Parcels		Total Irrigated Agriculture within New Easements or Acquisition Areas (acres)	Total Dryland Agriculture within New Easements or Acquisition (acres)	Total Open Land within New Easements or Acquisition Areas (acres)
		Crossed by Facility Centerline or within Facility Development Site	Crossed by New Easement but not Facility Centerline	Crossed by Facility Centerline or within Facility Development Site	Crossed by New Easement but not Facility Centerline	Crossed by Facility Centerline or within Facility Development Site	Crossed by New Easement but not Facility Centerline			
Canals and Constructed Wasteways (600–foot easements)	**2**	**1**	**3**	**0**	**12**	**3**	**1**	**183**	**148**	**25**
Adams	1	1	0	0	0	3	0	56	128	25
Grant	1	0	3	0	12	0	1	127	20	0
Pipelines (100 & 200–foot easements)	3	257	63	8	0	55	2	1,293	382	1,155
Adams	2	221	50	5	0	49	1	1,151	323	996
Grant	0	6	3	0	0	0	0	7	0	44
Franklin	1	30	10	3	0	6	1	135	59	115
Pumping plants, gravity turnout, and O&M Facilities	**0**	**4**	**NA**	**0**	**NA**	**2**	**NA**	**11**	**9**	**33**
Adams	0	4	NA	0	NA	2	NA	11	9	28
Grant	0	0	NA	0	NA	0	NA	0	0	4
Totals	**5**	**262**	**66**	**8**	**12**	**60**	**3**	**1,487**	**539**	**1,213**

*Data do not include impacts from transmission lines and construction access roads. The location of these facilities would not be determined until more detailed planning occurs.

Generally, agricultural operations could continue on easements for most of the acreage involved in the 20 other irrigated fields and 63 dryland farm parcels that would be impacted by the facilities. Impacts from pipeline installation would be temporary or short–term, while impacts from canal, siphon, wasteway, or pumping plant development would be permanent.

Approximately 37 percent of the land necessary for facility easements or fee–owned sites is currently open land. Parcels impacted range from section corners (the non–irrigated portion of a center–pivot field) to full sections of land in a relatively natural condition. Most of this land is private and none of it is formally designated as open space, recreation, or habitat by responsible planning jurisdictions. Lands owned by School District 146 are also currently open and undeveloped.

Related to shoreline resources, no waterbodies subject to the State Shoreline Management Act are present within the area impacted by development of the partial replacement alternatives.

Relevant Plans, Programs, or Policies

Alternative 2A: Partial—Banks would be broadly consistent with the comprehensive plans of all involved counties in the Study Area on lands south of I-90. The provision of CBP water to replace failing groundwater supplies would allow for the long-term continuation of irrigated agriculture, consistent with county goals, objectives, and policies that emphasize promotion and protection of this use. North of I-90, this alternative, as with the No Action Alternative, is inconsistent with those same plans. Similarly, Alternative 2A: Partial—Banks would support WDNR agricultural leasing programs for Trust lands in the Study Area south of I-90, and fail to support these programs for lands north of I-90.

Alternative 2A: Partial—Banks would involve no impacts on or inconsistencies with plans, programs, or policies related to the following:

- County Critical Areas Ordinances.
- State Shoreline Management Act and County Shoreline Master Programs.
- WDFW land—CBWA Management Plan (Billy Clapp Unit).
- Town of Warden.

Changes with Limited Spring Diversion Scenario

Under Alternative 2A, no impact should occur to current existing land use. Shoreline resources would be slightly impacted through increased shoreline exposure due to the drawdown levels.

4.13.4 Alternative 2B: Partial—Banks + FDR

Short- and long-term impacts would be the same as that presented for Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

Impacts under Alternative 2B would be the same or less than those for Alternative 2A as the drawdown under Alternative 2B would be approximately 1.5 feet less.

4.13.5 Alternative 3A: Full—Banks

Alternative 3A would result in important beneficial effects throughout the Study Area by supplying CBP surface water supply to replace groundwater for irrigated lands. Therefore, this alternative would fully support existing uses and related County and other agency plans and programs.

Similar to Alternative 2A, direct impacts would be associated with construction and operation of the irrigation infrastructure necessary to supply the water, but would be much more extensive. Implementation of this water delivery system would impact land ownership and use conditions predominantly in western Adams County and southeastern Grant County, with relatively limited impacts also occurring in northern Franklin and southwestern Lincoln counties. Impacts would be associated with Reclamation acquisition of necessary land rights (easements and fee title), as well as construction and operation of the facilities described in Chapter 2.

Water delivery system facilities south of I-90, and associated land use and shoreline resource impacts, are the same as those described for Alternative 2A: Partial—Banks. Thus, discussions below focus on land use and shoreline resources impacts of the facilities north of I–90, and impact discussions for facilities south of I-90 are not repeated, although the total impacted acreage is provided on tables in this discussion.

4.13.5.1 Short–term Impacts

Land Ownership and Land Status

The only potential for significant short–term impacts on land ownership or land status would be any requirements for temporary construction staging areas outside of lands already owned or newly acquired by Reclamation. The potential need for such temporary facilities has not been determined. To the extent that such sites are required, Reclamation would seek voluntary temporary lease arrangements with impacted landowners.

Existing Land Use and Shoreline Resources

With few exceptions, it is expected that all existing uses on lands acquired for construction and operation of Alternative 3A: Full—Banks (both easements and fee title) would be disrupted during construction. Exceptions include the flood control and drainage management easements along Black Rock and Farrier coulees, and some lands within the acquisition area for the Black Rock Reregulating Reservoir. In the case of flood control or drainage management easements, no physical construction is anticipated. At the site of the Black Rock Reregulating Reservoir, lands in the acquisition area outside of the reservoir pool, dike area, and the site of the pumping plant would likely remain generally undisturbed.

Construction of the water delivery system north of I–90 would be accomplished over approximately a 10–year period, as described in Chapter 2. Construction would begin at the northern edge of the impacted area, in Grant County, and proceed southward, concluding in Adams County. Seasonal considerations would dictate timing for some construction activities, while other work, such as pumping plants could be accomplished at any time.

In the case of the canals, siphons, distribution pipelines, and power transmission lines, existing non–structural uses (agriculture and open space) could resume at least to some extent after construction, specifically the following:

- Of the 600–foot easement to be acquired for new canals, siphons and constructed wasteways, 300 feet are expected to be committed to physical facilities and long–term operation and maintenance. The remaining 300 feet, expected to be disturbed as part of construction, could be returned to existing non–structural uses such agriculture after construction is completed.
- For pipelines and transmission lines, existing non–structural uses could likely be resumed in all or most of the easements upon completion of construction.

Significant disruption of agricultural operations would also occur outside of Reclamation easements and fee–owned parcels during delivery system construction. In the case of the distribution pipelines, most impacts would be temporary. Distribution pipelines would cross numerous irrigated fields, most with center–pivot systems. Where these crossings occur, full–circle operation of the pivot system would be disrupted during installation of the pipeline in the Reclamation easement (likely spanning no more than one growing season in any given instance). After the pipeline is installed, full use of the center–pivot systems could continue in most cases.

Relevant Plans, Programs, or Policies

No short term impacts would occur related to County Comprehensive Plans or other agency plans, programs, or policies associated with this or any of the full replacement alternatives.

4.13.5.2 Long–term Impacts

Land Ownership and Land Status

Construction of the water delivery system north of I-90 would have a significant land ownership impact. Reclamation would need to acquire the following:

- Easements for the East High Canal and Black Rock Branch Canal (including associated siphons, wasteways, and flood/drainage management corridors), the pipeline distribution system, and required power transmission lines.
- Fee title to lands necessary for the Black Rock Reregulating Reservoir, pumping plants, gravity turnouts, and O&M facilities.

Acquisition requirements for each type of facility are listed in Chapter 2, Table 2-6, Full Replacement Alternatives—Delivery System Facility Requirements. Total land interest acquisition requirements in terms of acreage and number of parcels impacted for both private and public land are shown for facilities north of I-90 in Table 4-66 for easement acquisition, and Table 4-67 for fee title acquisition. Total land ownership impact quantities, including facilities both north and south of I-90, are shown in Table 4-68 for easement acquisition and Table 4-69 for fee title acquisition.

Table 4-66. Full replacement alternatives – water delivery system: easement acquisition requirements north of I-90.

	Canals, Siphons, Wasteways		Pipelines		Transmission Lines	Totals	
	Acres	Parcels Impacted	Acres	Parcels Impacted	Acres	Acres	Parcels Impacted
Private land	8,101	337	3,132	575	Locations, land status, and parcels impacted undetermined	11,233	912
Public land	537	22	98	19		635	41
County and city land total	—	—	4	2		4	2
Adams County	—	—	1	1		1	1
Grant County	—	—	3	1		3	1
State land total	537	22	94	17		631	39
WDFW	89	6	—	—		89	6
WDNR	365	9	86	11		450	20
WSDOT	83	7	8	6		91	13
Totals	**8,638**	**359**	**3,230**	**594**	**1,540**	**13,408**[b]	**953**

[a] In addition to requirements south of I–90, described in Table 4-63 for the partial replacement alternatives
[b] Includes totals above plus transmission line acreage at left.

Table 4-67. Full replacement alternatives – water delivery system: fee title acquisition requirements north of I-90.

	Pumping plants, Gravity Turnouts, O&M Facilities		Black Rock Coulee Re–Regulating Reservoir		Totals	
	Acres	Parcels Impacted	Acres	Parcels Impacted	Acres	Parcels Impacted
Private	63	41	1,299	51	1,362	92
Public	5	2	1	1	6	3
State land (WDNR)	5	2	1	1	6	3
Totals	**68**	**43**	**1,300**	**52**	**1,368**	95
* In addition to requirements south of I–90, described in Table 4-64 for the partial replacement alternatives						

Table 4-68. Full replacement alternatives – water delivery system: easement acquisition requirement totals.

	Canals, Siphons, Wasteways		Pipelines		Transmission Lines	Totals	
	Acres	Parcels Impacted	Acres	Parcels Impacted	Acres	Acres	Parcels Impacted
Private land	8,457	364	5,861	889	Locations, land status, and parcels impacted undetermined	14,318	1,253
Public land	537	22	251	32		788	54
County and city land total	—	—	9	4		9	4
School District 146	—	—	5	1		5	1
Adams County			1	1		1	1
Grant County	—	—	3	1		4	1
State land total	537	22	242	28		779	50
WDFW	89	6	—	—		89	6
WDNR	365	9	233	22		598	31
WSDOT	83	7	8	6		91	13
Totals	**8,994**	**386**	**6,113**	**921**	**2,557**	**17,665***	**1,307**
* Includes totals above plus transmission line acreage at left.							

Table 4-69. Full replacement alternatives – water delivery system: fee title acquisition requirement totals.

	Pumping plants, Gravity Turnouts, O&M Facilities		Black Rock Coulee Re–Regulating Reservoir		Totals	
	Acres	Parcels Impacted	Acres	Parcels Impacted	Acres	Parcels Impacted
Private	102	65	1,299	51	1,401	116
Public	7	3	1	1	8	4
State land (WDNR)	7	3	1	1	8	4
Totals	**109**	**68**	**1,300**	**52**	**1,409**	**120**

Approximately 95 percent of the easement acquisition requirements north of I-90 would involve private land, reflecting the predominance of private ownership throughout the Study Area. Of the land necessary in fee title, over 99 percent is private land. Public lands subject to easement or fee acquisition north of I-90 would include small acreages owned by the Adams and Grant Counties (1 and 3 acres, respectively), and larger acreages owned by the State, as follows:

- WDFW: 89 acres of land in the Billy Clapp Lake Unit of the CBWA, required for routing of the East High Canal.
- WDNR: 450 acres of land involving 20 parcels scattered throughout the area, necessary for new canals and pipelines.
- WSDOT: 91 acres associated with a crossing of State Route 28 west of the town of Wilson Creek (see Section 4.16 – *Transportation*) and in the west–central Study area, where the alignment of Farrier Coulee parallels I-90.

Overall land rights acquisition requirements for Alternative 3A: Full—Banks (both north and south of I-90) total 17,665 acres of easements and 1,409 acres in fee title. Approximately 95 percent of this total acquisition requirement is private land.

Existing Land Use and Shoreline Resources

From the perspective of the entire Study Area, Alternative 3A: Full—Banks would have an important beneficial effect on land use. This alternative would provide CBP water to support the long–term viability of irrigated agriculture on lands now using groundwater for irrigation. At a more detailed level, adverse long–term land use impacts would derive directly from Reclamation acquisition of lands and land rights for water delivery system facility development and operation. Impacts north of I-90 would include the following:

- Residential or business displacements.
- Removing land from agricultural production and disrupting existing agricultural operations.

- Introducing major irrigation system infrastructure in currently open land.

In the first two of these categories, impacts would be significant. In cases where the facilities would be developed on currently open land, land use impacts would generally be considered minimal. Also, as noted above in discussion of land ownership, WSDOT lands along SR 28 and I-90 would also be affected. However, impact to these facilities would be minimal. SR 28 would be under–crossed by the East High Canal in the form of a pipeline, and Reclamation would only acquire or arrange an easement along Farrier Coulee where it parallels I-90, with no substantial construction necessary.

Data characterizing these impacts north of I-90 is shown in Table 4-70 and provides total impact data for the water delivery system of full replacement alternatives, including facilities north and south of I-90.

North of I-90, 10 residences may be displaced because of their location within needed facility easements or fee–title facility sites, but this is uncertain. For example, four potentially affected residences are within the easement acquisition area along Farrier Coulee within which no construction is planned; also, four residences are within the conceptual alignments of pipelines. In both cases, avoiding these residential displacements may be possible during later design phases.

Approximately 34 percent of the total acquisition required north of I–90 for Alternative 3A: Full—Banks is agricultural land (43 percent of which is irrigated, and 57 percent is dryland). Developing the facilities north of I-90 for this alterative would temporarily impact 213 center–pivot irrigated fields with pipeline construction, and permanently restrict full–circle irrigation on 48 fields. Additionally, portions of 217 center–pivot–irrigated fields would be within the easement acquisition area for the facilities. However, for the most part, operations could continue after construction.

Easements covering portions of six other irrigated fields would be acquired for pipeline installation and flood control easements, with continuation of current agricultural operations possible. Two other fields would be permanently retired in the footprint of the new canal. Finally, portions of 118 dryland farm parcels would be acquired. As with other forms of agriculture noted above, impacts from canal, siphon, wasteway, or pumping plant development would be permanent and impacts from pipeline installation could be temporary or short term.

Approximately 66 percent of the land necessary for facility easements or fee–owned sites north of I-90 is currently open land. Parcels impacted range from section corners (the non–irrigated portion of a center–pivot field) to full sections of land in a relatively natural condition. Most of this land is private and not formally designated as open space, recreation, or habitat; however, 89 acres are within the Billy Clapp Unit of the CBWA. The Adams and Grant County parcels noted in discussion of land ownership are also currently open and undeveloped.

Related to shoreline resources, Black Rock Lake in Grant County would not be impacted by development of the Black Rock Coulee Reregulating Reservoir or other facilities.

Table 4-70. Full replacement alternatives – water distribution system: land use impacts north of I–90.[a, b]

Construction Segment / County	Occupied Structures within New Easements or Acquisition Areas	Agriculture								Open Land
		Center Pivots		Other Irrigated Farm Parcels		Dryland Farm Parcels		Total Irrigated Agriculture within New Easements or Acquisition Areas (acres)	Total Dryland Agriculture within New Easements or Acquisition Areas (acres)	Total Open Land within New Easements or Acquisition Areas (acres)
		Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line			
Canals, Siphons, and Constructed Wasteways (600–foot easements)	**2**	**43**	**15**	**2**	**0**	**33**	**8**	**1,211**	**970**	**3,262**
Adams	1	6	3	1	0	8	1	206	473	1,033
Grant	1	29	8	1	0	19	5	795	448	2,229
Lincoln	2	26	34	1	0	8	0	210	49	0
Pipelines (200–foot easements)	**4**	**213**	**209**	**3**	**2**	**49**	**16**	**674**	**1,064**	**1,492**
Adams	0	42	45	1	0	12	4	142	110	588
Grant	2	145	130	1	2	29	12	467	692	837
Lincoln	2	26	34	1	0	8	0	65	262	67
Flood Easements (1,200–foot easements)	**4**	**0**	**8**	**0**	**1**	**0**	**6**	**27**	**508**	**2,661**
Adams (Farrier Coulee)	4	0	8	0	1	0	6	27	508	1,195
Grant (Black Rock Coulee)	0	0	0	0	0	0	0	0	0	1,466

Construction Segment County	Occupied Structures within New Easements or Acquisition Areas	Agriculture								Open Land
		Center Pivots		Other Irrigated Farm Parcels		Dryland Farm Parcels		Total Irrigated Agriculture within New Easements or Acquisition Areas (acres)	Total Dryland Agriculture within New Easements or Acquisition Areas (acres)	Total Open Land within New Easements or Acquisition Areas (acres)
		Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line			
Pumping plants, Gravity Turnouts, and O&M Facilities	**0**	**5**	**NA**	**0**	**NA**	**6**	**NA**	**13**	**20**	**35**
Adams	0	0	NA	0	NA	4	NA	3	13	11
Grant	0	5	NA	0	NA	1	NA	10	3	21
Lincoln	0	0	NA	0	NA	1	NA	0	3	3
Black Rock Reregulating Reservoir	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**11**	**0**	**1,289**
Totals	**10**	**261**	**232**	**5**	**3**	**88**	**30**	**1,912**	**2,542**	**8,739**

[a] Data do not include impacts from transmission lines and construction access roads; the location of these facilities would not be determined until more detailed planning occurs.
[b] In addition to those south of I-90, described in Table 4-65 for the partial replacement alternatives.

Table 4-71. Full replacement alternatives – water distribution system: land use impact totals*.

		Agriculture								Open Land
		Center Pivots		Other Irrigated Farm Parcels		Dryland Farm Parcels		Total Irrigated Agriculture within New Easements or Acquisition Areas (acres)	Total Dryland Agriculture within New Easements or Acquisition Areas (acres)	Total Open Land within New Easements or Acquisition Areas (acres)
Construction Segment County	Occupied Structures within New Easements or Acquisition Areas	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line			
Canals, Siphons, and Constructed Wasteways (600-foot easements)	**6**	**44**	**18**	**2**	**12**	**36**	**9**	**1,394**	**1,118**	**3,287**
Adams	2	7	3	1	0	11	1	262	601	1,058
Grant	2	29	11	1	12	19	6	922	468	2,229
Lincoln	2	8	4	0	0	6	2	210	49	0
Pipelines (200-foot easements)	**7**	**470**	**272**	**11**	**2**	**104**	**18**	**1,967**	**1,445**	**2,647**
Adams	2	263	95	6	0	61	5	1,293	433	1,584
Grant	2	151	133	1	2	29	12	474	692	881
Franklin	2	30	10	3	0	6	1	135	59	115
Lincoln	2	26	34	1	0	8	0	65	262	67
Flood Easements (1,200-foot easements)	**4**	**0**	**8**	**0**	**1**	**0**	**6**	**27**	**508**	**2,661**
Adams (Farrier Coulee)	4	0	8	0	1	0	6	27	508	1,195
Grant (Black Rock Coulee)	0	0	0	0	0	0	0	0	0	1,466
Pumping plants, Gravity Turnouts, and O&M Facilities	**0**	**9**	**0**	**0**	**0**	**8**	**0**	**24**	**29**	**67**
Adams	0	4	0	0	0	6	0	14	22	39
Grant	0	5	0	0	0	1	0	10	3	25
Lincoln	0	0	0	0	0	1	0	0	3	3

Construction Segment County	Occupied Structures within New Easements or Acquisition Areas	Agriculture								Open Land
		Center Pivots		Other Irrigated Farm Parcels		Dryland Farm Parcels		Total Irrigated Agriculture within New Easements or Acquisition Areas (acres)	Total Dryland Agriculture within New Easements or Acquisition Areas (acres)	Total Open Land within New Easements or Acquisition Areas (acres)
		Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line			
Black Rock Reregulation Reservoir	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**11**	**0**	**1,289**
Totals	**17**	**523**	**298**	**13**	**15**	**148**	**33**	**3,423**	**3,100**	**9,952**

*Data do not include impacts from transmission lines and construction access roads; the location of these facilities would not be determined until more detailed planning occurs.

Relevant Plans, Programs, or Policies

Alternative 3A: Full—Banks would be broadly consistent with the Comprehensive Plans of all involved counties in the Study Area for allowing long–term continuation of irrigated agriculture. Alternative 3A: Full—Banks would also support WDNR agricultural leasing programs for Trust lands throughout the Study Area.

Alternative 3A: Full—Banks would involve no impacts or inconsistencies with plans, programs, or policies related to the following:

- County critical areas ordinances.
- State Shoreline Management Act and County Shoreline Master Programs.

Changes with Limited Spring Diversion Scenario

Land use would be minimally impacted; shoreline resources would be subject to increased exposure and increased distance to water's edge.

4.13.6 Alternative 3B: Full—Banks + FDR

Short– and long–term impacts would be the same as those described for Alternative 3A: Full—Banks.

Changes with Limited Spring Diversion Scenario

Changes and impacts would be less than Alternative 2A; Alternative 3B drawdown would be 1.5 feet less than Alternative 2A. Changes would be proportionately less; however, the same as Alternative 2A.

4.13.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

Alternative 4A: Modified Partial—Banks would result in important beneficial effects in much of the Study Area by supplying CBP surface water supply to replace groundwater for a large proportion of irrigated lands, both North and South of I–90. Therefore, this alternative would largely support existing uses and related County and other agency plans and programs.

Direct impacts would be associated with construction and operation of the irrigation infrastructure necessary to provide the water to agricultural lands. The magnitude of these impacts would be slightly higher than those associated with Alternative 2A: Partial—Banks, requiring approximately 4,800 acres of land, compared with 4,300 acres required by Alternative 2A. These impacts would occur both north and south of I-90 and be generally concentrated in the central and western portions of the study area. Implementation of this water delivery system would impact land ownership and use conditions in western Adams County and southeastern Grant County, with minor impacts also occurring in northern Franklin County. Impacts would be associated with Reclamation acquisition of necessary land rights (easements and fee title), as well as construction and operation of the facilities described in Chapter 2.

4.13.7.1 Short-term Impacts

Land Ownership and Land Status

As stated for the other alternatives, the only potential for significant short-term impacts on land ownership or land status would be any requirements for temporary construction staging areas outside of lands already owned or newly acquired by Reclamation. The potential need for such temporary facilities has not been determined. To the extent that such sites are required, Reclamation would seek voluntary temporary lease arrangements with impacted landowners.

Existing Land Use and Shoreline Resources

With few exceptions, it is expected that all existing uses on lands acquired for construction and operation of Alternative 4A (both easements and fee title) would be disrupted during construction.

Construction of the water delivery system would be accomplished over approximately a 10-year period, as described in Chapter 2. Construction would begin in the northern part of the impacted area, in Grant County, proceed southward through Adams County, and conclude in Franklin County. Seasonal considerations would dictate timing for some construction activities, while other work, such as pumping plants could be accomplished at any time.

With most of the facilities constructed (i.e., predominantly pipelines and transmission lines), existing non-structural uses (agriculture and open space) could resume within Reclamation's easements, at least to some extent after construction. Significant disruption of existing agricultural operations would also occur immediately outside of Reclamation easements and fee-owned parcels during delivery system construction. In the case of the distribution pipelines, most impacts would be temporary. These pipelines would cross numerous irrigated fields, most with center-pivot systems. Where these crossings occur, full-circle operation of the pivot system would be disrupted during installation of the pipeline in the Reclamation easement (likely spanning no more than one growing season in any given instance). After the pipeline is installed, full use of the center-pivot systems could continue in most cases.

Relevant Plans, Programs, or Policies

No short term impacts would occur related to County Comprehensive Plans or other agency plans, programs, or policies associated with this or any of the Modified Partial Replacement alternatives.

4.13.7.2 Long-term Impacts

Land Ownership and Land Status

Construction of the water delivery system would have a significant land ownership impact. Reclamation would need to acquire easements for the water distribution pipelines and power transmission lines, and fee title to lands necessary for the pumping plants and other minor facilities.

Acquisition requirements for each type of facility are listed in Chapter 2, Table 2 6. Total land interest acquisition requirements in terms of acreage and number of parcels impacted for both private and public land are shown on Table 4-72 for easement acquisition, and Table 4-73for fee title acquisition.

Table 4-72. Modified partial replacement alternatives – water delivery system: easement acquisition requirements – totals (north and south of I-90).

	Canals, Siphons, Wasteways		Pipelines		Transmission Lines	Totals	
	Acres	**Parcels Impacted**	**Acres**	**Parcels Impacted**	**Acres**	**Acres**	**Parcels Impacted**
Private land	127	10	2650	308	Locations, land status, and parcels impacted undetermined	2,908	318
Public land	--	--	126	12		126	12
County and city land total	--	--	2	2		2	2
Adams County	--	--	1	1		1	1
Grant County	--	--	1	1		1	1
State (WDNR)	--	--	124	10		124	10
Totals	**127**	**10**	**2776**	**320**	**1,818**	**4,721**[a]	**330**

[a] Includes totals above plus transmission line acreage at left.

Table 4-73. Modified partial replacement alternatives – water delivery system: fee title acquisition requirements – totals (north and south of I-90).

	Pumping plants, gravity turnout, O&M Facility	
	Acres	**Parcels Impacted**
Private land	54	21
Public land	3	1
State land (WDNR)	**3**	**1**
Totals	**57**	**22**

Approximately 96 percent of the 4,721 acres required in easements and the 57 acres required in fee title would involve private land, reflecting the predominance of private ownership throughout the Study Area. Public lands subject to easement or fee acquisition would include small parcels owned by Adams and Grant Counties (1 acre each), and 11 parcels totaling 127 acres owned by the State (WDNR).

Existing Land Use and Shoreline Resources

From the perspective of the entire Study Area, Alternative 4A: Modified Partial—Banks would have an important beneficial effect on land use. This alternative would provide CBP water to support the long-term viability of irrigated agriculture on about 70 percent of the lands now using groundwater for irrigation. At a more detailed level, adverse long-term land use impacts would derive directly from Reclamation acquisition of lands and land rights for water delivery system facility development and operation. Impacts would include the following:

- Residential or business displacements
- Removing land from agricultural production and disrupting existing agricultural operations
- Introducing major irrigation system infrastructure in currently open land

In the first two of these categories, impacts would be significant. In cases where the facilities would be developed on currently open land, land use impacts would generally be considered minimal.

Data characterizing these impacts is provided on Table 4-74 and Table 4-75 for lands north and south of I-90, respectively, and on Table 4-76 for the study area as a whole.

Table 4-74. Modified partial replacement alternatives – water distribution system: land use impacts north of I-90

County	Occupied Structures within New Easements or Acquisition Areas	Agriculture								Open Land
		Center Pivots		Other Irrigated Farm Parcels		Dryland Farm Parcels		Total Irrigated Agriculture within New Easements or Acquisition Areas (acres)	Total Dryland Agriculture within New Easements or Acquisition Areas (acres)	Total Open Land within New Easements or Acquisition Areas (acres)
		Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line			
Pipelines (100-200-foot easements)	**2**	**82**	**49**	**2**	**0**	**21**	**4**	**319**	**286**	**383**
Adams	1	20	9	0	0	4	1	80	50	130
Grant	1	62	40	2	0	17	3	239	236	253
Pumping plants, Gravity Turnouts, and O&M Facilities	**0**	**2**	**0**	**0**	**0**	**3**	**0**	**4**	**5**	**13**
Adams	0	1	0	0	0	2	0	2	2	0
Grant	0	1	0	0	0	1	0	2	3	13
Totals	**2**	**84**	**49**	**2**	**0**	**24**	**4**	**323**	**291**	**396**

[a] Data do not include impacts from transmission lines and construction access roads; the location of these facilities would not be determined until more detailed planning occurs.

Table 4-75. Modified partial replacement alternatives – water distribution system: land use impacts south of I-90.[a]

County	Occupied Structures within New Easements or Acquisition Areas	Agriculture: Center Pivots – Crossed by Facility Center Line or within Facility Development Site	Agriculture: Center Pivots – Crossed by New Easement but not Facility Center Line	Agriculture: Other Irrigated Farm Parcels – Crossed by Facility Center Line or within Facility Development Site	Agriculture: Other Irrigated Farm Parcels – Crossed by New Easement but not Facility Center Line	Agriculture: Dryland Farm Parcels – Crossed by Facility Center Line or within Facility Development Site	Agriculture: Dryland Farm Parcels – Crossed by New Easement but not Facility Center Line	Agriculture: Total Irrigated Agriculture within New Easements or Acquisition Areas (acres)	Agriculture: Total Dryland Agriculture within New Easements or Acquisition Areas (acres)	Open Land: Total Open Land within New Easements or Acquisition Areas (acres)
Pipelines (100-200-foot easements)	**3**	**156**	**83**	**1**	**3**	**28**	**2**	**709**	**314**	**765**
Adams	3	153	65	1	0	26	1	669	292	734
Grant	0	0	7	0	0	1	0	5	1	13
Franklin	0	3	11	0	3	1	1	35	21	18
Pumping plants, Gravity Turnouts, and O&M Facilities	**0**	**4**	**0**	**0**	**0**	**4**	**0**	**37**	**30**	**40**
Adams	0	4	0	0	0	4	0	2	9	22
Franklin	0	0	0	0	0	0	0	35	21	18
Totals	**3**	**160**	**83**	**1**	**3**	**32**	**2**	**746**	**344**	**805**

[a] Data do not include impacts from transmission lines and construction access roads; the location of these facilities would not be determined until more detailed planning occurs.

Table 4-76. Modified partial replacement alternatives – water distribution system: land use impact totals.*

County	Occupied Structures within New Easements or Acquisition Areas	Agriculture								Open Land
		Center Pivots		Other Irrigated Farm Parcels		Dryland Farm Parcels		Total Irrigated Agriculture within New Easements or Acquisition Areas (acres)	Total Dryland Agriculture within New Easements or Acquisition Areas (acres)	Total Open Land within New Easements or Acquisition Areas (acres)
		Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line	Crossed by Facility Center Line or within Facility Development Site	Crossed by New Easement but not Facility Center Line			
Pipelines (100-200-foot easements)	**5**	**238**	**132**	**3**	**3**	**49**	**6**	**1028**	**600**	**1148**
Adams	4	173	74	1	0	30	2	749	342	864
Grant	1	62	47	2	0	18	3	244	237	266
Franklin	0	3	11	0	3	1	1	35	21	18
Pumping plants, Gravity Turnouts, and O&M Facilities	**0**	**6**	**0**	**0**	**0**	**7**	**0**	**41**	**35**	**53**
Adams	0	5	0	0	0	6	0	4	11	22
Grant	0	1	0	0	0	1	0	2	3	13
Franklin	0	0	0	0	0	0	0	35	21	18
Totals	**5**	**244**	**132**	**3**	**3**	**56**	**6**	**1069**	**635**	**1201**

*Data do not include impacts from transmission lines and construction access roads; the location of these facilities would not be determined until more detailed planning occurs.

Five residences (2 north and 3 south of I-90) may be displaced because of their location within needed facility easements. However, as stated for the other alternatives, easement locations/alignments are conceptual at this stage of planning; avoiding residential displacements may be possible during later design phases.

Approximately 59 percent of the total acquisition area required for Alternative 4A: Modified Partial—Banks is agricultural land (61% north and 58% south of I-90). 63 percent of this agricultural land is irrigated (53% north and 68% south of I-90), and 37 percent is dryland (39% north and 32% south of I-90).

Developing Project facilities for this alternative would temporarily impact 238 center-pivot irrigated fields with pipeline construction (82 north and 156 south of I 90), and permanently restrict full-circle irrigation on 6 fields (2 north and 4 south of I 90). Additionally, portions of 132 center-pivot-irrigated fields (49 north and 83 south of I 90) would be within the easement acquisition area for the facilities; the most part, operations could continue on these fields after construction.

Portions of 62 dryland farm parcels would be acquired, with 55 of these in easements for pipeline installation and 7 in fee title for pumping plant or other facility development. As with other forms of agriculture noted above, impacts from pipeline installation would likely be short term, while impacts from pumping plants would be long-term.

Approximately 41 percent of the land necessary for facility easements or fee-owned sites under this alternative is currently open land. Parcels impacted range from section corners (the non-irrigated portion of a center-pivot field) to full sections of land in a relatively natural condition. Most of this land is private and not formally designated as open space, recreation, or habitat. The Adams and Grant County parcels noted in discussion of land ownership are also currently open and undeveloped.

Relevant Plans, Programs, or Policies

Alternative 4A: Modified Partial—Banks would be broadly consistent with the Comprehensive Plans of involved counties and the WDNR agricultural leasing program in the Study Area, to the extent that it provides for long-term continuation of irrigated agriculture. Conversely, for the 30 percent of groundwater-irrigated land in the Study Area that would not receive long-term water supply from the CBP, this alternative is not supportive of local plans and policies related to irrigated agriculture or with WDNR programs. This condition applies to all lands in Lincoln County that are within the Study Area (in the northeastern part of the study area).

Finally, this alternative would involve no impacts or inconsistencies with plans, programs, or policies related to (1) County critical areas ordinances, or (2) State Shoreline Management Act and County Shoreline Master Programs.

Changes with Limited Spring Diversion Scenario

Changes would be minimal for land use, shoreline resources would be impacted under this scenario due to the drawdown of 11 feet in the month of August. Shoreline resources would experience increased exposure and an increase in distance to water's edge.

4.13.8 Alternative 4B: Modified Partial—Banks + FDR

Short– and long–term impacts would be the same as those described for Alternative 4A: Modified Partial—Banks.

Changes with Limited Spring Diversion Scenario

Changes and impacts would be the same as Alternative 2B.

4.13.9 Mitigation

4.13.9.1 Land Ownership and Land Status

Land interest acquisition requirements are an unavoidable consequence of all action alternatives. All acquisition of land interests (easements or fee title) necessary for facility construction, operation, or maintenance would be conducted in accordance with Federal laws. These regulations are generally considered full mitigation of ownership acquisition impact.

4.13.9.2 Existing Land Use and Shoreline Resources

To some extent, both short–term and long–term land use changes and impacts are unavoidable under all action alternatives. However, facility locations such as pipeline alignments and pumping plant sites are preliminary and subject to refinement and adjustment if an action alternative is selected for final design and implementation. Further, the locations of some facilities, particularly power transmission lines and potentially short distances of new access roads, have not yet been identified. Given the status of facility planning, the following measures would be taken to mitigate impacts to land use as more detailed planning occurs:

- Adjust facility alignments to avoid displacement of residences to the extent feasible.
- Adjust facility alignments or sites to avoid or minimize long–term disruption of adjacent irrigation system operation. In particular, locate pipelines and transmission lines along existing roads and section/quarter–section lines as much as possible.
- Accommodate as much as possible existing agricultural uses within easement or acquisition areas that are not directly involved with facility operation and

maintenance through permits.

If the above measures cannot avoid or mitigate impact to properties adjacent to facility easements or fee–owned sites, larger areas of acquisition and corresponding compensation to landowners would be necessary (for example, full acquisition of agricultural fields irrigated by center–pivot systems if facility development causes economic operation of the field to become infeasible beyond the construction period).

4.14 Recreation

Potential for adverse impacts on recreation resources focuses on long-term conditions in the shoreline environments of Banks Lake and FDR reservoirs, as applicable to the action alternatives (i.e., Banks Lake in all action alternatives and FDR in alternatives 2B, 3B, and 4B). In this regard, impact concerns center on reservoir drawdowns necessary to provide Project water supply to agricultural lands in the study area. No change from current conditions at either reservoir would occur under the No Action Alternative.

At Banks Lake, among the action alternatives, potential for adverse impact on recreation resources varies widely. In general, those alternatives that include FDR reservoir in Project water supply operations would result in the least impact to recreation at Banks Lake. These alternatives (including 2B: Partial—Banks + FDR, 3B: Full—Banks + FDR, and 4B: Modified Partial— Banks + FDR) would generally have the same effects, including:

- No significant impact on boat launch capacity (all five main, high-capacity ramps would be available throughout the recreation season without interruption.
- Most of the other, low-capacity ramps would, however, be out of service for up to 5 weeks).
- Significant increase in exposure to hazard boating conditions due to reservoir drawdowns (6 to 7 weeks).
- Significant increase in locations and durations of drawdown impacts to shoreline recreation sites (the distance to water's edge beyond 100 feet).
- No significant impact on fishing access or fishery conditions.

For the remaining alternatives (including 2A: Partial—Banks, 3A: Full—Banks, and 4A: Modified Partial—Banks), impacts increase in magnitude and significance with the amount of land that would be served by irrigation. Impacts are only slightly more severe with Alternative 2A, and substantially more severe with Alternative 3A. Significant impact on boat launch capacity and fishing begins to appear in dry conditions under Alternative 2A and becomes widespread and long duration under Alternative 3A. Impacts on shoreline facilities/activities, in terms of distance to the water's edge follows the same progression. Overall, the most significant impacts would occur with Alternative 3A.

At FDR reservoir, significant impacts to recreation resources would only occur under Alternative 3B: Full—Banks + FDR. This is the only alternative under which facility/activity availability along the National Park shore would exceed a 1 percent decrease (the threshold for significant impact).

For other recreation locations and activities, none of the alternatives raise significant impact concerns related to (1) short-term conditions at the reservoirs, (2) the upland environments surrounding the reservoirs, or (3) short- or long-term conditions in the Study Area.

4.14.1 Methods and Assumptions

4.14.1.1 Impact Indicators and Significance Criteria

Recreation impact indicators and associated criteria for determining impact significance are shown in Table 4-77. Criteria shown are for direct and indirect impact on recreational facilities and resources. For the economic implications impacts to recreation resources, see Section 4.15 – *Irrigated Agriculture and Socioeconomics*. All criteria are assessed in comparison to the No Action Alternative.

Table 4-77. Recreation resource impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Reservoir Recreation*	**Criteria applicable to the recreation season (generally May to September)**
Loss of boating capacity	• Any of the five developed, high–use ramps at Banks Lake become unusable for any period of time during the recreation season. • Loss of the ability to launch boats at Banks Lake in any of the four geographic sectors of the reservoir at any time during the recreation season. • Any launch ramps or marinas at Lake Roosevelt become unusable beyond No Action conditions to the extent that greater than 2 percent of capacity is lost during the recreation season (June through October).
Exposure of boating hazards	Drawdown at Banks Lake below pool elevation reaches 1564 feet amsl (6 feet below full pool) and beyond, which would result in an increase in submerged hazard conditions (such as rocks, tree stumps, and shoals) when compared with current and No Action Alternative drawdown conditions.
Loss of fishing opportunities	Fishing opportunities lost because of decreased boat launch capacity or reduced fish populations.
Loss of usability at developed swimming areas	Any developed shoreline swimming area becomes unusable for any period of time during the recreation season.

Impact Indicator	Significance Criteria
Decrease in usability or aesthetic quality at developed camping or day use facilities	• Loss of use at adjacent boat launch, marina, or developed swimming area during any part of the recreation season. • Shoreline recedes more than 100 feet from land facilities because of drawdown.
Dispersed Recreation	General loss of access to or usability of boat–in dispersed camping and day use sites (expressed as shoreline receding more than 100 feet from land–based use area).
Loss of opportunity for hunting, wildlife viewing, hiking, etc. on lands surrounding the reservoirs	A loss of hunting or wildlife viewing
Odessa Special Study Area	
Loss of hunting and/or wildlife viewing opportunities	Irreplaceable loss of opportunities for hunting and wildlife viewing. Loss of opportunities across the Study Area would be significant.
*Note: Significance criteria for impacts at Banks Lake and Lake Roosevelt have been defined in recognition of the fact that (1) both reservoirs represent major portions of regional capacity for lake/reservoir recreation activities, and (2) demand for lake/reservoir recreation in the region is currently not being met on peak weekends during the recreation season.	

4.14.1.2 Impact Analysis Methods

Impacts on recreation that would occur under each of the alternatives (including No Action) are compared against the current conditions within the Study Area and at Banks Lake and Lake Roosevelt.

Reservoir–Based Recreation (Banks Lake and Lake Roosevelt)

Boat Launches, Marinas, and Developed Swim Beaches

Loss of usability at boat launches, moorage facilities, and developed swimming areas was determined by direct comparison between reported minimum functional pool elevations for each facility and modeled end–of–month reservoir pool elevations for each alternative as described in Chapter 2. In the case of Banks Lake, where impacts would be significant, these comparisons are provided for both average and dry years, as defined in Chapter 2, Section 2.2.2 – *River and Reservoir Operational Changes and Hydrology under the Action Alternatives*. The analysis has not focused on the rare drought conditions, but rather under more widespread, average and dry conditions.

Boating Hazards at Banks Lake

Examination of subsurface elevation contours for the reservoir (based on historic, pre–reservoir topographic mapping) and discussions with knowledgeable agency personnel indicate that drawdowns lower than 6 feet (versus 5 feet under existing conditions and the No Action Alternative) would result in new areas being subject to submerged boating obstructions or hazards. Access to and from some launch areas would be more difficult because of shallow conditions. Because these conditions would be new to users, they are considered significant without some form of mitigation.

Fishing

Because a large majority of fishing activity at both reservoirs is conducted by boat, loss of boat launch capacity translates directly into loss of fishing opportunity.

Fishing opportunity is also based on the health and sustainability of game fish population. A significant adverse impact in this regard (as reported in Section 4.10 – *Fisheries and Aquatic Resources*) would translate into a corresponding impact on recreational fishing.

These direct impacts on fishing could have the secondary effect of reducing WDFW fishing license revenue to a small degree, with a corresponding effect on funding for that agency's fish and wildlife programs. However, this effect would apply only to anglers who use Banks Lake reservoir exclusively. Therefore, the impact would be minimal.

Campgrounds and Day Use Areas

Most, if not all, developed campgrounds and day use sites would remain technically functional regardless of reservoir water elevation. However, for the most part, these facilities are present at the reservoir because they provide access to the water—whether that access is provided by developed boat launch, marina, swimming area, or through more informal means. For this reason, loss of usability at adjacent developed water access facilities or substantial receding of the water line from a developed campground or day use area is considered a significant impact. Creation of a "bathtub ring" greater than 100 feet wide is set as the threshold of significance on the basis of professional judgment. Not only does such a distance directly reduce access to the water, it also reduces the aesthetic quality of the area and opens opportunity for conflicting uses on the exposed land for example, the intrusion of all–terrain vehicles (ATVs) or motorbikes, as illustrated on Photograph 4-6.

Photograph 4-6. Illustration of a reservoir drawdown, or bathtub ring conditions. This is a photo of Banks Lake reservoir at Steamboat State Park during approximately 33–foot maintenance drawdown (November 11, 2011).

Determination of the distance between developed campgrounds and day-use sites and the reservoir waterline at Banks Lake was based on subsurface contour maps. For each alternative, the horizontal distance was measured between the full pool water line and the estimated shoreline contour representing maximum recreation season drawdown.

Dispersed Recreation

Analysis of dispersed recreation sites focuses on boat–in locations and is related to the distance between the waterline and the shore. The same 100–foot threshold for significance used for developed sites is used for these sites. However, in this case, the basis for this threshold is "carry distance" (the distance that equipment, material, and supplies must be transported from boat to shore).

Land–Based Recreation near Reservoirs

As noted in discussion of the affected environment for recreation (Chapter 3, Section 3.14 – *Recreation*), the primary recreation uses on the lands surrounding the reservoirs are hunting and wildlife viewing. For the Study alternatives, the only significant potential for impact to these recreational activities would derive from adverse effects on wildlife populations because of reservoir drawdowns. Analysis presented in Section 4.9 – *Wildlife and Wildlife Habitat*, indicates that no to minimal impacts would occur to wildlife use of uplands surrounding the reservoirs under any of the alternatives while impacts to some shoreline nesting birds, such as grebes, would occur.

Study Area

Hunting and wildlife viewing are the most common recreational activities in the Study Area. Impacts to these activities are assessed qualitatively, based on changes in land use or access patterns resulting in reduction of opportunities (Sections 3.13 – *Land Use and Shoreline Resources*, and 3.16 – *Transportation*), and potential for adverse impacts on wildlife populations (Section 4.9 – *Wildlife and Wildlife Habitat*).

4.14.1.3 Impact Analysis Assumptions

Broadly applicable legal requirements are described in Chapter 5, *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all regulations would be followed. No BMPs are applicable to recreation resources or activities. After environmental impacts are determined, mitigation measures are applied to compensate for some or all remaining adverse impacts, which are described with the action alternatives and in Section 4.31 – *Environmental Commitments*.

Legal Requirements and BMPs for Recreation Resources

Federal agencies are required, to the extent permitted by law and where practicable, and in cooperation with States and Tribes, "to conserve, restore and enhance aquatic systems to provide for increased recreational fishing opportunities nationwide. These laws are described in Chapter 5, *Consultation and Coordination*. No BMPs are applicable to recreation resources or activities.

4.14.2 Alternative 1: No Action Alternative

4.14.2.1 Short–term Impacts

The No Action Alternative involves no facility construction or modification and would involve no short–term impacts on recreation.

4.14.2.2 Long–term Impacts

Reservoir–Based Recreation

The No Action Alternative involves no changes to reservoir operations and no facility modifications at either Banks Lake or Lake Roosevelt. Thus, this alternative would have no new long–term impact on recreational resources. However, for comparing the No Action Alternative to the action alternatives, this section describes the current conditions inherent in operations under the No Action Alternative.

Banks Lake

Few impacts to recreation facilities or activities would result from operations under the No Action Alternative at Banks Lake:

- All boat ramps are usable throughout the recreation season.
- The typical maximum summer drawdown conditions of about 5 feet below full pool in late August/early September are familiar to the boating public and subsurface hazard conditions are minimal (Section 4.2 – *Surface Water Quantity*, Figure 4-2).
- Fishing activities are fully supported from both the boating access and the fishery health perspectives.
- Three of the four developed swimming areas become unusable or marginally usable for approximately 2 weeks in late August/early September in all years.
- Some developed shore facilities are more than 100 feet from the water line during the typical maximum drawdown, including one of the two Million Dollar Mile facilities, Coulee City Community Park, and Dry Falls Campground. The same is true of some dispersed camping and day use areas.
- No impact to upland activities such as hunting and wildlife viewing.

Lake Roosevelt

The focus at Lake Roosevelt is late August/early September when operations under some action alternatives would differ from the No Action Alternative. During this period, continuing current operations under the No Action Alternative would correspondingly continue the following impacts on recreation facilities and activities:

- Six of the 22 boat launch ramps in the National Park Service (NPS) area become unavailable for 1 to 2 weeks in average years and 3 to 4 weeks in dry years. These ramps and the elevations at which they become unavailable are as follows:
    - Hawk Creek (1281 feet amsl)
    - Marcus Island (1281 feet amsl)
    - Napoleon Bridge (1280 feet amsl)
    - Evans (1280 feet amsl)
    - North Gorge (1280 feet amsl)
    - China Bend (1280 feet amsl)
- The Two Rivers marina in the NPS area would become unavailable for the same period of time as the six ramps identified above.
- Two to four of the 10 developed swimming areas are unusable for 1 to 2 weeks.

- Campgrounds and day use sites are adversely affected during the periods when adjacent boat launch, mooring, or swimming facilities are unusable.
- No impacts to upland activities such as hunting and wildlife viewing would occur.

Study Area

Under the No Action Alternative, lands that are currently irrigated with groundwater would transition to dryland farming. This change would not result in an adverse impact on access for hunting or wildlife viewing, but it would reduce local populations of wildlife species that benefit from the presence of irrigated agriculture (for example, waterfowl, doves, pheasants, and mule deer). From a Study Area–wide or regional perspective, the reduction in local populations of these species would be minimal as would the corresponding loss of opportunity for hunting or wildlife viewing. The level and extent of hunting and wildlife viewing opportunities available in the irrigated lands of the Study Area do not represent a substantial proportion of such opportunities present throughout the region. However, these changes would have an adverse impact over time on a small number of businesses (such as guides and outfitters) that currently focus on wildlife–based recreation within and near the irrigated acreage in the Study Area. Landowners who currently lease lands for hunting would lose this opportunity following the transition away from irrigated agriculture.

4.14.3 Alternative 2A: Partial—Banks

4.14.3.1 Short–term Impacts

Banks Lake

This alternative involves no facility construction or modification at Banks Lake Reservoir and would involve no short–term impacts on recreation.

Study Area

Minor disruptions of hunting or wildlife viewing opportunities could occur during facility construction south of I–90. No short–term impacts would occur north of I–90.

4.14.3.2 Long–term Impacts

Banks Lake

Boat Launch Capacity

In average water years, no significant impact would occur to boat launch capacity or geographic availability at Banks Lake. Throughout the recreation season, all five main, high-capacity ramps would be usable and launch opportunities would be available in all 4 geographic sectors of the reservoir (Figure 4-33).

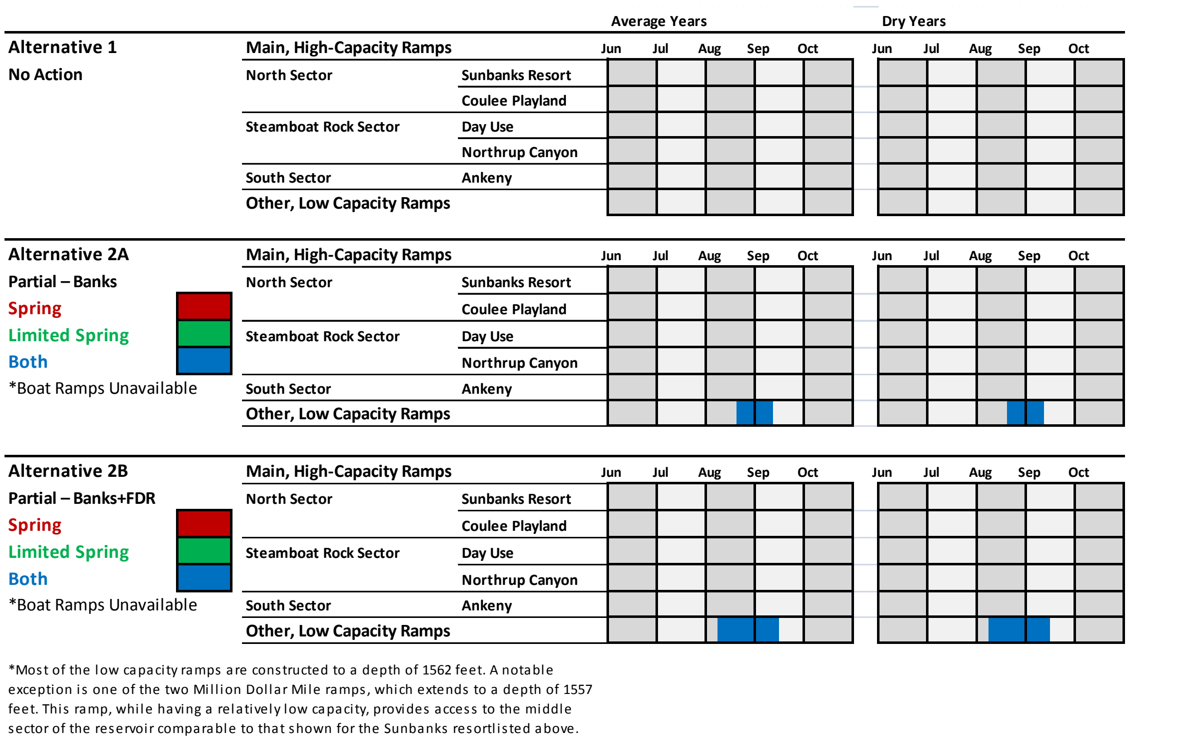


Figure 4-33. Partial replacement alternatives — Banks Lake boat launch ramp impacts (recreation season).

In drought or dry years, however, significant impacts would occur. Two of the five high-capacity ramps (Steamboat State Park Day Use and Coulee Playland) would be unavailable for 3 to 4 weeks. However, even in dry years there would still be access in the north, middle, and south sectors of the reservoir.

Boating Hazards

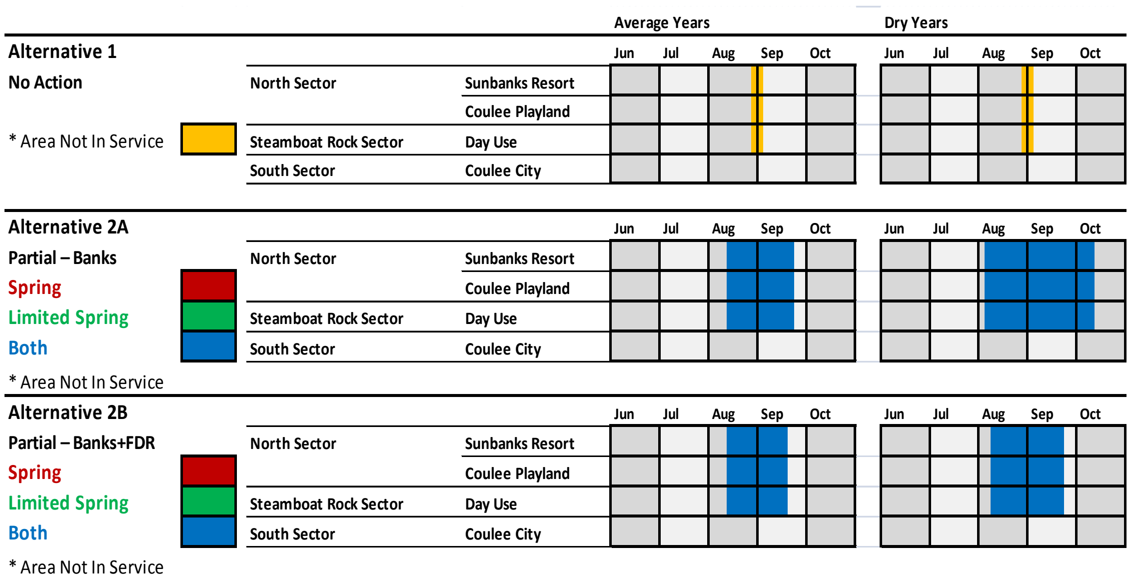
Reservoir drawdowns below 1,564 feet amsl (the threshold for significant impact) would occur in the late August/early September time frame during both average and dry years. Water levels below 1564 feet in elevation would last for approximately 3 weeks in average years and 6 weeks in dry years.

Fishing Opportunities

Fishing access would be significantly restricted when boat ramps are unavailable in dry years (as described above). However, this alternative would have no to minimal impact on the fishery itself. As noted above, any restriction of fishing activity can also have a minor effect on fishing license revenue to WDFW.

Swimming Areas

Three of the four developed swimming areas would be unusable for approximately 6 weeks during August and September in average water years and for approximately 7 weeks in dry years. This compares with 2 weeks in all water year types during which these three swimming areas are unusable under the No Action Alternative (Figure 4-34).



*The mininimal Pool Elevations for the Swimming Areas are 1566 with exception of Coulee Playland. It is accessible to 1560.

Figure 4-34. Partial replacement alternatives – Banks Lake developed swimming area impacts (recreation season).

Developed Campgrounds and Day Use Sites

Under Alternative 2A: Partial—Banks, participation in water–oriented activities near campgrounds and day use areas would be significantly impacted by loss of usability at nearby boat ramps and swimming areas, as described above, and increased distance to the water's edge. Table 4-78 and Table 4-79 provide the distances to the water's edge at maximum drawdown in average and dry water years, respectively, for selected sites around the reservoir—including the most heavily used sites. As shown on these tables, locations where this distance would exceed 100 feet are located in all but the Steamboat Rock sector, with distances extending to over 400 feet in both average and dry years.

Table 4-78. Partial replacement alternatives: distance to water's edge at selected Banks Lake recreation sites (camping or day use) – at maximum drawdown in average water years.

Partial Replacement Alternatives: Distance to Water's Edge at Selected Banks Lake Recreation Sites (camping or day use)—At Maximum Drawdown in Average Water Years

Alternative	No Action	2A-Ltd Spring	2A-Spring	2B-Ltd Spring	2B-Spring
Max. Drawdown Level (feet)	**1565 (-5.0)**	**1560.4 (9.6)**	**1562.7 (7.3)**	**1562 (-8.0)**	**1562.7 (-7.3)**
North Sector					
Coulee Playland	6	97	19	25	19
Sunbanks Resort	150	171	161	164	161
Osborn Bay SW	93	161	114	122	114
Steamboat Rock—Barker Canyon Sector					
SRSP Day Use Site	37	60	49	52	49
SRSP Rest Area	12	32	22	25	22
Barker Flat	0	66	4	19	4
Middle Sector					
Million Dollar North	78	258	166	191	166
Million Dollar South	11	19	15	16	15
South Sector					
Coulee City Community Park	57	262	121	147	121
Dry Falls/Ankeny 2	62	223	101	117	101
Dry Falls/Ankeny 1	180	441	411	417	411

* Full pool is 1570 feet

Note: Reflects approximate distance in feet, measured from full pool shoreline to the edge of the water.

Table 4-79. Partial replacement alternatives: distance to water's edge at selected Banks Lake recreation sites (camping or day use) – at maximum drawdown in dry water years.

Partial Replacement Alternatives: Distance to Water's Edge at Selected Banks Lake Recreation Sites (camping or day use)—At Maximum Drawdown in Dry Water Years

Alternative	No Action	2A-Ltd Spring	2A-Spring	2B-Ltd Spring	2B-Spring
Max. Drawdown Level (feet)	**1565 (-5.0)**	**1560.2 (9.8)**	**1560.2 (9.8)**	**1562 (-8.0)**	**1562 (-8.0)**
North Sector					
Coulee Playland	6	98	98	25	25
Sunbanks Resort	150	172	172	164	164
Osborn Bay SW	93	164	164	122	122
Steamboat Rock—Barker Canyon Sector					
SRSP Day Use Site	37	61	61	52	52
SRSP Rest Area	12	33	33	25	25
Barker Flat	0	71	71	19	19
Middle Sector					
Million Dollar North	78	266	266	191	191
Million Dollar South	11	19	19	16	16
South Sector					
Coulee City Community Park	57	272	272	147	147
Dry Falls/Ankeny 2	62	226	226	117	117
Dry Falls/Ankeny 1	180	444	444	417	417

* Full pool is 1570 feet

Note: Reflects approximate distance in feet, measured from full pool shoreline to the edge of the water.

Dispersed Recreation Sites

Distance to the reservoir pool has not been calculated for land–based dispersed recreation sites. However, similar to the developed sites discussed above, it can be expected that distances more than 100 feet would be seen at some dispersed sites during maximum drawdown conditions in late August and early September. This would be a significant impact.

Upland Recreation (Lands Surrounding the Reservoir)

Reservoir operations under this alternative would have no to minimal impact on upland recreation around Banks Lake.

Study Area

Under Alternative 2A: Partial—Banks, irrigated agriculture would be replaced with dryland farming north of I–90, resulting in the same impacts to hunting and wildlife viewing in this part of the Study Area as described for the No Action Alternative. South of I–90, hunting and wildlife viewing activities within or supported by irrigated agriculture would continue relatively unaffected over the long–term.

Changes with Limited Spring Diversion Scenario

For Alternative 2A under the Limited Spring Diversion Scenario, all sectors of Banks Lake are accessible via boat ramps. Swimming would be slightly impacted through an increased distance to the water's edge. Fishing would have no impact; however, with reduced reservoir pool levels the possibility of boating hazards due to snags and rocks unfamiliar to boaters may increase.

4.14.4 Alternative 2B: Partial—Banks + FDR

4.14.4.1 Short–term Impacts

Short–term impact conclusions for Banks Lake and the Study Area would be the same as described for Alternative 2A: Partial—Banks. The same conclusion applies to Lake Roosevelt in this alternative with no facility construction or modification involved, no short–term impact to recreation resources would occur.

4.14.4.2 Long-term Impacts

Banks Lake

Boat Launch Capacity

Alternative 2B: Partial—Banks + FDR would have no significant impact on boat-launch capacity or sector availability during the recreation season in either average or dry years. In both year types, all 5 high-capacity, developed launch ramps would remain accessible, and in the middle sector where there are no high-capacity ramp installations, one of the low capacity Million Dollar Mile ramps would be accessible throughout the June through October period.

Photograph 4-7. Boat launching facilities at Banks Lake.

Boating Hazards

Reservoir drawdowns below 1,564 feet amsl (the threshold for significant impact) would occur during part of the August/September period in both average and dry years. In both year types, these drawdowns would last 6 to 7 weeks.

Fishing Opportunities

This alternative would have no significant impact on fishing access/availability or on fishery health because of the absence of significant impact related to boat launch capacity and distribution, and the relatively modest reservoir drawdowns associated with this alternative.

Swimming Areas

Three of the four developed swimming areas would be unusable for approximately 5 to 6 weeks during August and September in all water year types.

Developed Campgrounds and Day Use Sites

Impacts to developed campgrounds and day use sites under Alternative 2B: Partial—Banks + FDR would be generally the same as that reported for Alternative 2A: Partial—Banks.

Dispersed Recreation Sites

Impacts with this alternative would be generally the same as those described for Alternative 2A: Partial—Banks.

Upland Recreation

Impacts with this alternative would be generally the same as those described for Alternative 2A: Partial—Banks.

Lake Roosevelt

In average, water years, Alternative 2B: Partial—Banks + FDR would not result in recreation impacts at Lake Roosevelt beyond those associated with the No Action Alternative (Table 4-9).

In dry years under this alternative, impacts described for the No Action Alternative would be extended for approximately 1 week during the August/September timeframe. The boat ramp at Snag Cove would also be unusable for 3 to 4 days in dry years. While these impacts would represent an approximately 1.5 percent reduction in facility availability,[7] they would not occur during average years and therefore, would not be considered significant.

Study Area

Impacts would be the same as Alternative 2A: Partial—Banks.

[7] Percent reduction in boat ramp availability is calculated as follows: A) total (100 percent) facility capacity, expressed as the number of ramp days, equals 3,300 (150 days in recreation season – June through October – multiplied by 22 ramps in the National Park); B) Loss of capacity due to reservoir drawdown, also expressed as number of ramp days, equals (for the condition under discussion above) 49 days (7 ramps affected multiplied by 7 days loss of availability); and C) Percent loss equals number of ramp days lost (49) divided by total capacity (3,300) equals .015 (1.5 percent).

Changes with Limited Spring Diversion Scenario

Impacts under Alternative 2B would not impact any boat ramps, swimming would be available; however, distance to water's edge would be slightly greater than with the Spring Diversion Scenario pool elevations. The increase in boating hazards would be minimal.

4.14.5 Alternative 3A: Full—Banks

4.14.5.1 Short–term Impacts

Banks Lake

This alternative involves no facility construction or modification at Banks Lake, and thus would involve no short–term impacts on recreation.

Study Area

Minor disruptions of hunting or wildlife viewing opportunities could occur throughout the Study Area during construction or modification of facilities.

4.14.5.2 Long–term Impacts

Banks Lake

This alternative would result in the widest extent and longest duration of significant impacts to recreation at Bank Lake among the action alternatives.

Boat Launch Capacity

This alternative would result in the following significant impacts to boat launch capacity at Banks Lake (Figure 4-35):

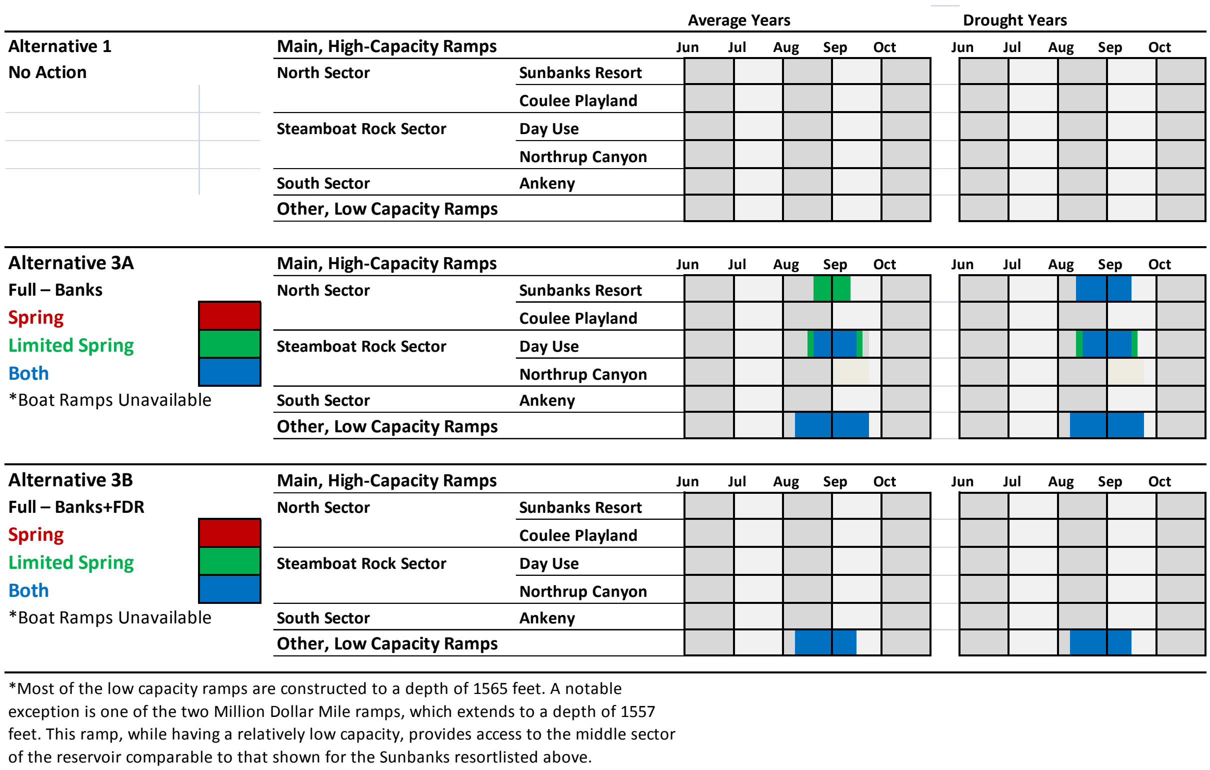


Figure 4-35. Full replacement alternatives—Banks Lake boat launch ramp impacts (recreation season).

- In average water years, all but one of the high-capacity, developed boat ramps would be unavailable for a period of time during the August/September part of the recreation season. As a result of this impact, two of the four sectors of the reservoir would lose boat launch capability for a corresponding period of time (Figure 4-35). Specifically:
  - Coulee Playland and SRSP Rest Area would become unusable for over a week.
  - SRSP Day Use and Coulee City would be unusable for approximately 4 weeks.
  - Most of the low capacity ramps would be unavailable for over half of the recreation season, starting in early August and extending through October.
  - Only boat launch facilities at Electric City Playland, Northrup (north sector), Million Dollar Mile South (middle sector), and Dry Falls Campground (Ankeny #1) would be available for small watercraft. These ramps would be available throughout the recreation season.
- Even in dry years, the north sector would have access via Electric City Playland, middle sector via Northrup, and the south sector via Ankeny #1. At no time would boat access be unavailable due to ramp inaccessibility.

Boating Hazards

Water levels below 1,564 feet amsl (i.e., significant impact) would occur for approximately 10 weeks in average years and 13 weeks in dry years.

Fishing Opportunities

Fishing activity would not be significantly restricted with Alternative 3A. Ecology and WDFW agree there is some degree of uncertainty in the impacts to the Banks Lake fishery. A monitoring and adaptive management plan will be developed by Ecology and WDFW to monitor and evaluate the Banks Lake fishery to avoid reasonably and avoidable loss to recreational fishing opportunities (see Section 4.10.9 – *Mitigation*). These impacts can also have the related effect of reducing WDFW fishing license revenues to a small degree.

Swimming Areas

All four developed swimming areas would be unusable for periods of time during the recreation season (Figure 4-36). The least affected would be the site in Coulee City, which would be unusable for approximately 1 week during August/September in average water years, and approximately 6 to 7 weeks in dry years. The other three areas would be unusable for up to 12 weeks in August through October in average years, and 16 weeks (July through October) in dry years.

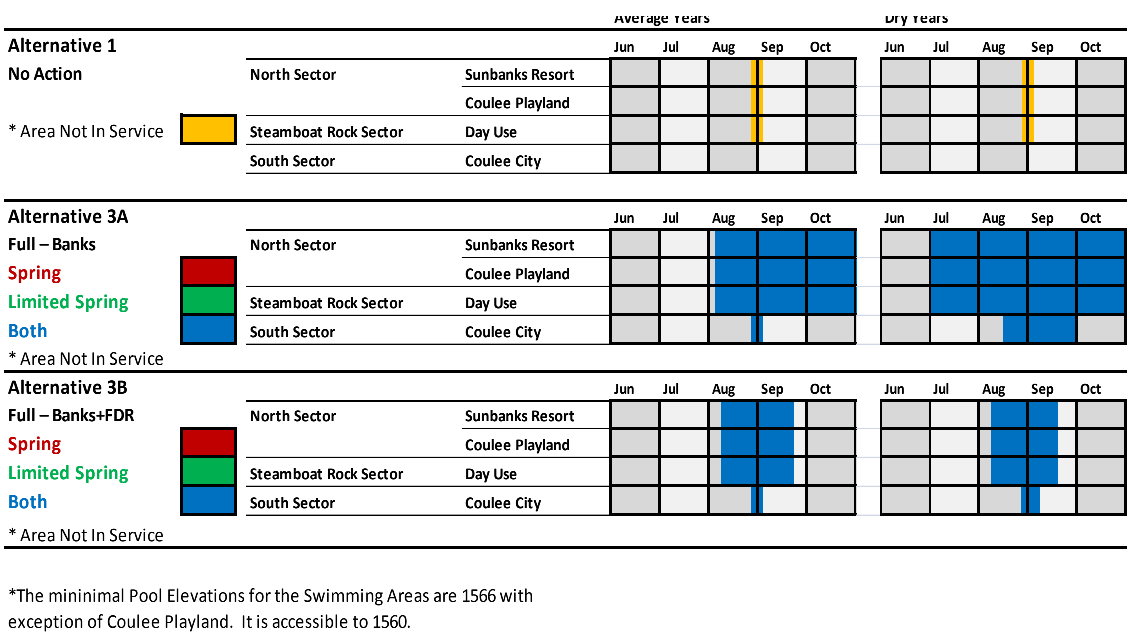


Figure 4-36. Full replacement alternatives – Banks Lake developed swimming area impacts (recreation season).

Developed Campgrounds and Day Use Sites

Under Alternative 3A: Full—Banks, participation in water–oriented activities near campgrounds and day use areas would be significantly impacted by the loss of usability at nearby boat ramps and swimming areas and increased distance to the water's edge.

Table 4-68 and Table 4-69 provide distance to the reservoir pool at maximum drawdown in average and dry water years, respectively, for selected sites around the reservoir, including the most highly used sites. Sites where this distance to the water's edge would exceed 100 feet are located in all geographic sectors of the reservoir, with distances reaching over 460 feet in average years and over 880 feet in dry in dry years.

Table 4-80 Full replacement alternatives: distance to water's edge at selected Banks Lake recreation sites (camping or day use) – at maximum drawdown in average water years.

Alternative	No Action	3A-Ltd Spring	3A-Spring	3B-Ltd Spring	3B-Spring
Max. Drawdown Level (feet)	**1565 (-5.0)**	**1555.2 (14.8)**	**1559.4 (10.6)**	**1562 (-8.0)**	**1562 (-8.0)**
North Sector					
Coulee Playland	6	121	101	25	25
Sunbanks Resort	150	221	197	164	164
Osborn Bay SW	93	290	173	122	122
Steamboat Rock—Barker Canyon Sector					
SRSP Day Use Site	37	442	407	52	52
SRSP Rest Area	12	84	37	25	25
Barker Flat	0	226	94	19	19
Middle Sector					
Million Dollar North	78	373	287	191	191
Million Dollar South	11	48	23	16	16
South Sector					
Coulee City Community Park	57	818	298	147	147
Dry Falls/Ankeny 2	62	882	290	117	117
Dry Falls/Ankeny 1	180	555	462	417	417
* Full pool is 1570 feet					
Note: Reflects approximate distance in feet, measured from full pool shoreline to the edge of the water.					

Table 4-81. Full replacement alternatives: distance to water's edge at selected Banks Lake recreation sites (camping or day use) – at maximum drawdown in dry water years.

Alternative	No Action	3A-Ltd Spring	3A-Spring	3B-Ltd Spring	3B-Spring
Max. Drawdown Level (feet)	1565 (-5.0)	1555 (15.0)	1555 (15.0)	1562 (-8.0)	1562 (-8.0)
North Sector					
Coulee Playland	6	123	123	25	25
Sunbanks Resort	150	222	222	164	164
Osborn Bay SW	93	292	292	122	122
Steamboat Rock—Barker Canyon Sector					
SRSP Day Use Site	37	444	444	52	52
SRSP Rest Area	12	88	88	25	25
Barker Flat	0	233	233	19	19
Middle Sector					
Million Dollar North	78	378	378	191	191
Million Dollar South	11	49	49	16	16
South Sector					
Coulee City Community Park	57	832	832	147	147
Dry Falls/Ankeny 2	62	885	885	117	117
Dry Falls/Ankeny 1	180	558	558	417	417

* Full pool is 1570 feet

Note: Reflects approximate distance in feet, measured from full pool shoreline to the edge of the water.

Dispersed Recreation Sites

Similar to the developed sites discussed above, it can be expected that distances over 100 feet would be seen at many dispersed sites during maximum drawdown conditions in August and September. This would be a significant impact.

Upland Recreation

Same as Alternative 2A: Partial—Banks (no impact).

Study Area

Under Alternative 3A: Full—Banks, hunting and wildlife viewing activities within or supported by irrigated agriculture would continue relatively unaffected throughout the Study Area over the long term.

Changes with Limited Spring Diversion Scenario

Impacts under Alternative 3A would reduce boat ramp accessibility; however, all sectors of the reservoir would have continued access. Camping would experience an increase in distance between campground and water's edge; swimming areas will see a reduction in tourist use days as a result of the drawdown. Fishing opportunities should remain static. Shoreline exposure would increase providing increased opportunity for hiking and walking with little hindrance by brush and blow down. Boating hazards would increase with any drawdown of the water body. Hunting and fishing opportunities would undergo substantive change.

4.14.6 Alternative 3B: Full—Banks + FDR

Related to Banks Lake and the agricultural study area, short– and long–term impacts would be the same as those described for other alternatives as follows:

- At Banks Lake: same as Alternative 2B.
- In the Study Area: the same as Alterative 3A.
- Mitigation would be the same as those under Alternative 2B.

For Lake Roosevelt, there would be no short–term impacts. Long-term impacts and available mitigation are described below.

4.14.6.1 Long–term Impacts

Lake Roosevelt

Reservoir-Oriented Recreation

Additional reservoir drawdown in late August/early September at Lake Roosevelt would increase the period which 6 of the 22 boat launch ramps and one of the four marinas would be unavailable when compared with the No Action Alternative. Associated impacts would also occur to other water-oriented facilities such as swimming areas, campgrounds, and day use sites.

In average water years, affected facilities would remain unusable for up to 1 week beyond No Action conditions. In dry years, the impact would extend 3 weeks beyond no action conditions, and the Snag Cove ramp would be unavailable for the same period of time. Without mitigation, these impacts would be significant, reflecting a 1.5 percent loss in facility capacity/usability during average years and a 5.1 percent loss of capacity in dry years.

Upland Recreation

Impacts would be the same as that described for Alternative 2B: Partial—Banks + FDR (i.e., no significant impact).

Changes with Limited Spring Diversion Scenario

Alternative 3B changes would lower Banks Lake elevation by a maximum of 8 feet for one month. All boat ramps, swimming areas, camping areas, and recreational opportunities may reflect some additional negative impacts with the Limited Spring Diversion Scenario.

4.14.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

4.14.7.1 Short–term Impacts

Banks Lake

This alternative involves no facility construction or modification at Banks Lake, and thus would involve no short–term impacts on recreation.

Study Area

Minor disruptions of hunting or wildlife viewing opportunities could occur throughout the Study Area during construction or modification of facilities.

4.14.7.2 Long–term Impacts

Banks Lake

Boat Launch Capacity

In average water years under this alternative, few significant impacts would occur to boat launch capacity or geographic availability at Banks Lake. The only significant impacts involving the main, high-capacity ramps would be a 2 to 3 day loss of access to the SRSP Day Use and the Coulee City ramps in early September (Figure 4-37). Other than these brief interruptions of service, the main ramps would remain available throughout the recreation season. Related to geographic sectors of the reservoir, the period during which the Coulee City ramp is unavailable would translate into a corresponding loss of ramp access in the South sector. In the middle sector of the reservoir, where there are no high-capacity ramps, one of the low capacity Million Dollar Mile ramps would be available throughout the recreation season. The north and Steamboat Rock sectors would have main ramp access without interruption.

*Most of the low capacity ramps are constructed to a depth of 1565 feet. A notable exception is one of the two Million Dollar Mile ramps, which extends to a depth of 1557 feet. This ramp, while having a relatively low capacity, provides access to the middle sector of the reservoir comparable to that shown for the Sunbanks resortlisted above.

Figure 4-37. Modified partial replacement alternatives—Banks Lake boat launch ramp impacts (recreation season).

In dry years, loss of ramp access due to reservoir drawdowns would be more extensive. Impacts during these years would include:

- Coulee Playland and SRSP Rest Area: 1 to 2 weeks.
- SRSP Day Use and Coulee City: 3 to 4 weeks.
- Majority of low capacity ramps: 8 weeks.
- Geographic sectors: Interruption of access in the Steamboat Rock and south sectors corresponding to the period of unavailability for the SRSP and Coulee City ramps.

Boating Hazards

Reservoir drawdowns below 1,564 feet amsl would occur during both average and dry years. In average years, this condition would last approximately 4 weeks in late August/early September. In dry years, the condition would last approximately 7 weeks, from early August through all of September.

Fishing Opportunities

Fishing activity would be significantly restricted during the periods of time that boat ramps are unavailable, as specified above. Ecology and WDFW agree there is some degree of uncertainty in the impacts to the Banks Lake fishery. A monitoring and adaptive management plan will be developed by Ecology and WDFW to monitor and evaluate the Banks Lake fishery to avoid reasonably and avoidable loss to recreational fishing opportunities (see Section 4.10.9 – *Mitigation*). These impacts can also have the related effect of reducing WDFW fishing license revenues to a small degree.

Swimming Areas

In average years, 3 of the 4 developed swimming areas would be unusable for at least 6 weeks during the recreation season (Figure 4-38). In dry years, all swimming areas would be affected, with the Coulee City location unavailable for 1 week and the other 3 locations unavailable for approximately 11 weeks from late July through mid-October.

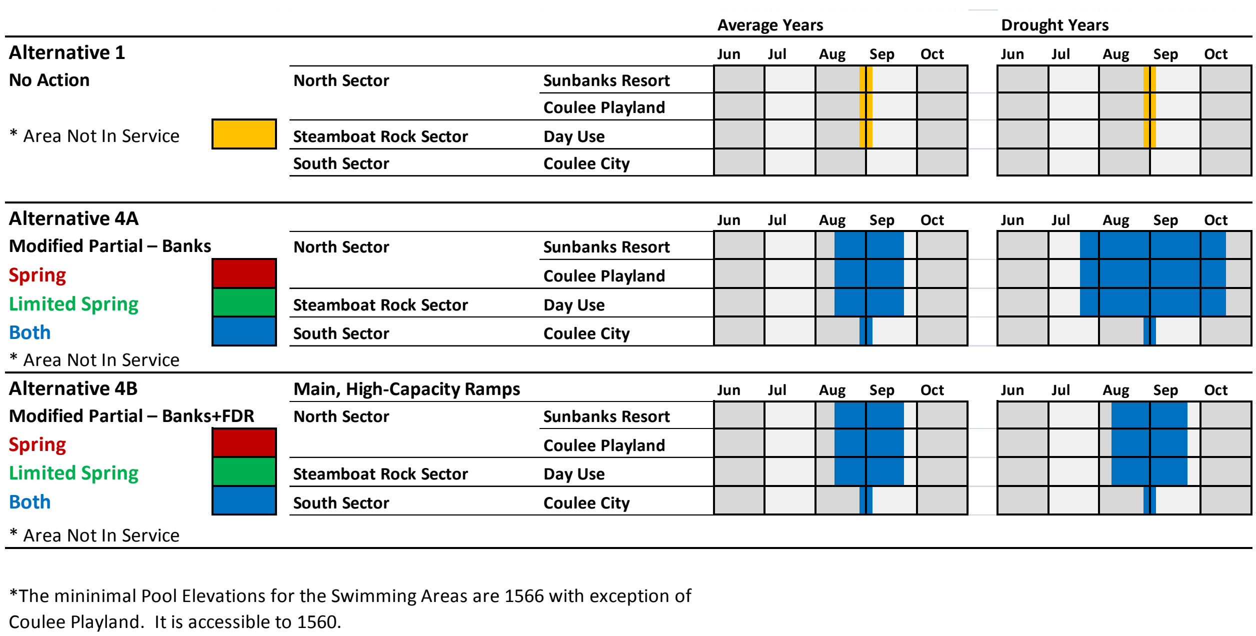


Figure 4-38. Modified partial replacement alternatives—Banks Lake developed swimming area impacts (recreation season).

Developed Campgrounds and Day Use Sites

Under Alternative 4A, participation in water-oriented activities near campgrounds and day use areas would be significantly impacted by the loss of usability at nearby boat ramps and swimming areas and by increased distance to the water's edge. In the latter regard, as shown on Table 4-82 and Table 4-83, activity sites where this distance would exceed 100 feet (the threshold for significant impact) are located in three of the four geographic sectors of the reservoir during average years and in all sectors during dry years.

Table 4-82. Modified partial replacement alternatives: distance to water's edge at selected Banks Lake recreation sites (camping or day use) – at maximum drawdown in average water years.

Alternative	No Action	4A-Ltd Spring	4A-Spring	4B-Ltd Spring	4B-Spring
Max. Drawdown Level (feet)	1565 (-5.0)	1559 (11.0)	1561.9 (8.1)	1562 (-8.0)	1562 (-8.0)
North Sector					
Coulee Playland	6	103	90	25	25
Sunbanks Resort	150	199	164	164	164
Osborn Bay SW	93	178	141	122	122
Steamboat Rock—Barker Canyon Sector					
SRSP Day Use Site	37	410	53	52	52
SRSP Rest Area	12	40	26	25	25
Barker Flat	0	105	21	19	19
Middle Sector					
Million Dollar North	78	296	195	191	191
Million Dollar South	11	25	16	16	16
South Sector					
Coulee City Community Park	57	309	182	147	147
Dry Falls/Ankeny 2	62	296	200	117	117
Dry Falls/Ankeny 1	180	472	418	417	417

* Full pool is 1570 feet

Note: Reflects approximate distance in feet, measured from full pool shoreline to the edge of the water.

Table 4-83. Modified partial replacement alternatives: distance to water's edge at selected Banks Lake recreation sites (camping or day use) – at maximum drawdown in dry water years.

Alternative	No Action	4A-Ltd Spring	4A-Spring	4B-Ltd Spring	4B-Spring
Max. Drawdown Level (feet)	1565 (-5.0)	1559.1 (10.9)	1559.1 (10.9)	1562 (-8.0)	1562 (-8.0)
North Sector					
Coulee Playland	6	102	102	25	25
Sunbanks Resort	150	198	198	164	164
Osborn Bay SW	93	177	177	122	122
Steamboat Rock—Barker Canyon Sector					
SRSP Day Use Site	37	409	409	52	52
SRSP Rest Area	12	39	39	25	25
Barker Flat	0	102	102	19	19
Middle Sector					
Million Dollar North	78	294	294	191	191
Million Dollar South	11	25	25	16	16
South Sector					
Coulee City Community Park	57	306	306	147	147
Dry Falls/Ankeny 2	62	294	294	117	117
Dry Falls/Ankeny 1	180	469	469	417	417

* Full pool is 1570 feet

Note: Reflects approximate distance in feet, measured from full pool shoreline to the edge of the water.

Dispersed Recreation Sites

Similar to the developed sites, distances over 100 feet would be expected at many dispersed sites during maximum drawdown conditions in August and September. This would be a significant impact.

Upland Recreation

Same as Alternative 2A: Partial—Banks (no impact).

Study Area

Under Alternative 4A: Modified Partial—Banks, hunting and wildlife viewing activities within or supported by irrigated agriculture would continue relatively unaffected throughout the Study Area over the long term.

Changes with Limited Spring Diversion Scenario

Alternative 4A would reduce boat ramp accessibility; however, all sectors of the reservoir would have continued access. Camping would experience an increase in distance between campground and water's edge; swimming areas will see a reduction in tourist use days as a result of the drawdown. Fishing opportunities should remain static. Shoreline exposure would increase providing increased opportunity for hiking and walking with little hindrance of brush and blow down. Boating hazards would increase with any drawdown of the water body.

4.14.8 Alternative 4B: Modified Partial—Banks + FDR

Short–term and long–term impacts with this alternative would be as follows:

- At Banks Lake: same as Alternative 2B: Partial Banks + FDR.
- In the Study Area: same as Alterative 4A: Modified Partial—Banks.
- Related to Lake Roosevelt: there would be no short-term impacts. Long-term impacts are discussed below.

4.14.8.1 Long–term Impacts

Lake Roosevelt

In average, water years, Alternative 4B: Modified Partial—Banks + FDR, would not result in recreation impacts at Lake Roosevelt beyond those associated with the No Action Alternative. This conclusion applies to boat launch capacity, boating hazards, fishing opportunities, swimming areas, developed and dispersed camping and day use sites, and upland recreation.

In dry years under this alternative, impacts described for the No Action Alternative would be extended for approximately 2 weeks in the August/September time frame. The boat ramp at Snag Cove would also be unusable for approximately 2 weeks in dry years. While these impacts would represent an approximately 3 percent reduction in facility availability, they would not occur during average years and thus would not be considered significant.

Changes with Limited Spring Diversion Scenario

Alternative 4B would have less of a drawdown than Alternative 2A and impacts would be similar or less than Alternative 2A.

4.14.9 Mitigation

Alternative 2A

For impacts to land–based camping and day use sites at Banks Lake, no mitigation measures are feasible and impacts are unavoidable.

Boat Launch Capacity

Restoration of full season–wide availability during dry years at all main, high–capacity ramps and in all geographic sections of the reservoir would be achieved by extension or other redevelopment of boat launch facilities at or near the SRSP Day Use site and Coulee City Community Park so that they remain usable at maximum reservoir drawdown in these years. These mitigation measures would eliminate significant adverse impacts to boat launch capacity and fishing access.

Boating Hazards

New or increased boating hazards (for example, shallow rocks, tree stumps, or shoals) caused by additional reservoir drawdown would be mitigated by providing information and educational materials to the boating public.

Developed Swimming Areas

While no direct mitigation is practical for impacts to most, if not all, existing developed swimming areas, organized, protected swimming opportunities could be replaced by designating new swimming areas near affected recreation sites. This measure, in context with the myriad of opportunities for in-lake swimming that would remain outside of developed sites, would at least partially compensate for significant impacts to existing developed swimming sites.

Alternative 2B

Available mitigation measures for significant impacts related to boating hazards and developed swimming areas are the same as those described for Alternative 2A. Also, as reported for Alternative 2A, no mitigation measures are available for impacts to land–based camping and day use sites at this reservoir; impacts described above would be unavoidable.

Alternative 3A

For impacts to the fishery and land–based camping and day use sites, no mitigation measures are feasible and impacts are unavoidable.

Boat Launch Capacity

As with other alternatives, restoration of full, season-wide availability at all main, high-capacity ramps and in all four sectors of the reservoir could be achieved by extending or redeveloping ramps so that they remain usable at maximum reservoir drawdown.

Boating Hazard and Swimming Areas

Mitigation measures would be the same as those under Alternative 2A.

Alternative 3B

Lake Roosevelt

Mitigation of significant impact to reservoir-oriented recreation facilities at Lake Roosevelt (especially boat launches and marina) could be accomplished by modification of facilities so that they remain functional during the additional drawdown period associated with this alternative.

Alternative 4A

No mitigation measures are feasible for impacts to the fishery and land–based camping and day use sites, and these impacts are unavoidable.

Boat Launch Capacity

Restoration of full season-wide availability at all main, high-capacity ramps and in all geographic sectors of the reservoir (during both average and dry years) would be achieved by extension or other modification of boat launch facilities identified above (i.e., facilities that would experience periods of unavailability due to reservoir drawdowns). Such action would eliminate significant adverse impacts to boat launch capacity.

Boating Hazard and Swimming Areas

New or increased boating hazards (e.g., shallow rocks, tree stumps, or shoals) caused by additional reservoir drawdown would be partially mitigated by providing information and educational materials to the boating public.

Developed Swimming Areas

Mitigation measures would be the same as those under Alternative 2A.

4.15 Irrigated Agriculture and Socioeconomics

4.15.1 Irrigated Agriculture

Future changes in the output of groundwater irrigation wells and associated changes in farm crop acreages (cropping patterns) were used to estimate gross farm income for the No Action Alternative; Alternative 2A: Partial—Banks; 2B: Partial – Banks + FDR; Alternative 3A: Full—Banks; 3B: Full – Banks + FDR; 4A: Modified Partial – Banks; and 4B: Modified Partial – Banks + FDR. The partial alternatives would provide 3 acre–feet per acre of replacement irrigation water to approximately 57,000 acres. Gross farm income would be the same for each of the partial alternatives. Each of the full replacement alternatives would provide 3 acre–feet per acre of replacement irrigation water to approximately 102,600 acres. Gross farm income would be the same for each of the full replacement alternatives. The modified partial alternatives would provide 3 acre–feet per acre of replacement irrigation water to approximately 70,000 acres. Gross farm income would be the same for each of the modified partial replacement alternatives.

After assessing current farm operations in the Study Area, assumptions were made about what would happen in the future under the No Action Alternative. Under the No Action Alternative, the project would not be built, no surface water would be provided to lands currently irrigating with groundwater, and it is assumed that groundwater wells would continue to irrigate crops as long as possible. It is further assumed that when the wells are no longer usable, a dryland wheat/fallow rotation would replace irrigated crops.

Evaluation of the changes in irrigated acres resulting from CBP surface water delivery to part or all of the Study Area under the partial and full replacement alternatives was also conducted. Under these action alternatives, facilities to deliver surface irrigation water would be constructed in phases between 2015 and 2025. There would be four construction phases for partial replacement alternatives and nine phases for full replacement alternatives. Until the construction phases are completed, there would be no difference between an action alternative and the No Action Alternative, with respect to the number of irrigated acres lost and change in gross farm income. Once a construction phase would be completed, irrigated acres would increase along with gross farm income. These changes in irrigated acres and gross farm income were tracked each year to compare the No Action Alternative to the action alternatives.

The analysis found that the Alternative 2A: Partial—Banks would provide $118.8 million more in gross farm income than the No Action Alternative in 2025, at the end of four construction phases. The Alternative 3A: Full—Banks would return $178.0 million more in gross farm income at the end of all nine construction phases. Alternative 4A: Modified Partial—Banks (Preferred Alternative) would return $123.1 million more than the No Action Alternative in 2025 in gross farm income at the end of four construction phases. The analysis results are presented in Table 4-84.

Table 4-84. Comparison of the difference in the 2025 gross farm income between the No Action Alternative and Alternative 2A: Partial – Banks, Alternative 3A: Full—Banks, and Alternative 4A: Modified Partial—Banks (Preferred Alternative).

	No Action Alternative	Alternative 2A: Partial Replacement	Alternative 3A: Full Replacement	Alternative 4A: Modified Partial Replacement
Gross Farm Income in 2025				
Potato	$16,983,000	$102,021,000	$169,886,000	$122,059,000
Wheat	$18,955,000	$18,644,000	$16,341,000	$17,964,000
Mixed Crops	$14,421,000	$25,044,000	$0	$4,511,000
Alfalfa	$0	$23,429,000	$42,127,000	$28,949,000
Total	$50,359,000	$169,138,000	$228,354,000	$173,483,000
Difference in Income Compared to the No Action Alternative				
Potato		$85,038,000	$152,903,000	$105,076,000
Wheat		-$311,000	-$2,614,000	-$991,000
Mixed Crops		$10,623,000	-$14,421,000	-$9,910,000
Alfalfa		$23,429,000	$42,127,000	$28,949,000
Total		$118,779,000	$177,995,000	$123,124,000

The No Action Alternative gross farm income, $50.4 million, would be almost 3.2 percent of the $1.6 billion total gross farm income for the four–county analysis area. Alternative 2a: Partial—Banks change in gross farm income, $119.0 million, would be almost 7.4 percent, and the change under Alternative 3A: Full—Banks, $178.0 million, would be almost 11 percent. Alternative 4A: Modified Partial—Banks (Preferred Alternative) + FDR, $123.1million, would be 7.7 percent.

4.15.2 Methods and Assumptions

Table 4-85 presents impact indicators and significance criteria for irrigated agriculture in the Study Area.

Table 4-85. Irrigated agriculture impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Gross Farm Income	Changes greater than 10 percent

Impact Analysis Methods

Approximately 102,600 acres in the Study Area are currently irrigated with groundwater. The most common crops are potatoes, corn, alfalfa, dry beans, and wheat. If these currently irrigated crops were taken out of production because of failing groundwater wells, the primary crop would be dryland wheat. The annual precipitation in the Study Area is too low to sustain an annual wheat crop; therefore, dryland wheat would be rotated with fallow; one–half the acreage would be fallowed and one–half the acreage would produce a wheat crop. In that case, there would be a significant reduction in gross farm income for the Study Area.

Agricultural impacts for the Study Area were measured as changes in gross farm income that would result from the alternatives considered in this study. Under the No Action Alternative, groundwater irrigating the Study Area would be dramatically reduced and would not be replaced by surface water. As groundwater depletes, farmers would transition into growing dryland wheat in rotation with fallow land. Ultimately, farmers in the entire Study Area would grow dryland crops under the No Action Alternative, because a source of irrigation water would not be available. If a partial replacement alternative was implemented, some of the currently irrigated lands in the Study Area would receive surface water to support irrigated crops, while other crops would revert to dryland crop production. The full replacement alternatives would deliver CBP surface water to all of the acres currently irrigated with groundwater in the Study Area; very few dryland crops would be grown, unless the farmer chose to do so.

After forecasting the future number of irrigated and dryland acres, gross farm income was estimated for each alternative. Then, the gross farm income from the partial or full replacement alternatives was compared to the gross farm income from the No Action Alternative. The resulting difference in gross farm income provides an indicator of the change in irrigated agricultural crop production reasonably expected to occur if a partial or full replacement surface water supply was provided to lands currently irrigated with groundwater.

Information about crops grown in the Study Area and the number and status of groundwater wells in the Study Area was obtained from GWMA (Chapter 3, Section 3.15.1.4 – *GWMA*

Data). In addition to helping describe current conditions, GWMA also provided guidance and assumptions on the future status of groundwater wells and cropping patterns in the Study Area under the No Action Alternative.

Groundwater wells in the area were ranked by GWMA according to five status levels (Levels 1 to 5) based on output and dependability (Chapter 3, Section 3.15.1.4 – *GWMA Data*). Assumptions were made about how long wells would remain in use and what crops would be grown as wells declined in output and dependability. This information was used in a spreadsheet model to predict changes in irrigated acres in the future and subsequent change in gross farm income.

The spreadsheet model was used to estimate the change in gross farm income if a substitute irrigation water supply were not available. Also, the model was used to estimate the change in gross farm income if a substitute irrigation water supply were available for some, or all, of the acres in the Study Area. The change in gross farm income between the No Action Alternative and an action alternative compared to the gross farm income for the four–county analysis area is the agricultural impact for an action alternative.

4.15.2.1 Alternative 1: No Action Alternative

After an initial cropping pattern and distribution of crop acres among different well levels were established, the agricultural impact analysis evaluated annual changes in irrigated acres. Over time, some groundwater wells would become unusable and previously irrigated acres would transition into a dryland wheat/fallow rotation. The agricultural impact model accounted for two actions for each well level concurrently. First, acres served by wells in each of Levels 2 to 5 gained acres from the next highest well level every year. Second, acres served by wells in each of Levels 2 to 4 lost 10 percent of acreage as well production decreased each year.

The acreage for the beginning of each year was estimated based on the ending crop acreage from the previous year. Then, the number of acres gained from a higher well level was added to the beginning acreage. It was assumed that 10 percent of the acres in each well level would be lost to the next lowest well level each year (except for Well Level 1, which was assumed to be stable). After adding the acres gained from the next highest well level to the beginning acreage, 10 percent of that subtotal was assumed to be lost to the next lowest well level. The year–ending acreage for each well level was calculated by taking the beginning acreage, adding acres gained from the next highest well level, and subtracting acres lost for each well level. An example is in Table 4-86, showing the beginning and ending acreages by well level for 2025.

Table 4-86. Beginning and ending 2025 acreages for each well level.

Well Level	2025 Acres in Well Level (Start of Year)	PLUS Acres Gained from Next Highest Well Level*	MINUS Acres Lost to Next Lowest Well Level	EQUALS 2025 End of Year Acres by Well Level
1	5,131			5,131
2	6,338	0	634	5,704
3	16,198	704	1,690	15,212
4	23,319	1,800	2,512	22,607
5	46,535	2,591	0	49,126
Subtotal	97,521	5,095	4,836	97,780

If the 2025 start–of–year acres and the acres gained from the next highest well level are added together, the total number of acres comes to approximately 102,600. Similarly, if the end–of–year acres and the number of acres lost to the next lowest level are added together, the total comes to approximately 102,600 acres. All approximately 102,600 acres in the Study Area were tracked on a year–to–year basis.

In 2010, there were 5,131 acres in Well Level 1. No Well Level 1 acres were lost, so the percentage change in Well Level 1 acres between 2010 and 2025 was 0 percent. There were 30,785 acres each in Well Levels 2, 3, and 4 in 2010. By 2025, there were 5,704 acres in Well Level 2, 15,212 acres in Well Level 3, and 22,607 acres in Well Level 4. This equated to losses of 81.5 percent, 50.1 percent, and 26.6 percent of the groundwater irrigated lands in Well Levels 2, 3, and 4, respectively. Conversely, the number of acres in Well Level 5 increased from 5,131 acres to 49,126 acres, a nearly nine–fold increase.

Once the change in irrigated acres was calculated, the gross farm income for each year could be estimated. Gross farm income was calculated using the ending year acreage total. It was assumed that about one–half the Well Level 5 acres each year would not generate income for that year.

Since a large proportion of wells became unusable within the first 15 years of the analysis, there was a precipitous drop in gross farm income between 2010 and 2025. After that, the drop in gross farm income was less pronounced, because a large proportion of previously irrigated land had transitioned into a dryland wheat/fallow rotation. For example, in the year 2010, the agricultural impact model estimated that the total gross farm income under the No Action Alternative came to $111,108,000. By 2025, 49,126 acres had been placed in a dryland wheat/fallow rotation due to wells becoming unusable and gross farm income dropped by $60,749,000, a 45 percent decrease.

Since the largest impact to the Study Area would happen between 2010 and 2025, the results of this analysis focused on those 2 years; however, a change in gross farm income was calculated for each year between 2010 and 2025 and then graphed. Figure 4-39 shows the change in estimated gross farm income for the 16 years between 2010 and 2025 for the approximately 102,600 acres in the Study Area.

Total gross farm income was estimated for each year in the analysis period based on well and cropping assumptions described above. Gross farm income estimates for the No Action Alternative in 2010 and 2025 are shown in Table 4-87 along with the number of acres of each crop.

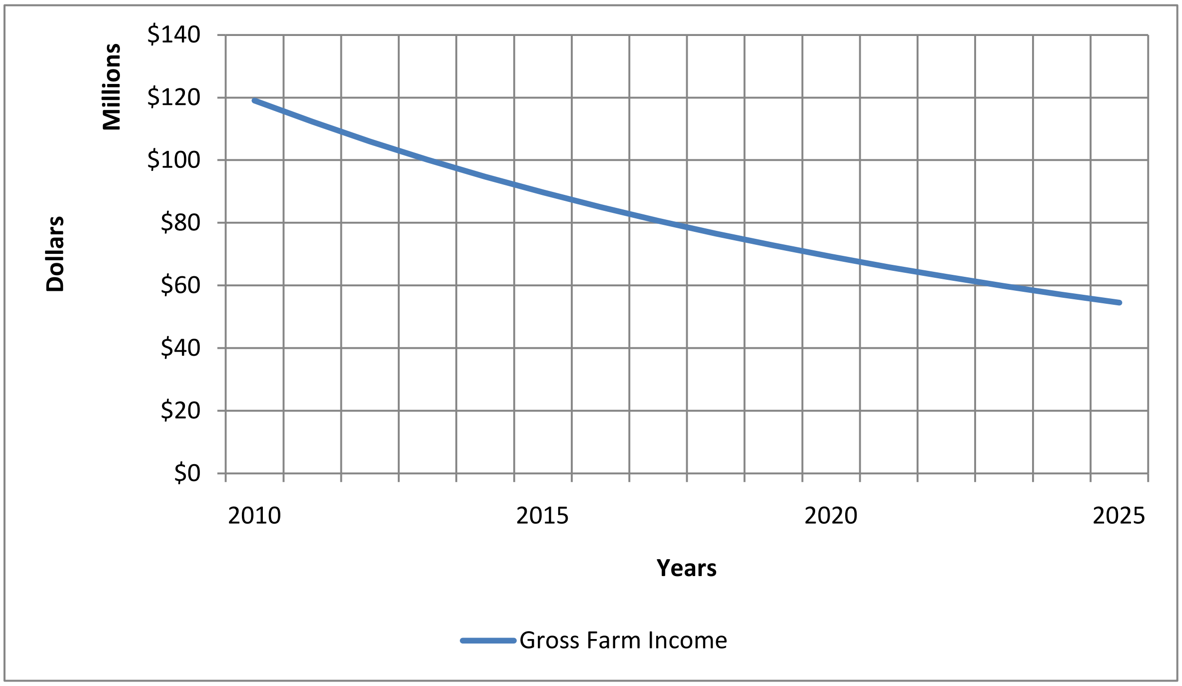


Figure 4-39. Total gross farm income under the No Action Alternative from 2010 until 2015.

Table 4-87. Total gross farm income for 2010 and 2025, No Action Alternative.

Crop	2010 Acres by Crop	Year 2010 Gross Farm Income*	2025 Acres by Crop	Year 2025 Gross Farm Income
Potato	15,496	$2,527,000	4,209	$16,983,000
Wheat	42,791	$23,253,000	26,538	$14,421,000
Mixed Crops	39,198	$24,854,000	22,743	$14,421,000
Dryland Wheat Produced	2,565	$474,000	24,563	$4,535,000
Fallow Acres in Rotation	2,565	$0	24,563	$0
Total	102,616	$111,108,000	102,616	$50,359,000

* The agricultural impact model used 2010 as the base year and estimated changes in gross farm income for each year until 2025, when all construction would end.

4.15.2.2 Alternative 2A: Partial—Banks

Analysis of Alternative 2A: Partial—Banks evaluated the change in gross farm income resulting from delivery of surface water to approximately 57,000 acres. It was assumed that each acre of land would receive 3 acre–feet of irrigation water, regardless of the existing pumping level. Estimates of gross farm income for the approximately 57,000 acres were calculated using a representative crop mix of irrigated potatoes, mixed crops, and wheat.

Cropping patterns on acres served by Level 1 wells were assumed to not change under this alternative. Acres served by Level 3, Level 4, and Level 5 wells were assumed to proportionately move into the cropping pattern served by Level 2 wells. The cropping pattern served by Level 2 wells changed from a representative crop mix consisting of potato/mixed crop/irrigated wheat/dryland wheat–fallow rotation to a representative crop mix of potato/alfalfa/irrigated wheat. Estimates of prices received for crops were held constant over the period of analysis for wheat and potatoes and a 5–year average price for alfalfa was used. Although prices vary annually and yields would change over the long run, reasonably forecasting changes in prices of crops was not possible. Additionally, there was an increase in wheat yield. Potato yield remained constant. A 5–year county average yield for alfalfa was used.

During construction phases of this alternative, there would be no difference in gross farm income between this alternative and the No Action Alternative because the same losses in gross farm income would occur for both until construction would be completed. The 2010 gross farm income estimate for the partial replacement alternatives and the No Action Alternative would be $111,108,000.

The same gross farm income holds for the No Action Alternative and the partial replacement alternatives each year until 2019, when construction Phase 1 is completed. Then, a difference in gross farm income between the No Action and the partial replacement alternatives can be detected.

Short–term Impacts

Short–term impacts would result from construction activities. Some irrigated land would be taken out of production to facilitate construction. After construction is completed, those acres would resume irrigated farming practices. Construction activities could result in a small temporary reduction in gross farm income.

Long–term Impacts

Under this alternative, the loss of viable wells in each of five well levels was estimated, along with the change in crops and the loss of irrigated crop income. Four construction phases would be completed under this alternative. Agricultural lands (approximately 57,000 acres) would switch from groundwater irrigation to surface water irrigation by the end of construction Phase 4 in 2025.

Before construction would be completed, there would be a loss of irrigated acreage as wells are taken offline. At the completion of construction, the acres associated with each construction phase are assumed to go back into irrigated production. Table 4-88 presents the number of acres for each of the four construction phases by well level that would receive surface water deliveries.

Table 4-88. Total number of acres receiving surface water deliveries by construction phase, and cropped acreage by well level by construction phases, south of I–90 for Alternative 2A: Partial – Banks.

Construction Phase	Acres Receiving Surface Water	Level 1 Cropped Acres	Level 2 Cropped Acres	Level 3 and 4 Cropped Acres	Level 5 Cropped Acres
South of I–90					
1	18,713	936	5,614	11,227	936
2	22,002	1,100	6,601	13,202	1,100
3	8,932	447	2,679	5,357	447
4	7,423	371	2,227	4,454	371
Subtotal of Acres	**57,070**	**2,854**	**17,121**	**34,240**	**2,854**

Alternative 2A: Partial—Banks would supply replacement water to maintain or bring back into irrigated production, approximately 57,000 acres. Table 4-84 shows that Alternative 2A: Partial—Banks had 25,284 acres of potatoes compared to 4,209 acres of potatoes under the No Action Alternative (in 2025). This is 21,075 more acres of potatoes. Irrigated wheat production under the two alternatives came to 24,745 acres and 26,538 acres, respectively in 2025, a decrease of 1,793 acres of irrigated wheat due to Alternative 2A: Partial—Banks. Mixed crops decreased by 12,649 acres by 2025, and by 2025, acres of dryland wheat under the Alternative 2A: Partial—Banks had decreased by 13,661 acres compared to the No Action Alternative.

Table 4-89. Acreages by crop for 2010 and 2025, No Action Alternative and Alternative 2A: Partial – Banks.

Crop	2010 Acres by Crop	2025 Acres by Crop: No Action Alternative	2025 Acres by Crop: Alternative 2A: Partial—Banks	Difference Between No Action and Alternative 2A: Partial—Banks
Potato	15,496	4,209	25,284	21,075
Wheat	42,791	26,538	24,745	–1,793
Mixed Crops	39,198	22,743	10,094	–12,649
Alfalfa Hay	0	0	20,688	20,688
Dryland Wheat Produced	2,565	24,563	10,902	–13,661
Fallow Acres in Rotation	2,565	24,563	10,903	–13,660
Total	102,616	102,616	102,616	

Construction would be completed by 2025 and approximately 57,000 acres would receive 3 acre–feet of water per acre. As soon as the lands start receiving a full water supply, they would be put into the crop rotation at Well Level 2, which has the highest return on gross farm income. Even though the approximately 57,000 acres under Alternative 2A: Partial—Banks would be planted with an irrigated crop mix, there would still be 45,546 acres of cropland that would not receive surface irrigation water and the Study Area would continue to lose acres of irrigated land every year through 2025 at the same rate as the No Action Alternative.

Figure 4-40 shows the annual change in gross farm income estimated for Alternative 2A: Partial—Banks. As expected, gross farm income would decrease over time as irrigation wells go out of production and cropping patterns would revert to the dryland wheat/fallow rotation pattern prevalent in the 1960s. Upward ticks in gross farm income reflect completion of a construction phase when acres begin to receive surface irrigation deliveries and are proportionately incorporated into the cropping pattern associated with acres served by Level 2 wells.

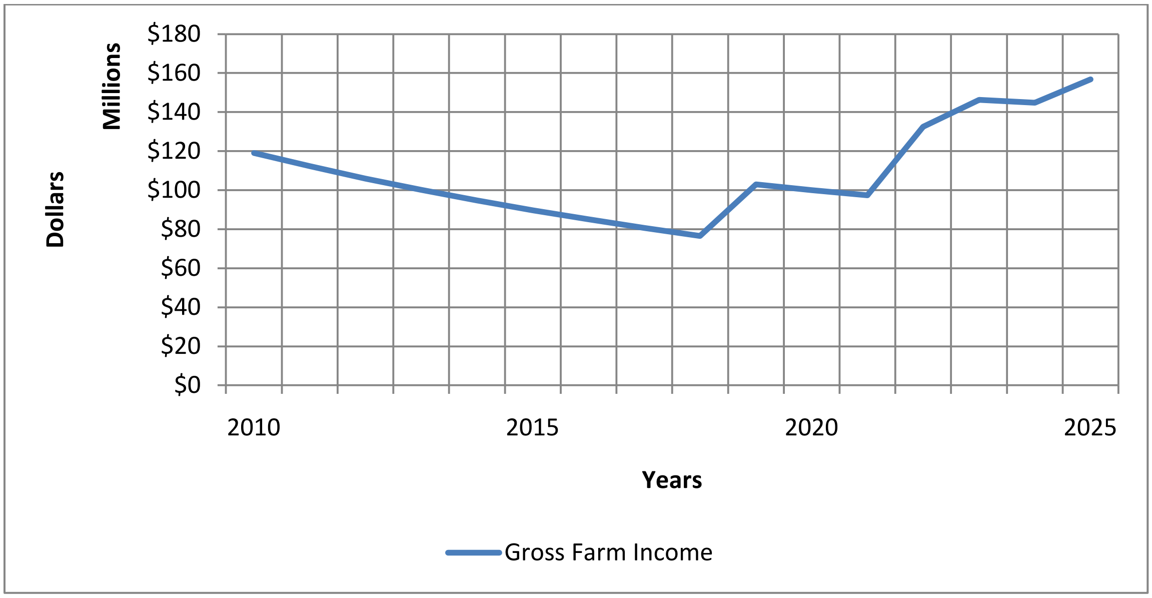


Figure 4-40. Total gross farm income Alternative 2A: Partial – Banks.

Table 4-90 shows gross farm income estimates for 2010 and for 2025 for Alternative 2A: Partial—Banks. Comparison of the 2025 No Action Alternative to the 2025 partial replacement alternatives shows that any of the partial replacement alternatives would generate $118.8 million more in gross farm income.

Table 4-90. Comparison of 2010 and 2025 gross farm incomes for the No Action Alternative and Alternative 2A: Partial – Banks.

Gross Farm Income by Crop	Year 2010	Year 2025
No Action Alternative Gross Farm Income		
Potato	$62,527,000	$16,983,000
Wheat	$23,727,000	$18,955,000
Mixed Crops	$24,854,000	$14,421,000
Total	**$111,108,000**	**$54,550,107**
Alternative 2A : Partial—Banks Gross Farm Income		
Potato	$62,527,000	$102,021,000
Wheat	$23,727,000	$18,644,000
Mixed Crops	$24,854,000	$25,044,000
Alfalfa	$0	$23,429,000
Total	**$111,108,000**	**$169,138,000**
Difference in Income		
Potato	$0	$85,038,000
Wheat	$0	-$311,000
Mixed Crops	$0	$10,623,000

Gross Farm Income by Crop	Year 2010	Year 2025
Alfalfa	$0	$23,429,000
Total	**$0**	**$118,779,000**

Figure 4-41 compares gross farm income for the No Action Alternative and the Alternative 2A: Partial—Banks.

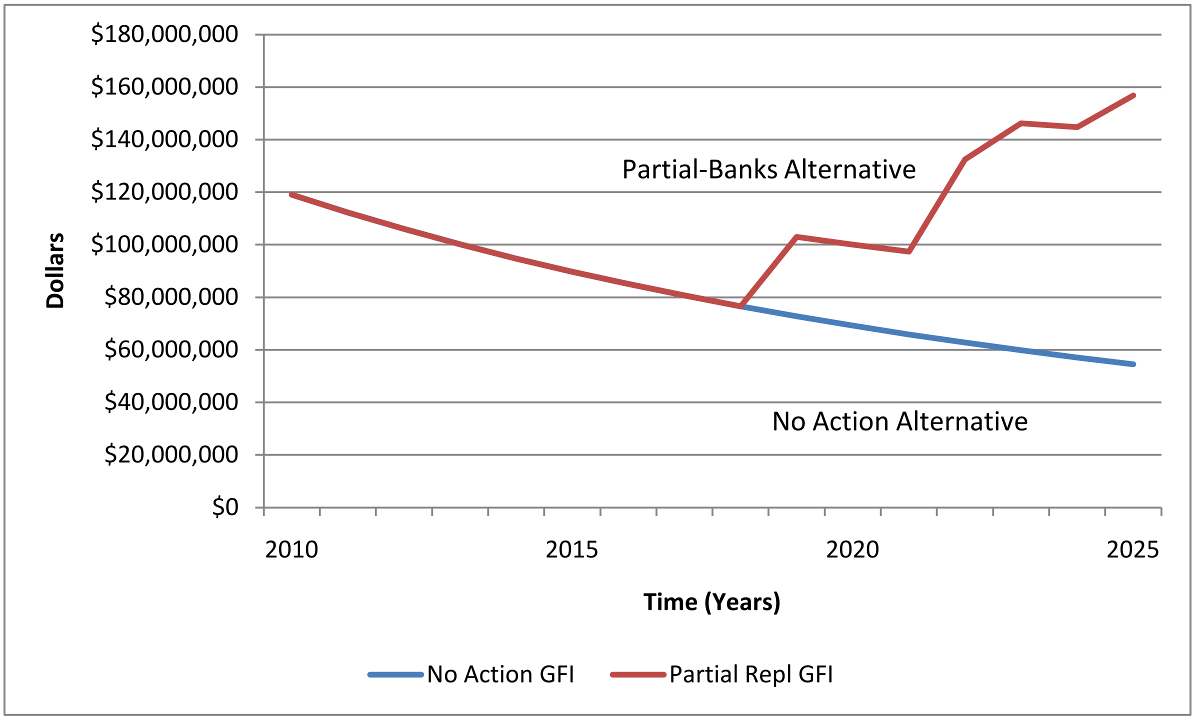


Figure 4-41. Comparison of gross farm income between the No Action Alternative and Alternative 2A: Partial – Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to agriculture are anticipated from the Limited Spring Diversion Scenario

4.15.2.3 Alternative 2B: Partial—Banks + FDR

Short– and long–term impacts for irrigated agriculture are the same as those presented for Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to agriculture are anticipated from the Limited Spring Diversion Scenario

4.15.2.4 Alternative 3A: Full—Banks

Short–term Impacts

Short–term impacts would result from construction activities. Some irrigated land would be taken out of production to facilitate construction. After construction would be completed, those acres would resume irrigated farming practices. These construction activities could result in a small, temporary reduction in gross farm income.

Long–term Impacts

Nine construction phases would be completed under this Alternative by 2025. At completion of construction, all approximately 102,600 acres would receive 3 acre–feet of surface irrigation water from the CBP project. The replacement irrigation water was assumed to be delivered to 42,103 acres of potatoes, 23,314 acres of irrigated wheat, and 0 acres of irrigated mixed crops, 37,199 acres of alfalfa, and 0 acres of dryland wheat annually; this crop mix provided the highest gross farm income that could be expected from the approximately 102,600 acres cropped acres.

Table 4-91 presents the number of acres for each of the nine construction phases that would receive surface water deliveries, along with the number of acres of each crop by well level.

Table 4-91. Total number of acres receiving surface water deliveries by construction phase and cropped acreage by well level by construction phases south of I–90 and north of I–90.

Construction Phase	Acres Receiving Surface Water	Level 1 Cropped Acres	Level 2 Cropped Acres	Level 3 and 4 Cropped Acres	Level 5 Cropped Acres
South of I–90					
1	18,713	936	5,614	11,227	936
2	22,002	1,100	6,601	13,202	1,100
3	8,932	447	2,679	5,357	447
4	7,423	371	2,227	4,454	371
Subtotal of Acres & Wells South of I–90	**57,070**	**2,854**	**17,121**	**34,240**	**2,854**
North of I–90					
5	7,085	354	2,126	4,251	354
6	11,671	584	3,501	7,002	584
7	6,147	307	1,844	3,689	307
8	12,756	638	3,827	7,653	638
9	7,887	394	2,366	4,733	394
Subtotal of Acres & Wells North of I–90	**45,546**	**2,277**	**13,664**	**27,328**	**2,277**
Total Acres	**102,616**	**5,131**	**30,785**	**61,570**	**5,131**

Alternative 3A: Full—Banks would substantially increase the acres of irrigated crop production compared to the No Action Alternative. Table 4-92 shows that Alternative 3A: Full—Banks has 37,894 more acres of potatoes, 3,224 less acres of irrigated wheat, zero acres of mixed crops, 37,199 acres of alfalfa, and 24,563 fewer acres of dryland wheat compared to the No Action Alternative. By 2025, all nine construction phases would be completed and approximately 102,600 acres would receive 3 acre–feet of water per acre. As soon as the lands would receive a full water supply, farmers would begin crop rotation prevalent in acres served by Level 2 wells, which provided the highest gross farm income. A change in crops grown was assumed for Alternative 3A: Full—Banks; mixed crops are replaced by alfalfa due to additional water supplies becoming available and the number of acres of each crop reflects the crop pattern assumed for future agricultural production. There would be no acres in the dryland wheat/fallow rotation under Alternative 3A: Full—Banks, because all acres were assumed to receive 3 acre–feet per acre.

Table 4-92. Acreages by crops for 2010 and 2025 Alternative 1: No Action and Alternative 3A: Full—Banks.

Crop	2010 Acres by Crop	2025 Acres by Crop No Action Alternative	2025 Acres by Crop Alternative 3A: Full—Banks	Difference Between No Action and Alternative 3A: Full—Banks
Potato	15,495	4,209	42,103	+37,894
Wheat	38,481	26,538	23,314	–3,224
Mixed Crops	43,509	22,743	0	–22,743
Alfalfa	0	0	37,199	+37,199
Dryland Wheat Produced	2,565	24,563	0	–24,563
Fallow Acres in Rotation	2,566	24,563	0	–24,563
Total Income	**102,616**	**102,616**	**102,616**	

Figure 4-42 shows the annual change in gross farm income estimated under Alternative 3A: Full—Banks. Upward ticks in gross farm income reflect completion of a construction phase when acres begin to receive surface irrigation deliveries and are proportionately incorporated into a cropping pattern associated with acres served by Level 2 wells.

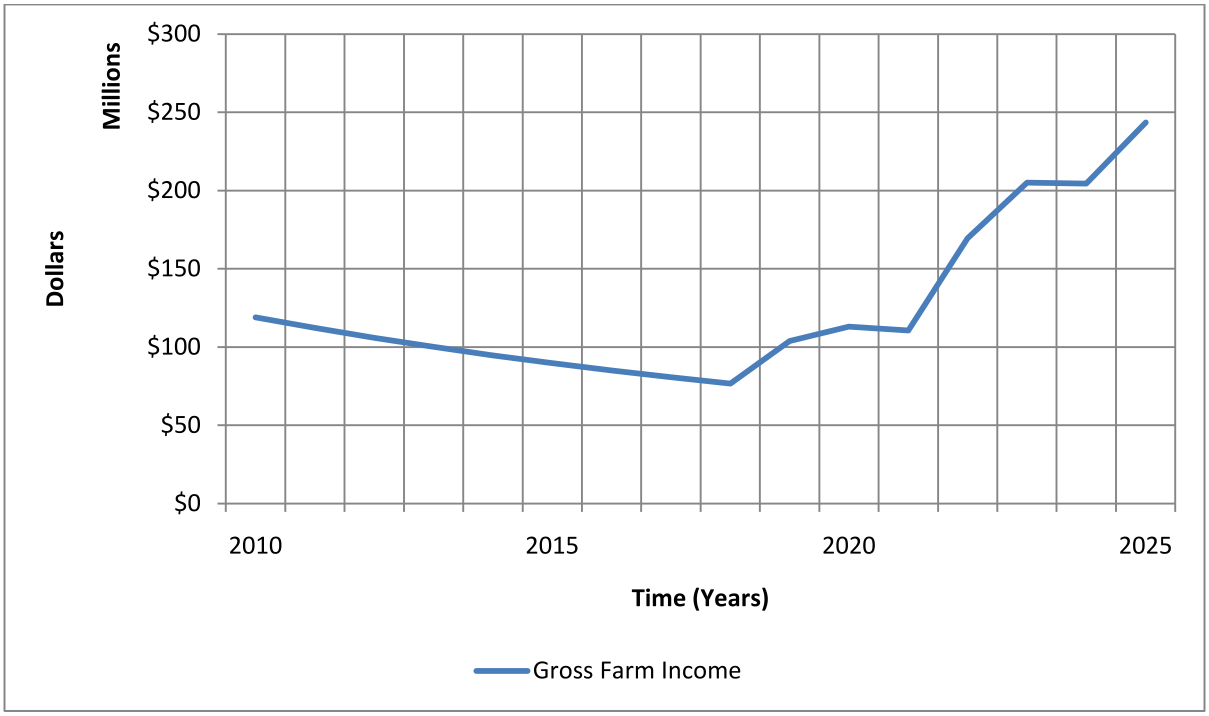


Figure 4-42. Total gross farm income Alternative 3A: Full—Banks.

Table 4-93 shows gross farm income estimates for 2010 and 2025 for Alternative 3A: Full—Banks. This alternative would provide $178.0 million more in gross farm income than the No Action Alternative.

Table 4-93. Comparison of 2010 and 2025 gross farm incomes for No Action Alternative and Alternative 3A: Full—Banks.

Gross Farm Income by Crop	Year 2010	Year 2025
No Action Alternative Gross Farm Income		
Potato	$62,527,000	$16,983,000
Wheat	$23,727,000	$18,955,000
Mixed Crops	$24,854,000	$14,421,000
Total	**$111,108,000**	**$54,550,107**
Alternative 3A: Full—Banks Gross Farm Income		
Potato	$62,527,000	$169,886,000
Wheat	$23,727,000	$16,341,000
Mixed Crops	$24,854,000	$0
Alfalfa	$0	$42,127,000
Total	**$111,108,000**	**$228,354,000**
Difference in Income		
Potato	$0	$152,903,000
Wheat	$0	-$2,614,000

Gross Farm Income by Crop	Year 2010	Year 2025
Mixed Crops	$0	-$14,421,000
Alfalfa	$0	$42,127,000
Total	**$0**	**$177,995,000**

Figure 4-43 compares gross farm income for the No Action Alternative and the Alternative 3A: Full—Banks Alternative.

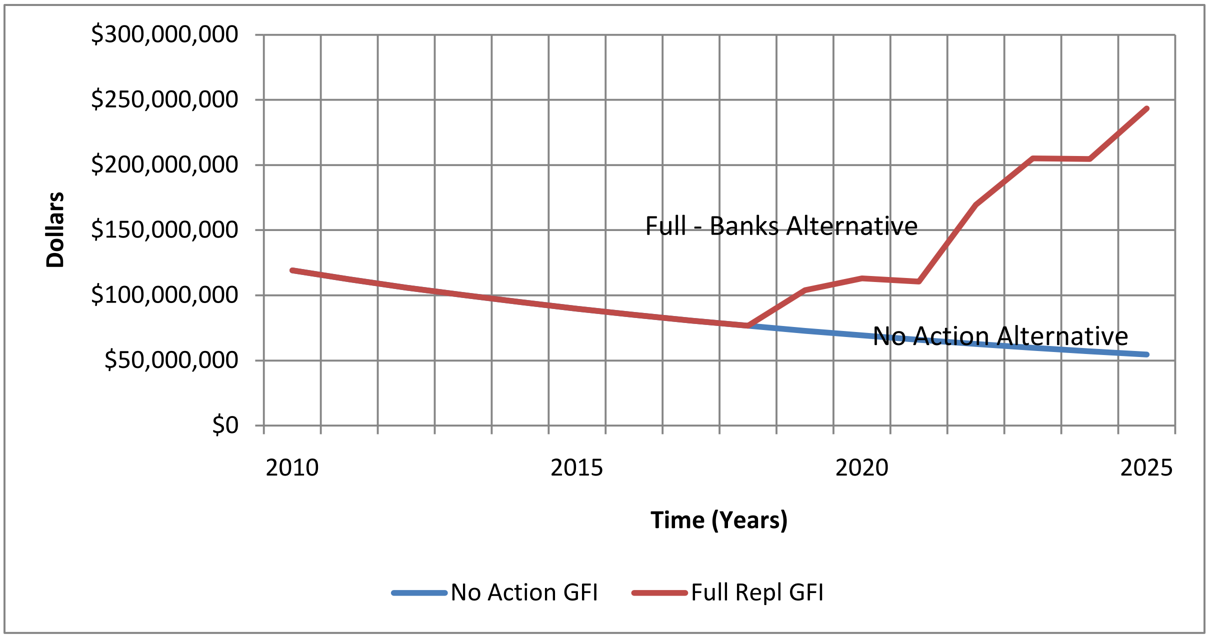


Figure 4-43. Comparison of gross farm income between the No Action Alternative and Alternative 3A: Full—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to agriculture are anticipated from the Limited Spring Diversion Scenario

4.15.2.5 Alternative 4A: Modified Partial—Banks

Analysis of Alternative 4A: Modified Partial—Banks (Preferred Alternative) evaluated the change in gross farm income resulting from delivery of surface water to approximately 70,000 acres. It was assumed that all would receive 3 acre–feet of irrigation water per acre, regardless of the existing pumping level. Estimates of gross farm income for the approximately 70,000 acres were calculated using a representative crop mix of irrigated potatoes, mixed crops, alfalfa, and wheat.

Cropping patterns on acres served by Level 1 wells were assumed to not change under this alternative. Acres served by Level 3, Level 4, and Level 5 wells were assumed to proportionately move into the cropping pattern served by Level 2 wells. The cropping pattern served by Level 2 wells changed from a representative crop mix consisting of potato/mixed crop/irrigated wheat/dryland wheat–fallow rotation to a representative crop mix of potato/alfalfa/irrigated wheat. Estimates of prices received for crops were held constant over the period of analysis for wheat and potatoes. A 5–year average price for alfalfa was used. Although prices vary annually and yields would change over the long run, reasonably forecasting changes in prices of crops was not possible. Additionally, there was an increase in wheat yield. Potato yield remained constant. A 5–year county average yield for alfalfa was used.

In the early years of constructing this alternative, there would be no difference in gross farm income between this alternative and the No Action Alternative. This is because the same losses in gross farm income would occur for both until construction would be completed. The 2010 gross farm income estimate for the modified partial replacement alternatives and the No Action Alternative would be $119,071,463.

The same gross farm income holds for the No Action Alternative and the modified partial replacement alternatives each year until 2019, when construction Phase 1 is completed. Then, a difference in gross farm income between the No Action and the modified partial replacement alternatives can be detected.

Short–term Impacts

Short–term impacts would result from construction activities. Some irrigated land would be taken out of production to facilitate construction. After construction is completed, those acres would resume irrigated farming practices. Construction activities could result in a small temporary reduction in gross farm income.

Long–term Impacts

Under this alternative, the loss of viable wells in each of five well levels was estimated, along with the change in crops and the loss of irrigated crop income. Four construction phases would be completed under this alternative. Agricultural lands (approximately 70,000 acres) would switch from groundwater irrigation to surface water irrigation by the end of construction Phase 4 in 2025.

Before construction would be completed, there would be a loss of irrigated acreage as wells are taken offline. At the completion of construction, the acres associated with each construction phase are assumed to go back into irrigated production. Table 4-94 presents the number of acres for each of the four construction phases by well level that would receive surface water deliveries.

Alternative 4A: Modified Partial—Banks would supply replacement water to maintain or bring back into irrigated production, approximately 70,000 acres. Table 4-95 shows that Alternative 4A: Modified Partial—Banks (Preferred Alternative) had 30,250 acres of potatoes compared to 4,209 acres of potatoes under the No Action Alternative (in 2025). This is 26,041 more acres of potatoes. Irrigated wheat production under the two alternatives came to 26,538 acres and 24,323 acres, respectively in 2025, a decrease of 2,215 acres of irrigated wheat due to Alternative 4A: Modified Partial—Banks. Mixed crops decreased 15,629 acres in 2025, and by 2025, acres of dryland wheat under the Alternative 4A: Modified Partial—Banks (Preferred Alternative) had decreased by 16,880 acres compared to the No Action Alternative. Alfalfa had increased by 25,562 acres by 2025.

Table 4-94. Total number of acres receiving surface water deliveries by construction phase, and cropped acreage by well level by construction phases, north and south of I–90 for Alternative 4A: Modified Partial—Banks (Preferred Alternative) (Preferred Alternative).

Construction Phase	Acres Receiving Surface Water	Level 1 Cropped Acres	Level 2 Cropped Acres	Level 3 and 4 Cropped Acres	Level 5 Cropped Acres
North of I–90					
1	25,313	1,266	7,594	15,188	1,266
South of I–90					
2	15,902	795	4,770	9,541	795
3	19,544	977	5,863	11,726	977
4	9,758	488	2,927	5,855	488
Rest of Acres	32,099	1,605	9,230	19,259	1,605
Subtotal of Acres	**102,616**	**5,131**	**30,384**	**61,569**	**5,131**

Table 4-95. Acreages by crop for 2010 and 2025, No Action Alternative and Alternative 4A: Modified Partial—Banks (Preferred Alternative) (Preferred Alternative).

Crop	2010 Acres by Crop	2025 Acres by Crop: No Action Alternative	2025 Acres by Crop: Alternative 4A: Modified Partial—Banks (Preferred Alternative)	Difference Between No Action and Alternative 4A: Modified Partial—Banks (Preferred Alternative)
Potato	15,496	4,209	30,250	+26,041
Wheat	42,791	26,538	24,323	–2,215
Mixed Crops	39,198	22,743	7,114	–15,629
Alfalfa Hay	0	0	25,562	+25,562
Dryland Wheat Produced	2,565	24,563	7,683	–16,880
Fallow Acres in Rotation	2,565	24,563	7,684	–16,879
Total	102,616	102,616	102,616	

Construction would be completed by 2025 and approximately 70,000 acres would receive 3 acre–feet of water per acre. As soon as the lands start receiving a full water supply, they would be put into the crop rotation at Well Level 2, which has the highest return on gross farm income. Even though the approximately 70,000 acres under Alternative 4A: Modified Partial—Banks (Preferred Alternative) would be planted with an irrigated crop mix, there would still be 32,099 acres of cropland that would not receive surface irrigation water and the Study Area would continue to lose acres of irrigated land every year through 2025 at the same rate as the No Action Alternative.

Figure 4-44 shows the annual change in gross farm income estimated for Alternative 4A: Modified Partial—Banks. As expected, gross farm income would decrease over time as irrigation wells go out of production and cropping patterns would revert to the dryland wheat/fallow rotation pattern prevalent in the 1960s. Upward ticks in gross farm income reflect completion of a construction phase when acres begin to receive surface irrigation deliveries and are proportionately incorporated into the cropping pattern associated with acres served by Level 2 wells.

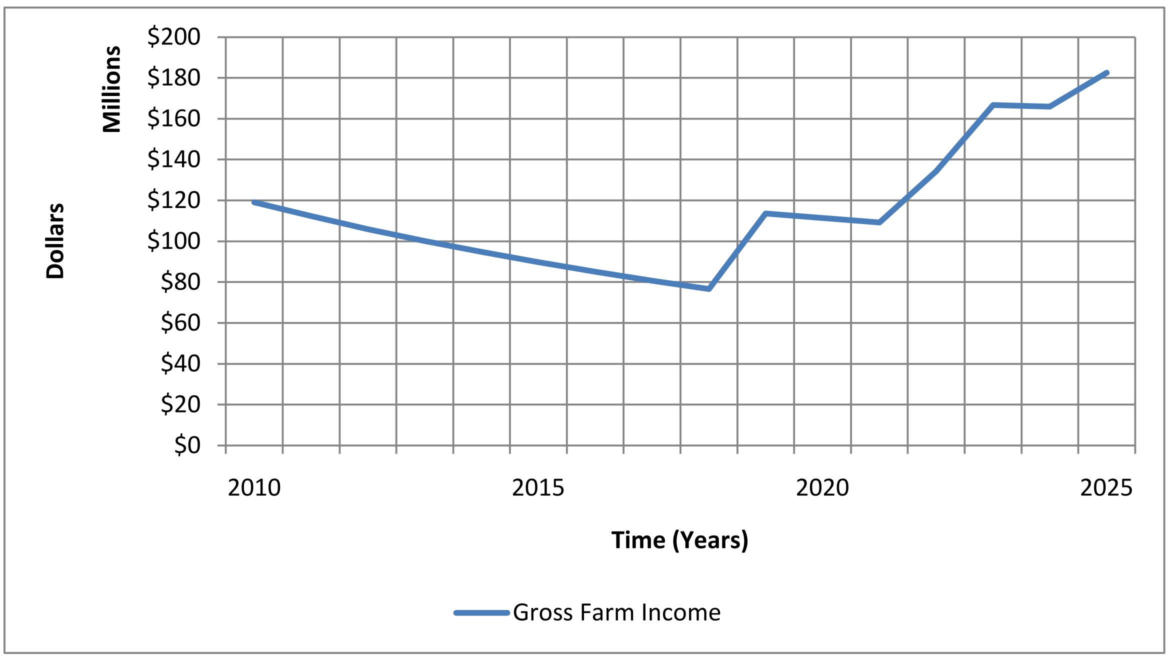


Figure 4-44. Total gross farm income Alternative 4A: Modified Partial—Banks (Preferred Alternative).

Table 4-96 shows gross farm income estimates for 2010 and for 2025 for Alternative 4A: Modified Partial—Banks. Comparison of the 2025 No Action Alternative to the 2025 modified partial replacement alternatives shows that any of the modified partial replacement alternatives would generate $123 million more in gross farm income.

Table 4-96. Comparison of 2010 and 2025 gross farm income for the No Action Alternative and Alternative 4A: Modified Partial—Banks (Preferred Alternative).

Gross Farm Income by Crop	Year 2010	Year 2025
No Action Alternative Gross Farm Income		
Potato	$62,527,000	$16,983,000
Wheat	$23,727,000	$18,955,000
Mixed Crops	$24,854,000	$14,421,000
Total	**$111,108,000**	**$54,550,107**
Alternative 4A : Partial—Banks Gross Farm Income		
Potato	$62,527,000	$122,059,000
Wheat	$23,727,000	$17,964,000
Mixed Crops	$24,854,000	$4,511,000
Alfalfa	**$111,108,000**	$28,949,000
Total	$62,527,000	**$173,483,000**
Difference in Income		
Potato	$0	$105,076,000
Wheat	$0	-$991,000
Mixed Crops	$0	-$9,910,000
Alfalfa	$0	$28,949,000
Total	**$0**	**$123,124,000**

Figure 4-45 compares gross farm income for the No Action Alternative and the Alternative 4A: Modified Partial—Banks.

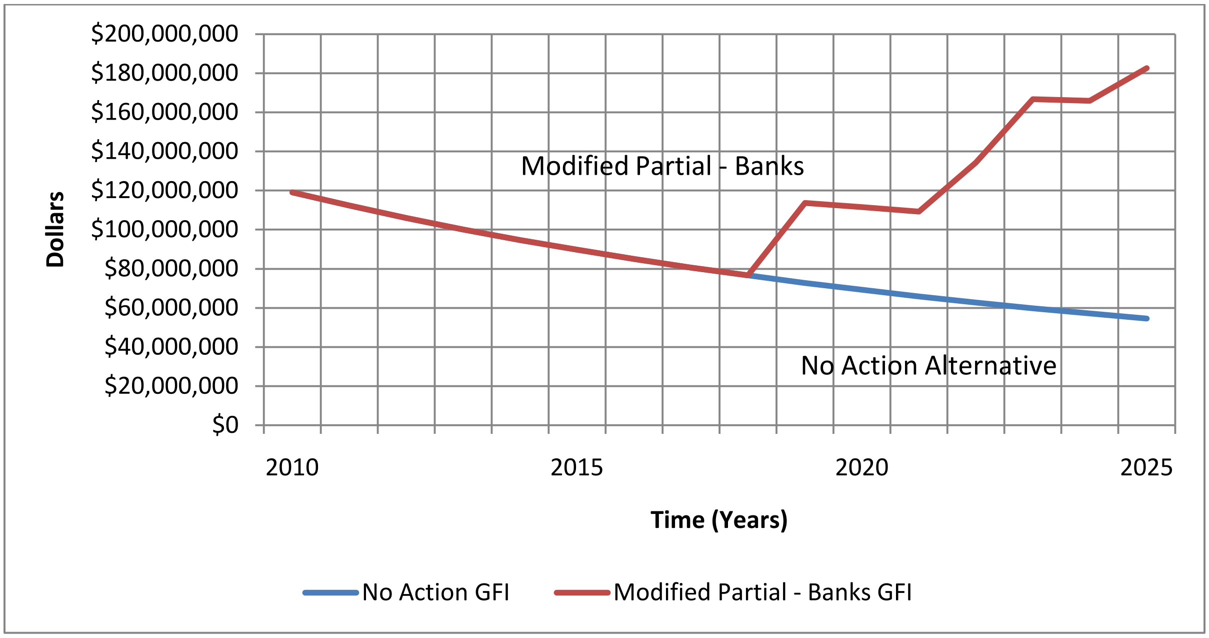


Figure 4-45. Comparison of gross farm income between the No Action Alternative and Alternative 4A: Modified Partial—Banks (Preferred Alternative).

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to agriculture are anticipated from the Limited Spring Diversion Scenario.

4.15.2.6 Alternative 4B: Modified Partial—Banks + FDR

Short- and long-term impacts for irrigated agriculture are the same as those presented for Alternative 4A: Modified Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to agriculture are anticipated from the Limited Spring Diversion Scenario.

4.15.3 Mitigation

No mitigation measures have been identified for irrigated agriculture.

4.15.4 Socioeconomics

This section describes potential regional economic impacts associated with implementation of the alternatives to the four–county analysis area composed of Adams, Franklin, Grant, and

Lincoln counties. Socioeconomic impacts were measured as changes in regional employment, income, and sales associated with implementation of the action alternatives, as compared to those associated with implementation of the No Action Alternative.

The regional economic analysis of the proposed alternatives focuses on economic impacts stemming from construction costs, annual O&M costs, and agricultural gross farm income. The change in agricultural income was estimated for each action alternative and compared to the No Action Alternative.

As discussed in Section 4.15.1 – *Irrigated Agriculture*, under the No Action Alternative, well levels would continue to decline, and farmers would transition from irrigated to dryland farming, resulting in decreased gross farm income and fewer potatoes. Gross farm income and potato processing affect the economy of the four–county analysis area. Implementation of the No Action Alternative would result in long–term decreases in gross farm income and potato processing having a negative impact on employment, labor income, and sales in the four–county regional economy. No construction or O&M expenditures are associated with the No Action Alternative.

As shown in Table 4-97, gross farm income, potato production, and O&M expenditures would increase with implementation of any of the partial, modified partial, or full replacement action alternatives, resulting in long–term positive impacts to employment, labor income, and sales in the regional economy, when compared to the No Action Alternative. Additional short–term positive impacts to the regional economy would stem from expenditures associated with construction expenditures during the construction period.

4.15.4.1 Economics Context and Background

Chapter 1 of this Final EIS describes the purpose and need for the Study. One of the needs identified for bringing CBP surface water to the Odessa Subarea is to “avoid economic loss to the region’s agricultural sector.”

In the Notice of Intent published in the Federal Register on August 2008 that initiated preparation of this Final EIS, the need to avoid significant economic loss was supported by reference to a study by Bhattacharjee and Holland (2005) on the economic impact of lost potato production and processing in the region resulting from groundwater decline.

Since publication of the Bhattacharjee and Holland (2005) analysis, other reports by Holland and Beleiciks (2005), Razack and Holland (2007), and Entrix (2010) have been published that also address the economic impacts of various aspects of the region’s agricultural sector. The questions addressed by these studies, along with their results and conclusions differ from the Bhattacharjee and Holland (2005) study.

Reclamation conducted an economic analysis of the four–county area specific to the Final EIS alternatives, which begins in Section 4.15.2 – *Methods and Assumptions*. The main differences between Reclamation's analysis and the others are related to geographic scope or Study Area and the purpose or intent of the analysis (Table 4-97).

Table 4-97. Overview of socioeconomics impacts by alternative.

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives		Full Groundwater Irrigation Replacement Alternatives
		2A: Partial—Banks 2B: Partial—Banks + FDR	**4A: Modified Partial – Banks 4B: Modified Partial—Banks + FDR**	**3A: Full—Banks 3B: Full—Banks + FDR**
Change in regional employment (number of jobs) within the four–county analysis area	Minimal long–term impact: less than 1 percent decrease in jobs	Short–term beneficial effects: less than one percent increase in jobs. Net long–term beneficial effects: less than 1 percent increase in jobs. Ag: less than 2 percent in jobs.	Short–term beneficial effects: less than one percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 2 percent in jobs.	Short–term beneficial effects: less than four percent increase in jobs. Net long–term beneficial effects: less than 1 percent increase in jobs. Ag: less than 2 percent in jobs.
Change in regional labor income within the four–county analysis area	Minimal long–term impact: less than ½ of 1 percent decrease in labor income	Short–term beneficial effects: less than 2 percent increase in labor income. Net long–term beneficial effects: less than 1 percent increase in labor income. Ag: less than 2 percent in jobs.	Short–term beneficial effects: less than one percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 2 percent in jobs.	Short–term beneficial effects: less than 6 percent increase in labor income. Net long–term beneficial effects: less than 1 percent increase in labor income. Ag: less than 3 percent in jobs.
Change in regional sales within the four–county analysis area	Minimal long–term impact: less than ½ of 1 percent decrease in sales	Short–term beneficial effects: less than 1 percent increase in sales. Net long–term beneficial effects: less than 1 percent increase in sales. Ag: less than 2 percent in jobs.	Short–term beneficial effects: less than 1 percent increase in jobs. Net long–term beneficial effects: O&M: less than 1 percent increase in jobs. Ag: less than 3 percent in jobs.	Short–term beneficial effects: less than 4 percent increase in sales. Net long–term beneficial effects: less than 1 percent increase in sales. Ag: less than 4 percent in jobs.

Regional Economic Studies

Over the past 5 years, four studies have evaluated economic impacts associated with the loss of crop production in the CBP or Odessa Subarea.

- Bhattacharjee and Holland (2005), *The Economic Impact of a Possible Irrigation–Water Shortage in Odessa Sub–Basin: Potato Production and Processing*
- Holland and Beleiciks (2005), *Potatoes in Washington State*
- Razack and Holland (2007), *The Economic Impact of a Possible Irrigation–Water Shortage in the Odessa Subbasin of Adams and Lincoln Counties*
- Entrix (2010), *Economic Contribution of Agriculture Irrigated by the CBP*

From the titles, it appears that these studies are similar; however, each of these studies differs in assumptions regarding the geographic region and purpose of the analysis. To place Reclamation's economic analysis in context with these regional studies, the geographic scope or Study Area, purpose, and analysis area are presented in Table 4-98.

Table 4-98. Comparison of regional economic studies.

Study Area	Study Purpose	Analysis Area
Bhattacharjee and Holland (2005). *The Economic Impact of Possible Irrigation–Water Shortage in Odessa Subbasin: Potato Production and Processing*		
Odessa Subarea defined as Franklin, Adams, Grant, and Lincoln counties of Washington state	Evaluate the regional economic impacts of the possible losses of potato production and its associated processing in the Odessa Subarea as a result of possible irrigation water shortages.	Franklin, Adams, Grant, and Lincoln counties of Washington state
Holland and Beleiciks (2005). *The Economic Impact of Potatoes in Washington State*		
Washington State	Measure the economic contributions of the potato industry to Washington state's economy.	Washington State, plus Morrow and Umatilla counties of Oregon state

Study Area	Study Purpose	Analysis Area
Razack and Holland (2007). *The Economic Impact of Possible Irrigation–Water Shortage in the Odessa Sub–basin of Adams and Lincoln Counties*		
Odessa Subarea defined as Lincoln and Adams counties of Washington state	Explore the regional economic impacts of the possible crop production losses and its associated processing in the Odessa Subarea of Lincoln and Adams Counties as a result of possible irrigation–water shortages.	Lincoln and Adams counties of Washington state
Entrix (2010). *Economic Contribution of Agriculture Irrigated by the CBP*		
CBP defined as: 1) SCBID 2) QCBID 3) ECBID	Evaluate the economic and fiscal impacts of CBP irrigated agriculture on the local, state, and national economies	Adams, Grant, and Franklin counties of Washington state
Reclamation (2012). Odessa Subarea Special Study Final EIS		
Odessa Study Area defined as approximately 102,600 groundwater irrigated acres within the Odessa Subarea that are eligible to receive CBP surface water	Evaluate the economic impacts of the No Action, and the partial and full replacement alternatives defined in the Odessa Subarea Special Study Final EIS	Adams, Grant, Franklin, and Lincoln counties of Washington state

4.15.4.2 Methods and Assumptions

Impact Indicators and Significance Criteria

Table 4-99 presents the indicators and associated criteria for determining potential significant socioeconomic impacts.

Table 4-99. Socioeconomics impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Employment	Change greater than 10 percent of the four–county area
Labor Income	Change greater than 10 percent of the four–county area
Regional Sales	Change greater than 10 percent of the four–county area

Impact Analysis Methods

The modeling package used to assess the regional economic effects stemming from the agricultural gross value of production, construction, and O&M expenditures for each alternative is IMPLAN (IMpact analysis for PLANning). IMPLAN is an economic input–

output modeling system that estimates the effects of economic changes in a defined analysis area.

IMPLAN is a static model that estimates impacts for a snapshot in time when the impacts are expected to occur, based on the makeup of the economy at the time of the underlying IMPLAN data. Therefore, it is difficult to address dynamic impacts, such as a decline in gross farm income due to progressively failing wells using IMPLAN. As wells become less productive, farmers may adapt by using new technology or planting new crop varieties. As the economy adapts to changing farm practices, labor, and capital inputs would move to alternative uses. IMPLAN measures the initial impact to the economy, but does not consider long-term adjustments as labor and capital move into alternative uses.

The analysis assumes that the structure of the economy remains static between 2010 and 2025. This approach is used for the purposes of comparing the alternatives. Realistically, the structure of the economy will adapt and change; therefore, these numbers only can be used to compare relative changes between the No Action Alternative and the action alternatives and cannot be used to predict or forecast employment, labor income, or output (sales).

The common measures of regional economic impacts include employment, regional income, and regional output (sales). Input–output models measure commodity flows from producers to intermediate and final consumers. Purchases for final use (final demand) drive the model. Industries produce goods and services for final demand and purchase goods and services from other producers. These other producers, in turn, purchase goods and services. This buying of goods and services (indirect purchases) continues until leakages from the analysis area (imports and value added) stop the cycle. These indirect and induced effects (the effects of household spending) can be mathematically derived using a set of multipliers. The multipliers describe the change in output for each regional industry caused by a one-dollar change in final demand.

This analysis uses 2008 IMPLAN data for the four counties within the analysis area. IMPLAN data files were compiled from a variety of sources for the analysis area, including the U.S. Bureau of Economic Analysis, the U.S. Bureau of Labor, and the U.S. Census Bureau.

Construction

The construction costs associated with each alternative were divided into the construction phases described in Chapter 2. The construction–related expenditures for each phase were divided into expenditures that would be made inside the analysis area. The construction expenditures inside the analysis area were used in IMPLAN to estimate employment, labor income, and regional sales stemming from construction–related activities for each phase.

Construction expenditures made outside the analysis area were considered "leakages" and would have no impact on the local economy.

Reclamation's construction cost engineers allocated the costs associated with major construction activities to within–region expenditures, as shown in Table 4-100.

Table 4-100. Allocations by construction activity within the analysis area.

Construction Activity	In–Region Expenditures
Canal Enlargement and Linings	75%
Water Service Contracts	75%
Pump Station Modifications	75%
Wasteways	30%
Siphons	60%
Laterals	45%
Drains Subsurface	50%
Pumping Plants	35%
Switchyards and Transmission Lines	25%
Maintenance Buildings	40%
SCADA Systems	20%
Mobilization and Preparatory Work	60%

The analysis assumes that the onsite construction workforce would be hired from within the analysis area or would commute to the area from nearby communities. It is also assumed that most of the construction expenditures would be funded from sources outside the analysis area. Money from outside the analysis area spent on goods and services within the analysis area contributes to regional economic impacts, while money that originates from within the analysis area is much less likely to generate regional economic impacts. Spending from sources within the analysis area represents a redistribution of income and output rather than an increase in economic activity.

The impacts by phase would be spread over the length of the construction period and would vary year–by–year proportionate to actual expenditures. The regional impacts associated with each phase cannot be summed into a total construction impact for a particular alternative to avoid double counting.

O&M

Expenditures made inside the study region related to O&M generate positive economic output to the regional economy. For the purpose of this analysis, it is assumed that 80 percent of the O&M expenditures would be made inside the four–county area. As construction phases are completed, annual O&M expenditures would begin to accrue; however, this analysis measures annual O&M impacts after all the construction phases are implemented. The analysis does not quantify the positive impacts resulting from replacement costs given these are distributed over the entire study period. Like the construction related expenditures, O&M expenditures made inside the analysis area associated with each alternative were placed into categories related to the each sector of the economy and run through IMPLAN to estimate impacts to the regional economy.

Agriculture

Gross farm income estimates discussed in Section 4.15.1 – *Irrigated Agriculture*, are used in IMPLAN to measure changes in regional impacts. The analysis also measures regional economic impacts stemming from potato processing activities. Potato processors in the four–county area rely on irrigated potatoes grown in the Study Area because the potatoes are high quality and have desirable storage characteristics. Local processors use all of the potatoes grown in the Study Area; therefore, the regional economy will be impacted by both losses in gross farm income and the loss of Odessa potatoes by the processing plants. This analysis measures regional economic impacts stemming from both these activities.

The analysis measures the combined estimated employment, labor income, and output (sales) stemming from changes in gross farm income and the activities related to potato processing. Impacts were measured for year 2010, the beginning of construction, and year 2025 when all construction phases are completed for each alternative, including the No Action Alternative. Regional impacts were not estimated beyond the end of the construction phases, because of the uncertainties related to the re–employment of labor and capital.

4.15.4.3 Alternative 1: No Action Alternative

Short–term Impacts

Construction

No short–term impacts are anticipated, because no new project facilities would constructed under this alternative.

Agriculture

Impacts to agriculture under the No Action Alternative are considered long–term and are discussed in the next subsection.

Long-Term Impacts

O&M

No long-term impacts are anticipated, because no new project facilities would be constructed under this alternative.

Agriculture

Selecting the No Action Alternative, as shown in Table 4-101, would result in 1,334 jobs (1.49 percent of the employment with in the four–county area) in 2010 within the four–county area. These jobs are the result of gross farm income from 102,416 acres of farmland and the jobs generated by activities related to processing of potatoes grown within the Study Area. Regional employment would decline from 1,334 jobs to 619 jobs, which is 0.69 percent of the employment with in the four–county area, between 2010 and 2025. The job loss of 715 jobs in 2025 would be due to losses in both gross farm income and Odessa potatoes supplied to local processors.

Table 4-101. No Action Alternative regional impacts for 2010 and 2025.

		Employment [a]		Labor Income [b]		Output [c]	
		Total	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area
Four–County Analysis Area		89,255		$3,385		$12,862	
2010	1,334	1.49%	$37	1.08%	$211	1.64%	1.73%
2025	619	0.69%	$12	0.35%	$80	0.62%	0.66%
	–715	–0.80%	–25.0	-0.73	–131.0	–1.02	–1.07

[a] Employment is measured in number of jobs.

[b] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self–employed individuals located within the analysis area.

[c] Output represents the dollar value of industry production.

Labor income as a result of implementation of the No Action Alternative would equal $37 million (1.08 percent of the four–county area) and would drop to $12 million (0.35 percent of the four–county area) in 2025. Implementation of the No Action Alternative would result in $211 million (1.64 percent of the four–county area) of output in the four–county area. Output would decline to $80 million (0.62 percent of the four–county area) by 2025. The drop in both Labor Income and Output also would be due to the loss of gross farm income and the Odessa potato supply to the local processors.

4.15.4.4 Alternative 2A: Partial—Banks

Short–term Impacts

Construction

Construction expenditures spent within the analysis area would positively impact employment, labor income, and regional sales, as shown in Table 4-102.

These would be short–term impacts during construction phases proportional to expenditure levels during each construction year. Because construction phases would overlap, regional impacts associated with each phase cannot be summed into a total construction impact for this alternative to avoid double counting. The Tribal Employment Rights Ordinance (TERO) of the Colville, Spokane, and Yakama Tribes may be applicable to construction of this alternative.

Table 4-102. Total regional economic impacts stemming from Alternative 2A: Partial – Banks related construction phases.

	Employment [a]		Labor Income [b]		Output [c]	
	Total	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area
Four–County Analysis Area	89,255		$3,385		$12,862	
Phase 1	735	0.82%	$38.1	1.13%	$107.5	0.84%
Phase 2	870	0.98%	$45.1	1.33%	$127.0	0.99%
Phase 3	307	0.34%	$15.9	0.47%	$44.9	0.35%
Phase 4	284	0.32%	$14.7	0.43%	$41.5	0.32%

[a] Employment is measured in number of jobs. Construction–related employment estimates include the in–field workforce defined in Chapter 2 plus all additional jobs generated by project construction in retail, services, manufacturing, and other related sectors throughout the economy.

[b] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self–employed individuals located within the analysis area.

[c] Output represents the dollar value of industry production.

Agriculture

Short–term impacts would result from construction activities. Some irrigated land would be taken out of production to facilitate construction. After construction is completed, those acres would resume irrigated farming practices. These losses could result in a small temporary reduction in gross farm income; therefore, regional employment, labor income, and sales could be slightly reduced.

Long–term Impacts

O&M

Annual O&M expenditures required for this alternative would result in positive economic long–term impacts that would be greater than with the No Action Alternative. Table 4-103 summarizes the regional impacts stemming from total annual O&M activities after all the construction phases have been implemented.

Table 4-103. Total regional economic impacts stemming from Alternative 2A: Partial – Banks related to annual O&M expenditures.

	Employment [a]		Labor Income [b]		Output [c]	
	Total	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area
Four–County Analysis Area	89,255		$3,385		$12,862	
Annual O&M Impacts	33	Less than 1%	$2.06	Less than 1%	$4.09	Less than 1%

[a] Employment is measured in number of jobs.

[b] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self–employed individuals located within the analysis area.

[c] Output represents the dollar value of industry production.

Agriculture

Implementing a partial replacement alternative would result in 1,598 jobs in the four–county area (1.79 percent of total employment in the four–county area) compared to the No Action Alternative of 619 jobs in year 2025, as shown in Table 4-104. Compared to the No Action Alternative, a partial replacement alternative would result in a net change of 979 jobs in year 2025. The job increases would be due to an increase in gross farm income and an increase of Odessa potatoes supplied to the local processors in 2025, associated with implementation of a partial replacement alternative.

Table 4-104. Partial replacement alternatives: regional impacts stemming from changes in gross farm income and associated potato processing.

		Employment [a]		Labor Income [b]		Output [c]	
		Total	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area
Four–County Analysis Area		89,255		$3,385		$12,862	
2025	No Action	619	0.69%	$12	0.35%	$80	0.62%
2025	Partial	1,598	1.79%	$60	1.77%	$316	2.45%
	Net Change	979	1.10%	$48	1.42%	$236	1.83%

[a] Employment is measured in number of jobs

[b] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self–employed individuals located within the analysis area.

[c] Output represents the dollar value of industry production.

Labor income in 2025 for a partial replacement alternative would equal $60 million (1.77 percent of total labor income in the four–county area) in 2025. Labor income as a result of implementation of a partial replacement alternative would increase by $48 million compared to year 2025 of the No Action Alternative.

Output in 2025 for a partial replacement alternative would equal $316 million (2.45 percent of total output in the four–county area). Implementation of a partial replacement alternative would create $236 million more in output compared to year 2025 of the No Action Alternative.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to economics are anticipated from the Limited Spring Diversion Scenario.

4.15.4.5 Alternative 2B: Partial—Banks + FDR

Short- and long-term impacts for construction, O&M, and agriculture would be the same as those presented for Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to economics are anticipated from the Limited Spring Diversion Scenario.

4.15.4.6 Alternative 3A: Full—Banks

Short–term Impacts

Construction expenditures within the analysis area would positively impact employment, labor income, and regional sales, as shown in Table 4-105. These short–term impacts would occur during construction phases proportional to expenditure levels during each year of construction. In the analysis when construction phases overlapped, construction costs were combined to measure regional economic impacts. Because not all construction phases would be concurrent, the economic impacts cannot be summed into a total construction–related regional economic impact for this alternative to avoid double counting. The TEROs of the Colville, Spokane, and Yakama Tribes may apply to construction of this alternative.

Table 4-105. Total regional economic impacts stemming from Alternative 3A: Full—Banks related construction phases.

	Employment [a]		Labor Income [b]		Output [c]	
	Total	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area
Four–County Analysis Area	89,255		$3,385		$12,862	
Phase 1	735	0.82%	$38.1	1.13%	$107.5	0.84%
Phase 5	3,382	3.79%	$175.5	5.19%	$494.3	3.85%
Phase 2&8	1,713	1.92%	$89	2.63%	$250.7	1.95%
Phase 3 &6	1,356	1.52%	$70.3	2.08%	$198	1.54%
Phase 4, 7, & 9	1,385	1.55%	$71.8	2.12%	$202.3	1.53%

[a] Employment is measured in number of jobs. Construction–related employment estimates include the in–field workforce defined in Chapter 2 plus all additional jobs generated by project construction in retail, services, manufacturing, and other related sectors throughout the economy.

[b] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self–employed individuals located within the analysis area.

[c] Output represents the dollar value of industry production.

Short–term impacts to agriculture would be the same as Alternative 2A: Partial—Banks.

Long–term Impacts

O&M

Annual O&M expenditures required for this alternative would result in positive economic long–term impacts, which would be greater than the No Action Alternative. Table 4-106 summarizes the regional impacts stemming from total annual O&M activities after all the construction phases have been implemented.

Table 4-106. Total regional economic impacts stemming from Alternative 3A: Full—Banks annual O&M expenditures.

	Employment [a]		Labor Income [b]		Output [c]	
	Total	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area
Four–County Analysis Area	89,255		$3,385		$12,862	
Annual O&M Impacts	62	Less than 1%	$3.86	Less than 1%	$7.65	Less than 1%

[a] Employment is measured in number of jobs.
[b] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self–employed individuals located within the analysis area.
[c] Output represents the dollar value of industry production.

Agriculture

Implementing a full replacement alternative would result in 2,353 jobs (2.64 percent of total employment in the four–county area) in the four–county area, as shown in Table 4-107. Implementation of a full replacement alternative would cause a net change of 1,734 jobs, compared to the No Action Alternative in year 2025. The job increases would be due to an increase in gross farm income and an increase of Odessa potatoes supplied to the local processors in 2025.

Table 4-107. Full replacement alternatives regional impacts stemming from changes in gross farm income and associated potato processing.

		Employment [a]		Labor Income [b]		Output [c]	
		Total	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area
Four–County Analysis Area		89,255		$3,385		$12,862	
2025	No Action	619	0.69%	$12	0.35%	$80	0.62%
2025	Full	2,353	2.64%	$98	2.90%	$500	3.89%
	Net Change	1,1734	1.95%	$86	2.55%	$421	3.27%

[a] Employment is measured in number of jobs.
[b] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self–employed individuals located within the analysis area.
[c] Output represents the dollar value of industry production.

Labor income in 2025 for a full replacement alternative would equal $98 million (2.90 percent of total labor income in the four–county area) in 2025. Labor income would increase by $86 million, as compared the No Action Alternative, as a result of constructing a full replacement alternative.

Full replacement alternatives output would equal $500 million (3.89 percent of total output in the four–county area). Implementing a full replacement alternative would result in a net change of $421 of output compared to the No Action Alternative.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to economics are anticipated from the Limited Spring Diversion Scenario.

4.15.4.7 Alternative 3B: Full—Banks + FDR

The short-term and long-term impacts from construction, O&M, and agriculture would be the same as Alternative 3A: Full—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to economics are anticipated from the Limited Spring Diversion Scenario.

4.15.4.8 Alternative 4A: Modified Partial—Banks

Short–term Impacts

Construction

Construction expenditures spent within the analysis area would positively impact employment, labor income, and regional sales, as shown in Table 4-108.

These would be short–term impacts during construction phases proportional to expenditure levels during each construction year. Because construction phases would overlap, regional impacts associated with each phase cannot be summed into a total construction impact for this alternative to avoid double counting. The TEROs of the Colville, Spokane, and Yakama Tribes may be applicable to construction of this alternative.

Table 4-108. Total regional economic impacts stemming from Alternative 4A: Modified Partial—Banks (Preferred Alternative) related construction phases.

	Employment [a]		Labor Income [b]		Output [c]	
	Total	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area
Four–County Analysis Area	89,255		$3,385		$12,862	
Phase 1	724	0.81%	$37.6	1.11%	$105.8	0.82%
Phase 2	469	0.53%	$24.3	0.72%	$68.5	0.53%
Phase 3	702	0.79%	$36.4	1.08%	$102.6	0.80%
Phase 4	279	0.31%	$14.5	0.43%	$40.7	0.32%

[a] Employment is measured in number of jobs. Construction–related employment estimates include the in–field workforce defined in Chapter 2 plus all additional jobs generated by project construction in retail, services, manufacturing, and other related sectors throughout the economy.

[b] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self–employed individuals located within the analysis area.

[c] Output represents the dollar value of industry production.

Agriculture

Short–term impacts would result from construction activities. Some irrigated land would be taken out of production to facilitate construction. After construction is completed, those acres would resume irrigated farming practices. These losses could result in a small temporary reduction in gross farm income; therefore, regional employment, labor income, and sales could be slightly reduced.

Long–term Impacts

O&M

Annual O&M expenditures required for this alternative will result in positive economic long-term impacts that will be greater than with the No Action Alternative. Table 4-109 summarizes the regional impacts stemming from total annual O&M activities after all the construction phases have been implemented.

Table 4-109. Total regional economic impacts stemming from Alternative 4A: Modified Partial—Banks (Preferred Alternative) related annual O&M expenditures.

	Employment [a]		Labor Income [b]		Output [c]	
	Total	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area
Four–County Analysis Area	89,255		$3,385		$12,862	
Annual O&M Impacts	39	Less than 1%	$2.45	Less than 1%	$4.86	Less than 1%

[a] Employment is measured in number of jobs.
[b] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self–employed individuals located within the analysis area.
[c] Output represents the dollar value of industry production.

Agriculture

Implementing a modified partial replacement alternative would result in 1,774 jobs (1.99 percent of total employment in the four–county area) in the four–county area compared to the No Action Alternative of 619 jobs in year 2025, as shown in Table 4-110.

Compared to the No Action Alternative, a modified partial replacement alternative would result in a net change of 1,155 jobs in year 2025. The job increases would be due to an increase in gross farm income and an increase of Odessa potatoes supplied to the local processors in 2025, associated with implementation of a modified partial replacement alternative.

Table 4-110. Alternative 4A: Modified Partial—Banks (Preferred Alternative) regional impacts stemming from changes in gross farm income and associated potato processing.

		Employment [a]		Labor Income [b]		Output [c]	
		Total	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area	Total ($ millions)	Percent of the Four–County Area
Four–County Analysis Area		89,255		$3,385		$12,862	
2025	No Action	619	0.69%	$12	0.35%	$80	0.62%
2025	Modified Partial	1,774	1.99%	$68	2.02%	$356	2.77%
	Net Change	1,155	1.30%	$56	1.67%	$276	2.15%

[a] Employment is measured in number of jobs
[b] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self–employed individuals located within the analysis area.
[c] Output represents the dollar value of industry production.

Labor income in 2025 for a modified partial replacement alternative would equal $68 million (2.02 percent of total labor income in the four–county area) in 2025. Labor income as a result of implementation of a modified partial replacement alternative would increase by $56 million compared to year 2025 of the No Action Alternative.

Output in 2025 for a modified partial replacement alternative would equal $356 million (2.77 percent of total output in the four–county area). Implementation of a modified partial replacement alternative would create $276 million more in output compared to year 2025 of the No Action Alternative.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to economics are anticipated from the Limited Spring Diversion Scenario.

4.15.4.9 Alternative 4B: Modified Partial—Banks + FDR

Short– and long–term impacts for construction, O&M, and agriculture would be the same as those presented for Alternative 4A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to economics are anticipated from the Limited Spring Diversion Scenario.

4.15.5 Mitigation

Construction

No mitigation measures are required for regional economic impacts associated with construction-related activities.

O&M

No mitigation measures are required for regional economic impacts associated with O&M activities.

Agriculture

No mitigation measures are required for regional agricultural economic impacts.

4.16 Transportation

Impact analysis focuses on how the alternatives would affect roads, highways, and railroad transportation facilities. No air or navigable waterway transportation systems or facilities would be involved in or impacted by any of the alternatives. For transportation resources, no short– or long–term impacts to transportation resources would occur under the No Action Alternative.

The only short–term construction impacts under all of the action alternatives would be increased traffic and heavy–vehicle use on the roadway systems and temporary disruptions of access to land parcels. For the partial replacement alternatives, these impacts would generally be limited to the Study Area south of I–90. For the full replacement delivery alternatives, short–term impacts would occur throughout the Study Area as construction proceeds. Given the BMPs included as part of Study planning and implementation, these short–term impacts would be minimal for any of the action alternatives. For the modified partial replacement alternatives, short–term impacts would be similar to those impacts associated with the full replacement alternatives. These impacts would be less in that fewer acres of land would be affected and the East High Canal would not be constructed.

Long–term impacts under the partial replacement alternatives would be limited to closure of through access on one local road (Howard Road) because of the East Low Canal extension. This would not represent a significant impact because the affected road is not an important through–travel route and alternative routes are locally available without a significant increase in travel distance. The partial replacement alternatives would involve no other new crossings of roads, highways, or railroads.

In addition to the impact on Howard Road, the full replacement alternatives would involve more than 60 crossings of existing roadways, including one state highway, and one crossing of an active rail line. Where necessary to maintain adequate transportation service, bridges over these travel facilities would be constructed or the water delivery system would be placed in a pipeline or siphon under the facility. The Black Rock Coulee Reregulating Reservoir would inundate county roads at three additional locations. Some long–term adverse impacts caused by re–routing local traffic would likely be necessary. However, a transportation management plan would be developed with affected jurisdictions and other entities to specify actions to be taken where transportation facilities intersect Study features. Through this planning process, potential for significant long–term impact would be avoided.

4.16.1 Methods and Assumptions

4.16.1.1 Impact Indicators and Significance Criteria

Table 4-111 presents the indicators and associated criteria for determining potential significance are used to evaluate transportation impacts.

Table 4-111. Indicators and associated significance criteria.

Impact Indicator	Significance Criteria
Short– or long–term increases in traffic (general average daily and peak hour) on regional or local roads	Any increases in traffic volumes to the extent that congestion/traffic delays occur or increase. Significance dependents on specific circumstances, such as road conditions, existing traffic volumes, and duration of induced congestion or traffic delay.
Increases in large or heavy–load vehicle traffic on regional or local roads	Increases in large or heavy vehicle usage on roadways would increase repair or maintenance costs for responsible jurisdictions (WSDOT, counties). This type of vehicle traffic would create significant safety concerns because of wide loads or slow vehicle speeds, especially on highly traveled local routes.
Crossings of existing roads and railroads by new facilities such as canals, siphons or constructed wasteways; and instances where new reservoirs would inundate segments of existing roads or railroads.	Interruptions of existing roadway routes, whether short–term or long–term would be significant if the following is true: Access to individual land parcels is lost Response times by emergency service providers is increased above established standards Substantial increases in travel distance (time and fuel consumption) are imposed on local residents or other road users Any unmitigated severing of an active rail line would be a significant impact.

4.16.1.2 Impact Analysis Methods

Impacts on transportation that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Impact analysis for transportation was conducted in a programmatic, qualitative fashion. For short–term, construction impacts, the analysis considers known factors such as construction workforce using the roads, and overall construction schedule and phasing. However, the analysis recognizes that details of construction access routes, sources, and quantities of materials and equipment, as well as other aspects of construction, have not been determined.

For long–term impacts, the interactions between proposed facilities and the existing road and railroad systems can be generally quantified. For example, the number of times that new canal sections would cross existing roads has been quantified based on the preliminary alignments of these facilities. However, a number of potential responses to these crossings exist, such as bridges, road realignments, or permanent closures and detours on other existing roads or a new canal–side road. Decisions on the most appropriate and acceptable response in each case would not be made until more detailed levels of Study planning and design.

4.16.1.3 Impact Analysis Assumptions

Applicable legal requirements are described in Chapter 5 – *Consultation and Coordination*. No specific State or Federal statutes apply. For the alternative impact analysis, it is assumed that all regulations would be followed, along with the BMPs listed in Section 4.31 – *Environmental Commitments*. After environmental impacts are determined, mitigation measures are applied to compensate for some or all remaining adverse impacts, which are described with the action alternatives and summarized along with the BMPs in Section 4.31 – *Environmental Commitments*.

Legal Requirements and BMPs for Transportation

Consistent with standard coordination procedures and requirements, and in recognition of the programmatic analysis contained in this Final EIS, Reclamation is committed to working with WSDOT, involved counties, and emergency service providers to prepare a Transportation Management Plan prior to the start of construction of any of the action alternatives. The BMPs listed in Section 4.31 – *Environmental Commitments*, would guide preparation and implementation of the Transportation Management Plan.

4.16.2 Alternative 1: No Action Alternative

Because no facilities would be constructed or operated under this alternative, no direct, short– or long–term impacts would occur on regional or local transportation systems. From the standpoint of indirect impacts, traffic on both the road and railroad systems would decline to some degree as lands currently irrigated with groundwater convert to less intensive or less productive dryland farming conditions.

4.16.3 Alternative 2A: Partial—Banks

4.16.3.1 Short–term Impacts

Short–term, construction phase impacts under this alternative would fall into two categories: increased traffic on the roadway system and temporary disruptions of access to land parcels.

Increased Traffic

Overall traffic volumes would increase, as would the number of large or heavy vehicle movements on local roads, during the construction period. Specific construction access routes have not been defined, but routes would change relatively frequently as construction for canal enlargement and extension, pumping plants, and pipelines and transmission lines proceeds north to south.

General traffic volume increases would occur because of workforce travel and delivery of equipment and material. As discussed in Chapter 2, the total construction workforce at any given time during the construction period is not expected to exceed approximately 130 round trips to and from construction areas each day, assuming each worker uses his or her own vehicle. Construction–related material and equipment delivery traffic has not been estimated, but should contribute additional volumes substantially less than the workforce. Overall, these increases in traffic volumes should have only a minimal impact on the local road system. This is especially true given the following:

- Construction would be occurring at multiple dispersed sites, not concentrated in one area.
- Multiple local routes would likely be available to any given construction site.
- Construction would move progressively through the landscape as pipelines and transmission lines are installed and access routes change.

Increases in large or heavy vehicle movements could raise concerns for roadway damage or wear (with corresponding needs for repair and maintenance), or for traffic safety, especially at intersections or along narrow, rural roads. However, many of the potentially impacted roads are gravel requiring only regular maintenance grading and drivers in the area are accustomed to sharing transportation facilities in the region with large, slow–moving farm equipment (Photograph 4-8). Movements of equipment on public roads for canal enlargement and construction, pipeline installation, or transmission line installation would be infrequent, with necessary equipment delivered to the beginning of a facility alignment and staying within the Reclamation easement throughout long, continuous reaches of construction. Also, most construction activity would focus on ground excavation and onsite placement of excavated materials. No large quantities of construction aggregate, concrete, or other materials would be needed.

Photograph 4-8. Gravel road in the Study Area.

Access Disruption

As with all partial replacement alternatives, Alternative 2A: Partial—Banks could involve reconstructing some of the existing bridges over the East Low Canal to accommodate canal widening. A full inventory of the potential need for such work has not been completed, but any necessary reconstruction work would be accomplished within the combination of the existing East Low Canal easement and road right-of-way. As reconstruction is carried out, local detours would be needed.

New pipelines and transmission lines would cross existing county roads and access points for private property at many locations, including residences, farm fields or other developed land uses. Temporary local detours or road realignments would be needed to retain access along impacted roads and to impacted land parcels.

4.16.3.2 Long–term Impacts

The only potential conflict of this alternative with regional or local transportation systems would be closure of through travel on one existing local county road (Howard Road) by the East Low Canal extension in southern Adams County. Howard Road is currently not a long distance through route and no bridge over the canal or realignment is proposed. Local traffic would need to use available alternative routes, which would involve 1 to 2 miles of additional travel distance. This would represent an adverse, but not significant, impact. No new crossings of state highways or railroads would be involved.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to transportation are anticipated from the Limited Spring Diversion Scenario.

4.16.4 Alternative 2B: Partial—Banks + FDR

Short– and long–term impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to transportation are anticipated from the Limited Spring Diversion Scenario.

4.16.5 Alternative 3A: Full—Banks

Short– and long–term impacts south of I–90 would be the same as described for Alternative 2A: Partial—Banks.

4.16.5.1 Short–Term Impacts

Short–term construction impacts under this and the other full replacement alternatives would be increased traffic on the roadway systems and temporary disruptions of access to land parcels.

Increased Traffic

Overall traffic volumes would increase, as would the number of large or heavy vehicle movements, on local roads during the construction period. Specific construction access routes have not been defined, but routes would change relatively frequently as major construction on new canals, siphons, tunnels, pipelines, and transmission lines proceeds north to south.

General traffic volume increases would result from workforce travel and delivery of equipment and material. As discussed in Chapter 2, the total construction work force north of I–90 at any given time during the construction period is not expected to exceed approximately 420 round trips to construction areas each day, assuming each worker uses his or her own vehicle. Construction–related material and equipment delivery traffic has not been estimated, but with the exception of the East High Canal, should be relatively minor for most proposed facilities.

Increases in large or heavy vehicle movements would raise concerns for roadway damage or wear and traffic safety, especially at intersections or along narrow, rural roads. However, many of the potentially impacted roads are gravel, requiring only regular maintenance grading and drivers in the area are accustomed to sharing transportation facilities in the region with large, slow–moving farm equipment. Consideration should be given to construction–period provisions for enhanced road maintenance or traffic safety measures during the next level of Study planning as anticipated in the Transportation Management Plan, described in Section 4.31 – *Environmental Commitments*.

Access Disruption

Linear facilities such as canals, pipelines, and transmission lines would cross existing county roads at many locations. The East High Canal would involve one crossing each of a state highway and an active rail line. These linear facilities would also cross numerous access points for individual land parcels including residences, farm fields, or other developed land uses.

In most cases, access and travel disruption along these facilities would be temporary with needed continuity of access provided through temporary local detours. This is especially true for underground pipelines and for transmission lines.

4.16.5.2 Long–term Impacts

Major facilities associated with this and the other full replacement alternatives would cross or inundate segments of numerous existing roads and one railroad line. Table 4-112 presents a summary of these instances.

The East High Canal, north of the Black Rock Coulee Reregulating Reservoir, would cross SR 28 and the Burlington Northern and Santa Fe railroad in the Crab Creek corridor approximately 4 miles west of the town of Wilson Creek. Reclamation would install siphons and pipelines at both of these crossings; thus impacts would be short–term and minimal.

Table 4-112. Transportation route crossings.

	East High Canal*				
	North of Reregulating Reservoir	South of Reregulating Reservoir	Black Rock Branch Canal*	Black Rock Coulee Reregulating Reservoir	Totals
State highways	1	–	–	–	1
County roads (total)	4	28	28	3	63
Grant	4	28	3	3	38
Adams	–	–	20	–	20
Lincoln	–	–	5	–	5
Railroad	1	–	–	–	1

*Including siphons and constructed wasteways

Construction Delivery Traffic for the Full Replacement Alternatives

Delivery traffic for each proposed facility would be as follows:

- All Facilities—Construction Equipment. Transport of major equipment on public roads to construction locations would be infrequent, with necessary equipment delivered to the facility site or to the beginning of a linear facility alignment (such as canals and pipelines), and staying within the Reclamation site or easement throughout continuous reaches of construction.

- East High Canal. Most of the East High Canal would be concrete–lined, requiring that a steady supply of concrete be delivered along the canal alignment to support construction. Concrete delivery represents the most demand for material and equipment deliveries of any facility type. All concrete required for facility construction is expected to be obtained from existing sources in the region (for example, Moses Lake and other local towns and cities, or perhaps from the Spokane or the Tri–City areas during periods of peak demand). Aside from required delivery of concrete, no other significant material or equipment deliveries would be required. All earth material excavated for the canal would be placed within the Reclamation easement with some used for canal–side access roads.

- Black Rock Branch Canal. This canal would be predominantly earth–lined. As with the East High Canal, all earth material excavated would be placed within the Reclamation easement as construction proceeds, with some of this material used for construction of canal–side O&M roads.

- Black Rock Coulee Reregulating Reservoir. This reregulating reservoir would be impounded by an earthen or rockfill dike and all materials necessary for dike construction would be obtained within Reclamation's acquisition area for the facility.

- Pipelines and Transmission Lines. Deliveries for these facilities would be limited to the facilities themselves (e.g., pipeline segments, transmission line poles, and conductors). Little, if any, concrete or other construction material would be delivered.

- Pumping Plants. These are relatively minor facilities, not requiring large quantities of construction materials.

New canals, siphons, or constructed wasteways would cross existing county roads at 60 locations, with the Black Rock Coulee Reregulating Reservoir impacting county roads at another 3 locations. Among these 63 locations, a wide variety of conditions and potential for impact are represented. The relative importance of impacted roads ranges from important, through–travel routes to minor roads currently accessing a limited number of undeveloped land parcels. Also, in a number of instances, roads would be crossed multiple times over a short distance (up to five times within 0.5 mile as the canal alignment follows land contours). No decisions have been made regarding specific actions at each county road crossing location, such as bridges or road re–routing. Reclamation would prepare a Transportation Management Plan during the next phase of Study planning to address these issues.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to transportation are anticipated from the Limited Spring Diversion Scenario.

4.16.6 Alternative 3B: Full—Banks + FDR

Short– and long–term impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to transportation are anticipated from the Limited Spring Diversion Scenario.

4.16.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

Short– and long–term impacts south of I–90 would be the same as described for Alternative 2A: Partial—Banks with the exception of impacts to Howard Road. The modified partial replacement alternative would not include the extension of the East Low Canal. North of I–90 impacts associated with the modified partial replacement alternative would be similar to the full replacement alternative with notable exceptions. The modified partial replacement alternative does not include the construction of the new East High Canal. Short– and long–term impacts to transportation facilities associated with the construction of the new canal would not occur with the modified partial replacement alternatives. Therefore, neither State Highway SR28 or Burlington Northern and Santa Fe railroads would be impacted with the modified partial replacement alternatives.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to transportation are anticipated from the Limited Spring Diversion Scenario.

4.16.8 Alternative 4B: Modified Partial—Banks +FDR

Short– and long–term impacts, as well as mitigation measures, would be the same as Alternative 4A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to transportation are anticipated from the Limited Spring Diversion Scenario.

4.16.9 Mitigation

No mitigation measures are proposed or necessary.

4.17 Energy

Implementation of the No Action Alternative would result in maintaining the current irrigation and hydroelectric generation scenarios and thus not impact the regional power system or John W. Keys III Pump-Generating Plant (Keys Pump-Generating Plant).

The action alternatives have the potential to impact the regional power system. Under the action alternatives, conversion to surface water for irrigation would decrease the consumption of energy from groundwater pumping. Surface water pumping to convey water from Banks Lake to its final destination would increase the consumption of energy.

Additional diversion from the Columbia River would result in increased pumping into Banks Lake, decreased hydroelectric generation through the system, and decrease in availability of pump-generating units to provide spinning and non-spinning reserves. Overall, the potential increase in pumping and decrease of hydropower generation in comparison to the regional power system is considered minimal.

At the Keys Pump-Generating Plant, hydroelectric generation operations would be limited during a portion of each year under the No Action and all action alternatives. This is due to units being inoperable in generation mode at lower elevations in Banks Lake. The ability of pump-generating units to operate in generation mode varies among alternatives, water year types, and diversion scenario. Units would remain operable in pump mode.

The action alternatives have the potential to impact the maintenance schedule for needed work to ensure continued reliability of all units (pump and pump-generators) at the Keys Pump-Generating Plant. BPA funded a multi-year study and has begun an investment process at Keys Pump-Generating Plant to maintain the facility's flexibility and increase its reliability to better meet the demands of its irrigation and power-related purposes. All action alternatives may make these investments no longer cost effective by limiting generation from August and September (at a minimum). Changes in irrigation demand and/or operations at Banks lake that result in drawdowns beyond what occurs today could have substantial impacts on the ability to use the Keys Pump-Generating Plant for power generation, balancing reserves, and load shifting during portions of the year.

The Tribes of the Colville Reservation Grand Coulee Dam Settlement Act

Lost hydropower generation has an indirect impact on the Confederated Tribes of the Colville Reservation. The Confederated Tribes of the Colville Reservation Grand Coulee Dam Settlement Act (Settlement Agreement) stipulates that BPA pay the Confederated Tribes of the Colville Reservation an annual monetary compensation for the reservation lands used to build Grand Coulee Dam and reservoir. The amount of compensation is based partially upon the preceding fiscal year's generation in megawatt (MW) hours at the Grand Coulee Dam.

Water withdrawal from Lake Roosevelt to supply activities covered in the Final EIS would reduce water flow past Grand Coulee Dam. A reduction in water flow results in a reduction of generation. Thus, a reduction in generation has the potential to reduce the monetary compensation per calculation formulas outlined by the Settlement Agreement. Based on preliminary flow information data, it appears that the amount of generation at Grand Coulee Dam would be reduced as a result of activities covered in this Final EIS. The exact amount of the reductions would be based on a variety of factors. During April and May 2012, BPA coordinated with representatives for the Confederated Tribes of the Colville Reservation on this issue and provided information which should assist them in estimating the potential impacts to the monetary compensation.

4.17.1 Methods and Assumptions

4.17.1.1 Impact Indicators and Significance Criteria

Table 4-113 presents impact indicators and significance criteria for energy resources.

Table 4-113. Energy impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Change in regional power system.	If the regional power system generation or load changes by more than 1 percent, the impact would be considered significant.
Keys Pump-Generating Plant reserves (spinning and non-spinning), reliability, and diurnal load shifting.	Keys Pump-Generating Plant pump/generators availability may be reduced for generation between August and September due to additional drawdowns at Banks Lake beyond present operations, the impacts would be determined as follows: • 4 available would be no impact • 3 available would be minimal • 2 available would be adverse • 1 available would be significant

4.17.1.2 Impact Analysis Methods

Since the action alternatives have the potential to impact the regional power system, BPA conducted a power analysis for each of the action alternatives to project energy changes in Banks Lake pumping and total hydropower generation. The action alternatives also have the potential to impact pump-generation operations at Keys Pump-Generating Plant. Potential environmental impacts were then evaluated.

- Banks Lake Pumping. Consumption of energy would increase because additional Columbia River water would be diverted and pumped through the Keys Pump-Generating Plant and into Banks Lake in order to replace deep well water use in the Odessa Subarea.
- Hydroelectric Generation. Generation of hydroelectricity would decrease because Columbia River water would be diverted upstream of Grand Coulee Dam, which would reduce the power generation of 11 hydroelectric projects.
- Keys Pump-Generating Plant. Pump-generation operations would be reduced due to drawdown of Banks Lake, negatively impacting energy reliability, reserves, or ability to diurnally shape load.

In performing this power analysis, BPA utilized the HYDSIM model. HYDSIM is a hydro regulation model that simulates power production for the month-to-month operation of the Pacific Northwest hydropower system. HYDSIM is used to determine the hydro system generation and resulting project outflows, ending storage contents, etc., under varying inputs of inflows, power loads, operating procedures and constraints, and physical plant data. The model is jointly maintained by BPA and British Columbia Hydropower. HYDSIM is not an optimizing model; instead, it is a deterministic model that uses rule curves and flow or storage constraints to achieve operating objectives, especially for power, flood control, fish flows and spill, and recreation. HYDSIM simulates one period at a time without looking ahead.

BPA’s HYDSIM modeling assumed additional withdrawals of approximately 138,000 acre–feet for the partial replacement alternatives (Alternatives 2A and 2B) and approximately 273,000 acre–feet for the full replacement alternatives (Alternatives 3A and 3B), and approximately 164,000 acre–feet for the modified partial alternatives (Alternatives 4A and 4B).

Terms are expressed in average megawatts (aMW) which are an annualized value determined by extrapolating the total energy gained or lost by an activity over an entire year. Use of the aMW is standard in energy planning in the Pacific Northwest and provides a common frame of reference for all entities engaged in the energy industry.

To evaluate effects on the Keys Pump-Generating Plant, the Banks Lake drawdown tables were reviewed and compared to the generation capability at the facility.

4.17.1.3 Impact Analysis Assumptions

No specific State or Federal statutes or BMPs apply. Mitigation measures are required.

4.17.2 Alternative 1: No Action Alternative

4.17.2.1 Short–term Impacts

No short–term impacts would be expected to the net available energy on a regional basis or to Keys Pump-Generating Plant reliability, reserves, or ability to diurnally load shape because no new facilities would be constructed or operated under this alternative and no changes would be made to the current irrigation or hydroelectric generation scenarios.

4.17.2.2 Long–term Impacts

No long–term impacts would be expected to the net available energy on a regional basis or to Keys Pump-Generating Plant reliability, reserves, or ability to diurnally load shape because no new facilities would be constructed or operated under this alternative and no changes would be made to the current irrigation or hydroelectric generation scenarios. Operations are limited to four units at the end of August when Banks Lake is drawn down 1565 feet.

4.17.3 Alternative 2A: Partial—Banks

4.17.3.1 Short–term Impacts

No short–term impacts to the net available energy on a regional basis would be expected from the construction of facilities required by this alternative.

To evaluate effects on the Keys Pump-Generating Plant, the Banks Lake drawdown tables were reviewed. Additional diversions out of Banks Lake would result in additional end of August drawdowns ranging from 2.3 feet (average year) to 4.8 feet (dry year). Under current operations, as part of the FCRPS BiOp, pumping to Banks Lake is reduced and irrigation withdrawals draw down Banks Lake elevation to 1565 feet amsl by the end of August. Water left in Lake Roosevelt due to reduction in pumping is released downstream of Grand Coulee for summer flow augmentation. Alternative 2A with the Spring Diversion Scenario results in an additional 3 to 6 feet of drawdown at Banks Lake. This puts Banks Lake elevation below the level necessary to utilize most of the generation capability at Keys Pump-Generating Plant. Table 4-114 shows the limitations on generation by elevation at Banks Lake.

Table 4-114. Limitation on the Keys Pump-Generating Plant generation by Banks Lake elevation.

Number of pump-generator units that can operate in generation mode	Minimum Banks Lake Elevation (feet amsl)
1	1560.5
2	1562.0
3	1563.5
4	1565.0
5	1566.5
6	1568.0

Losing the ability to generate at Keys Pump-Generating Plant during the months of August and September removes BPA's existing ability to utilize these generators for meeting peak loads. Since pumping during August and September has primarily occurred during Light Load Hours (LLH) and BPA's loads peak in these months during Heavy Load Hours (HLH), the loss of these generators has an impact. The ability to both pump and generate during August and September has operational and economic value for BPA and their ratepayers.

The current operation (Banks Lake at 1565 feet, end of August) results in 4 of the 6 pump-generator units available for generation (Table 4-108) in August. Alternative 2A with the Spring Diversion Scenario would result in an additional August drawdown ranging from 2.3 to 4.8 feet at Banks Lake by the end of August (1560.2 to 1563.7 feet elevation). Under Alternative 2A, there would be zero to two (Table 4-108) pump-generator units available for generation, thus, the short-term impacts of Alternative 2A to the Keys Pump-Generating Plant are considered adverse to significant as defined in Table 4-113.

4.17.3.2 Long–term Impacts

This alternative would result in long–term impacts to the net available energy on a regional basis because additional water diversion pumping facilities would be operated differently due to changes in hydroelectric generation scenarios. Table 4-115 presents the predicted average annual change in hydroelectric generation as a result of the action alternatives diverting additional Columbia River water, which could otherwise be used to generate electricity by the 11 downstream hydroelectric projects. Predicted values include increased energy consumption by the Keys Pump-Generating Plant to pump water from Lake Roosevelt to Banks Lake, and reduced generation resulting from lower flow through the hydro system.

Impacts to the regional power system are considerably less than 1 percent of the forecasted Total Regional Power Load in 2020. Thus, the impacts of Alternative 2A: Partial—Banks to the regional power system are not considered significant.

Table 4-115. Change in Regional power system and significance.

Alternative	Increase in Banks Lake Pumping (aMW)	Reduction in Columbia River Power Generation (aMW)	Total Energy System Impact (aMW)	2020 Total PNW Load	1 Percent of PNW Load	Significant Impact
Partial replacement – 2A and 2B	5-6	14	19-20	23,996	240	No
Full replacement – 3A and 3B	10	25-26	35-36	23,996	240	No
Modified partial – 4A and 4B	6-7	16	22-23	23,996	240	No

As for the Keys Pump-Generating Plant, the Alternative 2A long-term impacts are the same as the short-term impacts in that there would be zero to two pump-generator units available in August and September for generation given the additional water withdraws from Banks Lake thus, the long-term impacts of Alternative 2A to the Keys Pump-Generating Plant are considered adverse to significant.

Changes with Limited Spring Diversion Scenario

Analysis of the Limited Spring Diversion Scenario resulted in less than 1 average megawatt generation difference from the base-case analysis. Thus, the impacts to the regional power system for this scenario are considerably less than 1 percent of the forecasted Total Regional Power Load in 2020. Therefore, the impacts of Alternative 2A for this scenario to the regional power system are not considered significant.

Changes with Limited Spring Diversion Scenario to the Keys Pump-Generating Plant would be the same as both short-term and long-term impacts for Alternative 2A and are considered adverse to significant.

4.17.4 Alternative 2B: Partial—Banks + FDR

4.17.4.1 Short-term Impacts

Short–term impacts to the net available energy on a regional basis would be the same as Alternative 2A: Partial—Banks.

As for the Keys Pump-Generating Plant, Alternative 2B with the Spring Diversion Scenario would result in an additional August drawdown that is limited to 3 feet at Banks Lake during the August and September time period. Under Alternative 2B, there would be two pump-generators available for generation in August and September, thus, the short-term impacts of Alternative 2B to the Keys Pump-Generating Plant are considered adverse.

4.17.4.2 Long-term Impacts

Long-term impacts to the net available energy on a regional basis would be the same as described for Alternative 2A.

As for the Keys Pump-Generating Plant, Alternative 2B long-term impacts are the same as the short-term impacts in that there would be two pump-generator units available for generation given the additional water withdraws from Banks Lake, thus the long-term impacts of Alternative 2B to the Keys Pump-Generating Plant are considered adverse.

Changes with Limited Spring Diversion Scenario

Changes with Limited Spring Diversion Scenario to the net available energy on a regional basis would be the same as Alternative 2A and are not considered significant.

Changes with Limited Spring Diversion Scenario to the Keys Pump-Generating Plant would be the same as short-term and long-term impacts in Alternative 2B and are considered adverse.

4.17.5 Alternative 3A: Full—Banks

4.17.5.1 Short-term Impacts

No short–term impacts to the net available energy on a regional basis would be expected from the construction of facilities required by this alternative.

Alternative 3A would result in an additional August drawdown ranging from 5.6 to 10.2 feet at Banks Lake during the August and September time period. Under the Alternative 3A with the Spring Diversion Scenario, no PGs would be available for generation in August and September given the additional water withdraws required from Banks Lake thus, the short-term impacts of Alternative 3A: Full—Banks to the Keys Pump-Generating Plant are considered significant.

4.17.5.2 Long–term Impacts

Long–term impacts are similar to those presented for Alternative 2A: Partial—Banks, except that more water would be diverted for surface water irrigation, thus resulting in increased energy consumption by the Keys Pump-Generating Plant to pump water from Lake Roosevelt to Banks Lake, and reduced generation resulting from lower flow through the hydro system (Table 4-115). These impacts to the regional power system are less than 1 percent of the forecasted Total Regional Power Load in 2020. Therefore, the impacts of Alternative 3A: Full—Banks to the regional power system are not considered significant.

As for the Keys Pump-Generating Plant, Alternative 3A long-term impacts are the same as the short-term impacts in that no pump generators would be available for generation given the additional water withdraws from Banks Lake, thus the long-term impacts of Alternative 3A to the Keys Pump-Generating Plant are considered significant.

Changes with Limited Spring Diversion Scenario

Analysis of the Limited Spring Diversion Scenario resulted in less than 1 average megawatt generation difference from the base-case analysis. Thus, the impacts to the regional power system for this scenario are considerably less than 1 percent of the forecasted Total Regional Power Load in 2020. Therefore, the impacts of Alternative 3A: Full—Banks for this scenario to the regional power system are not considered significant.

Changes with Limited Spring Diversion Scenario to the Keys Pump-Generating Plant would be the same as short-term and long-term impacts in Alternative 3A and are considered significant.

4.17.6 Alternative 3B: Full—Banks + FDR

4.17.6.1 Short-term Impacts

Short–term impacts to the net available energy on a regional basis would be the same as Alternative 3A: Full—Banks.

Alternative 3B Spring Diversion Scenario would result in an additional drawdown limited to 3 feet at Banks Lake during the August and September. Under Alternative 3B, there would be two pump-generator units available for generation thus, the short-term impacts of Alternative 3B to the Keys Pump-Generating Plant are considered adverse.

4.17.6.2 Long-term Impacts

Long-term impacts to the net available energy on a regional basis would be the same as described for Alternative 3A.

For the Keys Pump-Generating Plant, Alternative 3B long-term impacts are the same as the short-term impacts in that there would be two pump generator units available for generation given the additional water withdraws from Banks Lake, thus the long-term impacts of Alternative 3B to the Keys Pump-Generating Plant are considered adverse.

Changes with Limited Spring Diversion Scenario

Changes with Limited Spring Diversion Scenario to the net available energy on a regional basis would be the same as Alternative 3A and are not considered significant.

Changes with Limited Spring Diversion Scenario to the Keys Pump-Generating Plant would be the same as short-term and long-term impacts in Alternative 3B and are considered adverse.

4.17.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

4.17.7.1 Short-term Impacts

No short–term impacts to the net available energy on a regional basis would be expected from the construction of facilities required by this alternative.

Alternative 4A with the Spring Diversion Scenario would result in an additional drawdown ranging from 3.1 to 5.9 feet at Banks Lake during the August and September. Under Alternative 4A, there would be zero to one pump-generator unit available for generation, thus, the short-term impacts of Alternative 4A to the Keys Pump-Generating Plant are considered significant.

4.17.7.2 Long-term Impacts

Long-term impacts for Alternative 4A with Spring Diversion Scenario falls between the impacts for Alternatives 2A and3A. The impacts to the regional power system are less than 1 percent of the forecasted Total Regional Power Load in 2020. Therefore, the impacts of Alternative 4A: Modified Partial—Banks (Preferred Alternative) to the regional power system are not considered significant.

Alternative 4A long-term impacts for the Keys Pump-Generating Plant are the same as the short-term impacts; there would be zero to one pump-generator unit available for generation, thus the long-term impacts of Alternative 4A to the Keys Pump-Generating Plant are considered significant.

Changes with Limited Spring Diversion Scenario

Analysis of the Limited Spring Diversion Scenario resulted in less than 1 average megawatt generation difference from the base-case analysis. Thus, the impacts to the regional power system for this scenario are considerably less than 1 percent of the forecasted Total Regional Power Load in 2020. Therefore, the impacts of Alternative 4A for this scenario to the regional power system are not considered significant.

Changes with Limited Spring Diversion Scenario to the Keys Pump-Generating Plant would be the same as short-term and long-term impacts in Alternative 4A and are considered significant.

4.17.8 Alternative 4B: Modified Partial—Banks + FDR

4.17.8.1 Short-term Impacts

Short–term impacts to the net available energy on a regional basis would be same as Alternative 4A.

Alternative 4B with the Spring Diversion Scenario would result in an additional drawdown that is limited to 3 feet at Banks Lake during the August and September. Under Alternative 4B, only two pump-generator units would be available for generation, thus, the short-term impacts of Alternative 4B to the Keys Pump-Generating Plant are considered adverse.

4.17.8.2 Long-term Impacts

Long-term impacts to the net available energy on a regional basis would be the same as described for Alternative 4A.

Alternative 4B long-term impacts are the same as the short-term impacts in that two pump-generator units would be available for generation given the additional water withdraws from Banks Lake, thus, the long-term impacts of Alternative 4B to the Keys Pump-Generating Plant are considered adverse.

Changes with Limited Spring Diversion Scenario

Changes with Limited Spring Diversion Scenario to the net available energy on a regional basis would be the same as Alternative 4A and are not considered significant.

Changes with Limited Spring Diversion Scenario to the Keys Pump-Generating Plant would be the same as short-term and long-term impacts in Alternative 4B and are considered adverse.

4.17.9 Mitigation

Mitigation is not required from any of the action alternatives to the net available energy on a regional basis because minimal impacts are expected.

Key’s Pump-Generating Plant pump/generators availability is reduced for all of the action alternatives for generation between August and September due to the additional drawdowns at Banks Lake beyond present operations. Mitigations measures that would be potentially available to address the reduce generation are deepening of the Banks Lake Feeder Canal and purchasing of replacement power for the duration of the project. During the analysis, Reclamation has determined that these measures do not constitute reasonable or appropriate mitigation for this project.

4.18 Public Services and Utilities

Many public service agencies and utilities provide non–emergency and emergency services throughout the Study Area. These services and utilities need to be able to provide efficient, uninterrupted service to the people living within the Study Area. Construction and operation of the various facilities associated with the action alternatives have the potential to disrupt those services. Implementation of the No Action Alternative also has the potential to impact public services and utilities.

No short–term impacts would occur under the No Action Alternative. Minimal short–term impacts to existing public services and local utility services would occur in association with all of the action alternatives because of construction activities and altered transportation corridors.

Minimal to adverse long–term impacts could occur in association with the No Action Alternative, specifically stemming from a downturn in the economy that would be anticipated with reduction of irrigated agriculture caused by decreased groundwater availability. The same type of impact could occur, but to a lesser extent, with the partial replacement alternatives, given that surface water replacement would not be provided in the Study Area north of I–90. Similarly, with the modified partial replacement alternatives there would be fewer acres served with replacement water as compared to the full replacement alternative. This would lead to groundwater decline rates continuing, but to a lesser extent than the partial replacement alternatives or the No Action Alternative. No other long–term impacts to public services and utilities would occur if any of the action alternatives are implemented.

4.18.1 Methods and Assumptions

4.18.1.1 Impact Indicators and Significance Criteria

The impact indicators and associated criteria for determining significance shown in Table 4-116 were used to evaluate public services and utilities impacts.

Table 4-116. Public services and utilities impact indicators and significance criteria.

Impact Indicator	Significance Criteria

Impact Indicator	Significance Criteria
Exceedance of service or utility capacity (long–term impact)	Public service or utility capacities are exceeded. For example, if the power demand for the proposed pumping plants exceeds the amount of power available from utilities, or if permanent changes to the transportation network cause emergency response times to exceed local established standards.
Disruption of services or utilities for existing residents and landowners (short–term, construction impacts)	Services or utilities are disrupted during construction to an extent that would impose unacceptable health and safety risk or additional cost on impacted residents and landowners. Such risks could include disrupting electrical, natural gas, water, or telecommunications service.
Impacts on emergency response times (short–term, construction impacts)	Construction activities block or disrupt efficient access by police, fire, or emergency medical service personnel.

4.18.1.2 Impact Analysis Methods

Impacts to public service and utility providers that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Impacts to public service and utility providers focus on the following issues:

- The ability of the electric utilities to accommodate increasing electrical demand as groundwater pumping depths or durations continue to increase, or as new pumping plants and other utilities are constructed.
- The potential impact on law enforcement, fire protection, or medical response times during construction and operation.
- Siting facilities to avoid potential conflicts with existing overhead and underground utilities (electric, gas, telecommunications, water, and wastewater).

4.18.1.3 Impact Analysis Assumptions

Applicable legal requirements are described in Chapter 5 – *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all laws and regulations would be followed, along with the related BMPs listed in Section 4.31 – *Environmental Commitments*.

Legal Requirements and BMPs for Public Services and Utilities

To prevent water pollution and protect the public health (both during and after construction) the State requires adherence to state water quality standards for surface water and groundwater. More information regarding these regulations, as well as applicable BMPs, is presented in Sections 3.4 – *Surface Water Quality*, and 4.31 – *Environmental Commitments*. To minimize disruption to emergency service providers, Reclamation would implement a Transportation Management Plan, as described in Section 4.16 – *Transportation* and in Section 4.31 – *Environmental Commitments*. Facility planning and construction activities would be conducted to avoid conflicts with existing overhead and underground utilities, such as electric, gas, telecommunications, water, and wastewater.

4.18.2 Alternative 1: No Action Alternative

4.18.2.1 Short–term Impacts

No short–term impacts are anticipated because no new facilities would be constructed if this alternative is implemented.

4.18.2.2 Long–term Impacts

Implementation of the No Action Alternative would result in the continuation of current ongoing activities and programs, so groundwater availability would continue to decline for commercial, municipal, and industrial water users. This decline could result in the need to drill deeper wells, thus increasing drilling and pumping costs to supply water. Larger pumps for deeper wells require more energy, although some wells would no longer be used.

Drilling and pumping costs could, however, increase to the point where farmers, landowners, residents, or business owners cannot afford the pumping costs associated with using the water. This could result in changes in land use and impacts on existing businesses. In addition, if the quality of the water declines over time (as is expected with this alternative), this could also result in changes in land use, impacts on existing businesses, and health risks to human populations relying on the water.

The loss of irrigated agriculture associated with the No Action Alternative could impact businesses and people that are linked to the agricultural industry, such as farm workers, food processing facilities, seed and pesticide companies, and trucking companies. This could result in a decreased population base to support law enforcement, fire protection, and medical services, resulting in layoffs of police, fire, and medical personnel, closure of fire and police stations, or closure of some medical facilities in or near the Study Area. Closure of local facilities would increase response times during emergencies. It is difficult to predict exactly when or how these changes might occur, so the significance of this potential impact cannot be determined at this time.

A similar change in the demand for local utilities from these land use changes could occur. If population decreases, the demand for electricity, natural gas, telecommunications, water, and wastewater services could drop. Section 4.17 – *Energy* concluded no net energy use change for the No Action Alternative; therefore, no impact on local electrical utilities would occur.

4.18.3 Alternative 2A: Partial—Banks

4.18.3.1 Short–term Impacts

Short–term impacts to public services from disrupting access for law enforcement, fire, and emergency medical personnel would be mitigated by the Transportation Management Plan (described in Section 4.31 – *Environmental Commitments*), and, therefore, would be minimal. Short–term impacts to existing local utility services, such as electrical, gas, telecommunications, water, and wastewater, are expected near the sites of the proposed facilities. These temporary service disruptions or necessary relocations of existing utilities to accommodate proposed facilities would represent minimal impacts.

In addition, several temporary utility services are expected to be used during construction. Portable restroom facilities, local generators for producing electricity, and additional cellular telephone connections would be required. These temporary facilities are not expected to substantially increase the burden on the suppliers of these services, and would result in no adverse impacts.

4.18.3.2 Long–term Impacts

North of I–90, long–term impacts would be similar to those described for the No Action Alternative. The discussion for this and the other partial replacement alternatives focuses on the area south of I–90.

Public Services

Operation and maintenance of the proposed facilities would require few onsite personnel located at specific facilities. Most of these employees are expected to currently live within the Study Area counties. The exception is for positions that require specialized training, which could result in a few workers and their families relocating to the area from beyond the counties' boundaries. Therefore, long–term increases in the demand for public services and utilities would not likely occur, resulting in a no to minimal impact.

Electricity

With implementation of the proposed facilities, conversion of groundwater–irrigated agricultural land to surface water irrigation would decrease the consumption of energy from groundwater pumping. Surface water pumping to convey water from Banks Lake to its final destination would increase the consumption of energy as described in Section 4.17 – *Energy*.

This alternative would also result in additional water diversions from the Columbia River, which would result in more pumping into Banks Lake and less hydroelectric generation as described in Section 4.17 – *Energy*. An increased consumption of energy for pumping into Banks Lake and a reduction in hydroelectric generation may result in a greater use of existing, but more costly, thermal generating resources. These more costly resources are typically gas–fired power plants. The potential increase in pumping and decrease of hydropower generation in comparison to the regional power system is considered minimal.

Natural Gas

Operation and maintenance of the proposed facilities would have no impact on natural gas because no connections to natural gas distribution systems would be required. If natural gas is needed, onsite systems would be used.

Telecommunications

Telecommunication system connections would likely be required at all major facility sites. Where landline connections are available, they would be installed. If landline connections are not available in select areas, wireless systems would likely be used. The few landline or wireless connections that would be needed for the proposed facilities would not increase the burden on the suppliers of these services. No adverse impacts on the suppliers or their ability to provide services to other customers are expected.

Water Supply and Wastewater Management

Water supply and wastewater management would not be required for any of the proposed facilities. No long–term impacts on law enforcement, fire, emergency medical, natural gas, telecommunications, water, and wastewater services and providers have been identified; therefore, no mitigation is required or recommended.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to public health are anticipated from the Limited Spring Diversion Scenario.

4.18.4 Alternative 2B: Partial—Banks + FDR

Short–term and long–term impacts, as well as mitigation measures, would be the same as that presented for Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to public health are anticipated from the Limited Spring Diversion Scenario.

4.18.5 Alternative 3A: Full—Banks

The impacts of this alternative are expected to be the same as that described for the area south of I–90 under Alternative 2A: Partial—Banks, with two differences:

- With this alternative, the number of construction workers is expected to increase. The conclusion for Alternative 2A: Partial—Banks still applies to this alternative.
- Over twice as many pumping plants would be constructed and operated if Alternative 3A: Full—Banks is implemented.

This section focuses on the long–term impacts from the expected changes in electrical energy demand. Short–term impacts and mitigation are the same as described for Alternative 2A: Partial—Banks and are not repeated here.

4.18.5.1 Long–term Impacts

Electricity

With Alternative 3A: Full—Banks, less groundwater would be pumped than with Alternative 2A: Partial—Banks. Also, less energy would be produced from hydroelectric generation, and more surface water pumping would occur, resulting in a greater net energy loss than with the partial replacement alternatives. The increase in electricity demand is expected to be offset by the system surplus through BPA, resulting in no to minimal impact.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to public health are anticipated from the Limited Spring Diversion Scenario.

4.18.6 Alternative 3B: Full—Banks + FDR

Short–term and long–term impacts would be the same as that presented for Alternative 3A: Full—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to public health are anticipated from the Limited Spring Diversion Scenario.

4.18.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

The impacts of this alternative are expected to be the same as that described for the area south of I–90 under Alternative 2A: Partial—Banks, with one difference:

- With this alternative, the number of construction workers is expected to increase. The conclusion for Alternative 2A: Partial—Banks still applies to this alternative.

This section focuses on the long–term impacts from the expected changes in electrical energy demand. Short–term impacts and mitigation requirements are the same as described for Alternative 2A: Partial—Banks and are not repeated here.

4.18.7.1 Long–term Impacts

Electricity

With Alternative 4A: Modified Partial—Banks, less groundwater would be pumped than with Alternative 2A: Partial—Banks. Also, less energy would be produced from hydroelectric generation, and more surface water pumping would occur, resulting in a greater net energy loss than with the partial replacement alternatives.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to public health are anticipated from the Limited Spring Diversion Scenario.

4.18.8 Alternative 4B: Modified Partial—Banks + FDR

Short–term and long–term impacts would be the same as that presented for Alternative 4A: Modified Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to public health are anticipated from the Limited Spring Diversion Scenario.

4.18.9 Mitigation

No mitigation measures would be required for any of the action alternatives.

4.19 Noise

Noise sensitive locations in the Study Area include several small communities as well as scattered residences where the presence of unwanted sound could adversely impact the designated use of the land. No short- or long-term noise level impacts would occur under the No Action Alternative, and the primary potential for short-term impacts under all the action alternatives would be from construction noise.

Short-term noise impacts under all action alternatives would generally be localized as construction of linear facilities such as canals and pipelines moves through the landscape (south of I-90 for the partial replacement alternatives and both north and south of I-90 for the full and modified partial replacement alternatives). BMPs would be employed to control and minimize construction noise to the extent practical. Nonetheless, adverse short-term noise impacts are anticipated under any of the action alternatives. Since construction noise is exempt from State noise regulations, these impacts would not be considered significant.

Ambient noise levels would increase slightly over the long term next to pumping plants. The partial replacement alternatives would require a total of 11 new pumping plants; the full replacement delivery alternatives would involve 30 new pumping plants, and the modified partial replacement alternatives would construct 11 new pumping plants. All required facilities for all action alternatives would be designed to incorporate noise control and reduction measures to comply with state noise standards. Therefore, long-term noise impacts with any of the action alternatives would be minimal.

4.19.1 Methods and Assumptions

4.19.1.1 Impact Indicators and Significance Criteria

Table 4-117 presents the indicators and significance criteria that have been identified for noise.

Table 4-117. Noise impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Short–term (construction) increases in noise levels	Construction noise is specifically exempt from State noise regulations and standards; however, construction near sensitive receptors (Class A lands*), outside of daylight hours would be considered a significant short–term impact
Long–term increases in noise levels	Exceeding State noise standards
*Class A: Lands where people reside and sleep (such as residential)	

4.19.1.2 Impact Analysis Methods

Impacts from noise that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Equipment used to construct the action alternatives would generate noise. The types of construction equipment that would be used are common, and their associated noise levels have been calculated and published in various reference documents. The source used in this evaluation is the *Roadway Construction Noise Model User's Guide* prepared by the Federal Highway Administration (FHWA 2006).

The model output used for this analysis is considered conservatively high. The model output includes the maximum noise level (Lmax) based on the highest noise levels generated by the construction equipment and the equivalent noise level (Leq) which is the average (on an acoustical energy basis), taking into account the usage factor.

4.19.1.3 Impact Analysis Assumptions

Applicable legal requirements are described in Chapter 5 – *Consultation and Coordination*. State of Washington Noise Regulations (WAC 173–60–040) are listed in Table 4-118. For the alternative impact analysis, it is assumed that all regulations would be followed, along with the BMPs listed in Section 4.31 – *Environmental Commitments*. No mitigation measures are required.

Table 4-118. State of Washington maximum permissible noise levels (dBA) at a Class A receiver from a Class C source.

Statistical Descriptor	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
L_{eq} (hourly average)	60	50
L_{25} (15 minutes per hour)	65	55
L_{16} (7.5 minutes per hour)	70	60
$L_{2.5}$ (1.5 minutes per hour)	75	65
Source: State of Washington Noise Regulations (WAC 173–60–040)		

Legal Requirements and BMPs for Noise Abatement

State noise standards are established related to permissible long–term environmental noise levels; construction noise between 7:00 a.m. and 10:00 p.m. is specifically exempt from the standards. Reclamation and Ecology would implement a series of BMPs related to noise generated during construction to further avoid or minimize noise impacts, as listed in Section 4.31 – *Environmental Commitments*.

4.19.2 Alternative 1: No Action Alternative

Since no construction or operation of facilities would occur with the No Action Alternative, there would be no short–term or long–term changes in the noise environment. Noise resulting from agricultural activities would continue to be the dominate source of noise in the Study Area.

4.19.3 Alternative 2A: Partial—Banks

4.19.3.1 Short–term Impacts

Short–term impacts would center on construction noise, including related material and equipment transportation. Generally, the loudest construction equipment emits noise in the range of 80 to 90 dBA at 50 feet. Based on general construction conditions expected with the action alternatives, the noise versus distance estimates shown in Table 4-119 are expected to be representative. These data are illustrated in Figure 4-46.

Table 4-119. Construction noise levels versus distance.

Distance from Canal Easement or Pumping plant Property Line (feet)	L_{eq} Noise Level (dBA)
50	83
100	79
200	74
400	69
800	63
1,600	58
3,200	52
6,400	46

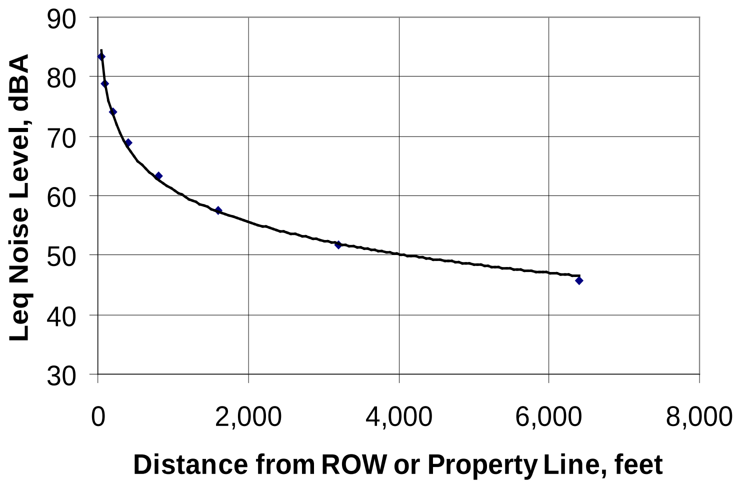


Figure 4-46. Estimated construction noise levels.

Daytime construction noise is exempt from State regulations, and one of the committed BMPs is to construct facilities only during daylight hours. Thus, the proposed construction would comply with applicable standards. Beyond this, it is not expected that construction near any given sensitive receptor would span more than a year, and in most cases would be substantially less, as construction progresses from north to south. Given these conditions, short–term noise impacts would be adverse, but not significant.

4.19.3.2 Long–term Impacts

Noise levels would not increase significantly next to the pumping plants. All 11 pumping plants would be located in remote areas south of I–90. Separation distances between proposed facilities and occupied structures (primarily residences) range from 850 to 5,900 feet, with an average separation distance of 4,400 feet (see Chapter 2, Figure 2–1, *Overview of Action Alternatives: Major Delivery and Supply Elements*). Vendor–specific noise information is not currently available for pumping plant equipment. However, to achieve compliance with State noise requirements, noise-reducing features would be included in facility design to the extent necessary. These features may include specification of low noise equipment, barrier walls, or tight fitting acoustical enclosures. Aboveground piping and valving may also be acoustically lagged or enclosed.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to noise are anticipated from the Limited Spring Diversion Scenario.

4.19.4 Alternative 2B: Partial—Banks + FDR

Short–term and long–term impacts would be the same as that presented for Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to noise are anticipated from the Limited Spring Diversion Scenario.

4.19.5 Alternative 3A: Full—Banks

4.19.5.1 Short–term Impacts

Short–term impacts for Alternative 3A: Full—Banks would be similar in type but wider in extent to those described for Alternative 2A: Partial—Banks. Alternative 3A: Full—Banks would include all of the facilities described for the partial replacement alternatives, as well as construction activities associated with an additional 19 pumping plants, associated distribution pipelines, siphons, and canals north of I–90. As a result, a greater area would be exposed to construction noise.

Daytime construction noise is exempt from State regulations and noise limits, and nighttime construction would not occur. As a result, construction activities would not exceed State noise limits. Beyond this, it is not expected that construction near any given sensitive receptor would span more than 1 year as construction progresses from north to south. Given these conditions, short–term noise impacts would be adverse but not significant.

4.19.5.2 Long–term Impacts

As with the partial replacement alternatives, noise levels would increase slightly next to the pumping plants. In addition to the 11 pumping plants in the partial replacement alternatives, the full replacement alternatives would require another 19 pumping plants. Separation distances between proposed facilities and occupied structures (primarily residences) range from 800 to 12,800 feet, with an average separation distance of 5,300 feet (Chapter 2, Figure 2-19). As discussed previously, all required facilities would be designed to incorporate noise control and reduction measures as necessary to comply with state noise standards.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to noise are anticipated from the Limited Spring Diversion Scenario.

4.19.6 Alternative 3B: Full—Banks + FDR

Short–term and long–term impacts would be the same as that presented for Alternative 3A: Full—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to noise are anticipated from the Limited Spring Diversion Scenario.

4.19.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

4.19.7.1 Short–term Impacts

The sources of short-term (construction) noise impacts associated with Alternative 4A: Modified Partial—Banks, as well as the magnitude (noise levels) of these impacts would be the same as described for Alternative 2A: Partial—Banks. However, the area affected by noise impacts under this alternative would extend along and eastward of the East Low canal, both north and south of I-90, as specified in Chapter 2. North of I-90 three pumping plants and associated distribution pipelines, siphons, and other distribution equipment would be constructed. South of I-90, construction would include 8 pumping plants and associated pipelines and other equipment.

Perspectives on construction noise regulations and limitations, as well as the commitment of the project proponents to conduct construction activities only in the daytime, are the same as those presented for Alternative 2A: Partial—Banks.

4.19.7.2 Long–term Impacts

As with the partial replacement alternatives, noise levels would increase slightly next to the pumping plants. Separation distances between proposed facilities and occupied structures (primarily residences) range from 800 to 12,800 feet, with an average separation distance of 5,300 feet (Chapter 2, Figure 2-8, and Figure 2-19). As discussed previously, all required facilities would be designed to incorporate noise control and reduction measures as necessary to comply with state noise standards.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to noise are anticipated from the Limited Spring Diversion Scenario.

4.19.8 Alternative 4B: Modified Partial—Banks + FDR

Short–term and long–term impacts would be the same as that presented for Alternative 4A: Modified Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to noise are anticipated from the Limited Spring Diversion Scenario.

4.19.9 Mitigation

Assuming full compliance with applicable State noise standards and application of BMPs, no additional mitigation measures are proposed or necessary, for any of the action alternatives.

4.20 Public Health (Hazardous Materials)

The public health analysis addresses the potential for the Study alternatives to increase or decrease threats to human health from hazardous materials or mosquito–borne illness. No additional short– or long–term impacts are anticipated with the No Action Alternative, and impacts from the action alternatives can largely be addressed through BMPs.

Short–term impacts would occur during construction or operation of any of the action alternatives in association with the use of fuels, oils, solvents, pesticides, and other potentially hazardous materials that would be introduced to surface water by spills or releases. In addition, the risk of mosquitoes over the short term would increase with all of the action alternatives because of the potential for accumulation of rainwater in temporary, shallow pools or puddles caused by construction activities. However, with committed BMPs, no to minimal short–term impacts to public health would occur under any of the action alternatives.

Potential long–term impacts associated with hazardous site locations in proximity to the action alternatives would likely be encountered during construction that would require long–term clean up or monitoring. As with the potential for short–term impacts noted above, committed BMPs would ensure that any long–term impacts are either avoided or reduced to minimal levels.

4.20.1 Methods and Assumptions

4.20.1.1 Impact Indicators and Significance Criteria

The impact indicators and associated criteria for determining significance shown in Table 4-120 were used to evaluate public health impacts.

Table 4-120. Public health impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Hazardous Sites	• Encountering and potentially disturbing hazardous sites associated with historic uses on lands needed for facility construction and operation. • Potential for fuel spills or other hazardous materials being released during construction. • Public exposure to contaminated sediments from drawdown of Lake Roosevelt.
Mosquito Habitat	Creation of large, new inundations conducive to mosquito propagation, and thus increasing potential for transmission of mosquito–borne diseases such as the West Nile Virus.

4.20.1.2 Impact Analysis Methods

Impacts to public health that would occur under each of the action alternatives are compared against the current conditions or the No Action Alternative within the Study Area.

Indicators used for analyzing potential for impacts to public health associated with the Study alternatives focused on the following:

1. Likelihood of encountering hazardous sites during construction, assessed in terms of the number of known hazardous sites within or near potential facility sites associated with the alternatives.

2. Potential for water quality degradation as a result of construction and/or operation and maintenance of facilities, assessed in terms of the likelihood of the following incidents:

   – Spills during construction.

   – Spills or misuse of chemicals related to irrigation system operations.

   – Spills or misuse of agrichemicals resulting in contamination of groundwater or surface water.

3. Potential for human exposure to contaminated sediments and resultant risk of adverse public health impacts at Lake Roosevelt. Although available data suggests that the

potential for adverse public health impacts is low under current conditions, the following sources were used to assess this concern related to additional drawdowns at Lake Roosevelt:

- Human Health Risk Assessment Work Plan for the Upper Columbia River Site Remedial Investigation and Feasibility Study, Syracuse Research Corporation, March 2009 (Syracuse Research Corporation 2009).
- Phase 1 Sediment Sampling Data Evaluation, Upper Columbia River Site CERCLA Remedial Investigation/Feasibility Study, CH2M HILL/Ecology & Environment, Inc., August 2006 (CH2M HILL and E&E 2006).
- Lake Roosevelt Remedial Investigation and Feasibility Study, A Public Guide, Lake Roosevelt Forum, June 2009 (Lake Roosevelt Forum 2009).
- Personal communication: Jim Blanchard, U.S. Bureau of Reclamation, July 10, 2009, Ephrata, Washington (Blanchard 2009).

4. Potential for creating new or additional mosquito habitat: Impacts were assessed in terms of the changes in land or water use that could lead to the creation of mosquito habitat or otherwise increase propagation of mosquitoes.

Methods for conducting these studies included database surveys, aerial photography analysis, and field visits.

4.20.1.3 Impact Analysis Assumptions

Broadly applicable legal requirements are described in Chapter 5 – *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all regulations would be followed, along with the BMPs listed in Section 4.31 – *Environmental Commitments.* No mitigation measures are required.

Legal Requirements and BMPs for Public Health

To prevent deterioration of groundwater and surface waters the State requires adherence of the Water Quality Standards under the jurisdiction of either the Federal, State, or Tribal governments. This and other related Federal, State, or Tribal laws pertaining to water pollution are described in Section 3.4 – *Surface Water Quality*. Legal requirements regarding the control of mosquitoes are described in Chapter 5, *Consultation and Coordination*.

Hazardous sites would be managed by being cautious in excavating or disturbing the grounds in areas near a potential hazardous site. Reclamation and Ecology would implement the BMPs listed in Section 4.31 – *Environmental Commitments*, to further manage hazardous materials, and to avoid or minimize water pollution during and after construction.

4.20.2 Alternative 1: No Action Alternative

4.20.2.1 Short–term Impacts

No short–term direct or indirect impacts related to hazardous sites, hazardous materials, or mosquito populations are anticipated under the No Action Alternative because there would be no ground disturbance or construction activities.

4.20.2.2 Long–term Impacts

Hazardous Materials

Odessa Special Study Area

No long–term impacts related to hazardous sites are anticipated under the No Action Alternative. No new construction would occur that might encounter a hazardous site.

Agricultural use of fertilizers and other chemicals, with the potential for nitrogen and phosphorus to enter surface and groundwater would be progressively reduced as current groundwater–irrigated lands are converted to dryland farming.

Shorelines of Banks Lake and Lake Roosevelt

Current drawdown patterns at Banks Lake and Lake Roosevelt would not be changed under the No Action Alternative; therefore, no additional impacts are expected.

Mosquitoes

In the Study Area over the long term, any mosquito habitat associated with agricultural lands now irrigated with groundwater would be eliminated as these lands transition to dryland farming. Currently some mosquito habitat is created by ponding irrigation water and flood irrigation.

Drawdown patterns under the No Action Alternative at Banks Lake do not create extensive mosquito habitat (Reclamation 2004). The same is true at Lake Roosevelt, because the reservoir has flowing water, deep reaches, little vegetation, and mostly sandy or rocky shorelines that drain quickly, the reservoir shorelines are not favorable for mosquito propagation.

4.20.3 Alternative 2A: Partial—Banks

4.20.3.1 Short–term Impacts

Hazardous Materials

During construction or operation and maintenance of any of the action alternatives, fuels, oils, solvents, pesticides, and other potentially hazardous materials may be introduced to surface water through spills or other releases. Although this could result in an incremental increase in contamination, anticipated impacts are addressed through regulations and BMPs and would be minimal. Likewise, hazardous sites would be identified and appropriate response would be undertaken during site planning and construction, resulting in no to minimal adverse impact.

Mosquitoes

Compared to the No Action Alternative, Alternative 2A: Partial—Banks would have a greater potential for temporary formation of mosquito habitat and increases in local mosquito populations during construction. These impacts would occur during dewatering, or when rainwater accumulates in shallow pools or puddles resulting from the construction activities associated with material and equipment staging. Adherence to applicable regulations and implementation of committed BMPs would reduce potential for such impacts to minimal levels.

4.20.3.2 Long–term Impacts

Hazardous Materials

Odessa Special Study Area

Long–term impacts associated with hazardous sites encountered during construction may require long–term clean up or monitoring. Applicable regulations and BMPs would be implemented, reducing the potential long–term impacts to minimal levels. This would be the case with all of the action alternatives.

Potential for adverse impacts resulting from the use or misuse of hazardous materials during long–term operation of Alternative 2A: Partial—Banks (and all action alternatives) would also be reduced to minimal levels given applicable regulations and committed BMPs.

Alternative 2A: Partial—Banks, and all partial replacement alternatives, would result in a net reduction in agricultural use of fertilizers and other potential water contaminants. While use of these materials would continue unchanged on current groundwater–irrigated lands south of I–90, it would be substantially reduced north of I–90 as groundwater–irrigated lands transition to dryland farming.

Banks Lake Shoreline

Drawdown of Banks Lake, to some degree, is expected under all action alternatives, including Alternative 2A: Partial—Banks. No leaking underground storage tanks, contaminated sediments, or other hazardous sites have been identified immediately adjacent to the reservoir that could be impacted by these additional drawdowns. Therefore, no related adverse impacts are expected with this or any of the action alternatives.

Mosquitoes

Expansion of the CBP south of I–90 would result in minimal, if any, increase in mosquito habitat or populations associated with facilities. In the overall Study Area and the area south of I–90 where surface water would replace groundwater irrigation, there would be no adverse change in potential for irrigation–related mosquito habitat on irrigated lands, such as ponding or standing water. North of I–90, the potential for irrigation–related mosquito habitat would be eliminated over time as these lands transition to dryland farming.

All irrigation waters under Alternative 2A: Partial—Banks would be supplied from Banks Lake reservoir. Changes in drawdown patterns at Banks Lake are not expected to increase the potential for mosquito habitat compared with the No Action Alternative. Withdrawal of water from vegetated shoreline would likely decrease mosquito populations and mitigate against any potential production from drawdown pools. In many cases, the combination of sparse vegetation along with the presence of insectivores would decrease opportunities for mosquito colonization of newly formed pools. Summer is also the time of year when rapid evaporation of pools would take place because of high ambient temperatures and relatively low humidity.

Mosquito control that is undertaken by local authorities to minimize West Nile Virus infection in humans would take place early in the season. Therefore, only a minimal number of adults would be present for potential use of drawdown areas. The later refill period associated with the action alternatives would likely further limit mosquito production from the vegetated margins of the reservoir.

Types and abundance of mosquitoes potentially associated with the drawdown could be documented. Often mosquitoes that are assumed to come from a wetland or ponded water in an impoundment originate elsewhere. However, a review of the topography indicates few ponding areas are evident in the Banks Lake pool. There is ponded water below Dry Falls Dam that would not be affected by the action alternatives. However, should mosquito population's increase unexpectedly under this alternative or any of the action alternatives, regulations and BMPs would be implemented to keep impacts to a minimum.

Changes with Limited Spring Diversion Scenario

No substantive changes are anticipated with the Limited Spring Diversion Scenario for any of the action alternatives for any of the public health impact indicators.

4.20.4 Alternative 2B: Partial—Banks + FDR

With the exception of long–term concerns related to contaminated sediment at Lake Roosevelt, short–term and long–term impacts would be the same for this alternative as described above for Alternative 2A: Partial—Banks.

4.20.4.1 Long–term Impacts

Lake Roosevelt Shoreline

Contaminated sediments in the Upper Columbia River that are exposed during Lake Roosevelt drawdowns have generated public health concerns for swimmers using shoreline beaches and to those exposed to wind–blown suspension and dispersion of sediments and soils. This transport mechanism is of principal interest where there are large expanses of exposed, contaminated sediments. The risks of exposure to airborne dispersion of contaminated sediments from the shore lands of Lake Roosevelt are currently assessed as low by WDOH. Further exposure of the Lake Roosevelt shoreline would not be substantially different from what currently occurs as the No Action Alternative. Therefore, impacts would be considered minimal.

Mosquitoes

The addition of Lake Roosevelt as a water supply would have no impact on the mosquito population under Alternative 2B: Partial—Banks + FDR. The minor changes in drawdown patterns for the reservoir would not change shoreline or mosquito habitat conditions appreciably from the No Action Alternative. It should also be noted that the shoreline of Lake Roosevelt is predominantly sandy and well drained when dewatered. This soil condition does not promote the development of appreciable standing water for the gestational period required for mosquito larvae.

Changes with Limited Spring Diversion Scenario

No substantive changes are anticipated with the Limited Spring Diversion Scenario for any of the action alternatives for any of the public health impact indicators.

4.20.5 Alternative 3A: Full—Banks

All impact considerations for this alternative would be generally the same as discussed for Alternative 2A: Partial—Banks. The only difference would be related to agricultural use of fertilizers and other chemicals, and irrigation–related mosquito habitat. Under Alternative 3A: Full—Banks, as with all full replacement alternatives, all eligible lands currently using groundwater irrigation (both north and south of I–90) would be provided with replacement surface water supply. Thus, there would be no change in these impact indicators from existing conditions. The reductions in fertilizer, chemical use, and irrigation–related mosquito habitat associated with the partial replacement alternatives (north of I–90) and the No Action Alternative (north and south of I–90) would not occur.

Changes with Limited Spring Diversion Scenario

No substantive changes are anticipated with the Limited Spring Diversion Scenario for any of the action alternatives for any of the public health impact indicators.

4.20.6 Alternative 3B: Full—Banks + FDR

Short–term and long–term impacts would be the same as Alternative 3A: Full—Banks, with the addition of the considerations at Lake Roosevelt described for Alternative 2B: Partial—Banks + FDR.

Changes with Limited Spring Diversion Scenario

No substantive changes are anticipated with the Limited Spring Diversion Scenario for any of the action alternatives for any of the public health impact indicators.

4.20.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

Short–term and long–term impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks.

Changes with Limited Spring Diversion Scenario

No substantive changes are anticipated with the Limited Spring Diversion Scenario for any of the action alternatives for any of the public health impact indicators.

4.20.8 Alternative 4B: Modified Partial—Banks + FDR

Short–term and long–term impacts would be the same as Alternative 3A: Full—Banks, with the addition of the considerations at Lake Roosevelt described for Alternative 2B: Partial—Banks + FDR.

Changes with Limited Spring Diversion Scenario

No substantive changes are anticipated with the Limited Spring Diversion Scenario for any of the action alternatives for any of the public health impact indicators.

4.20.9 Mitigation

No mitigation measures beyond the committed BMPs would be necessary for any of the public health impact indicators.

4.21 Visual Resources

Impacts to visual resources within the Study Area relate to both the general transition over time of existing groundwater–irrigated lands to dryland agriculture, and also introduction of substantial new irrigation infrastructure. Impact concerns in the viewsheds of both Banks Lake and Lake Roosevelt relate primarily to the potential for visual resource changes resulting from additional reservoir drawdowns.

From a short–term perspective, the No Action Alternative would result in no impacts to visual resources, while all action alternatives would involve adverse short–term visual impacts to local residents during construction activities. None of these short–term impacts would be significant.

Significant long–term impacts to the broad visual character of the Study Area would occur under both the No Action Alternative and partial replacement alternatives, in association with a shift from irrigated agriculture to dryland farming. With the No Action Alternative, this impact would occur throughout the Study Area on lands currently irrigated with groundwater. With the partial replacement alternatives, this effect would be limited to lands north of I–90. Minimal, if any, visual impacts would occur at Lake Roosevelt under any of the alternatives.

More localized, significant, long–term visual impacts would accompany the action alternatives in two ways:

- Substantial New Infrastructure: Facilities such as tall, widely visible water tanks would change the viewscape, and these changes would occur more extensively in the full replacement alternatives simply because of the larger area involved.
- Banks Lake Drawdown under Alternative 3A: Full—Banks: Average–year summer drawdowns would not be more than 8 feet lower than under the No Action Alternative, which would not create a significant adverse impact. Additional drawdowns at Banks Lake reservoir under the other action alternatives would generally not result in significant adverse visual quality changes.

4.21.1 Methods and Assumptions

4.21.1.1 Impact Indicators and Significance Criteria

Table 4-121 presents the indicators and associated criteria for determining potential significant impacts to visual resources.

Table 4-121. Impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Landscape–level change in Odessa Special Study Area (Study Area)	Long–term, distinct, fundamental, or widespread change in the visual character of a viewshed with this change visible to residents and others familiar with the landscape.
Introduction of new developed facilities and infrastructure in the Study Area	Permanent introduction of prominent new facilities or infrastructure that are incongruous with the existing visual environment, or detract from the aesthetic quality of an area. Such changes can be localized but significant if visible to residents and others familiar with the pre–existing visual quality of the area.
Changes in reservoir drawdown patterns at Banks Lake and Lake Roosevelt	Changes to drawdown patterns that leave a "bathtub ring" to such an extent that it would make the area less desirable for recreation. Significance is based on knowledge of the affected environment, types of viewers involved, and professional judgment.

4.21.1.2 Impact Analysis Methods

Impacts on visual quality that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Significant visual quality effects can range from positive (for example, restoration of a damaged natural landscape) to adverse (for example, major introduction of contrasting, developed facilities in an otherwise natural landscape). The perspective would be dependent upon specific circumstances and the varying perceptions and opinions of viewers.

Study Area Land and Agricultural Use Patterns

Assessment of this impact indicator is straightforward. Given that irrigated agriculture is a defining element in the visual character of the Study Area, decisions regarding continuation or eventual elimination of this element would significantly influence the future character of the area. Thus, impact is understood simply by noting for each alternative the extent to which irrigated agriculture is continued or eventually eliminated in different parts of the Study Area.

Study Area Facilities and Infrastructure

Impact assessment was based on reviewing the existing visual environment and the types of development expected in facility corridors and sites. This review was done with aerial photography supplemented and confirmed by field reconnaissance. Emphasis was placed on the following:

1. Character of existing development.

2. Viewpoints within 0.5 mile of the facilities. A viewing distance of 0.5 mile was used because of the relatively level to rolling terrain. Changes associated with new facilities would generally be difficult to notice outside of this viewing radius.

Impacts were determined, based on professional judgment, by comparing the existing conditions with those that would occur if facilities associated with the various alternatives were built. The focus was on defining the extent to which new facilities would be similar or dissimilar in character, scale, form, and color with development currently seen from residences and highways within the viewing radius.

Banks Lake and Lake Roosevelt Drawdown Patterns

Drawdowns at Banks Lake reservoir and Lake Roosevelt result in varying amounts of reservoir bottom or shoreline being exposed. Some areas would have “bathtub rings” left on rocks and outcroppings as pool elevations decrease. In other areas, broad expanses of sand or mud flats devoid of vegetation could be exposed. These effects could result in both overall, resource–wide impacts from the standpoint of broad, panoramic views, or a decrease in the attractiveness and desirability of localized areas, especially areas containing or adjacent to recreational facilities or residences.

Assessment of these types of impact for Lake Roosevelt was done on a general, qualitative basis because of the small changes in drawdown patterns that would accompany the alternative. For Banks Lake reservoir, impact assessments used the more quantitative information that was applied for recreation resources: drawdown impacts based on the extent of exposed shore at various pool elevations. In both cases, determination of impact significance is based on knowledge of the effected environment, types of viewers involved, and professional judgment.

4.21.1.3 Impact Analysis Assumptions

Broadly applicable legal requirements are described in Chapter 5 – *Consultation and Coordination*, although no regulations apply specifically to visual resources. For the alternative impact analysis, it is assumed that all regulations would be followed, along with the BMPs listed in Section 4.31 – *Environmental Commitments*. After environmental impacts are determined, mitigation measures are applied to compensate for some or all remaining adverse impacts, which are described with the action alternatives and summarized along with the BMPs in Section 4.31 – *Environmental Commitments*.

Legal Requirements and BMPs for Visual Resources

No State or Federal laws, regulations, or policies govern visual resources. BMPs generally involve designing new facilities to be compatible with the surrounding environment to the extent feasible (including both architectural and landscape design treatments, as applicable), or screening incongruous or incompatible facilities from view.

4.21.2 Alternative 1: No Action Alternative

4.21.2.1 Short–term Impacts

No short–term impacts are anticipated because no new facilities would be constructed under this alternative.

4.21.2.2 Long–term Impacts

Study Area

The No Action Alternative would result in a significant change in the visual character of the Study Area, both north and south of I–90. This change would be visible by all types of viewers from all vantage points, including local residences, highways, and roads. While currently irrigated lands are expected to be used for dryland farming, the farmed portions of the Study Area would have a very different appearance in terms of crop variety, visual texture, and color. The multiple shades of greens from the numerous kinds of crops grown annually, along with the irrigation systems (predominantly center pivots) and other facilities that support them, would be eliminated. This landscape would be replaced with broad monocultures of crops like wheat, grown on an every–other–year rotation.

Farm developments and agriculture–related infrastructure might be abandoned as farms consolidate to the much larger operations characteristic of dryland farming. To the extent that this occurs, the result would likely be deterioration in visual quality in some locations.

Banks Lake and Lake Roosevelt

The No Action Alternative involves no change in operations at either of these reservoirs, and would thus have no impact on visual quality conditions.

4.21.3 Alternative 2A: Partial—Banks

4.21.3.1 Short–term Impacts

Construction of required facilities in the Study Area south of I–90 would involve short–term adverse visual impacts to local residents. Examples include construction-generated dust, moving equipment, and the storage of materials and cleared debris storage. These impacts would be temporary and not significant. No short–term construction–related impacts at Banks Lake reservoir would occur.

4.21.3.2 Long–term Impacts

Study Area

North of I–90, this alternative and partial replacement alternative 2B would have the same broad–scale, significant impact on visual character described under the No Action Alternative. South of I–90, the general character of the Study Area would essentially be preserved through provision of surface water to support continued irrigated agriculture. In this portion of the Study Area, visual impacts would be related to introduction of new facilities and infrastructure, such as canal extensions, and pumping plants. Overall, these facilities would be consistent with similar irrigation–related infrastructure in the area. However, the regulating tanks associated with the pumping plants would be up to 275 feet tall. This would be a prominent new visual element to nearby residents and other viewers, and substantially taller than other agricultural features such as silos and water tanks in the irrigated agriculture environment (Photograph 4-9).

Photograph 4-9. Silos are common agricultural features in the Study Area.

Banks Lake

Compared with the No Action Alternative, Alternative 2A: Partial—Banks would expose more "bathtub ring" and reservoir bottom for short periods of time in August of each year. The relatively small, short–duration decrease in water level would have an adverse but not significant impact on the broad–scale visual resource in which the reservoir lies. The exposure of additional reservoir bottom would do little to detract from the overall setting of Banks Lake reservoir because of the large–scale, dramatic terrain that surrounds it. At the more localized level, the additional drawdown with this alternative (generally exposing less than 100 feet of shore beyond the No Action Alternative) would also be considered an adverse visual impact.

Changes with Limited Spring Diversion Scenario

No substantive changes to the analysis or impacts to visual resources are anticipated from the Limited Spring Diversion Scenario.

4.21.4 Alternative 2B: Partial—Banks + FDR

Short–term and long–term impacts would be the same as that presented for Alternative 2A: Partial—Banks. Regarding the Lake Roosevelt role in this alternative, no short–term impacts would occur.

Changes with Limited Spring Diversion Scenario

No substantive changes to the analysis or impacts to visual resources are anticipated from the Limited Spring Diversion Scenario.

4.21.5 Alternative 3A: Full—Banks

4.21.5.1 Short–term Impacts

Short–term impact would be the same as those described under Alternative 2A: Partial—Banks, except that impacts in the Study Area would occur north as well as south of I–90.

4.21.5.2 Long–term Impacts

Study Area

This alternative, with its support for continuing irrigated agriculture in the Study Area both north and south of I–90, would avoid the broad changes in visual character described under the No Action Alternative.

Perspectives and conclusions on visual impacts resulting from the development of new irrigation infrastructure south of I–90 are presented in the discussion of Alternative 2A: Partial—Banks. They are the same for this alternative and are not repeated here.

North of I–90, considerably more new facilities would need to be developed when compared with the area south of I–90. However, this development would result in minimal adverse impact. This judgment is based on the following factors:

- For the most part, these facilities would be consistent with similar irrigation–related infrastructure in the area. However, the regulating tanks associated with the pumping plants would be up to 275 feet tall. This would be a prominent new visual element to nearby residents and other viewers, and substantially taller than other agricultural features such as silos and water tanks in the irrigated agriculture environment.
- Most reaches of new canal would be excavated, with the only evidence of their presence (visible over a distance) being a mound of earth formed with the excavated material.
- Development of the Black Rock Coulee Reregulating Reservoir would introduce a substantial new dike and water body to the landscape. However, these features would not be visible to most people (few, if any, residents live in the immediate reservoir site area).

Banks Lake

Drawdowns at Banks Lake under Alternative 3A: Full—Banks would be deeper exposing more shoreline than would be the case with the No Action Alternative or the partial replacement alternatives. In August of average years, the drawdown would be approximately 11 feet, which is about 6 feet deeper than the No Action Alternative. Average-year summer drawdowns would not be more than 8 feet lower than the No Action Alternative. Though the viewsheds would be negatively impacted, the resulting increased shoreline exposure would not create a significant adverse impacts.

At the drawdown levels projected with this alternative, the "bathtub ring" effect would be pronounced, and exposed shoreline would range from 0 to 907 feet larger than with the No Action Alternative (Table 4-78 and Table 4-79), which provide the distance to the water's edge at Banks Lake reservoir recreation sites in average and dry water years, respectively. In addition, objects such as tree stumps that are normally covered by water would be exposed and would contribute to an unattractive setting. These conditions detract from the overall visual quality of the Bank Lake setting and would be unappealing to many recreationists and other viewers. These changes would represent a significant adverse impact to visual quality at Banks Lake during August and September of wet, dry, and drought water years.

Changes with Limited Spring Diversion Scenario

With the Limited Spring Diversion Scenario, visual impacts at Banks Lake would be slightly more pronounced in that, at the drawdown levels projected with this alternative, the "bathtub ring" effect would be pronounced at Banks Lake. Exposed shoreline would range from 0 to 1,701 feet larger than with the No Action Alternative.

4.21.6 Alternative 3B: Full—Banks + FDR

Short–term and long–term impacts would be the same as Alternative 3A: Full—Banks for the Study Area, and the same as Alternative 2B: Partial—Banks + FDR for both Banks Lake and Lake Roosevelt.

Changes with Limited Spring Diversion Scenario

No substantive changes to the analysis or impacts to visual resources are anticipated from the Limited Spring Diversion Scenario.

4.21.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

Short–term and long–term impacts would be the same as Alternative 2A: Partial—Banks for the Study Area, and the same as Alternative 2B: Partial—Banks + FDR for both Banks Lake and Lake Roosevelt.

Changes with Limited Spring Diversion Scenario

No substantive changes to the analysis or impacts to visual resources are anticipated from the Limited Spring Diversion Scenario.

4.21.8 Alternative 4B: Modified Partial—Banks + FDR

Short–term and long–term impacts would be the same as Alternative 2B: Partial—Banks for the Study Area, and the same as Alternative 2B: Partial—Banks + FDR for both Banks Lake and Lake Roosevelt.

Changes with Limited Spring Diversion Scenario

No substantive changes to the analysis or impacts to visual resources are anticipated from the Limited Spring Diversion Scenario.

4.21.9 Mitigation

No mitigation measures are proposed or necessary.

4.22 Cultural and Historic Resources

Potential for impacts to cultural and historic resources have been assessed by using a predictive model to estimate the extent to which facility development and O&M related to the Study alternatives would have a high, moderate, or low likelihood of encountering and impacting cultural or historic resources. Based on this analysis, the No Action Alternative would have no potential for such impacts beyond those impacts currently occurring from Columbia River and CBP programs.

As the action alternatives (and the purpose and need of the Special Study) would provide surface water to lands already under irrigation or otherwise disturbed by previous or existing agricultural practices, there is no potential to cause effects to cultural resources to service lands with the introduction of surface water.

However, all of the action alternatives, since they involve development and operation of new delivery system facilities, and involve additional reservoir drawdown each year, will impact cultural resources to varying degrees. Generally, the alternatives that include development in areas with high potential for significant resources combined with exposing more shoreline with potential to contain significant resources in areas with high potential to contain significant cultural resources, are the most likely to result in significant impacts to cultural resources. While specific impacts to specific cultural resources are not identified at this point in the planning process, because of the cultural richness of the area, and the scale and complexity of this project, impacts are presumed and considered to be adverse.

Generally, the partial replacement alternatives (including the modified partial replacement alternatives) would have considerably less potential for encountering significant cultural resources than the full replacement alternatives because fewer new facilities would be built in less sensitive areas. Where there is no FDR component, additional drawdowns at Banks Lake are also generally less for the partial replacement alternatives compared with the full replacement alternatives.

Full field surveys to identify cultural and historic resources would be completed and all necessary consultation with the State Historic Preservation Officer and involved Tribes would be carried out if a decision is made to proceed with one of the action alternatives. Through this regulatory effort, appropriate impact avoidance and mitigation would be defined.

4.22.1 Methods and Assumptions

4.22.1.1 Impact Indicators and Significance Criteria

As defined by Federal regulations, cultural resources that are deemed significant are subject to additional determination of effects and the design of special mitigation measures. The Criteria of Adverse Effect (36 CFR 800.5) is used to determine whether a proposed action would affect a historic property. Any element of an action would have an adverse effect if it changes the characteristics that qualify a historic property for inclusion in the NRHP in a manner that would diminish the integrity of that property. Potential adverse effects include:

- Physical destruction of an entire historic property
- Damage or alteration of a portion of a historic property, or removal of a portion of the property
- Introduction of audible, visible, or atmospheric elements that are out of character with the historic property or alter its setting

Each of these adverse effects could accompany implementation of the action alternatives being considered in the Odessa Subarea Special Study.

Impact indicators used in this analysis to report potential for impact to cultural resources are based on the predictive model described in Chapter 3, Section 3.22 – *Cultural and Historic Resources*. These indicators are shown in Table 4-122.

Table 4-122. Impact indicators and significance criteria.

Impact Indicator	Significance Criteria
Miles of new linear facilities with high potential for encountering and impacting cultural resources	Alternatives are compared by quantifying the relative potential for impacts according to these indicators. At this level of study, the exact nature, location, and potential significance of impacts cannot be quantified.
Acres of facility site acquisition areas with high potential for encountering and impacting cultural resources	
Additional acreage exposed by drawdown changes at Banks Lake	

4.22.1.2 Impact Analysis Methods

Impacts on cultural resources that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Intensive cultural resource investigations are not considered feasible or justified at the current level of planning because of the scale and complexity of the alternatives. Intensive cultural resource investigations include background archival research, as well as an intensive on–the–ground pedestrian inventory survey, and possibly subsurface testing and site significance evaluations. Instead, a predictive model approach has been applied to estimate relative probabilities of encountering cultural resources along the alignments or at the sites of facilities that would be built with the various action alternatives. Alternatives are compared in terms of their respective high, moderate, and low potential (reported in miles and acres, as appropriate) to encounter and impact cultural resource resources during implementation.

4.22.1.3 Impact Analysis Assumptions

Broadly applicable legal requirements are described in Chapter 5 – *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all regulations and associated procedures would be followed. After environmental impacts are determined, mitigation measures are applied to compensate for some or all remaining adverse impacts, which are described with the action alternatives and summarized in Section 4.31 – *Environmental Commitments*.

As noted above, intensive cultural resource investigations are not feasible at the current level of planning. Instead, within the regulatory framework, necessary studies would be conducted and approaches to impact avoidance or mitigation would be developed as part of final design and prior to construction for a proposed action, if the decision is made to proceed with one of the action alternatives. In conducting this further work, Reclamation and Ecology would follow standard procedures, as described in this section and in Section 4.31 – *Environmental Commitments*.

Legal Requirements and Standards for Cultural and Historic Resources

Numerous Federal and State laws, regulations, and Executive Orders focus on protecting one or more aspects of cultural resources; these are summarized in Chapter 5 – *Consultation and Coordination*. The most prominent and over–arching legislation is National Historic Preservation Act, which was passed in 1966 and amended as recently as 1992. It is intended to protect and preserve our nation's important cultural heritage by means of stewardship, funding, guidance, and partnership with agencies, Tribes, and private parties.

Section 106 of the National Historic Preservation Act is a part of Federal legislation that guides, instructs, and provides a way to implement the overall intent of the National Historic Preservation Act by requiring Federally funded or permitted projects to undertake cultural resource studies as a part of the permitting process. Section 106, as amended, requires agencies to account for effects on cultural resources that are listed in or eligible for inclusion in the National Register of Historic Places**.**

Standard Procedures Pursuant to Regulatory Requirements

As the lead Federal agency for the undertaking, Reclamation would define a formal Area of Potential Effects (APE) for the selected alternative in consultation with the Washington State Historic Preservation Officer [SHPO; 36 CFR 800.4(a)(1)] and affected Tribes. The APE is defined as the area within which direct and indirect impacts to cultural resources would occur. Input in defining the APE would also include affected Tribes or other agencies. Consultation with the SHPO and Tribes would be carried out for the duration of the planning and permitting stages.

Pedestrian cultural resource inventories would be conducted for the APE to confirm and document the numbers, nature, and extent of cultural resources present and subject to potential impact. The cultural resource predictive model would guide survey intensity, focusing on areas containing high probability for cultural resources, with lower probability areas needing lesser investigation; however, it is recognized that cultural resources would likely be present even in low potential areas.

Once identified, a cultural resource's significance would be documented using Washington Department of Archaeology and Historic Preservation (DAHP) inventory forms. Determining a resource's significance may require subsurface testing, additional fieldwork, or additional research. Eligibility recommendations would be submitted in reports, agency determinations, and on DAHP inventory forms to SHPO and the affected Tribes for review and concurrence. The significance and eligibility of cultural resources would be determined through consultation with SHPO and the affected tribes (36 CFR 800.4[c][1]). If impacts to NRHP eligible, significant resources cannot be avoided, treatment may be necessary.

4.22.2 Alternative 1: No Action Alternative

4.22.2.1 Short–term Impacts

No short–term impacts are anticipated because no new facilities would be constructed under this alternative.

4.22.2.2 Long–term Impacts

Odessa Subarea

With no construction involved in the No Action Alternative, direct physical impacts to cultural and historic resources would not occur beyond those impacts currently occurring from existing Columbia River and CBP programs.

Banks Lake and Lake Roosevelt

The No Action Alternative would have no additional impact on cultural and historic resources beyond those occurring due to current operations; this alternative involves no change in reservoir drawdown patterns or extent.

4.22.3 Alternative 2A: Partial—Banks

4.22.3.1 Short–term Impacts

Impacts to cultural and historic resources are generally not short–term (that is, not limited to the construction period). Most potential impacts to these resources associated with this and all action alternatives are considered long–term. However, there may be short–term impacts to cultural resources as a result of dust, vibration, noise, and access restrictions during construction. For instance, construction activities could temporarily have aesthetic impacts and restrict access to Traditional Cultural Properties by native practitioners.

4.22.3.2 Long–term Impacts

Odessa Subarea

Impacts to cultural and historic resources associated with this alternative could include be direct or indirect impacts. With any of the action alternatives in the Final EIS, direct impacts could occur from such actions as physical destruction or inundation of all or portion of the resource. Indirect impacts associated with this and all action alternatives could result from human destruction caused by increased access to areas containing sensitive cultural resources, increased degradation of subsurface deposits for historic and pre–contact archaeological resources caused over time by unstable or shifting soils, increased irrigation runoff, and mitigation measures for other protected resources (e.g., habitat or wetlands improvements).

The potential for Alternative 2A: Partial—Banks to result in these adverse impacts to cultural and historic resources during construction and management of the water delivery system is shown in Table 4-123. These impacts are the same for all of the partial replacement alternatives.

Table 4-123. Likelihood of encountering cultural resources during construction for Alternatives 2A and 2B.

	High Potential	Moderate Potential	Low Potential
Miles of Linear Facilities [a]	166	15	27
Acres of Site Facilities [b]	38	1	3

[a] Includes East Low Canal enlargement and extension (46.9 miles) and distribution pipelines (161.3 miles); alignments of necessary transmission lines are not known and are not included.

[b] Includes pumping plants and O&M facility (totaling 42 acres)

Note: Locations of facilities are illustrated in Figure 2-8 in Chapter 2

Banks Lake

The additional drawdown at Banks Lake under this alternative, when compared with the No Action Alternative, would expose an additional 560 acres of land during an average water year, as shown in Table 4-124. A high potential for encountering and enabling impacts to significant cultural resources would occur with Alternative 2A: Partial—Banks. Previously inundated cultural resources around the reservoir would be exposed because of drawdowns. This increased exposure alone leads to site degradation over time, and, more importantly, also invites increased visitation and potential looting or vandalism opportunities.

Table 4-124. Acreage of shoreline exposed during drawdown for Alternative 2A.

Alternative	Total Dewatered Shoreline (acres)	Difference from No Action (acres)
No Action Alternative	1,304	0
2A: Partial—Banks	1,864	560
2A: Partial—Banks w/Limited Spring Diversion	2,383	1,079

Changes with Limited Spring Diversion Scenario

Additional drawdown would occur exposing more substrate and potentially cultural resources for a longer period of time under average water conditions. This would intensify the impacts to potentially expose cultural resources. There would be no changes in a dry or drought years.

4.22.4 Alternative 2B: Partial—Banks + FDR

Short–term and long–term impacts differ from those presented for Alternative 2A: Partial—Banks. Approximately 700 acres of land, beyond the No Action Alternative, would be exposed at Banks Lake, as shown in Table 4-125. Operations at Lake Roosevelt under this alternative would not involve drawdowns deeper than what currently occur over the course of the year.

Table 4-125. Acreage of Banks Lake shoreline exposed during drawdown under Alternative 2B.

Alternative	Total Dewatered Shoreline (acres)	Difference from No Action (acres)
No Action Alternative	1,304	0
2B: Partial—Banks + FDR	1,864	560
2B: Partial—Banks + FDR w/Limited Spring Diversions	2,004	700

Changes with Limited Spring Diversion Scenario

There is no difference presented by the Limited Spring Diversion Scenario.

4.22.5 Alternative 3A: Full—Banks

The types of short–term and long–term impacts for Alternative 3A would be similar as those presented for Alternative 2A. While the types of impacts are the same, the degree of impact is greater. For instance, there are substantially more miles of linear facilities and acres of site facilities planned in High Potential areas for Alternative 3A (Table 4-126). These impacts are further intensified under the Limited Spring Diversion Scenario. Potential impact to these resources associated with this and all action alternatives is considered adverse.

Table 4-126. Likelihood of encountering cultural resources during construction for Alternative 3A.

	High Potential	Moderate Potential	Low Potential
Miles of Linear Facilities [a]	245	26	203
Acres of Site Facilities [b]	100	9	1,300

[a] Includes East Low Canal enlargement and extension (46.9 miles), EHC (44.8 miles), BRBC 26.8 miles), and distribution pipelines (348.6 miles); alignments of necessary transmission lines are not known and are not included.

[b] Includes pumping plants (totaling 109 acres, and Black Rock Coulee Reregulating Reservoir (1,300 acres)

Note: Locations of facilities are illustrated in Figure 2-8, Figure 2-19, and Figure 2-29 in Chapter 2.

4.22.5.1 Long–term Impacts

Odessa Subarea

The potential for Alternative 3A: Full—Banks to result in adverse impacts to cultural and historic resources during construction and management of the water delivery system is shown in Table 4-126. These impacts are the same for all of the full replacement alternatives.

Banks Lake

The drawdown at Banks Lake under this alternative, when compared with the No Action Alternative, would expose an additional 1,395 acres of land in an average water year, as shown in Table 4-127. This creates a high potential for encountering and enabling impacts to significant cultural resources.

Table 4-127. Area of potential cultural resources that may be exposed on Banks Lake shoreline during drawdown for Alternative 3A.

Alternative	Total Dewatered Shoreline (acres)	Difference from No Action (acres)
No Action Alternative	1,304	0
3A: Full—Banks	2,699	1,395
3A: Full—Banks w/Limited Spring Diversion	3,737	2,433

Changes with Limited Spring Diversion Scenario

Additional drawdown would occur exposing more substrate and potentially cultural resources for a longer period of time under average water conditions. This would intensify the impacts to potentially expose cultural resources. There would be no changes in a dry or drought years.

4.22.6 Alternative 3B: Full—Banks + FDR

Short–term and long–term impacts in regards to reservoir operations would be identical to those presented for Alternative 2B. Approximately 700 acres of land, beyond the No Action Alternative, would be exposed at Banks Lake, as shown in Table 4-128. Operations at Lake Roosevelt under this alternative would not involve drawdowns deeper than what currently occur over the course of the year.

Table 4-128. Area of potential cultural resources that may be exposed on Banks Lake shoreline during drawdown under Alternative 3B.

Alternative	Total Dewatered Shoreline (acres)	Difference from No Action (acres)
No Action Alternative	1,304	0
3B: Full—Banks + FDR	2,004	700
3B: Full—Banks + FDR w/Limited Spring Diversions	2,004	700

Changes with Limited Spring Diversion Scenario

There would be no change with the Limited Spring Diversion Scenario.

4.22.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

Short–term and long–term impacts are similar to those presented for Alternative 2A: Partial—Banks. The primary difference between this alternative and Alternative 2A is that the total length of new lateral pipeline is by reduced by 22 miles; and the 2 mile–long extension of the East Low Canal would not be built. Therefore, while the exposure of resources along the shoreline of Banks Lake is somewhat increased, the potential impacts to cultural resources posed by construction are somewhat reduced. The impacts in low, moderate, and high potential areas are shown in Table 4-129.

Table 4-129. Likelihood of encountering cultural resources during construction for Alternatives 4A and 4B.

	High Potential	Moderate Potential	Low Potential
Miles of Linear Facilities [a]	162	12	21
Acres of Site Facilities [b]	27	3	10

[a] Includes East Low Canal enlargement (44.8 miles) and distribution pipelines (150 miles); alignments of necessary transmission lines are not known and are not included.

[b] Includes pumping plants lift stations, and O&M facility (totaling 40 acres)

Note: Locations of facilities are illustrated in Figure 2-29 in Chapter 2.

4.22.7.1 Long–term Impacts

Odessa Subarea

The potential for Alternative 4A: Modified Partial—Banks (Preferred Alternative) to result in adverse impacts to cultural and historic resources during construction and management of the water delivery system is shown in Table 4-129. These impacts are the same for all of the modified partial replacement alternatives.

Banks Lake

The drawdown impacts at Banks Lake under this alternative, when compared with the No Action Alternative, are higher than those displayed for Alternative 2A: Partial—Banks. These impacts are intensified under the Limited Spring Diversion Scenario (1,479 acres of land would be exposed). Refer to Table 4-130. This creates a high potential for encountering and enabling impacts to significant cultural resources.

Table 4-130. Area of potential cultural resources that may be exposed on Banks Lake shoreline during drawdown for Alternative 4A.

Alternative	Total Dewatered Shoreline (acres)	Difference from No Action (acres)
No Action Alternative	1,304	0
4A: Modified Partial—Banks	2,088	784
4A: Modified Partial—Banks w/Limited Spring Diversions	2,783	1,479

Changes with Limited Spring Diversion Scenario

Additional drawdown would occur exposing more substrate and potentially cultural resources for a longer period of time under average water conditions. This would intensify the impacts to potentially expose cultural resources. There would be no changes in a dry or drought years.

4.22.8 Alternative 4B: Modified Partial—Banks + FDR

Short–term and long–term impacts would be similar as that presented for Alternative 2B: Partial—Banks + FDR. The primary difference between this alternative and Alternative 2B is that the total length of new lateral pipeline is by reduced by 22 miles; and the two mile–long extension of the East Low Canal will not be built. Therefore the potential impacts to cultural resources posed by construction are somewhat reduced. The impacts in low, moderate, and high potential areas are shown in Table 4-129.

The drawdown at Banks Lake + FDR under this alternative, when compared with the No Action Alternative, are shown in Table 4-131. Operations at Lake Roosevelt under this alternative would not involve drawdowns deeper than what currently occur over the course of the year.

Table 4-131. Area of potential cultural resources exposed that may be exposed on Banks Lake shoreline during drawdown for Alternative 4B.

Alternative	Total Dewatered Shoreline (acres)	Difference from No Action (acres)
No Action Alternative	1,304	0
4B: Modified Partial—Banks + FDR	2,004	700
4B: Modified Partial—Banks + FDR w/Limited Spring Diversion	2,004	700

Changes with Limited Spring Diversion Scenario

There would be no change with the Limited Spring Diversion Scenario.

4.22.9 Mitigation

In regards to impacts to cultural resources, among the action alternatives, Alternative 3A (especially the Limited Spring Diversion Scenario) poses the greatest harm to the resource. This is due to the amount of exposed shoreline at Banks Lake in an average year combined with the construction of new linear facilities and site facilities planned in High Potential areas. Conversely, Alternative 4B poses the least harm. Reclamation's Preferred, Alternative 4A, poses a slightly higher impact than 4B. However, the introduction of Limited Spring Diversions to alternatives lacking an FDR component leads to higher impacts to cultural resources and subsequently greater mitigation requirements. Regardless, for all of the action alternatives impacts are presumed and considered to be adverse. The identification of resources that may be subject to mitigation measures are described above under "Standard Procedures Pursuant to Regulatory Requirements."

Reclamation's policy is to seek to avoid impacts to historic resources whenever possible. Upon issuance of a Record of Decision on the project and prior to construction, an intensive cultural resources survey of the APE will be conducted to specifically identify any cultural resources that may be affected by this action. If an action is planned that could adversely affect a National Register of Historic Places (NRHP) -eligible archeological, historical, or traditional cultural property site, then Reclamation would investigate options to avoid the site. If avoidance is not possible, protective or mitigative measures would be developed and considered. Cultural resources management actions would be planned and implemented consistent with consultation requirements defined in 36 CFR 800, using methods consistent with the Secretary of the Interior's Standards and Guidelines.

Where mitigation is necessary, Reclamation would develop measures that would detail any requirements needed to mitigate and resolve adverse effects to eligible cultural resources that may result from the implementation of the selected alternative. Reclamation would work in coordination with other involved parties as necessary, depending on the level of mitigation and kinds of resources affected, such as the Tribes, the Washington State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation.

To minimize anticipated impacts to significant cultural resources, the following measures would be implemented as appropriate:

- Because of the potential size and variable land ownership of the APE, Reclamation may enter into a Programmatic Agreement with the affected Tribes, SHPO, and other interested parties in order to meet cultural resource protection goals and objectives, per applicable laws. The Programmatic Agreement would establish a process to ensure the identification, protection, proper treatment, and management of all cultural resources, both documented and yet undiscovered, and to ensure that cultural resources are not inadvertently impacted during implementation to the extent feasible. This plan would include periodic monitoring of identified sites and an "unanticipated discovery" plan, and set forth protocols to be initiated if cultural resources are inadvertently discovered during construction and into the operational phase. The plan would also describe the legal requirements and regulatory protocols to be followed if human remains are encountered during any phase.
- To the extent feasible, facilities would be selected, designed, or modified to avoid identified cultural resources.
- Inventories would be conducted for sited facilities, and any identified resources would be evaluated to determine if they are eligible to the NRHP. If this process results in SHPO/Tribal concurrence, and the cultural properties are determined eligible for inclusion in the NRHP, then additional measures would be required to avoid or mitigate adverse effects. Depending on the resource type, mitigation may include additional historic research or subsurface testing, possible data recovery, large format black–and–white photographic documentation, an ethnographic study, or other measures.
- Prior to construction, the following actions may occur:
  - Conduct informational cultural resource sensitivity training with construction and operations personnel to alert them to the appropriate treatment and protocols for cultural resources encountered during implementation.
  - Require that personnel and equipment be excluded from access to any identified cultural resources.
  - Place protective fencing and other exclusion measures around identified cultural resources to ensure their protection.
- For cultural resource areas or known historic properties that have a potential to be adversely impacted, conduct monitoring on a periodic basis during ground–disturbing activities. Archaeological monitors would be trained in identifying, documenting,

and properly treating cultural resource discoveries, and would be able to direct construction personnel away from sensitive areas.

- A plan would be developed to establish a protocol for responding if cultural resources are inadvertently discovered during project implementation.

Any cumulative impacts to cultural resources are addressed in Section 4.27.

4.23 Indian Sacred Sites

To date, no sacred sites have been identified in the Study Area. However, Reclamation fully acknowledges the potential for the existence of sacred sites in the Study Area. Identification efforts will be made in consultation with the Tribes as areas on Federal lands potentially impacted by the selected alternative are defined. Appropriate measures will be taken to prevent and/or minimize impacts. If a sacred site is identified on Federal Lands affected by the preferred alternative, Reclamation would promote accommodation of access and protect the physical integrity of the site. Reclamation accommodates access to and ceremonial use of Indian sacred sites, and traditional places for gathering resources, on Reclamation land by Indian religious practitioners under Executive Order (EO) 13007 and Reclamation resource management planning.

Legal Requirements and BMPs for Indian Sacred Sites and Indian Trust Assets

No BMPs have been developed, as no sites have yet been identified. However, Reclamation is actively engaged in government–to–government consultation with the affected Tribes. Additionally, Reclamation would comply with all of the laws and regulations pertaining to Tribal rights as listed in Chapter 5 – *Consultation and Coordination*.

4.23.1 Methods and Impact Indicators

Impact indicators for Indian sacred sites are the potential for disturbing or limiting access to such sites.

4.23.2 Alternative 1: No Action Alternative

Under the No Action Alternative, no impacts to Indian sacred sites would occur as a result of this project.

4.23.3 Alternatives 2A, 2B, 3A, 3B, 4A, and 4B including Limited Spring Diversion Scenario

No sacred sites have yet been identified within the project area. Consultations with the potentially affected Tribes are ongoing. If any sacred sites are identified in the course of consultations or during the cultural resources inventory, they will be addressed in consultation with the potentially affected Tribes.

4.23.4 Mitigation

Reclamation's policy is to avoid impacts to sacred sites whenever possible. Additional efforts to identify sacred sites will occur as a part of the cultural resources inventories described in Section 4.22 – *Cultural and Historic Resources*. Consultation with the potentially affected Tribes would identify how to protect sacred sites if they are identified and provide continued access if any such sites that would be affected by construction or operation of the project.

4.24 Indian Trust Assets

Indian Trust Assets (ITAs) that potentially would be affected by the alternatives appear to be limited to fishing, hunting, and gathering rights reserved by the Yakama Nation's 1855 treaty. However, Reclamation has determined that there are no assets held for the benefit of tribes or individual tribal members that would be affected by the alternatives. The vast majority of property impacted by the alternatives would require the purchase of privately owned land. A very small percentage of project facilities would be located on public/Reclamation land. This property would not be considered an ITA since it would not be held in trust for the beneficial use of any Tribe or tribal individual.

None of the alternatives would impact ITA resources as land, minerals, instream flows, water rights, and hunting and fishing rights held in trust by the Federal government.

There are no changes to the above analysis associated with the Limited Spring Diversion Scenario.

4.25 Environmental Justice

The analysis area for environmental justice is primarily rural area and supports agricultural land uses, with few towns. Minority and low–income populations do reside within the environmental justice analysis area, as described in Chapter 3. However, no significant disproportionate impacts on these populations would occur with any of the Study alternatives.

4.25.1 Methods and Assumptions

4.25.1.1 Impact Indicators and Significance Criteria

Construction of the action alternatives would most directly impact those living, working, recreating, or pursuing other activities in the immediate areas. To the extent these are minority or low–income populations, there is potential for disproportionate adverse impacts. The criteria for determining a significant impact in environmental justice is shown in Table 4-132.

Table 4-132. Impact indicator and significant criteria.

Impact Indicator	Significance Criteria
Disproportionate Impacts to Minority or Low–Income Populations	Examples of significant disproportionate effects include substantial construction impacts immediately adjacent to or within minority or low–income populations that surrounding populations would not experience.

Disproportionate Impacts to Minority or Low–Income Populations

Examples of significant disproportionate impacts effects include substantial construction impacts immediately adjacent to or within minority or low–income populations that surrounding population areas would not experience.

4.25.1.2 Impact Analysis Methods

Impacts related to environmental justice that would occur under each of the alternatives are compared against the current conditions within the Study Area.

Environmental justice issues are focused on environmental impacts on natural resources, human health impacts, and potential socioeconomic impacts. In addition to identifying the minority or low–income populations in the Study Area, the following issues were evaluated:

- Are impacted resources used by minority or low–income populations?
- Are minority or low–income populations located in the path of planned facility construction?
- Are minority or low–income populations located in the area of influence of the Study Area?

As explained in Section 3.25 – *Environmental Justice* the analysis area is the Odessa Subarea, plus a 5–mile buffer. This was established as the influence area for the socioeconomics study (Section 4.15 – *Irrigated Agriculture and Socioeconomics*) and represents the extent of potential short– and long–term environmental, human health, and economic impacts to local populations.

4.25.1.3 Impact Analysis Assumptions

Broadly applicable legal requirements are described in Chapter 5 – *Consultation and Coordination*. For the alternative impact analysis, it is assumed that all regulations would be followed, along with the BMPs listed in Section 4.31 – *Environmental Commitments*. After environmental impacts are determined, mitigation measures are applied to compensate for some or all remaining adverse impacts, which are described with the action alternatives and summarized along with the BMPs in Section 4.31 – *Environmental Commitments*.

Legal Requirements and BMPs for Environmental Justice

Federal agencies are required to make achieving environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental impacts of its programs, policies, and activities on minority populations and low–income populations as described in Chapter 5 – *Consultation and Coordination*. No specific BMPs are developed to address environmental justice, but other BMPs listed in Section 4.31 – *Environmental Commitments*, contribute to the protection and well–being of minority and low–income populations.

4.25.2 Alternative 1: No Action Alternative

4.25.2.1 Short–term Impacts

No short–term impacts are anticipated because no new facilities would be constructed under this alternative.

4.25.2.2 Long–term Impacts

Implementation of the No Action Alternative would result in the decline in groundwater availability and water quality. This would affect all domestic, commercial, municipal, and industrial water users located in or near the Odessa Subarea, and possibly the environmental justice analysis area, that rely on groundwater supplies.

A decline in groundwater availability could result in the need to drill deeper wells, thus increasing drilling and pumping costs to provide water for all uses. If drilling and pumping costs increase to the point where people cannot afford the water, this could result in changes in land use, impacts on existing businesses, people relocating elsewhere, and/or health risks to human populations relying on the water. Because minority and low–income populations reside within the environmental justice Study Area, these anticipated impacts could be experienced by these persons. However, the effects are not expected to be disproportionately high or adverse; thus, no environmental justice impact is anticipated.

The primary land use change is expected to be a reduction in irrigated agriculture, which could impact businesses and people linked to the agricultural industry (including, but not limited to, farm workers, food processing facilities, seed and pesticide companies, and trucking companies). Minority or low–income populations associated with these impacted land uses could also then be adversely affected, but these effects are not expected to be disproportionately high or adverse. Therefore, no long–term environmental justice impact is anticipated under the No Action Alternative.

4.25.3 Alternative 2A: Partial—Banks

4.25.3.1 Short–term Impacts

Minority Populations

Of the six census block groups that are defined as minority, all are located south of I–90. However, these six block groups are mostly located outside the area where construction would occur. Any construction impacts relative to noise, traffic, water quality, light and glare, and air quality would be the same as experienced by the rest of the population throughout the Study Area, and would not affect the minority population disproportionately. Therefore, no short–term environmental justice impact is anticipated as a result of constructing Alternative 2A: Partial—Banks.

Low–Income Populations

Improvements and expansion of the East Low Canal fall within census block groups having 0 to 10 percent or 10.1 to 25 percent low–income persons. Construction impacts relative to noise, traffic, water quality, light and glare, and air quality would be the same as experienced by the rest of the population throughout the Study Area, and would not be disproportionate. Therefore, no environmental justice impact is anticipated.

4.25.3.2 Long–term Impacts

No long–term impacts would occur to minority or low–income populations from the presence of proposed facilities in Alternative 2A: Partial—Banks. Ongoing operation and maintenance activities would not result in impacts on such populations.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to environmental justice are anticipated from the Limited Spring Diversion Scenario.

4.25.4 Alternative 2B: Partial—Banks + FDR

Short–term and long–term impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to environmental justice are anticipated from the Limited Spring Diversion Scenario.

4.25.5 Alternative 3A: Full—Banks

Short–term and long–term impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks, except that this alternative includes more facilities and longer construction durations.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to environmental justice are anticipated from the Limited Spring Diversion Scenario.

4.25.6 Alternative 3B: Full—Banks + FDR

Short–term and long–term impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial —Banks.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to environmental justice are anticipated from the Limited Spring Diversion Scenario.

4.25.7 Alternative 4A: Modified Partial—Banks (Preferred Alternative)

Short–term and long–term impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks, except that this alternative includes more dispersed facilities including lands north of I–90.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to environmental justice are anticipated from the Limited Spring Diversion Scenario.

4.25.8 Alternative 4B: Modified Partial—Banks + FDR

Short–term and long–term impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks, except that this alternative includes more dispersed facilities including lands north of I–90.

Changes with Limited Spring Diversion Scenario

No changes to the analysis or impacts to environmental justice are anticipated from the Limited Spring Diversion Scenario.

4.25.9 Mitigation

In the absence of significant environmental justice impacts, no associated mitigation measures are necessary.

4.26 Climate Change

The potential impacts of climate change on the proposed Odessa operations were evaluated using climate change and hydrology datasets that were adopted by BPA, Corps, and Reclamation. These agencies collaborated to develop climate change and hydrology datasets to be used in their longer-term planning activities in the Columbia-Snake River Basin. The datasets development was coordinated through the River Management Joint Operating Committee (RMJOC), which is a subcommittee of the Joint Operating Committee.

Climate change simulations were conducted using global climate (circulation) models (GCMs) selected under the direction of the RMJOC. During this process, future climate change and hydrologic datasets were selected based on GCM type, assumed future GHG emissions, area of interest, and timescale. In addition, both the Hybrid-Delta (step change) and Transient (time evolving) techniques were used.[8] The data were downscaled (from a large coarse scale GCM resolution to a finer resolution scale that was better representative of the geographic area of study (i.e., the Columbia Basin) and bias-corrected (a process in which each GCMs tendencies to simulate past conditions that statistically differ from historical observations [e.g., too wet, too warm] are adjusted). This process is referred to as Bias Correction Spatial Disaggregation (BCSD).

For the RMJOC study, future climate change Hybrid-Delta datasets were selected for two future periods from 2010-2039 and 2030 to 2059. These 30-year periods are also referred to as “centered around” the 2020s and 2040s, respectively. Six scenarios were selected so that a

[8] Bureau of Reclamation, U.S. Army Corps of Engineers and Bonneville Power Administration, 2010. Climate and Hydrology Datasets for Use in the RMJOC Agencies’ Longer-Term Planning Studies: Part 1 – Future Climate and Hydrology Datasets.

range of future climate conditions could be evaluated relative to a simulated historical period from 1950 to 1999.[9] These selected scenarios included:

- Central (C) or the future projection closest to the 50th percentile temperature and 50th percentile precipitation;
- Minimal change (MC) roughly targeting less warming and 50th percentile precipitation;
- More warming and wetter (MW/W) or the future projection closest to the 90th percentile temperature and 90th percentile precipitation;
- Less warming and wetter (LW/W) or the future projection closest to the 10th percentile temperature and 90th percentile precipitation;
- More warming and drier (MW/D) or the future projection closest to the 90th percentile temperature and 10th percentile precipitation; and,
- Less warming and drier (LW/D) or the future projection closest to the 10th percentile temperature and 10th percentile precipitation.

These ranges of temperature and precipitation were generated using two of several future emission forcings available. Emission forcings make assumptions about future emissions based on different economic, technical, environmental, and social developments. The selected emission forcings included A1B, which assumes an average or medium emissions future and B1, which assumes a low emissions future. A more detailed description of the emission forcings can be found in the Special Report on Emissions Scenarios.

Only the data results from the Hybrid-Delta 2040s were selected and incorporated for the Odessa Subarea study. In addition, rather than choosing all six ranges of temperature of precipitation, only three were used in this analysis and include:

- Less Warming and Wetter (LW/W) with lower emissions (CGCM3.2.t47 and emissions scenario B1);
- Central Change (C) and lower emissions (HADCM with emissions scenario B1) ; and,
- More Warming and Drier (MW/D) with higher emissions than the B1 (HADGEM1 with emission scenario A1B).

The resulting hydrology datasets from these three scenarios were obtained from BPA's HYDSIM model results for three locations along the Columbia River including Priest Rapids, McNary, and Bonneville dams.

[9] The ranges were developed by selecting the scenario that was closest to the 90th, 50th and 10th percentile coordinates for change in mean annual temperature and mean annual precipitation over the Columbia River Basin. This enabled 'bracketing' the ranges so a broad range of future projections could be analyzed.

In general, the results showed higher winter-early spring flows and reduced late summer flows. The higher winter flows resulted in higher spring outflows and higher reservoir elevations compared to historical operations. The RMJOC study did not look at changes to evaporation, irrigation demand, cropping patterns, evapotranspiration, or return flows in the Columbia Basin; it only studied the changes to water supply and its impact on reservoir operations. The study recommended further investigations including using a daily model to evaluate the effects that the changing shape of the natural hydrographs would have on water use and flood management.

BPA's HYDSIM modeled flows in the Columbia River were used for analysis of climate change in the Odessa Subarea Special study. The HYDSIM model results using climate change data inputs were compared to the current ESA flow objectives on the Columbia River at Priest Rapids, McNary, and Bonneville dams. The model results cover a 70-year period from 1929-1998 with 14 periods per year (one for each month except for April and August which had two periods per month). Consistent with current state of Washington water law, it was assumed that there was no excess water available during July and August; therefore, no new diversions would occur during these months and diversions were not allowed in September because of concerns raised by the tribes during the review process of this study.

River discharges at Priest Rapids, McNary, and Bonneville dams were modeled for the existing conditions and for each of the climate change scenarios and compared to ESA flow objectives. Figure 4-47 shows by month the number of years out of 70 that water was available in excess of flow objectives on the Columbia River. No water was available in July, August, and September of any year.

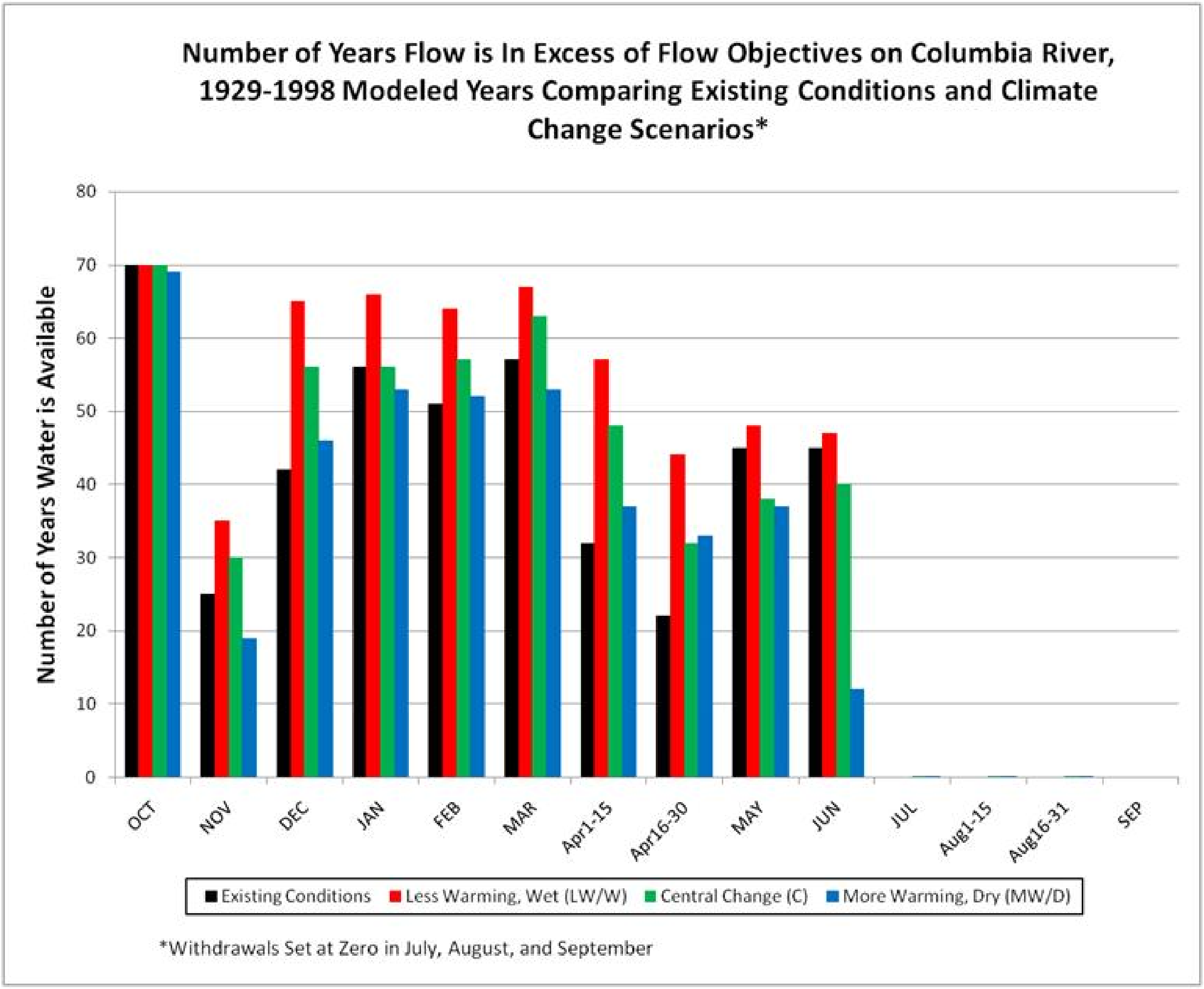


Figure 4-47. Number years flow is in excess of flow objectives on Columbia River for the Odessa Subarea, amount of water is based on exceeding ESA flow objectives at Priest Rapids, McNary and Bonneville dams; 1929-1998 modeled years comparing existing conditions and climate change scenarios; withdrawals were set at zero in July, August, and September.

Figure 4-47 shows that for the LW/W scenario the number of years where there was water available to divert in October through June was increased for the months November through June and was the same as the existing condition with water available all modeled years in October. The C scenario had fewer years with water available compared to existing conditions in January, May and June, more water was available in November, December, February , March, and April. In October, there was water available in all modeled years, which was the same as the existing condition. The MW/D scenario had more years where water was available in December, February, and April when compared to existing conditions, and less water available than existing conditions in all the other months. This scenario had a slight decrease in the number of years where water was available in October, which was different from the other two climate change scenarios.

These results are is consistent with the general pattern in the Pacific Northwest documented in the RMJOC study[10] of more water available in the winter months and less water in the late spring and summer months with climate change.

Figure 4-48 shows the average daily discharges over the period in excess of flow objectives at Priest Rapids, McNary, and Bonneville dams.

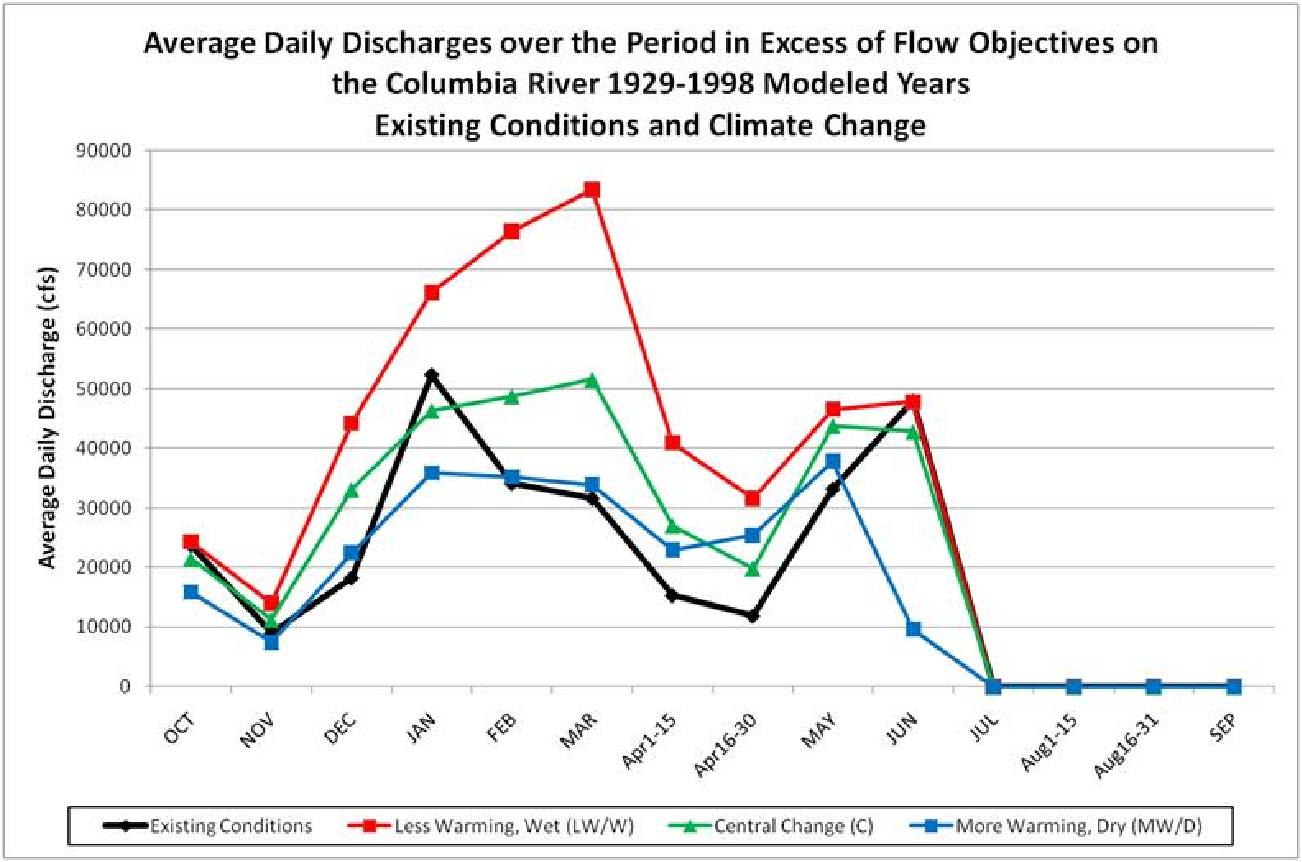


Figure 4-48. Average daily discharges over the period in excess of flow objectives at Priest Rapids, McNary, and Bonneville dams on the Columbia River, 1929-1998 modeled years comparing existing conditions and climate change scenarios.

The excess water above ESA flow objectives on the Columbia River was averaged for each period over 70-years (1929-98). Figure 4-48 shows that for existing conditions the greatest amount of flow available occurs in January with approximately 52,000 cfs average excess flow and in June with approximately 48,000 cfs average excess flow. The lowest amount of excess flow other than July, August, and September occurs in the second half of April with about 11,000 cfs excess flow and in November with approximately 9,000 cfs excess flow.

[10] U.S. Bureau of Reclamation, U.S. Army Corps of Engineers and Bonneville Power Administration, 2010. Climate and Hydrology Datasets for Use in the RMJOC Agencies' Longer-Term Planning Studies: Part 1 – Future Climate and Hydrology Datasets.

When the climate change scenarios were compared to existing conditions, there were generally more or equal volumes of water available in November, December, and February through May and less in January and June thru October. Less water available in October is important since it is a key months for refilling storage at either Banks Lake or Lake Roosevelt. Reducing the amount of water available in October means that under these climate change scenarios there would be less recovery of storage.

When looking at the individual climate change scenarios the LW/W scenario showed a shape of more water being available during the November to June period; the greatest amount of water was available in March with an average daily discharge of approximately 83,000 cfs. The C scenario also showed a different shape than existing conditions with more water being available in the February through May period. The MW/D scenario showed less water being available in January and June and slightly more water available in April and May.

The climate change scenarios that were used in this study showed that the timing of the maximum amount of water in excess of ESA flow objectives is changed when compared to modeled existing conditions. The maximum amount of water in excess of flow objectives would shift from June to the winter and spring months. There is a general trend of more water available above flow objectives in the winter months and less in the summer months with the climate change scenarios. This trend is most obvious with the MW/D scenario.

4.26.1 Uncertainties

This study uses climate change data that reflects the best available datasets and data development methodologies. However, the best available science includes a number of analytical uncertainties that are not reflected in this report's (or in the RMJOC Climate Change Study) characterization of future hydroclimate possibilities. These uncertainties range from the emission forcings used in the GCM to the quality of the hydrologic model that generates flow for use in an agency's reservoir model. There is also uncertainty in which GCM is most likely to reflect future conditions. The reader is encouraged to the Part I Report – Future Climate and Hydrology Datasets of the Climate and Hydrology Datasets for use in the RMJOC Agencies' Longer-Term Planning Studies (Reclamation 2010) to understand the data development and methodologies.

4.26.2 Conclusions

The climate change analysis showed that for the LW/W scenario the number of years where there was water available to divert in October through June was increased or the same when compared to existing conditions. The C scenario had fewer years with the water available in January, May and June, more years where water was available in November, December, February, March and April and the same number of years in October. The MW/C scenario showed more years where water was available in December, February, and April, the same number of years in November, and fewer years where this amount of water was available to divert to the Odessa Subarea in all other months. This analysis indicated that the C and MW/D climatic conditions will decrease the number of years where water could be diverted directly from the Columbia River during the late spring and summer months for irrigation demand forcing the Odessa Subarea to rely more heavily on supplying the full amount from storage. This would result in either irrigation shortages or a deeper drawdown of Banks Lake or Lake Roosevelt and greater refill requirements.

4.27 Cumulative Impacts

Cumulative impacts are the sum of all effects that may result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what public agency or private party in responsible for such other actions (40 CFR 1508.7). Many of the potential cumulative effects associated with the Study Proposed Action are examined under the various environmental elements in Chapters 3 and 4 of this Final EIS. Those analyses discuss the effects of past processes and trends that have cumulatively influenced or led to the resource conditions that exist today. In addition, they examine on-going or imminent actions that are considered to be part of the No Action Alternative and all action alternatives.

The cumulative impacts discussion presented in this section expands on the discussions of past processes, trends, and current actions by focusing on reasonably foreseeable future actions that are not considered part of the No Action Alternative or action alternatives.

A proposal must result in a potential direct or indirect impact in order for a cumulative impact to exist. The Proposed Action would not result in adverse impacts on groundwater resources, water rights, geology, soils, threatened and endangered species, air quality; land and shoreline resources, irrigated agriculture, socioeconomics, transportation, public services, utilities, public health, sacred sites, ITAs, or environmental justice. Thus, the Proposed Action would not contribute to potential adverse cumulative effects for these environmental resource topics, and they are not discussed further. Resources that could experience adverse cumulative impacts include surface water quantity and quality; vegetation and wetlands; wildlife and wildlife habitat; fisheries and aquatic resources; recreation resources; visual resources; cultural and historic resources; energy; and noise.

The following actions have been identified for potential cumulative effects:

- Columbia River Basin Water Management Program and its anticipated component actions (considered as part of the No Action Alternative).
- Lake Roosevelt Incremental Storage Releases (considered as part of the No Action Alternative).

- Coordinated Conservation Program (considered as part of the No Action Alternative).
- 2010 FCRPS BiOp and 2008 Fish Accords (considered as part of the No Action Alternative).
- Groundwater withdrawals of municipalities, communities, and irrigators (considered as part of the No Action Alternative).
- Potholes Supplemental Feed Route Project (considered as part of the No Action Alternative).
- Keys Pump-Generating Plant Modernization Project (a reasonably foreseeable future action examined below).
- Umatilla Basin Aquifer Recovery Project (a reasonably foreseeable future action examined below).
- Yakima River Basin Integrated Water Resource Management Plan (a reasonably foreseeable future action examined below).
- Assured Annual Flood Control provision of the Columbia River Treaty (a reasonably foreseeable future action examined below).

No other ongoing or reasonably foreseeable actions have been identified that would that would contribute to cumulative effects during the same time frame or in the same geographic area as the Study Proposed Action and alternatives.[11]

Keys Pump-Generating Plant Modernization Project

The Keys Pump-Generating Plant Modernization project is an approximately 20-year effort to overhaul and modernize the twelve Keys Pump-Generating Plant pump and pump-generating units that lift water from Lake Roosevelt to Banks Lake. This will make the facility more reliable for its intended purposes. The project will not change the existing protocols for operation of Banks Lake; however, the upgrades may result in more frequent incremental changes in daily reservoir levels as the plant serves its obligations for irrigation, electric load shaping, and balancing energy reserves. Daily changes in reservoir elevations would remain within several inches of what would occur without the proposed equipment upgrade.

[11] Reclamation and Ecology received several comments regarding the Lincoln County Passive Rehydration Project. This project is still early in the investigation process, with several phases of evaluation, assessment, and design remaining to be funded and conducted over the next several years before a final decision would be made regarding potential full implementation. For this reason, it is not considered to be a reasonably foreseeable project or action and has not been included as a potential cumulative impact for this Study.

Umatilla Basin Aquifer Recovery Project

The Umatilla Basin Aquifer Recovery Project would divert water from the Columbia and Umatilla Rivers during times that avoid impact to listed fish species and deliver that water for storage in groundwater aquifers to improve long-term water supply needs for local irrigation water supplies and instream flows. Because the project will meet the Columbia River flow objectives as a constraint of its implementation, it would not contribute to cumulative impacts on the Columbia River species of concern.

Yakima River Basin Integrated Water Resource Management Plan

The Yakima Integrated Water Resource Management Plan (Integrated Plan) is a $3 to $5 billion, 30-year program of investments intended to address a variety of water resource and ecosystem issues affecting fish passage and habitat and agricultural, municipal, and domestic water supplies in the Yakima River basin. The Plan's seven elements include projects and improvements related to reservoir fish passage above five existing reservoirs; modifying existing structures and operations to improve flows, fish bypass, and smolt outmigration; added surface water storage of approximately 530,000 acre-feet to supply instream and out-of-stream flows to meet agricultural, municipal, and domestic needs; groundwater storage using surface water to recharge aquifers and store water for later withdrawal and use; targeted habitat and watershed protections and enhancements; enhanced agricultural, municipal, and domestic water conservation programs; and reallocation of water resources through market mechanisms.

Columbia River Treaty

Since 1964, the Columbia River Treaty (CRT) has provided valuable benefits to the U.S. and Canada through coordinated river management by the two countries. When the CRT was negotiated, its goals were to provide significant flood control and power generation benefits to both countries. Within the terms of the CRT, the U.S. purchased 60 years of dedicated flood control space in Canadian reservoirs. This purchased flood control space expires September 16, 2024, although the other provisions of the CRT can remain in effect. Unless the provisions related to flood control are continued beyond 2024 through renegotiation, the existing coordinated plan that regulates both Canadian and U.S. projects for flood control would be replaced by operations under which the U.S. would have to call upon Canada if flood control assistance was needed. The U.S. could request this "called upon" assistance as necessary, but only to the extent needed to meet forecasted flood control needs in the U.S. that cannot be adequately met by U.S. projects. When called upon storage is requested, the U.S. would then be required to pay Canada for its operational costs and any economic losses resulting from the called upon flood control operation.

While the remainder of the CRT has no specified termination date, both Canada and the U.S. have the option to terminate most of its provisions on or after September 16, 2024, with a minimum of 10 years advance notice. Thus, the earliest potential notice of termination would be September 16, 2014, with September 16, 2024 being the earliest termination could take effect. Unless the CRT is terminated or the Federal governments agree to modify the CRT, its provisions continue indefinitely except for the changes in flood control discussed above.

Implementation of called upon flood control appears likely to cause changes to Canadian and U.S. reservoir operations that might have substantial effects on other operating objectives. With termination of the CRT, British Columbia could operate its Mica, Arrow, and Duncan reservoirs as it desires, except that provisions for called upon flood control storage continue, the Boundary Waters Treaty applies, and the provisions for Libby coordination and Kootenay River diversion options continue. Absent new agreements, Mica and Duncan reservoirs likely would continue to be operated for power and flood control generally similar to today's operation. Arrow's operation is expected to be quite different with higher reservoir elevations and a more constant level of outflows, although called upon flood control could occasionally require significant draft of Arrow in the winter. U.S. reservoirs within the Columbia River system including Lake Roosevelt, among others, could experience much deeper drafts in the winter to provide flood storage capacity that previously had been provided primarily by the Canadian projects. The U.S. would be relieved of the Canadian Energy Entitlement obligation, but the expected changes in storage operations, and the uncertainty in that operation, could cause the U.S. to compensate by acquiring additional generation or storage resources and operate U.S. projects differently. Nevertheless, the expected operation of Canadian storage for power, flood control, and other purposes would continue to produce substantial U.S. power and flood control benefits.

The flood storage and termination provisions, and changing needs and desires for hydropower, fish, recreation, and other water uses, make the future of the CRT uncertain. The Corps and BPA, the agencies that assist the U.S. Entity that implements the CRT in the U.S., have begun a multiyear effort to review the Treaty process to better understand the implications for post-2024 Treaty planning and Columbia River operations. This effort is called the 2014/2024 Columbia River Treaty Review. Phase One joint technical studies published in July and September 2010 provided fundamental information on potential post-2024 conditions related to power and flood control. Early results of recent Phase II studies indicate that Called Upon flood control needs are less than indicated in the Phase One study. However, all studies to date are preliminary, and as indicated by the current status of the CRT review process, any attempt to make further assessments of potential cumulative impacts related to renegotiation or termination of the CRT is premature and would be highly speculative.

4.27.1 Surface Water Quantity

The Umatilla Basin Aquifer Recovery Project will reduce flows in the Columbia River in combination with the Proposed Action by diverting water from the Columbia and Umatilla Rivers. After full implementation, the aquifer recovery project could divert from 80,000 to 120,000 acre-feet of Columbia River water annually during winter months. In addition, modeling conducted for the Yakima River Basin Integrated Plan indicates that on average, Yakima River flows at the Columbia River would decline less than 1 percent.

The potential conversion in 2024 of the Columbia River system flood control reservoirs to called-upon flood control operation would likely result in more frequent and substantially greater annual drawdowns of Lake Roosevelt than would occur under the Columbia River Water Management Program or the Study Proposed Action. This could adversely affect irrigation water supplies in some years (Columbia River Water Management Program Final Programmatic EIS Ecology 2007). Because this eventuality is still more than 10 years away, there is not sufficient reliable information available to describe potential effects or their magnitude with reasonable confidence.

4.27.2 Vegetation and Wildlife Habitat

The Study Proposed Action could contribute to cumulative impacts on rare plants and losses or fragmentation of shrub-steppe habitat and other native communities if conversion of the Columbia River system flood control reservoirs to called-upon flood control operation leads to replacement of the lost Columbia River hydroelectric generation capacity with other forms of power generation. The other forms of replacement power generation such as hydro, solar, wind, or combustion-fired turbine, among others, could disturb, fragment, or consume additional habitat, although the extent of these combined losses above those described previously for the Study Proposed Action in Chapter 4 is not able to be estimated. Shrub-steppe habitat in the Columbia River Basin already has declined by over 50 percent from historic levels through agricultural and other development (Ecology 2007). Increased loss of shrub-steppe habitat could further impact associated plant species and communities that are already in decline.

The Keys Pump-Generating Plant Modernization is the only cumulative action that would affect reservoir elevations at Banks Lake. The reservoir water levels are linked to potential impacts on western grebes and other migratory bird populations that rely on the fringe wetland habitats for nesting. With the potential changes in plant operation enabled by the proposed modernization, there could be minor increases in daily fluctuations in reservoir elevations but no addition to anticipated drawdowns (*John W. Keys III Pump-Generating Plant Modernization Project Environmental Assessment and Finding of No Significant Impact*, Reclamation 2012). The combined effect of the Keys Pump-Generating Plant and Study Proposed Action on Banks Lake elevations would be within a few inches of the upper and lower levels that would occur as a result of the Proposed Action alone; thus, the cumulative effects on western grebes and other migratory bird nesting habitat and success would be the same as discussed in Chapter 4.

4.27.3 Fisheries and Aquatic Resources

Adverse impacts on fisheries and aquatic resources at Banks Lake reservoir would arise from the substantial temporary drawdowns under Alternative 3A and less sever drawdowns under Alternative 4A. These drawdowns would increase exposure of littoral zones, reduce habitat availability for various life stages of fish, force fish out of the cover of aquatic macrophytes for an extended period of time, shift zooplankton production, and increase fish and zooplankton entrainment. With the potential changes in Keys Pump-Generating Plant operation enabled by the proposed modernization, there could be minor increases in daily reservoir fluctuations; but no addition to anticipated drawdowns would occur. The combined effect of the Keys Pump-Generating Plant and Study Proposed Action on Banks Lake elevations would be within a few inches of the upper and lower levels that would occur as a result of the Proposed Action alone; thus, the cumulative effects on fisheries and aquatic resources would be the same as discussed in Chapter 4.

The Umatilla Basin Aquifer Recovery Project will meet the Columbia River flow objectives as a requirement of its implementation and will not add to cumulative impacts on the Columbia River species of concern. The Yakima River Basin Integrated Plan will contribute positively to fishery resources and populations in the Yakima River basin, including species of concern by improving flows for fish passage and rearing, opening up currently closed areas and improving physical habitat. Impacts in the Columbia River would include very slight reduction in flows as flows in the Yakima River are reduced in the winter and spring with estimated April to September flow reductions of 50-70,000 acre-feet.

4.27.4 Recreation Resources

With the potential changes in operation of the Keys Pump-Generating Plant enabled by the proposed modernization, there could be minor increases in daily fluctuations in reservoir elevations at Banks Lake. The combined effect of the Keys Pump-Generating Plant and Study Proposed Action on daily changes in elevations would be within a few inches of the upper and lower levels that would occur as a result of the Proposed Action alone; thus, the cumulative effects on recreation resources, opportunities, access, and boating hazards at Banks Lake would not be meaningfully different than the effects discussed previously for the Study Proposed Action in Chapter 4.

The diversions from Lake Roosevelt under the Study Proposed Action in combination with the potential conversion in 2024 of the Columbia River system flood control reservoirs to called-upon flood control operation would result in more frequent and substantially greater annual drawdowns of Lake Roosevelt. The potential magnitude of the cumulative effect on recreation resources, opportunities, and access to boat launches and marinas on Lake Roosevelt is unknown because the new operating parameters for the Columbia River system are not yet known. However, the cumulative adverse effect would be substantially greater than the relatively small contributions of any of the Study action alternatives described in Chapter 4.

4.27.5 Energy

Cumulative impacts to energy resources would include potential annual reductions in hydroelectric generation. Increased water deliveries within the Yakima River basin associated with the Yakima River Basin Integrated Plan would cause a reduction in the amount of hydropower generated at dams on the Columbia River below the confluence of the Yakima River, specifically McNary, John Day, The Dalles, and Bonneville Dams. The Umatilla Basin Aquifer Recovery Project would result in reduced hydropower generation at the same dams, excepting McNary.

In addition, potential conversion in 2024 of the Columbia River system flood control reservoirs to called-upon flood control operation would likely result in reduction in hydropower generation at Grand Coulee and all other downstream hydroelectric facilities identified above. The extent of these combined reductions cannot be estimated with reasonable confidence at this time, but the contribution to the overall cumulative effect by any of the Study action alternatives likely would be very small by comparison. Local electric service providers would be minimally affected because the increase in energy demand from surface water pumping is expected to be offset by the system surplus through BPA from reduced groundwater withdrawals.

When not needed to provide system balancing reserves, the modernized Keys Pump-Generating Plant with increased pump-generating reliability and flexibility may be able to support periods when additional power generation is needed.

4.27.6 Visual

Potential changes in operation of the Keys Pump-Generating Plant enabled by the proposed modernization could lead to minor increases in daily fluctuations of water levels at Banks Lake reservoir. The combined effect of the Keys Pump-Generating Plant and Study Proposed Action would be within a few inches of the upper and lower levels that would occur as a result of the Proposed Action alone; thus, the cumulative effects on visual resources at Banks Lake would not be perceptibly different than described for the Study Proposed Action in Chapter 4. The effects on views of Lake Roosevelt that would result from increased annual drawdowns associated with potential conversion of the Columbia River system flood control reservoirs to called-upon flood control operation could be substantial. However, the actual effect cannot be reasonably estimated based on the limited information that is available.

4.27.7 Cultural and Historic Resources

The combined effect of the Keys Pump-Generating Plant and Study Proposed Action on elevations of Banks Lake reservoir would be within a few inches of the upper and lower levels that would occur as a result of the Proposed Action alone; thus, the cumulative effects on exposure of cultural resources at Banks Lake would be the same as described for the Study Proposed Action in Chapter 4.

4.28 Unavoidable Adverse Impacts

Unavoidable, significant adverse impacts are defined as those that meet the following two criteria:

- No reasonably practicable mitigation measures exist to eliminate the impacts.
- No reasonable alternatives to the proposal would meet the purpose and need of the action, eliminate the impact, and not cause other or similar significant adverse impacts.

Based on the analysis of environmental consequences, the following topics or resource areas contain unavoidable adverse impacts related to the action alternatives:

- **Soils**. Impacts subject to the FPPA would be unavoidable but self mitigation.
- **Wildlife and Wildlife Habitat**. The full replacement alternatives would have significant impacts on shrub-steppe habitat and special status species. Wildlife movement barriers created by canal construction under both full replacement alternatives would have significant impacts. Similarly, both full replacement alternatives would cause significant effects because of shrub-steppe habitat fragmentation. Small populations of some species isolated by canals would be more susceptible to local die-off from stochastic events. Grebe nesting would be impacted at Banks Lake under all alternatives.
- **Land Use and Shoreline Resources**:
  - All action alternatives would require significant federal acquisition of private land interests (easements and fee title). The full replacement alternatives would involve substantially more of such acquisition compared with the partial replacement alternatives.

- Both partial replacement alternatives would result in major changes to land use in the Study Area north of I–90; it is expected that at least 85 percent groundwater–irrigated agricultural land would be transformed into dryland farming conditions.
- All action alternatives would involve displacement of occupied structures (primarily residences). In order from the fewest to the highest number of displacements, the alternatives rank as follows:
    1. Partial replacement alternatives consisting of Alternative 2A: Partial—Banks, Alternative 2B: Partial—Banks + FDR, Alternative 4A: Modified Partial—Banks (Preferred Alternative), and Alternative 4B: Modified Partial –Banks + FDR.
    2. Full replacement alternatives consisting of Alternative 3A: Full—Banks, and Alternative 3B: Full—Banks + FDR
- All action alternatives would take agricultural land out of production and interfere with operation of existing irrigation systems (predominantly center pivots). In order of relative severity, expressed both in acreage impacted and number of center pivots impacted, the alternatives rank as follows, from least to most impact:
    1. Partial replacement alternatives consisting of Alternative 2A: Partial—Banks, and Alternative 2B: Partial—Banks + FDR, Alternative 4A: Modified Partial—Banks (Preferred Alternative), and Alternative 4B: Modified Partial –Banks + FDR.
    2. Full replacement alternatives Alternative 3A: Full—Banks, and Alternative 3B: Full—Banks + FDR
- The partial replacement alternatives would be inconsistent with County Comprehensive Plan designations, goals and/or objectives related to protection of irrigated agriculture in the Study Area north of I-90 in that most of the lands would go out of irrigated cropland status.

- **Recreation (all impacts related to Banks Lake):**
    - All action alternatives would have significant impacts on fishing and recreation sites along the reservoir shore generally related to “distance to shore” impacts due to additional reservoir drawdowns.
    - All action alternatives would have impacts upon boat ramps. These impacts would range from minor to unusable for a portion of the summer recreation season. In addition, during specific periods of the summer boat ramps would have limited launch ability due to the shallow slope of the ramp and the shallow water at that ramp. However, at no time and under no alternative during the recreation season would Banks Lake be inaccessible to the boating public.
- **Energy:**

  - Under the actions alternatives drawdowns at Banks Lake would affect generation at the Keys Pump-Generating Plant. Losing the ability to generate at Keys Pump-Generating Plant during the months of August and September removes BPA's existing ability to utilize these generators for meeting peak loads. This is an unavoidable impact.

- **Visual:**
  - The partial replacement alternatives serving lands south of I-90 only, would result in a significant, landscape–level change in visual quality the irrigated parts of the Study Area north of I-90; the extent to which this change is considered adverse depends on the perspective of viewers.
  - All action alternatives would result in localized significant adverse visual impacts from the introduction of major new infrastructure. This impact would primarily result from such prominent features as the regulating tanks associated with the pumping stations. In the partial replacement alternatives serving only lands south of I-90, the impact would be limited to areas south of I–90; in the full and modified partial replacement alternatives, the impact would occur both north and south of I-90.
  - Alternative 3A: Full—Banks, 4A: Modified Partial —Banks, and 4B: Modified Partial—Banks + FDR would result in a significant adverse impact to visual quality in the Banks Lake environment during August and September of average water years from reservoir drawdowns.

- **Cultural Resources:**
  - All action alternatives would likely involve disturbance to significant cultural resources. This impact would be associated with both development of new facilities or expansion of existing facilities and additional drawdowns of Banks Lake. While mitigation is possible in the form of such actions as excavation, documentation, and/or relocation, the impact on resources would still be considered significant. In general, the potential magnitude of these impacts is higher for the full replacement alternatives. Impacts for the modified partial replacement and partial replacement alternatives would be less and similar except in a drought year when Alternative 4A would see a deeper drawdown and more impacts. This is because the full replacement alternatives would involve considerably more development of new linear and site facilities. Both Alternatives 3A and 4A would result in deeper drawdowns at Banks Lake in drought years with the drawdown with Alternative 3A being almost 10 feet more. In average water years, the drawdowns for all alternatives would be about the same except for Alternative 3A.

4.29 Relationship between Short–term and Long–term Productivity

NEPA requires considering “the relationship between short–term uses of man’s environment and the maintenance and enhancement of long–term productivity” (40 CFR 1502.16). Long–term productivity refers to the capability of the land to provide market outputs and amenity values for future decades. The quality of life for future generations is linked to the capability of the land to maintain its productivity.

To varying degrees, all partial, full, and modified partial replacement alternatives would implement ground–disturbing activities that would produce short–term and long–term impacts. Impacts would be expected to soil, vegetation and wetlands, wildlife and habitat, the Banks Lake fishery, land use, recreation, and visual resources. However, the action alternatives would also provide the long–term benefit of reducing or eliminating use of groundwater pumping for irrigation.

4.30 Irreversible and Irretrievable Commitments of Resources

An irreversible commitment is a permanent resource loss, including the loss of future options under action alternatives. These commitments are removed by an alternative without the option to renew these resources (such as spent time and money). These commitments usually apply to nonrenewable resources, such as minerals, or to factors that are renewable only over long periods, such as soil productivity.

An irretrievable commitment is the loss of use or production of a natural resource for some time. These commitments are used by an alternative. For example, if suitable wildlife habitat is being used for a reservoir, habitat growth or productivity is lost while the land is a reservoir but, at some point in time, could be revegetated. These commitments would include any constructed feature of an alternative for the life of that constructed feature. Table 4-133 presents a summary of irreversible and/or irretrievable commitments.

Table 4-133. Irreversible and irretrievable commitment of resources.

Resource	Alternatives 2A and 2B Partial Replacement	Alternatives 3A and 3B Full Replacement	Alternatives 4A and 4B Modified Partial Replacement
Materials, labor, and energy needed to construct the project represented by total project cost (million $).	Approximately $780.4	Approximately $2,785.5	Approximately $827.5
Materials, labor, and energy consumed in O&M of the project annually represented by the total annual O&M cost.	Approximately $6.6	Approximately $15.0	Approximately $7.9
Direct land uses (total acreages for reservoirs, canals, pipelines, pumping plants, switchyards, and other above–ground features)	2A: 5,240 acres 2B: 4,820 acres	3A: 17,632 acres 3B: 15,813 acres	4A: 6,221 acres 4B: 5,442 acres

4.31 Environmental Commitments

Environmental commitments are measures or practices adopted by a project proponent to reduce or avoid adverse affects that could result from project operations. The following list summarizes major environmental commitments for the Odessa Subarea Special Study. These commitments are "action" specific, therefore it is appropriate to include within an array of documents including but not limited to construction contracts, management agreements with resource agencies, water contracts, and management plans. In addition, Reclamation, Ecology, and WDFW have entered into a Memorandum of Understanding (Appendix C) that will facilitate coordination and communication concerning these mitigation measures and environmental commitments; Reclamation and Ecology share the responsibility to ensure obligations to protect natural resources are fulfilled.

The scale of which these mitigation measures and commitments will be implemented will likely occur in phases and are dependent of what actions are being undertaken by Reclamation and Ecology.

1. Prior to initiation of each phase of design and construction, Reclamation and Ecology will determine, in consultation with WDFW and USFWS, if terrestrial, plant, and

fisheries surveys will need to be conducted along proposed alignments for pipelines, facilities, roads, and distribution and transmission lines.

2. Reclamation will hold pre-construction meetings with all contractors to ensure that there is clear understanding of all environmental commitments associated with the construction activity.

3. Reclamation will acquire lands when appropriate and financially feasible, in geographic lows (coulees) to indirectly enhance wildlife habitat.

4. Reclamation and Ecology will consult with WDFW to establish a “Banks Lake Grebe Management” area and provide and maintain floating nesting structures to mitigate impacts to grebes on Banks Lake.

5. Should Alternatives 3A or 3B advance to implementation, the Black Rock Coulee Flood Storage Area has potential for significant impacts to Washington ground squirrels from inundation. In addition, excavation work to construct the East High Canal alignment will likely disturb Washington ground squirrel colonies. Should the EHC become the selected alternative, Reclamation and Ecology will coordinate with the Service and WDFW to identify suitable Washington Ground Squirrel habitat as target locations for translocation and develop translocation protocols to maximize success.

6. Install clusters of artificial burrowing owl nesting boxes in the banks of the East High Canal (south of Black Rock Coulee) and in the East Low Canal expansion and extension sections where appropriate.

7. Reclamation and Ecology will work with WDFW to identify and acquire lands, particularly within the Black Rock Coulee area if reasonable and feasible, and if the area is not selected for development, acquired lands would serve as an important component to mitigate for shrub–steppe habitat impacts associated with all Action Alternatives. Mitigation will be commensurate with the level of impacts. WDFW would be required to manage these lands for Reclamation under an existing management agreement.

8. In cooperation with the USFWS and WDFW, develop and implement a Native Plant Restoration and Conservation Management Plan as a means to mitigate impacts to upland and grassland habitats impacted by all Action Alternatives for a minimum of 7 years to monitor success.

   The plan should include but is not limited to:

   a. Clear goals, objectives, performance criteria, and an implementation schedule.

b. Provisions for reporting and evaluation of the success of native plant restoration and conservation. Part of the provisions will be to provide results to the USFWS to assist with recovery efforts of candidate, special interest, threatened and endangered species and their habitat, particularly pygmy rabbit, sharp–tailed grouse, and greater sage grouse habitats; WDFW special status species include Washington ground squirrels, black and white–tailed jackrabbits, American badger, and mule deer.

9. Reclamation and Ecology will coordinate with WDFW if infill as identified in Section 2.6 – *Modified Partial Replacement* lands occur to reduce impacts and identify adequate mitigation.

10. Reclamation and Ecology will work with WDFW to develop wetland projects to mitigate wetland impacts at Banks Lake. Specific projects, if feasible may include but are not limited to:

    a. Construct water turnouts within irrigation delivery systems within the Odessa Subarea Study Area for all action alternatives to facilitate, where ecologically appropriate, wetland establishment and/or expansion to existing wetlands to promote wildlife use and recreational opportunities. WDFW would be required to manage these lands for Reclamation under an existing management agreement.

    b. Enhance open–water habitat for waterfowl through the removal of invasive plants.

11. Reclamation will coordinate with irrigation districts, Ecology, and WDFW to locate water turnouts within irrigation delivery systems to facilitate, where ecologically appropriate, wetland establishment and/or expansion to existing wetlands to promote wildlife use and recreational opportunities within the Odessa Subarea Study Area.

12. Reclamation will coordinate/communicate flow management with the Columbia National Wildlife Refuge to the extent possible.

13. Ecology and WDFW agree that impacts to the fishery in Banks Lake present uncertainty. Ecology[12] and WDFW will develop an adaptive management plan to monitor and evaluate the Banks Lake fishery to avoid reasonably avoidable loss to recreational fishing opportunities and local economic activity generated by the Banks Lake fishery. WDFW, in consultation with Reclamation, would have responsibility for implementing fishery measures. The plan will include but is not limited to:

    a. Monitor reservoir and lake primary and secondary productivity (zooplankton) to evaluate fishery effects in Banks Lake for 5 consecutive years following operational changes and every 3 years for the life of the project;

[12] Per letter sent on January 28, 2011 to WDFW from Ecology to commit to, in good faith effort, providing funding and support to WDFW for the protection of natural resources within the Odessa Subarea using an adaptive management program.

b. Conduct creel surveys for 5 consecutive years following operational changes to assess any changes in annual angler effort, harvest, and catch and every 3 years for the life of the project;

c. Monitor warm water fish entrainment out of the irrigation delivery systems within the Odessa Subarea into the mid–Columbia River for 2 consecutive years to ensure protection of ESA listed spring Chinook salmon and threatened steelhead salmon;

d. Adapt fishery management actions in response to new conditions, including but not limited to changes in fish stocking strategies, system rehabilitation, and changes to fishing rules for the life of the project and;

e. Evaluate, and if feasible, implement a strategy to “boost” the kokanee fishery in Banks Lake;

f. Monitor changing reservoir conditions, including temperature and flow to evaluate changes to fish assemblages, spawning habitat, and entrainment rates and;

g. Report findings and recommendations for 5 consecutive years and every 3 years for the life of the projects to internal WDFW fish management staff, Reclamation, USFWS (Central Washington Field Office), and Ecology.

14. Reclamation will, in consultation with USFWS, incorporate *Mitigating Bird Collisions with Power Lines: The State of the Art in 1994* into construction designs and power line siting.

15. Reclamation’s policy is to seek to avoid impacts to historic resources whenever possible. Upon issuance of a Record of Decision on the project and prior to construction of a given feature, an intensive cultural resources survey of the APE will be conducted to specifically identify any cultural resources that may be affected by this action (Section 4.22.9). If an action is planned that could adversely affect a National Register of Historic Places (NRHP) -eligible archeological, historical, or traditional cultural property site, then Reclamation would investigate options to avoid the site. If avoidance is not possible, protective or mitigative measures would be developed and considered. Cultural resources management actions would be planned and implemented consistent with consultation requirements defined in 36 CFR 800, using methods consistent with the Secretary of the Interior’s Standards and Guidelines.

Current BMPs will be implemented, when appropriate, to enhance resource protection and avoid additional, potential affects to surface and groundwater quality, geology, soils, fish, wildlife, and their habitats, including:

1. Haul oils or chemicals to an approved site for disposal and use vegetable–based lubricants machinery when working in or near water to prevent petroleum products from entering surface or groundwater.

2. A Stormwater Pollution Prevention Plan (SWPPP) will be generated by the contractor(s) and implemented per Washington State Department of Ecology's rules and regulations. The plan should include erosion control methods, stockpiling, site containment, shoreline protection methods, equipment storage, fueling, maintenance, and washing, and methods to secure a construction site under circumstances of an unexpected high water or rain event.

3. Contractors will be required, where appropriate, to use the Integrated Streambank Protection Guidelines (WDFW 2003) to assist with bank stabilization.

4. Construction activities will be scheduled to avoid the breeding period of Federally-protected species. Where practicable, construction activities will be scheduled to avoid the breeding period of all native and special status species.

5. Construction equipment would be equipped with environmental spill kits to contain petroleum products in the event of a leak.

6. All necessary local, State, and Federal permits will be obtained.

7. All contractors will be required to have a Spill Prevention Plan and a Toxics Containment and Storage Plan.

8. Canal construction activities would be conducted outside of the irrigation season to avoid in–water work.

9. A spill plan would be developed to implement containment of construction materials such as treated woods, contaminated soils, concrete, concrete leachate, grout, and other substances that may be deleterious or toxic to fish and other aquatic organisms.

10. A plan to implement safe handling and storage of potentially toxic construction materials, fuels, and solvents would be developed for staging sites in close proximity to receiving waters and riparian areas.

11. Stockpiles of earthen materials would be strategically placed to minimize runoff into nearby receiving waters.

12. Utilized earthen materials excavated within reservoir footprint for dam construction when possible.

13. Gravel pits and rock quarries will be sited in areas with stable side slopes to ensure safety and minimize erosion.

14. Methods such as ripping will be used to reduce soil compaction prior to reseeding efforts.

15. Reclamation and Ecology will require all contractors to inventory noxious weed populations by marking with temporary fencing to avoid spreading weeds to other areas in accordance with local, State, and Federal weed control requirements.

16. Reclamation and Ecology would continue with ongoing weed control efforts on disturbed lands following construction and revegetation in accordance with local, State, and Federal laws.

17. Signage will be placed on the “tailings” piles (stockpiles) to alert people not to take soil from the site.

18. Borrow pits should be designed in areas that limit impacts to terrestrial wildlife and should be monitored to assure water collected in the pits is not contaminated.

CHAPTER 5 COORDINATION AND CONSULTATION

Chapter 5 CONSULTATION AND COORDINATION

5.1 Introduction

This chapter describes public involvement, consultation, and coordination activities conducted by Reclamation and Ecology to date. Also described are actions and regulatory compliance activities that occur either during the NEPA/SEPA process or later if a decision is made to pursue one of the action alternatives. Public involvement activities would continue throughout any future phases of planning and implementation.

5.2 Public Involvement

Public involvement allows interested and affected individuals, organizations, agencies, and governmental entities to be consulted and included in the decision-making process. In addition to providing information to the public regarding the Study and EIS, Reclamation and Ecology also solicited responses regarding the public's needs, values, and evaluations of the proposed alternatives. Public participation and input has been encouraged and used in preparing this Final EIS.

5.2.1 Scoping Process

The scoping process for this Study was initiated in August 2008. On August 21, 2008, a Federal Notice of Intent to prepare an EIS and to conduct public scoping meetings was published in the Federal Register; Ecology issued a Determination of Significance and a request for comments on the scope of the EIS; and Reclamation sent an e-mail message to 190 mailing list recipients announcing that the Study Update was available on the Study website (http://www.usbr.gov/pn/programs/ucao_misc/odessa).

On August 25, 2008, Ecology provided notice of scheduled public scoping meetings to subscribers of its e-mail list for the Columbia River Basin Water Management Program. On August 26, 2008, Reclamation mailed copies of the Study Update, which included notification of the scoping process and meetings, to 243 mailing list recipients. Reclamation issued a news release to local media on September 2, 2008. On September 4, 2008, Ecology provided a reminder notice to subscribers of its e-mail lists, including those for the Columbia River Basin Water Management Program and the Reclamation Yakima River Basin Water Storage Feasibility Study. The Notice of Intent, Determination of Significance, news releases, and meeting notice are attached to the Scoping Summary Report (Appendix B). The Scoping Summary Report is available upon request or can be accessed from the Odessa Special Study web site (http://www.usbr.gov/pn/programs/ucao_misc/odessa).

The purpose of scoping includes the following:

- Identifying the significant issues relevant to the Proposed Action.
- Identifying those elements of the environment that could be affected by the Proposed Action.
- Formulating alternatives for the Proposed Action.

5.2.1.1 Public Scoping Meetings

Reclamation and Ecology hosted two evening public scoping meetings, one at the Town of Coulee Dam Town Hall, Coulee Dam, Washington, on September 10, 2008, and one at the Advanced Technologies Education Center, Big Bend Community College, Moses Lake, Washington, on September 11, 2008. About 55 people attended the two scoping meetings. At the meetings, Reclamation and Ecology presented the proposed alternatives and an overview of the NEPA/SEPA process and provided opportunities for the public to identify issues and concerns associated with the Study.

5.2.1.2 Comments and Other Information Received from the Public

In addition to comments received at the scoping meetings, written comments were accepted through September 19, 2008. Including those from the scoping meetings, 33 written comment documents were received. The documents included two requests to be added to the mailing list with no comments and one request to be removed from the mailing list for this Study. Substantive input ranged from brief comments or questions to detailed statements. Comments about how each of the resources should be analyzed led to the development of the indicators used to evaluate the effects of the alternatives on the resources.

Scoping comments can be grouped into five major categories: Odessa Subarea facilities and operation; natural resources; recreation and tourism; socioeconomics; and Tribal and environmental justice concerns. Many comments were quite broad and overlapped these categories. Major comments included the following:

- Facilities and Operation: effects of water withdrawal on Columbia River flows and reservoir operations; potential for water conservation measures and use of reclaimed water and conversion to dryland farming as alternatives; options for off-channel storage; hydropower losses because of additional water withdrawals; and use of a phased approach to implementation.

- Natural Resources: effects of changes in Columbia River flows and reservoir operations on fish and wildlife, loss of wildlife habitat, and blockage of wildlife migration and local movements.
- Recreation and Tourism: effects of changes in reservoir operations on recreation, tourism, and boater safety at Banks Lake.
- Socioeconomics: exploration of various repayment options, preparing a thorough benefit-cost analysis, and exploring the economic effects of reduced tourism at Banks Lake.
- Tribal Concerns and Environmental Justice: role of the Tribes in the project and Tribal influence; impacts on environmental justice.

5.2.2 Public Meetings and Review of Draft EIS

Publication and distribution of the Draft EIS on October 26, 2010, began a 60-day public review and comment period; a 30-day extension was subsequently added. Written comments were submitted to Reclamation and Ecology throughout this period, which ended on January 31, 2011. Also during this period, Reclamation and Ecology held public hearings on November 17 and 18, 2010, to gather oral and written comments.

Upon completion of the extended review period and as part of preparing this Final EIS, Reclamation and Ecology responded to the over 1,000 comments received.

5.2.3 Other Meetings Held with Interested Parties

Other meetings held to provide information and answer questions about the Odessa Subarea Special Study, both prior to and during the NEPA/SEPA process, are listed in Table 5-1.

Table 5-1. Meetings held with interested parties.

Date of Meeting	Meeting With	Location
February 22, 2006	Public	Big Bend Community College, Moses Lake, Washington
October 11, 2006	Public	Big Bend Community College, Moses Lake, Washington
June 6, 2007	Columbia River Policy Advisory Group	Yakima, Washington
October 4, 2007	Colville Business Council, Colville River Water Management Program	Omak, Washington
October 23, 2007	Public	Big Bend Community College, Moses Lake, Washington
November 15, 2007	Washington Department of Fish and Wildlife	Ephrata, Washington
December 4, 2007	Confederated Tribes of the Colville Reservation	Nespelem, Washington
March 1, 2008	Public	Coulee Corridor Big Event
March 26, 2008	Grand Coulee History and Columbia River Management Program	Coulee City, Washington
September 2, 2008	Ephrata Lions Club	Ephrata, Washington
September 10, 2008	Public Scoping Meeting	Coulee Dam, Washington
September 11, 2008	Public Scoping Meeting	Moses Lake, Washington
October 3, 2008	American Society of Farm Managers and Rural Appraisers	Moses Lake, Washington
October 7, 2008	Confederated Tribes of the Colville Reservation, Colville Indian Agency	Nespelem, Washington
October 28, 2008	WSU Tri-Cities ES/RP590 Class	Richland, Washington
November 6, 2008	Columbia Basin Development League	Moses Lake, Washington
January 22, 2009	Columbia Basin Crop Consultants Association	Ephrata, Washington
January 22, 2009	Columbia Basin Railroad	Yakima, Washington
February 12, 2009	Public	Coulee City Firehall, Coulee City, Washington
February 18, 2009	Columbia Basin Development League	Moses Lake, Washington
February 19, 2009	Columbia Basin Development League	Moses Lake, Washington
March 3, 2009	Employee Presentation Columbia River Management Program	Bureau of Reclamation Field Office, Ephrata, Washington
March 5, 2009	Columbia River Policy Advisory Group	Yakima, Washington
March 13, 2009	Lake Roosevelt Forum	Colville, Washington
March 16, 2009	Othello Rotary Club	Othello, Washington

Date of Meeting	Meeting With	Location
March 18, 2009	Columbia Basin Development League	Moses Lake Fire Hall, Moses Lake, Washington
March 31, 2009	East Columbia Basin irrigation District	Ephrata, Washington
April 15, 2009	Columbia Basin Development League	Moses Lake, Washington
May 5, 2009	Audubon Society, Central Columbia Basin Chapter	Moses Lake, Washington
July 7, 2009	East Columbia Basin irrigation District	Bureau of Reclamation Field Office, Ephrata, Washington
September 2, 2009	East Columbia Basin irrigation District	Ephrata, Washington
July 10, 2009	U.S. Fish and Wildlife Service	Wenatchee, Washington
October 29, 2009	Columbia Basin Development League	Moses Lake, Washington
May 17, 2010	Washington Department of Fish and Wildlife	Ephrata, Washington
May 19, 2010	Columbia Basin Development League	Othello, Washington
June 16, 2010	Columbia Basin Development League	Moses Lake, Washington
March 18, 2011	Spokane Tribe of Indians	Spokane, Washington
April 15, 2011	Confederated Tribes of the Colville Reservation	Yakima, Washington
April 29, 2011	Environmental Protection Agency	Telephone conference
May 18, 2011	Columbia Basin Irrigation Districts	Yakima, Washington
May 20, 2011	Confederated Tribes and Bands of the Yakama Nation	Yakima, Washington
May 22, 2011	Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service	Ephrata, Washington
June 23, 2011	Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service	Wenatchee, Washington
June 28, 2011	Columbia Basin Pumpers Group	Moses Lake, Washington
June 30, 2011	Columbia Basin Irrigation Districts	Ephrata, Washington
July 8, 2011	Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service	Wenatchee, Washington
August 16, 2011	Columbia Basin Irrigation Districts	Ephrata, Washington
August 30, 2011	Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service	Ephrata, Washington
September 22, 2011	Confederated Tribes of the Umatilla Indian Reservation	Mission, Oregon
September 29, 2011	Columbia River Policy Advisory Group	Ellensburg, Washington
October 18, 2011	Confederated Tribes of the Colville Reservation	Nespelem, Washington

Date of Meeting	Meeting With	Location
October 24, 2011	Columbia Basin Pumpers Group	Moses Lake, Washington
October 27, 2011	Spokane Tribe of Indians	Wellpenit, Washington
November 1, 2011	Columbia Basin Development League	Moses Lake, Washington
January 11, 2012	Washington Department of Fish and Wildlife	Ephrata, Washington
February 6, 2012	Columbia Basin Pumpers Group	Moses Lake, Washington
February 10, 2012	Confederated Tribes of the Colville Reservation	Ephrata, Washington
May 16, 2012	Columbia River Policy Advisory Group	Ellensburg, Washington
June 7, 2012	McCain Foods	Othello, Washington
June 7, 2012	Columbia Basin Pumpers Group	Moses Lake, Washington
June 20, 2012	Washington Department of Fish and Wildlife	Yakima, Washington
July 3,2012	Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service	Wenatchee, Washington
July 26, 2012	Columbia River Policy Advisory Group	Ellensburg, Washington
August 7, 2012	Confederated Tribes of the Umatilla Indian Reservation	Mission, Oregon
August 16, 2012	Confederated Tribes of the Umatilla Indian Reservation	Mission, Oregon

5.3 Agency Coordination and Consultation

5.3.1 Bonneville Power Administration (BPA)

BPA is the only cooperating agency for this Study. In assuming this responsibility, BPA agreed to participate in the NEPA/SEPA process, develop information, prepare environmental analyses for which BPA has specific expertise, and review the Draft and Final EIS documents.

5.3.2 National Marine Fisheries Service (NMFS)

Section 7(a)(2) of the ESA requires Federal agencies to consult with NMFS when a Federal action may affect a listed endangered or threatened species or its critical habitat. This is to ensure that any action authorized, funded, or carried out by a Federal agency is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of its critical habitat.

Reclamation obtained a listing of the threatened and endangered species that reside within the Study Area from the NMFS website. If an alternative is selected for implementation, appropriate consultation will be completed prior to construction.

5.3.3 State Historic Preservation Officer (SHPO)

The National Historic Preservation Act of 1966 (NHPA), as amended in 1992, requires that Federal agencies consider the effects that their projects have on historic properties. Section 106 of this act and its implementing regulations (36 CFR Part 800) provide procedures that Federal agencies must follow to comply with the NHPA on specific undertakings.

To comply with Section 106 of the NHPA, Federal agencies must consult with the State Historic Preservation Officer, any cultural group (including Native American Tribes) with a traditional or religious interest in the Study Area, and the interested public. Federal agencies must show that a good faith effort has been made to identify historic properties in the area of potential effect for a project. The significance of historic properties must be evaluated, the effects of the project on the historic properties must be determined, and the Federal agency must mitigate adverse effects the projects may cause on significant resources. If an alternative is selected for implementation, appropriate consultation will be completed prior to construction.

5.3.4 U.S. Army Corps of Engineers (Corps)

Reclamation has ongoing coordination activities with the Corps in conjunction with their interests and responsibilities for wetlands. Reclamation will make application to the Corps under Section 404 of the Clean Water Act, when appropriate, as stated in Chapter 4, Section 4.31 – *Environmental Commitments*.

5.3.5 U.S. Department of Agriculture (USDA)

The Farmland Protection Policy Act of 1981 (FPPA) is intended to minimize the impact Federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. It assures that—to the extent possible—Federal programs are administered to be compatible with state, local units of government, and private programs and policies to protect farmland.

To comply with this statute, Federal agencies can request the USDA Natural Resources Conservation Service to complete a Farmland Conversion Impact Rating Form (Form AD-

1006) to determine the extent of farmland impact and the projects' adverse effects or to make the determination of significance on their own. The Odessa Subarea Special Study EIS provides compliance with the FPPA and as outlined in 7 CFR 658 part (c-4):

- The Project does not change the use of land from farmland to an agricultural noncompatible use. The Project does not encourage nonagricultural uses and the proposed structures are designed to improve agricultural practices, subsequently encouraging continued agricultural practices.
- Alternative sites that do not impact farmlands are not considered practical for the Project. The farmlands determined to be affected by the project are the same farmlands the Project is designed to service.
- Special siting of delivery pipes, canals, pumping facilities, and reservoirs were designed to limit impacts to on-farm improvements and protected soils. Most construction within farmed areas is planned to occur outside of the irrigation season, avoiding potential disruption of active farming as much as possible.

5.3.6 U.S. Fish and Wildlife Service (USFWS)

5.3.6.1 Endangered Species Act

The ESA requires Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Section 7 of the ESA (16 U.S.C. Section 1536[a][2]), requires all Federal agencies to consult with NMFS for marine and anadromous species or USFWS for freshwater and wildlife species, if an agency is proposing an action that may affect listed species or their designated habitat. If such species may be present, the Federal agency must conduct a biological assessment to analyze the potential effects of the project on listed species and critical habitat to establish and justify an effect determination. If an alternative is selected for implementation, appropriate consultation will be completed prior to construction.

5.3.6.2 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 U.S. Code 661-667e, as amended) requires Federal agencies to coordinate with USFWS when planning a new project or modifying existing projects so that wildlife resources receive equal consideration and are coordinated with other project objectives and features (Appendix D). The recommendations (Section 9) contained in the USFWS Final Coordination Act Report (CAR) and Reclamation's responses to those recommendations have been made available online with the release of this Final EIS at http://www.usbr.gov/pn/programs/ucao_misc/odessa.

5.3.7 Washington Department of Fish and Wildlife

The WDFW is conducting a series of biological studies to determine the effects of the Odessa action alternatives on wildlife throughout the analysis area and on the fishery in Banks Lake. The results of these studies completed in 2009 and 2010 are summarized in the Final EIS.

5.4 Tribal Consultation and Coordination

5.4.1 Government-to-Government Consultation

Executive Order 13175 establishes "regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications, to strengthen the U.S. government-to-government relationships with Indian Tribes, and to reduce the imposition of unfunded mandates upon Indian Tribes."

Government-to-Government consultation between Reclamation and the Spokane Tribe of Indians, the Confederated Tribes and Bands of the Yakama Nation, and the Confederated Tribes of the Colville Reservation is ongoing. This consultation encompasses coordination related to all relevant laws, regulations, and Executive Orders described in this chapter. See Table 5-1 for meeting information with Tribes and Appendix E – Tribal Correspondence Tribes.

5.5 Other Regulatory Compliance Requirements

In addition to the laws, Executive Orders, and regulations described above, Reclamation and Ecology have complied and will continue to comply with these and other Federal and State laws and Federal Executive Orders.

5.5.1 Natural Resources

5.5.1.1 Executive Order 11988: Floodplain Management

Reclamation will comply with Executive Order 11988 to reduce the risk of flood loss to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains.

5.5.1.2 Executive Order 11990: Protection of Wetlands

Reclamation will comply with Executive Order 11990 to minimize distribution, loss, or degradation of wetlands.

5.5.1.3 Federal Weed Control and Wetland Regulations

The following two laws serve to protect vegetation and wetland resources:

- The Federal Noxious Weed Act (Public Law 93-629: Title 7 U.S. Code 2801 et sequentia; 88 Statute 2148) provides for the control and management of nonindigenous weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health.
- Section 404 of the Clean Water Act (33 U.S.C. 1251 et seq.) regulates dredge and fill activities in Waters of the U.S., including regulated wetlands.

5.5.1.4 Wildlife Protection

In addition to the ESA, listed and nonlisted birds receive additional protection. Compliance with these laws is assumed in the impact analysis for this Final EIS. The Migratory Bird Treaty Act of 1918 and various Migratory Bird Conventions protect migratory birds and their parts (including eggs, nests, and feathers). In addition, bald and golden eagles are protected by the Bald and Golden Eagle Protection Act.

5.5.1.5 Executive Order 12962, Recreational Fisheries

Federal agencies are required to the extent permitted by law and where practicable, and in cooperation with States and Tribes, "to conserve, restore and enhance aquatic systems to provide for increased recreational fishing opportunities nationwide" under Executive Order 12962, Recreational Fisheries (effective June 7, 1995).

5.5.1.6 State Priority Habitats and Species (PHS) Program

The PHS Program fulfills one of the most fundamental responsibilities of the WDFW—to provide comprehensive information on important fish, wildlife, and habitat resources in Washington. PHS is the principal means by which WDFW provides important fish, wildlife, and habitat information to local governments; State and Federal agencies; private landowners and consultants; and Tribal biologists for land use planning purposes. PHS data are used by a majority of cities and counties, and is used in this Odessa Special Study Final EIS, to meet the requirements of the Washington Growth Management Act.

5.5.1.7 State Weed Control and Wetland Regulations

The State of Washington requires adherence to the following statutes intended to avoid or reduce weed expansion during and after construction, as well as to protect wetlands. These statutes and their general requirements and intent follow:

- RCW 17.10, Noxious Weeds—Control Boards, provides legal support for the State noxious weed control board to designate a noxious weeds list and designated listed weeds into one of three classes of weeds, each with specific weed control goals.
- RCW 79.70, Natural Area Preserves, provides for the protection of rare plant species and native plant communities by setting aside natural areas under Washington State's Natural Areas Program.
- RCW 90.48, State Water Pollution Control Act, is administered by Ecology and gives the State authority to control and prevent the pollution of streams, lakes, rivers, ponds, inland waters, salt waters, water courses, and other surface and underground waters of the State.

5.5.2 Cultural, Historic, and Tribal Resources

5.5.2.1 National Historic Preservation Act

As described in Section 5.3.3 − *State Historic Preservation Officer*, the NHPA requires Federal agencies to consult with the SHPO, Native American Tribes with a traditional or religious interest in the Study Area, and the interested public. Specifically, the NHPA requires that Federal agencies complete inventories and site evaluation actions to identify cultural resources that may be eligible for listing on the NRHP and then ensure those resources "are not inadvertently transferred, sold, demolished, substantially altered, or allowed to deteriorate significantly." Regulations entitled "Protection of Historic Properties" (36 CFR 800; Federal Register 1986) defines the process for implementing requirements of the NHPA, including consultation with the appropriate SHPO, Indian Tribes, and the Advisory Council on Historic Preservation.

5.5.2.2 Executive Order 13007: Indian Sacred Sites

Executive Order 13007 (1996) instructs Federal agencies to promote accommodation of, access to, and protection of the physical integrity of American Indian sacred sites on Federal land. A sacred site is defined as any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian Tribe (or Indian individual determined to be an appropriately authoritative representative of an Indian religion) as sacred by virtue of its established religious significance to or ceremonial use by an Indian religion. A sacred site can only be identified if the Tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of a site.

5.5.2.3 Indian Trust Assets (ITAs)

ITAs are legal interests in property held in trust by the U.S. for Indian Tribes, nations, or individuals. The Secretary of the Interior is the trustee for the U.S. on behalf of Indian Tribes. All U.S. DOI agencies share the Secretary's duty to act responsibly to protect and maintain ITAs reserved by or granted to Indian Tribes, nations, or individuals by treaties, statutes, and Executive Orders.

Reclamation's Indian policy is based on Secretarial Order 3175, DOI Responsibilities for Indian Trust Resources, November 8, 1993—reissued as U.S. DOI Manual Part 303: Indian Trust Responsibilities, Chapter 2: Principles for Managing Indian Trust Assets (303 DM 2), and most recently issued by Reclamation's Commissioner in his memorandum of February 25, 1998. This policy states Reclamation will carry out its activities in a manner that protects trust assets and avoids adverse impacts when possible. This EIS addresses ITA impacts under the alternatives in Chapter 4, *Environmental Consequences*. No adverse impacts to ITAs were identified.

5.5.2.4 Native American Graves Protection and Repatriation Act (NAGPRA)

NAGPRA establishes the rights of Native American groups to human remains of Native American ancestry and certain associated cultural or funerary objects recovered from Federal or Indian lands. The Act also establishes procedures and consultation requirements for intentional excavation or accidental discovery of Native American remains on Federal or Tribal lands. If these resources were discovered, Reclamation would consult with the appropriate Tribe or Tribes and the SHPO. These consultations would aid in determining measures to mitigate adverse effects.

Reclamation would include a stipulation and protocol in construction contracts in the event of inadvertent discovery of human remains that are determined to be American Indian.

5.5.2.5 State Archaeological Sites and Resources Act

The Archaeological Sites and Resources Act (RCW 27.53) prohibit knowingly excavating or disturbing pre-contact and historical archaeological sites on public or private land without a permit from the Washington Department of Archaeology and Historic Preservation. If an alternative were selected for implementation, appropriate consultation would be completed prior to construction.

5.5.2.6 State Indian Graves and Records Act

The Indian Graves and Records Act (RCW 27.44) prohibits knowingly destroying Native American graves and requires that discovered human remains at such graves be re-interred under supervision of the appropriate Tribe. In addition, RCW 42.56.300 states that records, maps, or other information about the location of archaeological sites do not have to be, and should not be, disclosed to the general public and are exempt under the Freedom of Information Act. By withholding the locations of these cultural resources, the law seeks to avoid looting and degradation of such sites. Reclamation will not reveal the locations or cultural resources to the public.

5.5.2.7 Tribal Employment Rights Ordinance (TERO)

A TERO extends Indian preference hiring to all construction projects “on or near” an Indian reservation. A TERO program monitors and enforces employment and contracting rights of Indians and ensures their rights are protected and exerted. Portions of the work associated with implementation of the action alternatives would be located near the Confederated Tribes of the Colville Reservation, the Spokane Tribe of Indians, and the Confederated Tribes and Bands of the Yakama Nation. Each of the three Tribes has enacted a TERO and other ordinances that may be applicable to this work. Tribal ordinances would be included among the laws, codes, and regulations covered by the “Permits and Responsibilities” clause of the Reclamation contract for the work. Reclamation’s contractor would be directed to contact the Tribal Employment Rights Offices for information about these requirements. However, Reclamation’s Contracting Officer is not a party to enforcing Indian preference requirements; it is a matter solely between the Tribe and the contractor.

5.5.3 Socioeconomic and Land Use Resources

5.5.3.1 Uniform Relocation Assistance and Real Property Acquisition Policies for Federal and Federally Assisted Programs

Private land would need to be acquired by Reclamation under any alternative. The Federal process for acquiring land includes appraisal of fair market value and compensation under the Uniform Relocation Assistance and Real Property Acquisition Policies for Federal and Federally Assisted Programs (42 USC Chapter 61). This regulation specifies the process for Federal acquisition of land, including appraisal of fair market value and compensation to impacted landowners.

5.5.3.2 Noise Abatement

State noise standards are specified in WAC 173-60. Standards are established related to permissible long-term environmental noise levels; construction noise between 7 a.m. and 10 p.m. is specifically exempt from the standards. Maximum permissible noise levels are established for three types of land use or receivers:

- Class A: Lands where people reside and sleep (such as residential)
- Class B: Lands requiring protection against noise interference with speech (such as commercial/recreational)
- Class C: Lands where economic activities are of such a nature that higher noise levels are anticipated (such as industrial/agricultural).

For analysis of the Special Study alternatives, noise-sensitive areas are defined as Class A, which are the residential portions of farm ownerships.

5.5.3.3 Public Health

To control and minimize the propagation of mosquitoes through spray application programs, the State has the following laws:

- State Health Department Authorization, Chapter 70.22.020 RCW.
- Declaration of Mosquito Breeding Places a Public Nuisance – Abatement, Chapter 17.28.170 RCW.
- Aquatic Mosquito Control, NPDES, State Waste Discharge General Permit, Chapter 90.48 RCW, and Federal Clean Water Act (Title 33, USC, Section 1251 et. seq.

5.5.3.4 Environmental Justice

Executive Order 12898 established environmental justice as a Federal agency priority to ensure that minority and low-income groups are not disproportionately affected by Federal actions.

Further, as stated in Title VI of the Civil Rights Act of 1964:

> No person in the U.S. shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance.

No disproportionate impacts on minority or low-income groups are expected with any of the alternatives under consideration.

5.6 Permitting

Implementing the preferred alternative may require obtaining permits. As each alternative would involve different actions, different permits may need to be obtained. This may involve permitting with the WDFW, Ecology, the Corps, WDNR, and other Federal, State, or local governments. Reclamation or managing partners would apply for all applicable permits.

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LIST OF PREPARERS

List of Preparers

Name	Education and Professional Experience	Affiliation	Contribution
Dustin Atchison Water Resources Engineer	M.S., Civil and Environmental Engineering, University of Wisconsin B.S., Civil Engineering, University of Washington 12 years of experience in hydrologic/hydraulic modeling and design.	CH2M HILL	Water Rights
Roger Beieler Senior Conveyance Technologist	M.S., Civil Engineering, Washington State University B.S., Agricultural Engineering, Washington State University 35 years of experience designing water projects.	CH2M HILL	Equipment and Work Force Analysis
Chuck Blair Senior Ecologist	M.S., Wildlife Biology, South Dakota State University B.S., Wildlife Ecology, University of Wisconsin- Madison Experience conducting wildlife/habitat studies and preparing NEPA documents.	CH2M HILL	Vegetation and Wetlands
Susan Broderick Fish Biologist	M.S. Wildlife Management, Washington State University B.S. Resource Management, Evergreen State College 20 years of experience in fish and wildlife research and management.	Bureau of Reclamation	Fish and Aquatic Resources
Ken Carlson Senior Water Resources Scientist	M.S., Water Resources Engineering and Science, University of Washington B.A., Zoology, University of Washington 23 years of experience in natural resources management, planning, and regulatory compliance.	CH2M HILL	Chapter contributor
Corey Carmack Native American Affairs Coordinator	M.S., Cultural Resource Management 12 years of experience in tribal relations, permitting, and environmental compliance including NEPA, NHPA, NAGPRA.	Bureau of Reclamation	Indian Trust Assets and Sacred Sites

Name	Education and Professional Experience	Affiliation	Contribution
Charles A. Carnohan Study Manager	M.S., Land and Water Resource Management, University of North Texas B.A., Anthropology, University of Texas, Austin 19 years of experience in environmental planning, permitting, and project management.	Bureau of Reclamation	Study coordination, document review
Jason Carr Geographic Information Systems Specialist	A.A.S., Geographic Information Systems, Central Oregon Community College Over 10 years of experience.	Critigen	GIS
Wendy Christensen Technical Projects Program Manager	M.S., Engineering Management, Washington State University B.S., Civil Engineering, Colorado State University 22 years of experience.	Bureau of Reclamation	Program/Projects Manager, study coordination, document review
Daniel Church Cartographer	B.A., Geography, Central Washington University 12 years of experience in GIS and visual information.	Bureau of Reclamation	Maps/reference graphics
Richard Cornett Natural Resource Specialist	B.S., Agriculture, Oregon State University 25 years experience	Bureau of Reclamation	Soils
Rob Davis Economist	Ph.D., Agricultural Economics, Colorado State University M.S., Agricultural Economics, Utah State University B.S., Agricultural Business, Colorado State University 17 years of experience agricultural economics.	Bureau of Reclamation	Agricultural Economics
Christina Davis-Kernan Water and Lands Contract Specialist	B.S., Business Management 11 years of experience.	Bureau of Reclamation	Water Rights, Transportation, and Public Services
Brian Drake Water Resources Engineer	M.S., Environmental and Water Resources Engineering, University of Texas at Austin B.S., Civil Engineering, Washington State University Experience in evaluating potential fish habitat and passage.	CH2M HILL	Water Quality

Name	Education and Professional Experience	Affiliation	Contribution
Paula Engel Economist	M.S., Agricultural Economics, University of Idaho B.S., Animal Science, University of Idaho 20 years of experience in resource economics.	Bureau of Reclamation	Socioeconomics
Guy J. Gregory Senior Hydrogeologist	M.S., Geology, University of Vermont B.S., Geology, Washington State University 22 years of experience.	Washington State Department of Ecology	Groundwater studies and hydrogeology
Teresa Hauser Hydraulic Engineer	M.S., Civil Engineering, Hydraulics and Hydrology, Washington State University B.S., Biology, University of Portland 7 years of experience in hydraulics, hydrology, and water resource engineering.	Bureau of Reclamation	Hydraulic Modeling Resource Analysis
Vickie Hawkins Technical Writer/Editor	B.S. in Public Administration 23 years of experience.	Bureau of Reclamation	Document coordination, writing/editing
Tim Hill Community Outreach and Environmental Education Specialist	M.A., Political Management, The George Washington University	Washington State Department of Ecology	Graphics
Gina Hoff Water Quality Specialist	B.S., Microbiology, Central Washington University 7 years of experience.	Bureau of Reclamation	Water Quality review
Lynn Holt Technical Writer	21 years of experience in public affairs, public involvement, and technical writing.	Bureau of Reclamation	Editing, Comments and Responses Volume, Public Involvement
Richard Honey Natural Resource Specialist	B.A., Geography, State University of New York Graduate Certificate, GIS, NW Missouri State Graduate course work, Environmental Management, University of Maryland 35 years of experience.	Bureau of Reclamation	Land acquisition estimates
Warren Hurley Archeologist	B.A., Anthropology, Northern Arizona University 29 years of experience.	Bureau of Reclamation	Cultural Resources, Sacred Sites, Indian Trust Assets
David Kaumheimer	M.S., Wildlife Management, University of Idaho B.S., Wildlife Ecology, University of Wisconsin 30 years of experience.	Contractor	NEPA compliance, document review

Name	Education and Professional Experience	Affiliation	Contribution
Carol Kjar Technical Writer/Editor	B.S., Mathematics, Black Hills State University 5 years experience	Bureau of Reclamation	Writing/editing
Michael Lesky Natural Resource Specialist	M.B.A., Financial and Investment Analysis 30 years of experience. B.S., Natural Resource Management A.A.S., Forestry	Bureau of Reclamation	Plants and Wetlands, Wildlife, Recreation
Rick McCormick Environmental Engineer	M.S., Environmental Engineering, University of Montana B.S., Biology, Montana State University Over 12 years of experience.	CH2M HILL	Air Quality
Keith McGowan Environmental Protection Specialist	Doctoral Research, Natural Resources Sociology, University of Washington M.S., Recreation and Park Administration, University of Oregon M.U.P., Urban and Regional Planning, University of Oregon B.S., Forest and Wildlife Management, Louisiana State University 29 years of experience in NEPA, SEPA.	Bureau of Reclamation	NEPA guidance, document review
Candace McKinley Environmental Program Manager	B.S. Biology, Central Washington University 20 years of experience.	Bureau of Reclamation	NEPA Manager, document review
Mary Mellema Hydrologist	M.S., Soil Science, University of Minnesota B.S., Soil Science, University of Minnesota 25 years of experience.	Bureau of Reclamation	Hydrologic Modeling Resource Analysis
John Petrovsky Environmental Planner	B.A., Psychology, University of California, Los Angeles M.L.A., Landscape Architecture, California Polytechnic University 30 years of experience.	JPA	Chapter 2, Land Use and Shoreline Resources, Transportation
Jonathan Platt Economist	M.S., Natural Resource Economics, Colorado State University M.S., Finance, University of Northern Colorado B.S., Finance and Economics, Bryant College 26 years of experience.	Bureau of Reclamation	Natural Resource Economics
Lori Postlethwait ESA Program Coordinator	B.S., Civil Engineering, Texas Tech University 30 years experience.	Bureau of Reclamation	Review of hydro operations and obligations under 2007 FCRPS BiOp

Name	Education and Professional Experience	Affiliation	Contribution
Derek Sandison Director, Office of Columbia River	M.S., Resource Management, Central Washington University B.A., Biological Science, Central Washington University Over 35 years of experience as environmental planner/manager, SEPA administration/EIS preparation.	Washington State Department of Ecology	Project Manager, SEPA Responsible Official document review
Jason Smesrud Senior Agricultural Engineer	M.S., Bioresource Engineering, Oregon State University, 1998 B.S., Soil Science, Evergreen State College, 1993 More than 13 years of experience.	CH2M HILL	Soils
Donnie Stelma Geologist	B.S., Geology, Boise State University 25 years of experience in engineering geology.	Bureau of Reclamation	Geology
James B. Taylor Regional NEPA Coordinator	B.S., Chemistry, Boise State University 12 years of experience in environmental compliance, remediation, and testing.	Bureau of Reclamation	NEPA guidance, document review, and filing
Stephanie Utter Ephrata Field Office Manager	B.S., Horticulture, Montana State University 20 years of experience in resource management	Bureau of Reclamation	Document review
Greg Warren Engineering/ Environmental Geologist	M.S., Geology, Utah State University B.S., Geology, University Of Texas at Austin More than 15 years of experience.	CH2M HILL	Geology and Groundwater
Bret Weiland Environmental Planner	B.S., Environmental Science, Iowa State University 9 years of experience conducting noise impact analyses.	CH2M HILL	Noise
Mike Wirtz Environmental Engineer	B.S., Environmental Engineering, Oregon State University 8 years of experience.	CH2M HILL	Air Quality
Edward Young GIS Coordinator	M.S., Geographic Information Systems, University of Idaho B.S., Mathematics, University of Idaho, 19 years of experience.	Bureau of Reclamation	GIS analysis, cartography

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Glossary

GLOSSARY

acre-foot	The volume of water that would cover 1 acre to a depth of 1 foot. Equivalent to 43,560 cubic feet or 325,851 gallons.
active capacity	The reservoir capacity or quantity of water which lies above the inactive reservoir capacity and normally is usable for storage and regulation of reservoir outflow to meet established reservoir operating requirements.
active storage	The volume of water in a reservoir between the full pool elevation and the lowest dam outlet elevation.
adfluvial spawner	Fish that spawn in tributaries and, as adults, reside in lakes.
adjudication	The judicial process through which the existence of a water right is confirmed by court decree.
alkali wetlands	Wetlands characterized by the occurrence of shallow saline (salty) water.
alluvium	Material composed of clay, silt, sand, gravel, or similar material that has been deposited by running water.
anadromous	Fish that migrate from saltwater to freshwater to breed. Going up rivers to spawn.
analysis area	The analysis area is defined for each environmental resource or topic discussed and varies according to the physical or geographic extent in which effects from the action alternatives may occur. For example, the analysis area for fisheries includes the Odessa Subarea and the Columbia River because changes in river flow may affect downstream resources. By contrast, the analysis area for vegetation is the physical footprint of facilities to be constructed and immediately adjacent areas that may be impacted.
appraisal-level study	Study based on limited analyses, available design data, and professional assumptions, but of sufficient detail to provide satisfactory material quantities and preliminary field cost estimates.

aquatic biota or aquatic resources	Collective term describing the organisms living in or depending on the aquatic (water) environment.
aquifer	A water-bearing stratum of permeable rock, sand, or gravel.
aquifer recovery	The process of water refilling an aquifer that occurs when pumping is stopped and aquifer levels rise toward their pre-pumping levels.
average condition	The watershed condition where half of the years would be wetter and half drier than the average condition year. 1995 is considered to represent the average condition year for this EIS.
A-weighted noise levels	A measure of sound similar to how a person perceives or hears sound, achieving very good correlation in terms of how to evaluate acceptable and unacceptable sound levels.
bankfull	The water level, or stage, at which a stream or river is at the top of its banks and any further rise would result in water moving into the flood plain.
basaltic flow	A flow of lava rock that, after becoming solid, contains many small holes or cavities formed as the rock solidifies.
bathymetry	The study of surfaces under water, such as a river or lake floor.
benthic	Relating to the bottom of a sea or lake or to the organisms that live there.
best management practices (BMPs)	Measures intended to avoid or reduce impacts while an action is being implemented (also see Mitigation Measures).
bifurcation	The place where something divides into two branches.
bioenergetics model	A tool to estimate the growth potential of fish as influenced primarily by water temperature and food availability.
biomass	The mass (weight) of living organisms in a given area or habitat. Often specified for an individual species or group of organisms (such as fish). Typically expressed as total weight per area or per volume or per specific system such as a lake.
biotic crust	An intimate association between soil particles and cyanobacteria, algae, micofungi, lichens, and bryophytes that live within or on top of the uppermost millimeters of soil. They are found in dry land regions of the world. Where not disturbed, biotic crusts often cover all soil spaces not occupied by trees, grasses or shrubs.

borrow area	An area from which soil or other material is excavated for use in construction.
cairns	A mound of stones piled up as a memorial or to mark a boundary or path.
capillary fringe	The capillary fringe is the subsurface layer in which groundwater seeps up from a water table by capillary action to fill soil pores. If pore size is small and relatively uniform, it is possible that soils can be completely saturated with water for several feet above the water table. Alternately, the saturated portion will extend only a few inches above the water table when pore size is large.
carbon dioxide equivalent	Greenhouse gas emissions are reported as tons of carbon dioxide equivalent. To obtain tons of carbon dioxide equivalent emissions, the emissions of each greenhouse gas are multiplied by their associated global warming potential and then summed.
cation exchange capacity	A measure of how easily soil-adsorbed cations, such as calcium, potassium, and iron, needed for plant growth are made available.
center pivot system	A method of irrigation in which equipment rotates around a pivot. A circular area centered on the pivot is irrigated.
cfs	Flow rate in cubic feet per second.
Columbia Basin Project	A multipurpose water development project in the central part of the State of Washington, east of the Cascade Range. The key structure, Grand Coulee Dam, is on the mainstem of the Columbia River about 90 miles west of Spokane. The Columbia Basin Project currently serves a total of about 671,000 acres in Grant, Adams, Walla Walla, and Franklin counties, with some northern facilities located in Douglas County.
comprehensive plan	A master plan to guide the long-term development of a government subdivision, such as a city or county to ensure that social and economic needs are balanced against environmental and aesthetic concerns.
consumptive uses of water	That portion of water withdrawn that is evaporated, transpired by plants, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the surface or groundwater supply.
cost allocation analysis	A financial analysis to determine reimbursable and nonreimbursable costs by project purpose and beneficiary.

cottid	A family of fish (*cottidae*) consisting of sculpin species, most of which are small, bottom-dwelling fish.
creel survey	A survey of fishermen to collect data on fish caught.
Critical Areas Ordinance (CAO)	Counties have a CAO, pursuant to the requirements of Washington's Growth Management Act. The provisions of these CAOs govern such resources/conditions as wetlands, habitat, geologically-hazardous areas, floodplains, and areas critical to aquifer recharge of potable water supplies.
cryptogams	Refers to plants that reproduce by spores. The best known groups of cryptogams are algae, lichens, mosses, and ferns.
cumulative impacts	For NEPA purposes, these are impacts to the environment that 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 action.
de minimis emissions	Air pollutant emission levels that are low enough to be of no relevance or importance.
decibel	A unit of measurement that expresses the magnitude of sound pressure relative to a specified or implied reference level.
deleterious	Having harmful effects.
delta flows	Monthly flow changes.
demographic parameters	Parameters associated with common characteristics used for population segmentation. Typical demographic data include age, gender, occupation, and income.
demographic stochasticity	Random variation.
depressional wetlands	Depressional wetlands occur in topographic depressions that allow the accumulation of surface water. Depressional wetlands may have any combination of inlets and outlets or lack them completely. Potential water sources are precipitation, overland flow, streams, or groundwater/interflow from adjacent uplands. The predominant direction of flow is from the higher elevations toward the center of the depression.
dispersal	A process common to wildlife that involves individuals leaving the place where they are resident and looking for a new place to live.

distinct population segments	A subgroup of a vertebrate species that is treated as a species for purposes of listing under the Endangered Species Act. It is required that the subgroup be separable from the remainder of and significant to the species to which it belongs.
diversionary uses of water	Water withdrawn from its source for another purpose. Some of the water may return to its source following the use, such as through irrigation return flows, spills, or drainage.
drawdown	The lowering of the water level in a reservoir.
drought condition	The watershed conditions where approximately 5 percent of years would be this dry or drier. 1931 is considered to represent the drought condition year for this EIS.
dry condition	The watershed conditions where approximately 15 percent of years would be this dry or drier. 1988 is considered to represent the dry condition year for this EIS.
easement	A right to use or control the property of another for a designated purpose.
economic feasibility	An economics term stemming from the results of the benefit-cost analysis. If a project’s benefits exceed its costs, the project is deemed economically feasible.
economic impacts	An economics term measuring total economic activity within a given region using such indicators as output, income, and employment.
ecosystem	A system formed by the interaction of a community of organisms with their physical environment.
embayments	A small bay in a lake or reservoir.
endangered species	A species that is in danger of extinction throughout all or a significant portion of its range. To term a run of salmon “endangered” is to say that particular run is in danger of extinction.
entrained	The act of a juvenile fish or zooplankton entering, either passively or actively, a diversion canal or pumping plant at the point of diversion from a stream or reservoir.
environmental justice	The fair treatment of people of all races and incomes with respect to actions affecting the environment. Fair treatment implies that there is equity of the distribution of benefits and risks associated with a proposed project and that one group does not suffer disproportionate adverse effects.

ephemeral streams	streams that flow only during and immediately after precipitation.
epilimnion	The upper layer of water in a thermally stratified lake or reservoir. This layer consist of the warmest water and has a fairly uniform temperature. The layer is readily mixed by wind action.
equivalent noise level (L_{eq})	The average noise level (on an acoustical energy basis) taking into account the usage factor (the fraction of time that the equipment generates noise at the maximum level).
equivalent sound pressure level (L_{eq}),	The average noise level over a given period of time.
escapement	The act of adult salmon and steelhead successfully arriving at their spawning areas by avoiding, harvest, predation, or other mortality.
estuarine areas	Areas of the wide lower course of a river where its current is met by ocean tides.
ethnographic	Relating to the branch of anthropology that deals historically with the origin and filiation of races and cultures.
evolutionarily significant unit	A Pacific salmon population or group of populations that is reproductively isolated from other populations and that represents an important component of the evolutionary legacy of the species.
exceedances	Cases where specific values are exceeded.
extirpated species	Species that are locally extinct.
fallowed	Land that has been allowed to lie fallow, or not be farmed.
feasibility study	Detailed investigation specifically authorized by the Congress to determine the desirability of seeking congressional authorization for implementation of a preferred alternative, normally the NED Alternative, which reasonably maximized net national economic development benefits.
fingerling	A juvenile fish during its first summer after emergence, usually under 3 inches long (see also fry and smolt).
fish flow augmentation	The use of stored water to increase streamflows to the benefit of fish. In the Columbia River system it generally refers to the increase of mainstem river flows during the spring and summer to aid the downstream migration of salmonid smolts.

fishway	A structure on or around an artificial barrier (typically a dam) in a river to facilitate the upstream or downstream passage of migratory fish.
flow augmentation	Water released from system storage at targeted times and places to increase streamflows to benefit migrating salmon and steelhead.
flow objectives	Federally established minimum flows for the Columbia River at Priest Rapids and McNary Dams.
flow rate	The volume of water passing a given point per unit of time.
fluctuation zone	The shoreline area of a water body (lake or river) that is watered and dewatered as the water level fluctuates over time.
fluvial spawner	Fish that spawn in tributaries and, as adults, reside in rivers.
foraging habitat	Habitat used by animal species to forage for food.
forb	A broad-leaved herbaceous plant—any broad-leaved herbaceous plant that is not a grass.
fry	The life stage of fish between the egg and fingerling stages. Depending on the fish species, fry can measure from a few millimeters to a few centimeters in length (see also fingerling and smolt).
fugitive dust	Windblown dust from open lands, outdoor and agricultural burning, wood burning stoves and fireplaces, wildfires, industrial sources, and motor vehicles.
full pool	The maximum operating water surface elevation or volume of a reservoir.
geomorphology	The branch of geology that studies the characteristics and configuration and evolution of rocks and land forms.
greenhouse gasses	Any of the gasses that contribute to the greenhouse effect. Common greenhouse gasses are carbon dioxide and methane.
habitat evaluation procedure (HEP)	Habitat-based evaluation methodology used as an analytical tool for wildlife and fish during impact assessments and project planning.
habitat fragmentation	The breaking apart of large adjacent blocks of wildlife habitat into smaller pieces separated by altered landscapes or movement barriers.

Hanford reach	Columbia River reach extending from 15 miles upstream of the mouth of the Yakima River to Priest Rapids Dam.
headwall	A wall surrounding a culvert or pipe inlet that provides structural reinforcement and minimizes erosion or seepage.
headworks structure	A structure at the beginning of a conveyance system to divert and control the flow exiting a river or reservoir and to regulate water supply into the canal.
historic property	Any building, site, district, structure, or object (that has archeological or cultural significance) included in, or eligible for inclusion in, the National Register.
homogenous	All of the same or similar kind or nature.
hydraulic gradient	The slope of the surface of open or underground water.
hydrogeomorphic class	Classifying wetlands into major classes of wetlands: riverine, depressional, slope, flats (mineral soil and organic soil), and fringe (estuarine and lacustrine). Hydrogeomorphic classification is based on three fundamental factors that influence how wetlands function, including geomorphic setting, water source, and hydrodynamics. Geomorphic setting refers to the landform of a wetland, its geologic evolution, and its topographic position in the landscape. Water source refers to the location of water just prior to entry into the wetland. Hydrodynamics refers to the energy level of moving water, and the direction that surface and near-surface water moves in the wetland.
hydrologic (as it applies to wetlands)	The movement, occurrence, circulation, distribution, and properties of the water flowing through or within a wetland. Wetland soils, vegetation, and landscape position alter water velocities, flow paths, and chemistry.
hydrologic function	The hydrologic functions of wetlands are the roles wetlands play in changing the quantity or quality of water moving through them, and are related to the wetland's physical setting. Hydrologic functions of wetlands are controlled by landscape position, vegetation, soil type, amount of water flowing into or out of the system, and climate.
hydrologic modeling	The use of mathematical techniques to simulate the hydrologic cycle (the interaction of rainfall or snow melt and surface water) and its effects on a watershed.

HYDSIM	The Bonneville Power Administration computer model used as the hydrologic basis for the 2000 Biological Opinion; it includes the significant United States Federal and non-Federal dams and the major Canadian projects on the mainstem Columbia River and its major tributaries.
hypolimnion	The lowermost, non-circulating layer of cold water in a thermally stratified lake or reservoir. This layer consists of colder, more dense water, has a constant temperature, and no mixing occurs.
hyporheic invertebrates	Aquatic insects that complete all or a portion of their lifecycle beneath the riverbed.
incremental releases	Strategic reservoir releases through a dam that are intended to provide some downstream benefit, such as streamflow enhancement for fish or improved municipal and industrial supply.
Indian sacred site	A specific, discrete, narrowly delineated location on Federal land that is identified by an Indian Tribe or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion.
Indian trust assets (ITA)	Legal interests in property held in trust by the United States for Indian Tribes or individuals. They are rights that were reserved by or granted to American Indian Tribes or Indian individuals by treaties, statutes, and Executive orders. These rights are sometimes further interpreted through court decisions and regulations.
individual “conditioned” rights	In Washington, groundwater right certificates issued or amended after 1967, and to a limited extent in the period during development of the groundwater management sub-area, are conditioned upon future replacement water provided by the CBP.
instream flows	Water flows for designated uses within a defined stream channel, such as minimum flows for fish, wildlife, recreation, or aesthetics.
interflow	Term given to the zone where most of the underground lateral (sideways) groundwater flow occurs in the Columbia River basalts. Consists of a combination of the permeable bottom of one basalt flow and the adjacent flow top of the underlying basalt flow.
intermittent streams	Streams that do not flow permanently but do have groundwater flows at times.

interruptible (junior) water rights	Water rights that can be temporarily withdrawn during a year to provide water for instream flows or other mitigation conditions to protect streamflows.
isolation	On a landscape scale isolation of plant communities or wildlife populations occur when small patches of habitat are cutoff from larger, more contiguous blocks by a physical barrier or altered habitat that prevents movements of organisms and processes within previously connected landscapes.
isothermal	A relatively constant temperature from the surface waters to the bottom of the lake or reservoir.
k	Hydraulic conductivity (the ease with which water can move through pore spaces or fractures in soil or rock).
kelts	adult steelhead that survive after spawning and attempt to migrate back to the ocean.
lacustrine	Sediments that are deposited in lakes. Of or relating to or living near lakes.
lithic scatters	Surface scatter of cultural artifacts and debris that consists entirely of lithic (i.e., stone) tools and chipped stone debris.
lithosols	Thin and stony soils with basalt bedrock immediately below.
littoral zone	Shallow water, near-shore areas with high fish and wildlife values. Littoral zones extend from the ordinary high water line, just above the influence of waves and spray to the maximum depth at which light is sufficient for rooted aquatic vegetation (macrophytes) to grow.
live storage	Same as reservoir active storage.
loafing habitat	Areas of open water, unvegetated shorelines, or protected bays used by waterfowl for resting during the day or night.
loess	Fine-grained (clay and silt) soil deposited by the wind.
long-term impacts	Associated with the permanent loss of existing resources because of construction of new facilities or other actions.
low-head power plant	A hydroelectric power plant that requires water to drop only a relatively small distance vertically to generate electricity.
macroinvertebrate	An invertebrate that is large enough to be seen without the use of a microscope.

macrophytes	Rooted aquatic vegetation. May be submerged, have leaves that float on the water surface, or emerge above the surface.
mainstem	The principal channel within a given drainage basin.
maximum noise level (L_{max})	Based on the highest noise levels generated by the construction equipment or another activity.
methemoglobinemia	"Blue-baby" syndrome, in which there is a reduction in the oxygen-carrying capacity of blood.
metric ton	2,204 pounds.
million acre-feet (maf)	The volume of water that could cover 1 million acres to a depth of 1 foot.
minimum viable population (MVP)	An estimate of the number of individuals required for a high probability of survival of an isolated animal population over a given period of time (often 20, 50, or 100 years).
mitigation measures	Includes: (a) Rectifying unavoidable impacts by repairing, rehabilitating, or restoring the affected environment; (b) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; (c) Compensating for the impact by replacing or providing substitute resources or environments (also see Best Management Practices).
natal stream	Stream of birth, as in the stream where a fish was born.
National Ambient Air Quality Standards (NAAQS)	Nationwide air quality standards to protect public health and welfare, with an adequate margin of safety.
National Economic Development account (NED)	An account that measures how the alternative would yield positive changes in the economic value of the national output of goods and services.
natural (unregulated) flows	The flow regime of a stream as it would occur without reservoirs, diversions, or other actions that may alter flow.
natural flow	River flow that originates from a source other than reservoir storage.
noxious weed	A plant species that is not of local origin that can directly or indirectly injure crops, other useful plants, livestock, poultry, fish, wildlife, habitat, the public health, or navigation.

nutrient cycling	The pathway through which nutrients move between living (plants, animals, etc.) and non-living (soil, rock, etc.) parts of the environment. Wetlands may be a sink for nutrients where they are accumulated or held for a long period of time.
Odessa Groundwater Management Sub-area (Odessa Subarea)	In 1967, the Washington legislature designated the Odessa Groundwater Management Area because of groundwater level declines resulting from pumping (Washington Administrative Code [WAC] 173-128A, *Odessa Groundwater Management Subarea*). This area encompasses portions of Lincoln, Adams, Franklin, and Grant counties.
Odessa Subarea	Shortened title for the Odessa Groundwater Management Sub-area.
Odessa Subarea Special Study Area (Study Area)	An area occupying the western portion of the Odessa Groundwater Management Sub-area that is the focus of this Odessa Special Study Environmental Impact Statement. This is the area where the preferred alternative would be applied.
operating pool elevation	The reservoir's water surface elevation that may fluctuate between the lowest dam outlet and the full pool elevation depending on operating procedures.
ordinary high water mark	The highest level reached by a water body and maintained at that elevation for a period of time sufficient to leave visible evidence.
Other Social Effects account (OSE)	A method to measure the extent and magnitude to which the alternative would affect the quality of life and social well-being in the area.
overburden	A thick deposit of sediments or soil overlying bedrock.
overstory	The highest layer of foliage within a plant community (for example, trees in a forest or shrubs in an area without trees).
Palustrine Emergent (PEM) wetlands	PEM wetlands are dominated by emergent vegetation.
Palustrine Forested (PFO) wetlands	PFO wetlands are characterized by woody vegetation that is 6 meters (20 feet) tall or taller. PFO wetlands normally possess an overstory of trees, an understory of young trees or shrubs, and a herbaceous layer.
Palustrine Scrub-Shrub (PSS) wetlands	PSS wetlands are dominated by woody vegetation (usually shrubs) less than 6 meters tall.

passerine	The largest order of birds, which includes over half of all living birds and consists chiefly of perching birds or sometimes referred to as songbirds.
pedestrian inventory surveys	A survey accomplished by walking the surface of a site or large region in stratified patterns, and either marking locations or collecting samples for further investigation.
perennial streams	Streams that flow year-round.
perennial vegetation	Plants with a life cycle extending for more than 2 years and that continue to live from year to year.
pervious material	Relatively free-draining material with no fines such as silt and clay. Allows water to drain through it.
petroglyphs	Also called rock engravings. Images created by removing part of a rock surface by incising, pecking, carving, and abrading.
photic zone	The depth at which light is sufficient for rooted aquatic vegetation (macrophytes) to grow and to influence the vertical migration of zooplankton—the primary producers which make up the foundation of food webs (see Littoral).
pictographs	Also called pictogram. A pictorial representation of an object.
piezometers	A non-pumping well, generally of small diameter, for measuring the elevation of a water table.
population (of animals)	A population is an interacting collection of animals of the same species occupying a defined geographic area. Movements and interactions by individuals are relatively continuous over the population area even though the habitat may vary in quality somewhat from place to place. Individuals may or may not move long distances within the geographic area.
population viability analysis (PVA)	PVA models are often used to analyze data, project population trends, make policy decisions regarding management of rare species, and assess the genetic impacts of isolation or reduced habitat connectivity on the survival of isolated low mobility species.
Prairie-steppe	Native upland plant communities similar to shrub steppe mostly characterized by a mix of bunch grasses and forbs but with few shrub species and occurring primarily in the Intermountain West and Columbia Plateau.
pre-contact	The period of time before a native human population is contacted by people from an outside culture.

predation	The act of preying by a predator who kills and eats the prey.
Prevention of Significant Deterioration (PSD)	Program established to protect air quality that is already in attainment with NAAQS from becoming significantly worse.
Priority Habitats and Species (PHS)	In Washington, the Priority Habitats and Species (PHS) list includes a catalog of habitats and species considered to be priorities for conservation and management. Priority species require protective measures for their survival due to their population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance. Priority species include State Endangered, Threatened, Sensitive, and Candidate species; animal aggregations (e.g., heron colonies, bat colonies) considered vulnerable; and species of recreational, commercial, or tribal importance that are vulnerable.
Probabilistic Seismic Hazard Assessment (PSHA)	A technique that provides an assessment of the annual levels of earthquake ground motions that the site might experience based on the rates of seismic activity and fault movements in the region surrounding the site.
radiative forcing	Degree of warming to the atmosphere.
redd	The nest that a spawning female salmon digs in gravel to deposit her eggs.
refugia	Refers to an area that is relatively isolated and protected from extreme changes that have occurred in surrounding areas. Shallow vegetated bays provide refugia for small fish.
Regional Economic Development account (RED)	A method that measures the degree to which the alternative would affect the region’s income, employment, population, economic base, and social development.
regional economic impact study	An economic analysis which estimates the effect of changes in expenditures and revenues on the local economy of the study region.
relift pumping plants	Pumping plants along a canal that add sufficient head to raise the water surface elevation several feet or more as needed to extend gravity deliveries in the canal system typically by several miles.
re-regulating reservoir	A reservoir that equalizes supply and demand and prevents spills or shortages by providing temporary storage.
return flow	The part of irrigation water that is not consumed by evapotranspiration and that flows back into an aquifer or surface-water body.

rhizomes	A horizontal stem of a plant that is usually found underground, often sending out roots and shoots from its nodes.
riparian	Relating to, living in, or located on a watercourse.
riverine wetlands	That area that is adjacent to a stream or river, is underlain with hydric soils developed in fluvial conditions, derives a significant portion of its hydrology from bank full conditions, or overbank flooding, and is within, at a minimum, the 5-year floodplain area.
RiverWare	A daily time-step reservoir and river operation computer model created with the RiverWare software and used to project reservoir operations under the Study Area alternatives.
rule curve	Rules under which reservoirs are operated to account for flood control and required releases for downstream needs.
salmonid	Trout or salmon. Many species of each belong to this family.
Secchi depths	A circular disc with a pattern on it that is used to measure water clarity. The disc is lowered slowly into the water until the pattern is no longer visible. This depth is the Secchi depth and can be related to water turbidity.
sediment	Any very finely divided organic or mineral matter deposited by water in nonturbulent areas.
sediment barriers	An erosion control measure to prevent sediment from entering a waterway.
semi-pervious material	Material with a low hydraulic conductivity but not completely impermeable, may contain fine-grained materials such as silt and clay.
shoal	A place where the water of a sea, lake, river, pond, reservoir, etc., is shallow; a shallow.
short-term impacts	Impacts related to construction that are not permanent. Short-term impacts may persist for a few weeks or months to several years.
shrub-steppe	Native upland plant communities mostly characterized by a mix of low shrubs, bunch grasses, and forbs and occurring primarily in the Intermountain West and Columbia Plateau.
siphon	A pipeline, box culvert, or tunnel that allows water to flow by gravity through an intermediate point that is higher or lower than the point of origination, without pumping.

slope characteristics of wetlands	Slope wetlands are found in association with the discharge of groundwater to the land surface or sites with saturated overflow with no channel formation. They normally occur on sloping land ranging from slight to steep. The predominant source of water is groundwater or flow discharging at the land surface.
smolt	Juvenile salmon or steelhead, usually 3 to 8 inches long, that are undergoing changes preparatory for living in saltwater (see also fry and fingerling).
spawner	Adult salmon that has left the ocean and entered a river to spawn.
spawning escapement	The number of fish that successfully return to their spawning grounds. Excludes those fish captured in sport and commercial fisheries or that die from other causes.
specific conductance (surrogates for salinity)	A measure of the ability of water to conduct an electrical current. Used as a measure of salinity (salt content).
spoil material	Soil and rock removed from an excavation.
State Implementation Plan	Counties or regions designated as nonattainment areas for one or more airborne pollutants must prepare a State Implementation Plan that demonstrates how the area will achieve attainment by Federally mandated deadlines.
stochastic event	A random or chance event that affects one or more ecosystem processes, functions, or components. Small populations are less resilient and less able to adapt to the changes in their environment that may result from stochastic events. Therefore, smaller populations have a higher susceptibility to stochastic events and are less able to recover from the adverse effects of such events.
stratification	Layering. May apply to geologic features or water layers in a reservoir that separate by temperature.
Study Area	Shortened title for the Odessa Subarea Special Study Area.
talus slopes	A sloping mass of rocky fragments or debris typically formed at the base of a cliff.
terrestrial	Of or relating to land as distinct from air or water.
thermocline	A thin layer in a water body where temperature changes more rapidly with depth than it does in the water layers above or below.
threatened species	A species that is likely to become endangered within the foreseeable future.

total maximum daily load (TMDL)	A calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.
Traditional Cultural Property (TCP)	A place eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that are both rooted in that community's history and important in maintaining the cultural identity of the community.
tributaries	Stream or river that flows into a mainstem or larger river.
tunnel portals	Entrances to a tunnel.
turbidity	Water cloudiness caused by sediment or other suspended materials.
turnout	A small scale irrigation diversion that is often controlled by a gate or valve.
understory	An underlying layer of vegetation.
uninterruptible water rights	Rights established prior to 1980, senior to instream flow rights and are considered uninterruptible.
upland vegetation	Native plant communities that occupy generally dry upland positions as opposed to those growing in wetter areas such as wetlands or riparian areas.
vernal pools	Seasonally flooded depressions found on soils with an impermeable layer such as a hardpan, claypan, or volcanic basalt. The impermeable layer allows the pools to retain water much longer then the surrounding uplands; nonetheless, the pools are shallow enough to dry up each season. Vernal pools often fill and empty several times during the rainy season.
wasteway	A channel for conveying or discharging excess water.
water particle retention time	The average time that a particle of water is retained in a reservoir, lake with an outlet, or section of river. Computed based on volume of the water body and the flow rate of water passing through it. Often referred to as water particle travel time.
water table	Underground surface below which the ground is wholly saturated with water.
water year	The 12-month period from October through September. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. For example, the year ending September 30, 1992, is called the "1992 water year."

watershed	The total land area draining to any point in a stream or river.
wet condition	The watershed conditions where approximately 10 percent of years would be this wet or wetter. 1982 is considered to represent the wet condition year for this EIS.
wetland	Generally, an area characterized by periodic inundation or saturation, hydric soils, and vegetation adapted for life in saturated soil conditions.
Yakima fold belt	One of three informally designated physiographic subprovinces of the Columbia Plateau. Consists of northwest-southeast-trending ridges (anticlines) separated by broad, flat valleys (synclines) that were folded and faulted under north-south compression.
yearling	A fish that is one year old and not yet completed its second year.
zooplankton	The animal component of plankton, generally consisting of small aquatic invertebrate animals and larval fish that drift in the water column.
zooplankton entrainment	The passage of zooplankton through the water outlet works at a dam or drawn into a pumping station.

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CONTACTS AND DISTRIBUTION LIST

Contacts and Distribution

This Final EIS is available for information and review on Reclamation's Pacific Northwest Region Web site at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html. Copies of the Final EIS were sent to those who requested a copy and to those who commented on the Draft EIS (denoted by an asterisk [*]).

All locations are in the State of Washington, unless otherwise noted.

U.S. Congressional Delegation

United States Senate

Honorable Maria Cantwell, Seattle
Honorable Patty Murray, Seattle

House of Representatives

Honorable Doc Hastings, Pasco
Honorable Cathy McMorris Rodgers, Spokane

Governor of Washington

Honorable Christine Gregoire, Olympia

Indian Tribes

Confederated Tribes of the Colville Reservation, Nespelem,* Wilbur
  Department of Natural Resources
Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon
  Environmental Planning and Right Protection
Confederated Tribes of Warm Springs, Warm Springs, Oregon
Spokane Tribe of Indians, Wellpinit*
Confederated Tribes and Bands of the Yakama Nation, Toppenish*

Washington State Legislature

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Representative Bruce Chandler, Olympia
Representative Cary Condotta, Olympia
Senator Jerome Delvin, Olympia
Senator Linda Evans Parlette, Olympia
Representative Susan Fagan, Olympia
Representative Larry Haler, Olympia
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Senator Bob Morton, Olympia
Representative Joe Schmick, Olympia
Senator Mark Schoesler, Olympia
Representative Shelly Short, Olympia
Representative David Taylor, Olympia
Representative Judy Warnick, Olympia*

Federal Agencies

Department of Defense
    Department of the Army Corps of Engineers, Seattle
Department of Energy
    Bonneville Power Administration, Spokane; Portland, Oregon*
    Hanford Site, Office of River Protection, Richland
Department of Commerce
    National Marine Fisheries Service, Ellensburg; Portland, Oregon
Department of the Interior
    Bureau of Land Management, Wenatchee
    Bureau of Reclamation, Ephrata, Grand Coulee, Yakima; Boise, Idaho
    Fish and Wildlife Service, Burbank,* Othello, Richland, Wenatchee
    Geological Survey, Tacoma; Columbia River Research Laboratory, Cook
    National Park Service, Coulee Dam*
Environmental Protection Agency, Seattle,* Washington, D.C.

State and Local Government Agencies

State of Washington

Conservation Commission, Moses Lake, Okanagan, Lacey
    Warden Conservation District, Warden
    Franklin Conservation District, Pasco
Department of Agriculture, Olympia, Yakima
    Livestock Nutrient Management Program
Department of Archaeology and Historic Preservation, Olympia
Department of Community, Trade and Economic Development/Growth Management Services
Department of Ecology, Olympia, Spokane, Yakima
    SEPA Unit, Olympia
Department of Fish and Wildlife, Ellensburg, Ephrata,* Moses Lake, Olympia, Pasco, Spokane, Yakima
Department of Natural Resources, Ellensburg, Ephrata, Olympia*
Department of Transportation, Yakima
Recreation and Conservation Office, Olympia
State Parks and Recreation Commission, East Wenatchee,* Olympia

State of Oregon

Water Resources Department, Salem, Oregon

Local Agencies

Adams County
  City Council, Othello
  Commissioners, Ritzville*
  Health Department, Othello
City of Connell
City of Electric City*
Franklin County
  Commissioners, Pasco*
Grant County
  Commissioners, Ephrata
  Ecomomic Development Council*
  Fire District No. 4, Warden
  Planning, Ephrata
  Public Works Department, Ephrata
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  Community Development Services
Klickitat County
  Commissioners, Goldendale
Lincoln County
  Commissioners, Davenport*
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Port of Warden, Warden
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  Commissioners, Colville
Town of Lind*
Town of Odessa*
Yakima County
  Commissioners, Yakima

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Benton-Franklin County Regional Law Library, Pasco
Columbia Basin College Library, Pasco
Coulee City Public Library, Coulee City
Ephrata City Library, Ephrata
Grant County Law Library, Ephrata
Mid-Columbia Library, Basin City, Connell, Kahlotus, Othello, Pasco
Moses Lake Community Library, Moses Lake
North Central Regional Library, Royal City, Warden
Odessa Public Library, Odessa
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Ritzville Public Library, Ritzville
Seattle Public Library, Central Library, Seattle
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Washington State Library, Olympia

Organizations

American Rivers, Seattle*
American Whitewater, Enumclaw
Banks Lake Alliance, Wilbur
Big Bend Resource Conservation and Development Council, Ephrata*
Big Bend Economic Development Council, Moses Lake
Center for Water Advocacy, Moab, Utah
Center for Environmental Law and Policy, Seattle, Spokane*
Citizens for a Clean Columbia, Wenatchee
Columbia Basin Development League, Cashmere,* Moses Lake, Othello, Royal City, Riverside, California
Columbia Basin Environmental Council, Soap Lake,* Yakima
Columbia Basin Ground Water Management Area, Othello*
Columbia Basin Sand Commandos, Moses Lake
Columbia Gorge Audubon Society, White Salmon*
Columbia Institute for Water Policy, Spokane
Columbia River Inter-Tribal Fish Commission, Portland, Oregon*
Columbia Riverkeeper, Hood River, Oregon
Coulee Corridor Consortium, Grand Coulee
Grand Coulee Dam Area Chamber of Commerce, Grand Coulee
Grant County Economic Development Council, Moses Lake
Kittitas Audubon Society, Ellensburg*
Lower Columbia Basin Audubon Society, Pasco*
National Wildlife Federation, Seattle
North Columbia Community Action Council, Moses Lake
Northwest Council of Governments and Associates, Soap Lake
Northwest Power and Conservation Council, Portland, Oregon
P.O.W.E.R., Grand Coulee
Ritzville Area Chamber of Commerce, Ritzville
Sierra Club, Seattle
Sierra Club Upper Columbia River Group, Spokane
Soap Lake Conservancy, Soap Lake*
Tri-City Development Council, Kennewick
Umatilla County Critical Groundwater Taskforce, Hermiston, Oregon
Visions for our Future, Keller
Washington Environmental Council, Seattle
Washington Farm Bureau, Lacey
Washington Rivers Conservancy, Wenatchee
Washington State Council of the Federation of Fly Fishers
Washington State Potato Commission, Moses Lake*
Washington State Water Resources Association, Olympia
Water Policy Alliance, Olympia

Public Services and Utilities

Big Bend Electric Cooperative, Inc, Ritzville*
Black Sands Irrigation District, Ephrata*
Chelan County Public Utility District No. 1, Wenatchee
Columbia-Snake River Irrigators Association, Kennewick,* Moses Lake
East Columbia Basin Irrigation District, Othello, Ritzville*
Grant County Public Utility District, Ephrata*
Kennewick Irrigation District, Kennewick
Moses Lake Irrigation and Rehabilitation District, Moses Lake
Odessa School District # 105, Odessa*
Quincy-Columbia Basin Irrigation District, Quincy
South Columbia Basin Irrigation District, Mesa, Pasco*

Individuals

Edward J. Agnew, Leavenworth*
Donna Y. Anderson, Spokane
Brad Arlt, Odessa
Kenneth F. & Kathryn J. Arlt, Moses Lake
Karen Averitt, Newport*
Richard Badalamente, Kennewick*
Lyle Bair, Moses Lake
Brent Bair, e-mail*
James Baird, Wilson Creek* (email)
Peter Baird, Mercer Island*
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Kathy Cabrian, Seattle*
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Henry J. Franz Estate, Lind
Nancy L. Franz & Margaret Franz Robinson, Seattle
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Gladys A. Friesen CR Trust, Tacoma
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John Funaro, Spokane*
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Herbert Gamber, Richland*
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Daniel & Miriam A. Myers, Liberty Lake

James D. & Samantha Myers, Wilson Creek
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Louis Nevsimal, e-mail*
Robert Nuess, Spokane*
Neil Ofsthun, Kennewick*
Beverly Ogburn, Wapato*
M. Osborn, e-mail*
Lisi Ott, Leavenworth*
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Jacque Smith, Winthrop*
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R.K. and Kay Smith, Yakima*
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Narice Strom, Normandy Park
Scott Stromatt, Seattle*
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Dennis and Suzanne Franz Swinger, Jr., Lind
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Dick and Nancy Watts, West Richland*
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Dean White, Davenport*
Nancy White, Spokane Valley*
Norman Whittlesey, e-mail*
Den Mark Wichar, Vancouver*
Page Williams, Valley*
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Margaret Yeoman, Anacortes*
Amber Zagelow, Odessa*
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Jeff Zagelow, Odessa*
Larry Zagelow, Odessa*
Lewis Zundel, Marlin

Business Entities

77 Double Bar Ranch, Soap Lake
Air Ag, Warden
Anchor QEA, LLC, Richland
Association of Washington Businesses, Olympia
Avista Utility, Othello
Bailie Land & Cattle Co DBA Judson Properties Partnership, Mesa
Banks Lake Residential, LLC
Basic American Foods, Moses Lake
Bell Farms, Lamona
Bluff Valley Farm, Wilson Creek
Campbell Farms, Warden
Campbell Ranch, Inc., Othello
Cegnar Co., Moses Lake
CH2M HILL, Kennewick; Boise, Idaho
CHS Inc., Moses Lake
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Coulee Playland, Coulee City*
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Desert Grain Farms, Inc., Marlin
Desert Ridge Produce, Moses Lake
Emmerland Hills, Ritzville
Fode Farms, Inc., Moses Lake
G&C Schell Family LLC, Moses Lake
G&M Stocker Holdings LLC, Spokane
Geoengineers, Spokane
Giesco, Inc., Odessa
Golder Associates, Inc., Coeur d'Alene, Idaho
Goetz Farms Inc., Marlin
Grand Coulee Project Hydroelectric Authority, Ephrata
Gray & Osborne, Seattle
Hailey Co., Mesa
Hartland LLC, Connell
HDR Engineering, Bellevue
Higher Ground Organic Farm, Springdale
Higley Farms, Othello
Hodgson's Inc., Spokane
Iriehe Farms, Moses Lake
Irrigators, Inc., Moses Lake
Isaak Land, Inc., Coulee City
Jasman Farms, Inc., Marlin
Johnson Agriprises, Inc., Othello
J.R. Simplot Company, Moses Lake; Boise, Idaho
Kelsey 5, Inc., Connell
Kettle Falls Marina, Kettle Falls*
Klindworth, Inc., Connell
L&L Farms, Echo, Oregon
MAC Farms, Inc., Marlin, Moses Lake
Mar Don Resort, Othello
Melville Ranch, LLC, Lamont
Mikkelborg, Broz, Wells & Fryer, PLLC, Seattle
Northwest Food Processors Association, Moses Lake*
O'Neal Farms, Connell
Phillips Ranch, Lind
Prior Farms, Othello
Royal Bluffs Ranch II, LLC, Royal City
S&G Farms, Moses Lake
Seven Bays Marina, Davenport*
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V3, Inc., Odessa
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Zaser & Longston, Inc., Kirkland

Media

Agri-Times NW, Othello
Associated Press, Yakima
Columbia Basin Bulletin, Vancouver; Portland, Oregon
Capital Press, Spokane
Columbia Basin Herald, Moses Lake
Grant County Journal, Ephrata
High Country News, Berkeley, California
News Standard, Coulee City

Odessa Record, Odessa*
Othello Outlook, Othello
Spokane Public Radio, Spokane
Star Newspaper, Grand Coulee
The Wenatchee World, Wenatchee
Tri-City Herald, Tri-Cities

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APPENDICES

APPENDIX A

MEMORANDUM OF UNDERSTANDING CONCERNING THE STATE OF WASHINGTON'S COLUMBIA RIVER INITIATIVE – DECEMBER 2004

Memorandum of Understanding
Concerning the State of Washington's
Columbia River Initiative

PARTIES

This Memorandum of Understanding (MOU) is entered into between the State of Washington (State), acting through the state agencies which are signatories hereto; the Pacific Northwest Region of the U.S. Bureau of Reclamation (Reclamation); and the South Columbia Basin Irrigation District, the East Columbia Basin Irrigation District, and the Quincy-Columbia Basin Irrigation District (collectively, the Districts). The State, Reclamation, and the Districts are collectively referred to as the "parties" herein.

EFFECT

Section 1. This MOU is intended only to coordinate and facilitate cooperation between the parties to advance the actions described in this MOU and is not intended to and does not create a legally binding contract or any right or benefit, substantive or procedural, enforceable at law or in equity by any party against another party, its directors, officers, employees or other persons. This MOU does not constitute an explicit or implicit agreement by the parties to subject any of the parties to the jurisdiction of any federal or state court over and above any rights or procedures presently available to the parties. This MOU does not create any right or benefit, substantive or procedural, enforceable at law or in equity, by any person or entity against the parties. This MOU shall not be construed to create any right to judicial review involving the compliance or noncompliance of the parties with this MOU.

Section 2. Nothing in this MOU shall (a) result in any impairment to the existing water supplies or water rights for the Columbia Basin Project (Project), (b) result in an amendment or modification of the rights and obligations of the Districts and Reclamation under the existing Project repayment contracts, (c) affect the priority dates of any existing water rights, (d) impair the current operations of the Project, (e) impair or interfere with eventual completion of the Project as congressionally authorized, or (f) result in an increase in the Districts' construction cost obligations and operation and maintenance obligations under the existing Project repayment contracts.

PURPOSE AND OBJECTIVES

Section 3. The parties will use their best efforts in working collaboratively and in good faith to secure economic and environmental benefits from improved water management both within the federal Project and along the mainstem of the Columbia River by advancing the actions described in this MOU.

Section 4. Through the Columbia River Initiative (CRI), the State is developing a program for the mainstem of the Columbia River that will allow access to the river's water resources while providing support for salmon recovery. The objectives of the CRI are to meet the water needs of growing communities and their rural and agricultural economies along the mainstem of the Columbia River, and to do so in a manner that reduces the risk to fish resulting from out-of-stream use of water. While the CRI is focused on the mainstem of the Columbia River, the State recognizes that there are important needs within the Project that remain unmet and that require and warrant increased attention and resources from the State. As established in state statute and state-based water rights, the parties hereby affirm their long-standing and mutual commitment to the Project as congressionally authorized.

MAINSTEM STORAGE PROGRAM

Section 5. The parties recognize the growing water needs of the region will require development and use of new water storage facilities that are properly designed, constructed and managed to meet both economic and environmental needs – including power production, municipal water supplies, irrigation development, and improved stream flows to assist salmon recovery.

Section 6. The parties will cooperate in initiating an appraisal level assessment of the potential to store additional water from the Columbia River mainstem, including an assessment of the costs and benefits of alternative water storage sites (the Storage Assessment). The State will be responsible for conducting the Storage Assessment with existing state funds. The State will, in consultation with other parties, develop a scope of work for the Storage Assessment by December 31, 2004. The State will also secure by February 28, 2005, a contractor to conduct the Storage Assessment. The State will request additional state funding for the Storage Assessment for the coming state fiscal biennium. Reclamation will participate in and support the Storage Assessment to the extent funding is available to it within its Washington Investigations budget line item in federal fiscal years 2005 and 2006, as determined by it.

Section 7. If and as warranted by the initial results of the Storage Assessment, the State and the Districts will propose by July 2005 federal legislation to authorize and fund a mainstem storage program, including feasibility studies by Reclamation for proposed storage projects; provided, however, the Districts may participate and support one or more of these feasibility studies, as they determine. By December 20, 2004, the State will submit a budget request to support the new mainstem storage program during the state 2005-2007 biennium to include funding for feasibility studies. Reclamation's position regarding the authorization and funding of the mainstem storage program and feasibility studies will be determined by the views of the Administration at the time Congress considers authorizing legislation and appropriations. If and as authorized by Congress, the State and Reclamation will negotiate and enter into one or more feasibility study contracts. If federal authorization is not secured by January 2006, the State will fund the initiation of one or more feasibility studies to evaluate potential new storage sites, while continuing to pursue federal authorization. By July 2006, the parties will develop a schedule of future milestones for the mainstem storage program.

Section 8. If and as warranted by the feasibility studies, the State and the Districts agree to pursue federal authorization of mainstem storage projects to be undertaken by Reclamation, with the State as local sponsor for the storage projects. As authorized and as necessary to support the new mainstem storage program, or as specific storage projects are identified for feasibility studies, Reclamation and the State will work together to secure a new federal withdrawal of water from the mainstem pursuant to Chapter 90.40 RCW.

MAINSTEM DROUGHT RELIEF

Section 9. Reclamation and the State, acting through the Department of Ecology (Ecology), will use their best efforts to negotiate and enter into a contract by March 31, 2005 (the Drought Relief Contract), to make available up to 50,000 acre-feet from the Project storage rights from Lake Roosevelt for release into the Columbia River in any year in which the March 1 runoff forecast at the Dalles for April through September, as provided by the National Weather Service in their "Water Supply Outlook for the Western United States," is less than 60 MAF, and in which the Governor of the State of Washington makes a formal request in accordance with the Reclamation States Drought Relief Act of 1991 (P.L. 102-250) (the Drought Relief Act).

Section 10. The Drought Relief Contract, if entered into, will allow the use of the water to be made in accordance with applicable state and federal laws by existing water rights which divert from the Columbia River downstream of Grand Coulee Dam and to benefit fish in the Columbia River. Of the amount to be made available under the Drought Relief Contract, if entered into, up to 33,000 acre-feet would be made available for existing state-based water rights along the mainstem and up to 17,000 acre-feet would be made available for improving stream flows for fish during the drought. The Drought Relief Contract, if entered into, will be effective for a term not exceeding the maximum period authorized by law and will, as needed and if and when allowed by law, provide for renewal of the contract for a longer period of time.

Section 11. The parties acknowledge that the Drought Relief Act is set to expire on September 30, 2005, and that any subsequent renewals of the Drought Relief Contract, if entered into, will be contingent, in part, upon the Drought Relief Act being extended or otherwise reauthorized. The State and the Districts agree to seek and support favorable congressional action to extend or otherwise reauthorize the Drought Relief Act and to pursue authorization for drought relief contracts that could exceed the current two-year statutory limit. Reclamation's position will be determined by the views of the Administration at the time Congress considers any such extension, amendment or reauthorization. The State will request support for reauthorization of the Drought Relief Act from the Western States Water Council and the Western Governor's Association and will introduce federal legislation by no later than March 2005.

MUNICIPAL AND INDUSTRIAL WATER SUPPLY

Section 12. Reclamation and the State, acting through Ecology, will use their best efforts to negotiate and enter into a water service contract, in accordance with subsection 9(c) of the Reclamation Project Act of 1939 (53 Stat. 1187) by December 31, 2005 (the M&I Contract) to make available up to 37,500 acre-feet of water annually from the storage rights of the Project, of which up to 25,000 acre-feet would be available for municipal and industrial purposes and up to 12,500 acre-feet would be available to benefit stream flows and fish in the Columbia River. Most of this water would be delivered to the State by Reclamation in the Columbia River at the foot of Grand Coulee Dam, though a smaller portion of this water would be made available for direct withdrawal from Lake Roosevelt. Under the terms of the M&I Contract, if entered into, the State would accept this water and place it into the state trust water rights program as a water right for instream flow purposes to serve as mitigation for new water rights to be issued to qualifying municipalities and industries along the Columbia River.

Section 13. The term of the M&I Contract, if entered into, will be as allowed under federal reclamation law and policy and may be renewed as provided by the Act of June 21, 1963 (77 Stat. 68) pertaining to the renewal of certain municipal, domestic, and industrial water supply contracts entered into under the Reclamation Project Act of 1939. Allocation of water under the M&I Contract shall be in increments of time and quantity based on satisfactory performance in meeting the terms and milestones provided for the Odessa Subarea in Section 14 of this MOU. Water allocated for a given increment will be made available for the duration of the M&I Contract, while the remaining portion of the unallocated water will remain subject to satisfactory performance under this MOU. The initial increment for the contract will be the period of January 2006 through December 2007. Thereafter, the increments will run for a six-year period, to align water supply decisions with the next increment of municipal growth as projected through municipal water supply plans required by state law. These timeframes may be amended by the parties during negotiation of the contract. Release of future increments of water is subject to performance deemed satisfactory by all parties to this MOU. A decision to limit access to water under the contract based on unsatisfactory performance shall not result in loss of water previously committed and distributed under the contract. The amount of water available during the initial increment shall be specified in the contract, and the amount of water available for future increments shall be based on projected municipal and industrial water supply needs.

ODESSA SUBAREA

Section 14. The parties will cooperate to support and pursue the diversion and delivery of an additional 30,000 acre-feet of water from Lake Roosevelt to the Odessa Subarea. In an effort to satisfy this objective, Reclamation will file by March 2005 an application with the State for a water right permit to divert 30,000 acre-feet of water from the federal withdrawal and storage rights for the Project to serve the Odessa Subarea. The State will process the application and issue a permit decision by September 2005. If the permit decision is challenged, the State commits to active and good faith defense of the permit, with assistance from Reclamation and the Districts, as appropriate. The goal is to make up to 30,000 acre-feet of water available to the Odessa Subarea no later than December 2006 for use during the 2007 irrigation season. Use of this water is limited to existing agricultural lands, with priority for use on lands currently irrigated under state ground water permits in areas where the Odessa aquifer is declining. Lands receiving water under this section which are also covered by state ground water permits shall not divert water under the permits. This water is separate from and in addition to other ongoing programs to deliver water within the Project.

Section 15. In addition to the quantity of water described in Section 14, the parties will cooperate to explore opportunities for delivery of water to additional existing agricultural lands within the Odessa Subarea. As opportunities become known, the State will seek state funding to cost share the potential development of infrastructure to deliver this water. Reclamation's position regarding the future delivery of water under this section will be determined by the views of the Administration at the time.

Section 16. In addition, the State will conduct an appraisal level assessment of the potential to store additional water from the Columbia mainstem in the Odessa aquifer (the Odessa Assessment). Reclamation will participate in the Odessa Assessment to the extent funding is available in its Washington Investigations program. The Districts will assist in evaluating the infrastructure implications of delivering water to the aquifer.

POTHOLES RESERVOIR OPERATIONS

Section 17. The parties will cooperate in completing by March 2006 an appraisal level assessment of alternatives for managing Potholes Reservoir, including an alternative water feed route, changes in the storage rule curves, improving the water evacuation route, and evaluating potential solutions to the delivery constraints of the East Low Canal below Interstate 90 (the Potholes Assessment). The parties will cooperate to develop and execute a study contract to define and assign the remaining tasks of the Potholes Assessment. As part of the Potholes Assessment, Reclamation will initiate by January 2005 an appraisal level analysis of the hydrology of Potholes Reservoir and the implications of changes in the feed route, increased seasonal storage and flood evacuation. The State will request funding for its 2005-2007 biennium to complete the Potholes Assessment. Reclamation and the Districts will make available, subject to Reclamation security policies, studies and cost estimates previously prepared for the Potholes feed and evacuation routes, and for the improvements to the East Low Canal.

Section 18. The purpose of the Potholes Assessment is to determine whether changes in operations could secure additional benefits without jeopardizing existing Project benefits. These additional benefits could include increased reliability of irrigation water supply, the ability to irrigate additional lands, improved water quality in Project reservoirs, increased fish and wildlife habitat within the Project, and reduced reliance on the Columbia mainstem during the summer months. The parties recognize that Potholes Reservoir is first and foremost a water supply for two of the Project districts, and agree that the actions under this MOU are not intended to, and shall not, jeopardize the reliability of this water supply. The parties further recognize that any evaluation of the reservoir must be conducted within the context of the overall Project, as the feed route, reservoir operations and evacuation route must be considered together, and that the reservoir is central to the proper functioning of the Project as a whole.

Section 19. If and as warranted by the results of the Potholes Assessment, the State and the Districts will pursue appropriate feasibility level studies, including the authorization and funding of feasibility studies by Reclamation. Reclamation's position regarding authorization and funding of such feasibility studies will be determined by the views of the Administration at the time Congress considers authorizing legislation and appropriations. The State will cost share in any such feasibility studies should Reclamation be authorized and funded to conduct the studies. The State will request feasibility study funds for the next state fiscal biennium. The tasks and responsibilities for feasibility studies will be specified by contract. If and as warranted by the results of such feasibility studies, the parties will work in good faith to develop and implement a specific proposal for changes to the operation of Potholes Reservoir. Subject to congressional authorization, feasibility studies, if undertaken, would be completed by June 2008.

WATER FROM CANADA

Section 20. The parties acknowledge that the State will seek to secure, through the United States, water from Canadian reservoir storage facilities. The State and Reclamation will use their best efforts to cooperate in ensuring that water released from Canadian facilities is moved through Lake Roosevelt in an acceptable manner. In this regard, the State and Reclamation will consider whether a written agreement regarding the delivery of water from Canada through Lake Roosevelt would be desirable. If so, they will endeavor in good faith to negotiate and execute an operating agreement in this regard during calendar year 2005 and invite the Bonneville Power Administration to be a signatory to any such operating agreement.

ADDITIONAL PROVISIONS

Section 21. Reclamation will submit to the State a proof of appropriation form to request issuance of a state water right certificate for the perfected portions of the existing permit held by Reclamation for the Project. The State will issue a water right certificate reflecting the amount of Project water and land developed under the existing permit, and will issue a superceding permit for the amount of Project water and land that may continue to be developed under the superceding permit.

Section 22. In partial consideration of the State's contribution toward the Storage Assessment, the Potholes Assessment including an alternative feed route, improved evacuation route and solutions to East Low Canal delivery constraints, and the State's timely implementation and performance of other actions described in this MOU, the parties will cooperate to make available up to 15,000 acre-feet of water annually from the Project storage rights in Lake Roosevelt to benefit stream flows for fish. This water will be made available after December 2006. The timing of release of the water will be determined by Reclamation, in consultation with parties responsible for salmon recovery on the mainstem.

Section 23. The State will consult with the Colville Confederated Tribes and the Spokane Tribe of Indians regarding the CRI and will secure the concurrence of these tribal governments. Given the concurrence obtained by the State, Reclamation will be responsible for Government to Government consultation with the Tribes.

Section 24. The State will consult with NOAA Fisheries and the US Fish and Wildlife Service (USFWS) regarding the CRI and will obtain their concurrence. Given the concurrence obtained by the State, Reclamation will consult with NOAA Fisheries and USFWS as required by the Endangered Species Act.

IMPLEMENTING CONTRACTS

Section 25. Implementation of the actions described in this MOU is subject to the authority of the parties and the availability of funding as approved by the State Legislature and Congress and will be undertaken pursuant to any contracts that may be subsequently entered into among the parties as described in this MOU. The contracts involving Reclamation as a party shall be prepared, negotiated, and executed in accordance with federal reclamation laws, rules and regulations, and policies.

Section 26. Any contracts prepared under this MOU shall be available for review by all parties to this MOU prior to execution of the contract. Where a party will not be a signatory to a contract, such party may request consultation with the other MOU parties to address any questions or concerns with a proposed contract. Any party requesting consultation concerning a contract shall be provided an opportunity for consultation before the contract is executed.

OVERSIGHT PANEL

Section 27. The parties will create an Oversight Panel to provide oversight and coordination for all aspects of this MOU. The Oversight Panel shall consist of one designated representative of each of the signatories to this MOU. The Oversight Panel's functions include, but are not limited to: (a) monitoring implementation of the actions set forth in this MOU, (b) tracking and reporting of performance by the parties under any contract executed under this MOU, (c) reviewing and evaluating, at least on an annual basis, this MOU and its implementation by the parties, and (d) resolving disagreements between the parties.

Section 28. In the event disagreements arise between the parties and cannot be resolved, any party to this MOU may request the Oversight Panel to attempt to resolve the disagreement. Within 45 days of any such request, the Oversight Panel shall notify the parties of its recommended proposal for resolving the disagreement; provided, however, such decision or proposal shall be advisory only and not binding on the parties.

GENERAL PROVISIONS

Section 29. The period of performance of this MOU shall commence on the date when it is signed by the last signatory. This MOU shall terminate on December 31, 2014, unless it is extended by mutual written consent of the parties. Termination of this MOU does not invalidate contracts executed under the MOU.

Section 30. Notwithstanding Section 29 above, any party desiring to terminate its participation in this MOU will give 90 days written notice to the other parties. Upon receipt of a notice of termination, the parties may meet or elect to convene the Oversight Panel within 45 days in a good faith effort to resolve any disagreements relating to the notice of termination. Termination by a party does not in any way invalidate contracts executed under this MOU; contracts may be terminated only through the provisions of the contract. Where one party terminates from this MOU, other parties may agree to continue to implement the MOU within the scope of their authority and funding.

Section 31. This MOU may only be amended by mutual written consent of the parties. No amendment shall be effective for any purpose unless it is made in writing and signed by authorized representatives of all the parties to this MOU.

Section 32. Notwithstanding any other provision of this MOU, the parties acknowledge that Reclamation's actions are subject to federal reclamation law, as amended and supplemented, and the policies, rules and regulations promulgated by the Secretary of the Interior under federal reclamation law; and applicable federal law, including but not limited to, the National Environmental Policy Act (NEPA), and the Endangered Species Act (ESA). NEPA compliance activities may include public scoping meetings and hearings, Fish and Wildlife Coordination Act and cultural resource consultations, and consultations with Tribes on Indian Trust Assets. ESA activities may include consultation with NOAA Fisheries and the USFWS.

Section 33. Notwithstanding any other provision of this MOU, the parties acknowledge that any contract executed under this MOU where Project benefits are afforded shall be subject to federal reclamation law, policies, and rules and regulations governing recovery of Project costs. The parties further acknowledge that the costs of development, review and approval of proposed actions, including but not limited to, environmental compliance activities, preparation, negotiation and execution of contracts, and any costs of mitigation determined to be required, shall be incurred by the benefiting contractor. Costs to the benefiting contractor may be mitigated by other enhancements or contributions that benefit the parties to this MOU, at the discretion of Reclamation. Any contract executed under this MOU that implements a joint federal and state program, as authorized and directed by federal law and funded through federal appropriations, shall be subject to federal cost sharing laws, policies and practices.

Section 34. The signatures of the Districts on this MOU shall not be interpreted as an acknowledgment or endorsement by the Districts of the technical conclusions and proposed policies of the State related to the Columbia River mainstem water management program, or in any way to be acceptance of or agreement with a "no net loss" policy for management of water resources in the Columbia River.

Section 35. As necessary to support budget development and legislative review of budget requests, the State and/or the Districts may request an estimate of costs for actions proposed under this MOU. Reclamation will provide estimates based on information available at the time of the request.

Section 36. All actions and schedules called for by this MOU are subject to and contingent upon the availability and allocation of future federal and state appropriations, existing and future limitations on a party's statutory authorities, and state and federal regulatory approvals as needed. The parties recognize that if any necessary authority and/or funding is not forthcoming, the schedules identified in this MOU will be reviewed and adjusted as necessary, by mutual consent.

Section 37. This MOU is executed in multiple originals, with one originally executed copy for each of the below signatories.

SIGNATORIES

Director, Pacific Northwest Region, U.S Bureau of Reclamation — DATE Dec 17, 2004

Governor, State of Washington — DATE Dec 17, 2004

Director, Washington State Department of Fish and Wildlife — DATE Dec 17, 2004

Attest:

Secretary

SOUTH COLUMBIA BASIN IRRIGATION DISTRICT
PO Box 1066
Pasco WA 99301

By
President, Board of Directors

Attest:

Secretary

EAST COLUMBIA BASIN IRRIGATION DISTRICT
PO Box E
Othello WA 99344

By
President, Board of Directors

Attest:

Asst Secretary

QUINCY-COLUMBIA BASIN IRRIGATION DISTRICT
PO Box 188
Quincy WA 98848

By
President, Board of Directors

APPENDIX B

SCOPING SUMMARY REPORT

Odessa Subarea Special Study

Environmental Impact Statement

SCOPING SUMMARY REPORT

Columbia Basin Project, Washington

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Upper Columbia Area Office
Yakima, Washington

State of Washington
Department of Ecology
Central Regional Office
Yakima, Washington

November 2008

Mission Statements

The Mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

The mission of the Department of Ecology is to protect, preserve and enhance Washington's environment, and promote the wise management of our air, land and water for the benefit of current and future generations.

Odessa Subarea Special Study

Environmental Impact Statement

SCOPING SUMMARY REPORT

Columbia Basin Project, Washington

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Upper Columbia Area Office
Yakima, Washington

State of Washington
Department of Ecology
Central Regional Office
Yakima, Washington

November 2008

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Introduction

This document serves as the scoping report for the environmental impact statement (EIS) to be prepared by the Bureau of Reclamation (Reclamation) and the State of Washington Department of Ecology (Ecology) for the Odessa Subarea Special Study (Study). The purpose of this report is to provide a summary of the major comments and issues provided as part of the scoping process.

Background

The Odessa Subarea Special Study is an investigation of continued phased development of the Columbia Basin Project to provide a replacement surface water supply for current groundwater irrigation occurring in the Odessa Groundwater Management Subarea. An estimated 170,000 acres within the Odessa Subarea are now being irrigated with groundwater; an estimated 140,000 of these acres are eligible to receive Columbia Basin Project surface water. Ecology is participating in the Study to provide support for State and local agency permit decisions that may be necessary to implement a selected alternative.

The purpose of the Odessa Subarea Special Study is to evaluate alternatives to replace current groundwater irrigation in the Odessa Subarea with Columbia Basin Project water. The Study is needed to fulfill the obligation Reclamation made in a Memorandum of Agreement between the State of Washington and the Columbia Basin Project irrigation districts in December 2004 to cooperatively explore opportunities for delivery of Columbia Basin Project water to existing groundwater-irrigated lands within the Odessa Subarea.

Action, if taken, would avoid significant economic loss in the near term to the region's agricultural sector resulting from resource conditions associated with continued decline of the aquifers in the Odessa Subarea. Groundwater is currently being depleted to such an extent that water must be pumped from depths as great as 750 feet in some areas, with well depths as great as 2,100–2,400 feet deep. Well drilling and pumping costs have resulted in expensive power costs and poor water quality due to high water temperatures and high sodium concentrations.

The proposed alternatives currently identified are as follows:

- No Action Alternative
- East Low/East High Alternative: Enlarge and extend existing East Low Canal south of Interstate 90 (I–90) and construct a new East High Canal system north of I–90 in phases; and
- East Low Alternative: Enlarge and extend existing East Low Canal south of I-90.

Additional information about the Study is available at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

Scoping Process

Scoping is an essential part of public involvement; public involvement is a process for including interested and affected individuals, organizations, agencies, and governmental agencies in an agency's decisionmaking process. Scoping is a term used for the process of seeking comments and public information to identify the significant issues related to a proposal.

The scoping process for this study was initiated in August 2008. A Federal Notice of Intent to prepare an EIS and to conduct public scoping meetings was published in the *Federal Register* on August 21, 2008. Also on August 21, 2008, Ecology issued a Determination of Significance and a request for comments on the scope of the EIS. Additionally, on August 21, 2008, Reclamation sent an e-mail message to 190 mailing list recipients announcing the Study Update was available on the Study Web site (http://www.usbr.gov/pn).

On August 25, 2008, Ecology provided notice of the meeting to subscribers of its e-mail list for the Columbia River Basin Water Management Program. On August 26, 2008, Reclamation mailed copies of the Study Update to 243 mailing list recipients. Reclamation issued a news release to local media on September 2, 2008. Ecology provided a reminder notice on September 4, 2008, to subscribers of its E-Mail Lists, including those for the Columbia River Basin Water Management Program and the Reclamation Yakima Water Storage Feasibility Study.

Reclamation and Ecology hosted two evening public scoping meetings, one at the Town of Coulee Dam Town Hall, Coulee Dam, Washington, on September 10, 2008, and one at the Advanced Technologies Education Center, Big Bend

Community College, Moses Lake, Washington, on September 11, 2008. About 55 people attended the two scoping meetings. At the public meetings, Reclamation and Ecology presented the proposed alternatives, provided an overview of the NEPA/SEPA process, and provided opportunities for the public to identify issues and concerns associated with the proposed project.

The Notice of Intent, Determination of Significance, Study Update, and news releases are attached to this document, along with handouts from the public scoping meetings.

In addition to comments received at the scoping meetings, written comments were accepted through September 19, 2008. Including those from the scoping meetings, 33 written comment documents were received. The documents included two requests to be added to the mailing list with no comments and one requesting removal from the mailing list for this study. The comments ranged from brief comments or questions to detailed statements

The comments received will be used to assist in the following:

- Identifying the significant issues relevant to the proposed action
- Identifying those elements of the environment that could be affected by the proposed action
- Formulating alternatives for the proposed action
- Determining the appropriate environmental documents to be prepared

All comments received during the scoping process dealing with issues, concerns, and potential impacts will be considered by Reclamation and Ecology in the preparation of the draft EIS. Additional issues will also be considered as they arise.

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Scoping Summary

This section identifies the major comments and issues provided to Reclamation and Ecology as part of the scoping process.

Purpose and Need

- Studying this problem in isolation from the rest of the river may ultimately be a mistake. The Department of Ecology is considering other factors and options to effect other changes that could at the same time possibly address the Odessa shortage through the water budget process.

- It may be that the task Ecology has asked the Bureau to accomplish is too narrow in scope. Thinking bigger may solve more problems and use taxpayer dollars more efficiently. We would hate to see the ruination of our regional tourism economy come about as a result of a piecemeal solution, the funding for which is likely to remain a large political question mark for years to come.

- The EIS should reflect not only the purpose and need of the irrigators but also the Tribal needs and the public need for water quality.

Alternatives

No Action Alternative

- Risks the loss of irrigated acres and will exacerbate the declining Odessa aquifer by not addressing the problem.

- Farmers chose to drill deep wells, they were not forced to; the taxpayers shouldn’t pay for their mistakes.

- The EIS should explore a modified No Action Alternative that encourages conversion of Odessa Subarea irrigated lands to dryland farming and conservation reserve; dryland farming makes more sense for the area.

Action Alternatives

- How, when, and by whom will the decision be made on where the first 30,000 acre-feet of drawdown water will be delivered inside the Odessa Subarea?

- Earlier options no longer under consideration were removed before we knew about them or could comment; we think they should be put back on the table.
- Consider gravity flow as opposed to pumping for East Low to avoid high power costs.
- Actively subsidizing the waste of a resource is the absolute, worst possible choice, and it's high time we change direction.
- There should be one or more scenarios for phasing implementation, e.g., consider the East Low Canal expansion in stages and then continue with the more costly areas later.
- Have hydropower stations been considered on the canal system as part of the development?
- Consider making more municipal and industrial contract water available through this process
- If canal development is phased, big to smaller pipelines are not reasonable; can't be used backwards to change flow direction.
- Phase development of areas north and south of I–90 to keep costs of repayment equal.
- To keep the costs for development of the alternatives at a reasonable level, maximize the use of existing project facilities.
- Make use of existing farm pipes to distribute around farms.
- Develop from existing East Low Canal first to avoid a new, open canal that will fragment areas.
- Bring water to farm boundary instead of section corner.
- Maintenance of steel pipelines may be a problem.
- Consider alternative to finance drip irrigation systems, install metering, and revamp water regulations to encourage thrift.
- The East Low/East High Alternative appears to resolve the aquifer problem the most by bringing water to the largest number of acres currently being irrigated by deep wells

- Perhaps it would be best to develop more now rather than wait and have costs increase; may be affordable now, but not in future.
- Are there adequate wasteways to handle pump rejection along East Low Canal?
- What will happen to existing drainage in the East Low Canal?

Water Supply Options

- Do storage options equate to a "new water supply"?
- Clarify the source and withdrawal logistics for the water supply.
- When would the irrigation wells be decommissioned and who would pay for it?
- Drawing Banks Lake down will have adverse impacts to tourism, economics).
- Reclamation is authorized to operate Banks Lake as a reregulation reservoir with the intention of using the active storage for the Columbia Basin Project water supply and it should do so.
- Consider a Banks Lake drawdown of 7–8 feet which would provide at least 60–65 percent of the water needed and not be as devastating to the local areas.
- Why draw down Banks Lake in August which is height of tourist/recreation season?
- Will there be a minimum lake level? Is the minimum lake level negotiable?
- Banks Lake full pool elevation is 1,570 feet:
    - Operations below 1,565 feet could require modifications to launch and mooring docks.
    - Operations below 1,555 feet may inhibit navigation, create significant submerged hazards, and place most launches out of service.
    - Adapting to operations of 1,560 feet or less may require significant investment in open water docking systems.

- Any drawdown of Banks Lake during the months of October–June would adversely effect fish pen operations. What mitigation will be provided?

- Higher volumes of water through Banks Lake cause a severe current where the fish pens are located; this should be evaluated and mitigated.

- Limiting Banks Lake refill to an elevation of 1,564 feet until late February, then filling to, and holding at, an elevation of 1,570 feet through June 30 each year will allow for expansion of riparian species into the newly barren literal zone exposed by the drawdown. This action, along with aggressive structural enhancement, could help offset some of the vegetation loss.

- Consider refilling Banks Lake in December and January instead of September and October to minimize effects to reservoir productivity.

- Consider the costs to address drawdown related recreational issues on Banks Lake relative to the cost of the creation of additional storage.

- Drawing down Banks Lake could require numerous infrastructure changes at Coulee Playland Resort, including erosion control and damage recovery; reconfiguring moorage, fueling, launching, and pumpout facilities.

Other Suggested Water Supply Options

- Recommend placing storage reservoir south of Warden to better match delivery with demand.

- What about onfarm storage ponds to smooth out on-off pumping?

- Draw directly out of Columbia River instead of drawing down Banks Lake?

- Consider including municipal water reclamation (reclaimed water), specifically from Warden, Royal City, Ephrata, and Quincy, as an additional source of water that can be used to reduce demands on the Odessa Subarea Aquifer. Fully investigate how Reclamation’s storage and delivery systems can be used to help deliver reclaimed water to local farmers.

- Would it be possible to budget more water for Odessa, through Banks Lake, if Columbia water now budgeted for other downstream uses were stored for those uses in off-stream reservoirs, the original idea behind the Columbia River Initiative?

- Additional storage capacity sufficient for the entire Columbia Basin Project could come from constructing two dams on Banks Lake to create a lake within a lake.

Water Supply

- Describe and provide graphic presentation of changes in reservoir conditions (water elevation changes, inflow and outflow volume, water particle travel time, and temperature) throughout the calendar year for current operations and for each proposed operation scenario.

- Prepare a map of irrigation return flows and identify where and when those flows enter the Columbia River or other water bodies.

- Clarify whether the additional water placed into storage in order to facilitate delivery will be considered under the Columbia River Basin Water Management bill formula, or some other such formula, for distributing water to instream use.

- Describe timing and rate of any incremental releases from Grand Coulee Dam associated with each operational scenario and the potential impacts or benefits to downstream resources.

- Include a means for measuring instream flow impacts of the Odessa Subarea diversion over a wide range of water year conditions and identify mitigation measures.

- How will changes to the Columbia River Treaty and the resultant changes in the operation of Canadian Columbia River dams affect the water supply for this project, the flow in the Columbia River, the availability of water in Franklin D. Roosevelt Lake, and aquatic habitat and water quality impacts associated with depletion of flows?

Groundwater (Aquifer)

- Evaluate the effects of the No Action Alternative and action alternatives on groundwater in the Odessa Subarea and its adjacent areas.

- Will there be any aquifer recharge?

- If well pumping is reduced south of I-90, will that alone help or impact the aquifer north of I-90?

- How many years will it take for the aquifer to recover?

Water Rights

- Consider how possible decisions to permit water withdrawals associated with the Columbia River Water Management Program (CRWMP) would be balanced with obligation to protect and enhance the quality of the natural environment.

- Ensure that the issuance of water rights does not violate the State water code and the Federal Endangered Species Act (ESA) of 1978, as amended.

- Commingling of Reclamation and State water creates problems; the EIS needs to discuss how to administratively divide the water.

- Will Odessa irrigators continue to be allowed to “move” water for crop rotation purposes from one location to another by making changes to existing State water rights (seasonal change and acreage expansion)?

- Describe water spreading, who regulates it, and how much is allowed for the Columbia Basin Project.

Water Quality

- How will the removal of 202,000–453,000 additional acre-feet of water affect temperature, dissolved oxygen, the movement of sediment and associated toxics, and dissolved gas in the Columbia River system? How will the removal of these quantities of water affect estuarine conditions at the mouth of the Columbia River, including movement of sediments into the Pacific Ocean?

- The quality of the water from the Columbia River is much better than water from the deep wells.

- Describe the impacts of changing reservoir conditions on water temperatures and reservoir temperature stratification.

- Do not allow municipal/industrial discharges into any Reclamation facility.

Hydropower Resources

- The energy gains and losses should be compared, including the effect on energy used for deep well pumping; additional energy needed for primary pumping at Grand Coulee Dam; additional energy needed for secondary pumping by the irrigation districts; and effects on streamflow for hydropower consumption as well as actual electric consumption.

- Provide examples of electric use by other energy intensive industries in the Columbia Basin Project area such as silicon plants and computer server farms, etc., for perspective purposes.

- In addition to the value of lost generation, the EIS also should evaluate diminishment of system flexibility, decreased ability to ramp generation up or down; amount of hydropower available to meet the load growth of the region.

- What are the impacts of the proposed water supply options on Project and Columbia River hydropower generation? If hydropower production decreases, to what extent will it be replaced by or otherwise facilitate the use of coal or other carbon-based fuels? Consider impacts associated with increasing electricity generation from natural gas and/or coal facilities.

- Identify impacts to regional ratepayers of the energy costs associated with pumping water (direct costs and foregone hydropower) to the Odessa Subarea combined with existing subsidies for the Columbia Basin Project.

Climate Change

- The EIS should evaluate the effect of climate change on Columbia River flows and the effects to aquatic habitat, water quality, ESA-listed and other species, and estuarine conditions, including movement of sediments into the Pacific Ocean.

- Consider whether providing surface water for irrigation to the Odessa Subarea might exacerbate the effects of climate change on water supply.

Vegetation

- Prepare maps of habitat types for all project development areas; include shrub-steppe, riparian, wetlands, seasonal lakes or ponds, open water/ponds, grasslands, existing nonirrigated agriculture, and existing irrigated agriculture.

- Consider impacts to shrub-steppe for immediate and potential future developments, especially at the north end of the study area (fragmentation).

- Consider effects of Banks Lake drawdown on riparian habitat.

- Provide analyses of the acres of conversion of previously nonirrigated agricultural lands and undisturbed lands to irrigation that could result, directly or indirectly, from this proposal and how those conversions can be mitigated.

- Will construction of East High Canal increase the wetlands in the Coulee City area?

- Impacts of conversions of existing priority shrub-steppe habitat to irrigated agriculture are a concern.

- Consider effects on the Upper Crab Creek watershed, which provides important aquatic and riparian habitat in an otherwise arid zone.

Fish

- How will the removal of 202,000–453,000 additional acre-feet of water affect aquatic habitat and the needs of both ESA-listed and other species in the Columbia River system?

- Fully comply with ESA.

- Describe the productivity of Banks Lake and other affected reservoirs, the retention times within the reservoirs, and the possible extension of seasonal entrainment impacts to productivity, and resident fish. Quantify the loss of fish to and from Banks Lake and other affected reservoirs associated with the proposal.

- Describe impacts from changing reservoir conditions (water elevation, inflow and outflow volume, water particle travel time, and temperature) on fish and fisheries in Banks Lake and other affected reservoirs.

- Identify impacts to artificial production ("hatchery") programs aimed at improving kokanee populations and/or benefiting Banks Lake and/or Franklin D. Roosevelt Lake fisheries.

- Consider effects of a 1- to 2-foot increase in Banks Lake water level on the fish pen operation.

- Any actions taken to provide water service to the Odessa Subarea lands must avoid or mitigate for any diminishment in Columbia River flows during the primary juvenile salmon migration season (April–August). Where such effects are identified during the juvenile salmon migration season, the EIS should identify sources of replacement water to compensate for such effects.

- Increased flows of irrigation water through the Columbia Basin Project can dramatically increase the recruitment through entrainment of undesirable vegetation and fish, which are conveyed throughout the Project and entrained into the Columbia River mainstem. Describe the change in these impacts attributable to the introduction of new irrigation water to the Odessa Subarea and the measures that will be taken to reduce these impacts.

- Evaluate effects of changing reservoir conditions on fish and their prey.

Wildlife

- How will loss of deep wells affect wildlife?

- Describe the impacts from changing reservoir conditions (water elevation, inflow and outflow volume, water particle travel time, and temperature) on wildlife, including nesting success of waterfowl and shorebirds and potential threat to raptor nests due to inundation.

- Describe the potential impacts of the proposed conveyance and storage systems on deer and other migratory wildlife and the effect on local movements of resident wildlife species, such as lizards and small mammals. Mechanisms should be included to provide for free movement of animals across any new or modified conveyance infrastructure.

- Conduct a habitat evaluation to determine gains and losses in the quality and quantity of wildlife habitat resulting from each alternative.

- Describe the potential impact to wildlife in disturbed areas and margins of agricultural areas and the manner in which those impacts will/can be mitigated.

- Describe how timing/scheduling of construction activities will take into consideration seasonal impacts to wildlife species present at each construction site.

Land and Shoreline Use

- Provide graphic presentation of exposed shorelines for each operational scenario under consideration.
- Describe/quantify the range or total area (square area exposed) by littoral habitat of horizontal shoreline affected by each alternative and identify potential temporary or permanent impacts associated with each operation scenario, such as erosion, ability for people to access recreational areas, ability for fish and wildlife to access tributaries, and loss of shallow habitats.
- Identify and quantify the changes in land and/or shoreline uses for each alternative.

Irrigation and Agriculture

- Consider adverse environmental, economic, and social impacts if deep-well irrigated farms revert back to dryland.
- Are the irrigators required to take the water? If not, can the water be directed to dry lands? Are "incidental acres" dryland acres?
- Describe the conditions that will be imposed on Odessa Subarea recipients of Columbia Basin Project irrigation water and analyze the extent of the market for this water under the stated conditions, including identifying the specific parcels and ownership patterns in the target area, and analysis of which landowners (and how much acreage they represent) are willing to accept the statutory and contractual conditions.
- Is there any possibility of irrigation water outside of the identified study area?
- Identify the numbers and locations of acres of currently nonirrigated land that will become irrigated under each alternative.
- Provide an estimated timeline for the transition from groundwater irrigated agriculture to dryland agriculture.

Visual Resources / Aesthetics

- What would the affected reservoirs look like under the various scenarios? Need visual representations of how the reservoirs and shorelines would look under best-case, worst-case, and average-case (average not mean or medium) scenarios.

Recreation

- Public perception of impacts is often misguided, resulting in a decline in visitation.
- Consider if action would affect currents in Banks Lake which can be a hazard to visitors and require major consideration in the design and anchoring of waterborne assets.
- Ensure compliance with Executive Order 12962 of June 7, 1995, as amended September 26, 2008, regarding recreational fisheries.
- Concerned about alleviating the economic impacts related to Banks Lake and Potholes Reservoirs, specifically with boat docks and ramps not being low enough.
- A summer drawdown of Banks Lake of more than 7 feet, elevation 1,563 feet, during the tourist and recreation seasons would negate prime recreation activities that drive the success of current and future recreation related developments, possibly forcing partial to complete abandonment.
- Consider effects of a 7-foot or more decline in the elevation of Banks Lank on the shoreline; mosquitoes; boat launches and moorages and recreation and tourist-related revenues, including effects to future recreation-related job and revenue growth.
- Evaluate impacts to recreational fishing, hunting, and wildlife-related viewing
- Evaluate the impacts of changing water operations on water- and land-related recreational activities.

Human Health

- Consider effects on mosquito-borne diseases such as the West Nile virus. What assistance/mitigation will be provided to control the mosquito infestation from a 16-foot drawdown of Banks Lake from May–September?

- Consider how additional diversions from Franklin D. Roosevelt Lake will affect bed and bank pollutants and human and environmental exposures to these toxins.

- To reduce the application of Columbia River toxic contaminants or disturbing sediments, discus using appropriate technologies that reduce the turbidity of the river and potentially suspend contaminants in the water column.

Social and Economic Issues and Analyses

- Consider adverse economic impacts, both present and future, from drawdown of Banks Lake.

- Reclamation must reassess the costs and benefits associated with crop production within the Odessa Subarea and not rely on the 2005 Washington State Potato Commission study.

- Reclamation's cost-benefit analysis for this study should not include loss of equipment or crop revenues without consideration of the State's decision to allow Odessa Subarea farmers to consume and profit from nonsustainable groundwater usage in a controlled fashion by providing a schedule for depletion of Odessa groundwater affording them the ability to amortize and receive a full economic return on their investments in wells and water distribution equipment.

- Evaluate the social and monetary effects of changing water operations on water- and land-related recreational activities; identify mitigation.

- Identify impacts to the tax base of the area for all alternatives.

- How will this project be paid for? Government funding vs. repayment by local entities, individuals?

- Provide discussion of monetary and social impacts for each alternative, identify mitigation for adverse impacts, and include analysis of who will pay.

- Economic analyses of the proposed alternatives need to include:

    - The loss of the existing irrigated acres and impacts to agricultural-related industries relying on the production of irrigated agriculture in the Odessa Subarea.

- Impacts to domestic, municipal, and industrial water uses.
- Impacts to recreation and the associated economic impacts for the Banks Lake drawdown options.
- The expenses of redoing existing farm wells and systems if water is not delivered to an onfarm point.
- Impacts of growing higher value crops with a full supply than currently able to grow under declining wells.
- Direct and indirect energy costs associated with pumping water to the Odessa Subarea.
- Expenditures for high-end housing developments.
- Impacts to industries attracted to the area by the natural environment.
- Multipliers for tourism.
- Consideration of future gains lost under the alternatives.
- Benefits of recreational fishing, hunting, and wildlife-related viewing and the value of associated goods and services.
- International impacts.

Cumulative Impacts

- The impact of a permit for Odessa with multiple permits issued using the CRWMP process, coupled with the many water withdrawal permits currently pending with Ecology.
- Impacts of multiple water diversions from the Columbia River, including present diversions and foreseeable proposals, such as:
    - *Potholes Supplemental Feedroute* (Federal Environmental Assessment and FONSI dated 8-07 and State Mitigated Determination of Non-Significance, dated January 17, 2008).
    - *Columbia Mainstem Off-Channel Study* (appraisal valuation dated May 2007).
    - *Yakima River Basin Water Storage Feasibility Study* (draft EIS dated January 2008).

- Walla Walla storage and pump exchange studies (U.S. Army Corps of Engineers reconnaissance report dated Octtober 30, 1997; no information regarding State funding and role released to public).
- Shankers Bend storage project (Okanogan PUD FERC application dated May 17, 2007; no information regarding State funding and role released to public).
- Odessa Subarea stratigraphic study (Columbia Groundwater Management Area, ongoing; no information regarding State funding and role released to public).
- Miscellaneous "Northeast Washington" water storage projects, including, but not limited to, the Lincoln County Passive Hydration Project, Mill Creek Water Storage Project, Campbell Creek Reservoir project, and WRIA 44/50 Surface Water Storage, now being funded by Ecology.
- Idaho projects that propose diversion of water from Snake River basin waterways, including the Minidoka enlargement and Teton and Twin Springs dam proposals (see Idaho House Joint Memorial No. 8, March 17, 2008).

Other Issues and Concerns

- East Irrigation District suggests there may be an opportunity for it to manage portions of construction of the phased development and/or perform work solely with their crews which may be financially beneficial and could be a factor in reducing construction costs and repayment.
- Growers and landowners are willing to share in the cost of development.
- Consider impacts on environmental justice.
- How will the Tribes affect the project? What is their role?
- Document the Tribal consultation and coordination process by providing a chronology with the dates and locations of meetings with Tribal governments, results of the meetings, and discussion of how the Tribes' input was used to develop the EIS. This consultation and coordination should continue throughout the EIS development phase.
- Ecology and Reclamation need to be sure residents of areas potentially affected by their CRWMP and Odessa Subarea projects actually receive

information about the projects and meetings, especially those whose lands may be involved. Use county public records to obtain names and addresses. Also suggest including information in the *South County Sun* and consider holding meetings in other places, including those closer to the location of the construction impacts, e.g., Royal Slope, Crab Creek, Sand Hollow, Royal City.

- What type of assistance will be provided to help mitigate impacts to those affected by the drawdown of Banks Lake? Financial mitigation needs to be provided for effects beyond the reasonable ability for self-adjustment, e.g., costs of modifying assets to deal with permanent change in reservoir elevation.

- While studying impacts on environmental and recreational facets affected by action alternatives, there is a need to recount the benefits that have resulted from the creation of the Columbia Basin Project.

- Define the CRWMP's meaning of "no negative impact" and the minimum standards and guidelines for measuring this "no negative impact" for this study.

- Expedite the process while interest rates are low.

Attachments

Notice of Intent

DEPARTMENT OF THE INTERIOR

National Park Service

Notice of Meetings for the National Park Service (NPS) Subsistence Resource Commission (SRC) Program Within the Alaska Region

AGENCY: National Park Service, Interior.

ACTION: Notice of meetings for the National Park Service (NPS) Subsistence Resource Commission (SRC) program within the Alaska Region.

SUMMARY: The NPS announces the SRC meeting schedules for the following areas: Aniakchak National Monument, Cape Krusenstern National Monument, Kobuk Valley National Park, Lake Clark National Park, and Wrangell-St. Elias National Park. The purpose of each meeting is to develop and continue work on NPS subsistence hunting program recommendations and other related subsistence management issues. Each meeting is open to the public and will have time allocated for public testimony. The public is welcome to present written or oral comments to the SRC. Each meeting will be recorded and meeting minutes will be available upon request from each Superintendent for public inspection approximately six weeks after each meeting. The NPS SRC program is authorized under Title VIII, Section 808 of the Alaska National Interest Lands Conservation Act, Pub. L. 96–487, to operate in accordance with the provisions of the Federal Advisory Committee Act.

DATES: The Aniakchak National Monument SRC meeting will be held on Monday, October 6, 2008, from 9 a.m. to 12 p.m., at the Katmai National Park and Preserve headquarters conference room in King Salmon, AK.

FOR FURTHER INFORMATION CONTACT: Mary McBurney, Subsistence Manager, telephone: (907) 235–7891, or Ralph Moore, Superintendent, telephone: (907) 246–2120, at Aniakchak National Park and Preserve, P.O. Box 7, King Salmon, AK 99613.

DATES: The Cape Krusenstern National Monument SRC and the Kobuk Valley National Park SRC meetings will be held on Thursday, October 9, 2008 and Friday, October 10, 2008 from 9 a.m. to 5 p.m., at the U.S. Fish and Wildlife Service Office in Kotzebue, AK.

FOR FURTHER INFORMATION CONTACT: Ken Adkisson, Subsistence Manager, telephone (907) 443–2522, or Willie Goodwin, Subsistence Manager, and George Helfrich, Superintendent, telephone: (907) 442–3890, at Western Arctic Parklands, P.O. Box 1029, Kotzebue, AK 99752.

DATES: The Lake Clark National Park SRC meeting will be held on September 24, 2008, from 1 p.m. to 5 p.m. at the Lake Clark National Park and Preserve Visitor Center in Port Alsworth, AK.

FOR FURTHER INFORMATION CONTACT: Mary McBurney, Subsistence Manager, telephone: (907) 235–7891, or Joel Hard, Superintendent, and Michelle Ravenmoon, Subsistence Coordinator, telephone: (907) 781–2218, at Lake Clark National Park and Preserve, 1 Park Place, Port Alsworth, AK 99653.

DATES: The Wrangell-St. Elias National Park SRC meeting will be held on Wednesday, October 29, 2008 and Thursday, October 30, 2008, from 9 a.m. to 5 p.m. at the Yakutat-Alaska Native Brotherhood Hall in Yakutat, AK.

FOR FURTHER INFORMATION CONTACT: Barbara Cellarius, Subsistence Manager, telephone: (907) 822–7236, or Meg Jensen, Superintendent, telephone: (907) 822–5234, at Wrangell-St. Elias National Park and Preserve, P.O. Box 439, Copper Center, AK 99573.

SUPPLEMENTARY INFORMATION: SRC meeting locations and dates may need to be changed based on weather or local circumstances. If meeting dates and locations are changed notice of each meeting will be published in local newspapers and announced on local radio stations prior to the meeting dates. The meetings may end early if all business is completed.

The agendas for each meeting include the following:

1. Call to Order (SRC Chair)
2. SRC Roll Call and Confirmation of Quorum
3. SRC Chair and Superintendent's Welcome and Introductions
4. Review and Approve Agenda
5. Status of SRC Membership
6. SRC Member Reports
7. Superintendent and NPS Staff Reports
8. Federal Subsistence Board Update (Review Proposals, Board Actions)
9. State of Alaska Board Actions Update
10. New Business
11. Agency and Public Comments
12. SRC Work Session
13. Set Time and Place of Next SRC Meeting

Adjournment

Victor Knox,

Deputy Regional Director.

[FR Doc. E8–19437 Filed 8–20–08; 8:45 am]

BILLING CODE 4312–HE–P

DEPARTMENT OF THE INTERIOR

Bureau of Reclamation

Odessa Subarea Special Study; Adams, Franklin, Grant, Lincoln and Walla Walla Counties, WA

AGENCY: Bureau of Reclamation, Interior.

ACTION: Notice of Intent to prepare an Environmental Impact Statement.

SUMMARY: Pursuant to section 102(2)(C) of the National Environmental Policy Act of 1969, as amended, the Bureau of Reclamation (Reclamation) proposes to prepare an Environmental Impact Statement (EIS) for the Odessa Subarea Special Study. The Washington Department of Ecology (Ecology) is a joint lead with Reclamation in the preparation of this Environmental Impact Statement which will also be used to comply with requirements of the Washington State Environmental Policy Act (SEPA).

The purpose of Reclamation's Odessa Subarea Special Study is to evaluate alternatives that would deliver project water from the Columbia Basin Project (CBP) to lands currently using groundwater for irrigation in the Odessa Ground Water Management Subarea. The Study is needed to fulfill the obligation Reclamation made in a Memorandum of Agreement between the State of Washington (State) and the Project irrigation districts in December 2004, which included cooperating on a study to explore opportunities for delivery of Columbia Basin Project water to existing groundwater-irrigated lands within the Odessa Subarea.

Action is needed to avoid significant economic loss, in the near term, to the region's agricultural sector because of resource conditions associated with continued decline of the aquifers in the Odessa Subarea. Groundwater in the Odessa Subarea is currently being depleted to such an extent that water must be pumped from great depths. Pumping depths are 750 feet in some areas, and well depths are as great as 2,100–2,400 feet. Well drilling costs and pumping water from this depth have resulted in expensive power costs and water quality concerns such as high water temperatures and high sodium concentrations.

The ability of farmers to irrigate their crops is at risk. Domestic, commercial, municipal, and industrial uses and water quality are also affected. Those irrigating with wells of lesser depth live with uncertainty about future well production.

Washington State University conducted a regional economic impact

study assessing the effects of lost potato production and processing in Adams, Franklin, Grant, and Lincoln counties from continued aquifer decline. Assuming that all potato production and processing is lost from the region, the analysis estimated the regional economic impact would be a loss of about $630 million dollars annually in regional sales, a loss of 3,600 jobs, and a loss of $211 million in regional income (Bhattacharjee and Holland 2005).

DATES: Scoping meetings will be held on September 10, 2008 and Sept 11, 2008, from 7 to 9 p.m., at the locations indicated under the **ADDRESSES** section. Written comments will be accepted through September 19, 2008, for inclusion in the scoping summary document. Requests for sign language interpretation for the hearing impaired or other special assistance needs should be submitted to Ellen Berggren as indicated under the **FOR FUTHER INFORMATION CONTACT** section by August 27, 2008.

ADDRESSES: Meetings will be held at:

- Town of Coulee Dam Town Hall, 300 Lincoln Avenue, Coulee Dam, WA 99116 (September 10, 2008);
- The Advanced Technologies Education Center (ATEC), Big Bend Community College, 7611 Bolling Street, NE., Moses Lake, WA 98837 (September 11, 2008).

The meeting facilities are physically accessible to people with disabilities.

Comments and requests to be added to the mailing list may be submitted to Bureau of Reclamation, Pacific Northwest Regional Office, Attention: Ellen Berggren, Activity Manager, 1150 N. Curtis Rd., Suite 100, Boise, ID 83706. Comments may also be submitted electronically to *StudyManager@pn.usbr.gov.*

FOR FURTHER INFORMATION CONTACT: Contact Ellen Berggren, Activity Manager, Telephone (208) 378–5090. TTY users in Washington may dial the following numbers to obtain a toll free TTY relay: 800–833–6384(V); for the hearing impaired 800–833–6388(T); for the deaf.

Information on this project can also be found at: *http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.*

SUPPLEMENTARY INFORMATION: The Columbia Basin Project is a multipurpose water development project in the central part of the State of Washington (State). The Grand Coulee Dam Project was authorized for construction by the Act of August 30, 1935, and reauthorized and renamed in the Columbia Basin Project Act of March 10, 1943. Congress authorized the CBP to irrigate a total of 1,029,000 acres; about 671,000 acres are currently irrigated.

Section 9(a) of the Reclamation Project Act of 1939 gave authority to the Secretary of the Interior (Secretary) to approve a finding of feasibility and thereby authorize construction of a project upon submitting a report to the President and the Congress. The Secretary approved a plan of development for the Columbia Basin Project, known as House Document No. 172 in 1945. House Document No. 172 anticipated that development of the Columbia Basin Project would occur in phases over a 70-year period. Reclamation is authorized to implement additional development phases as long as the Secretary finds it to be economically justified and financially feasible. The Odessa Subarea Special Study is conducted under the authority of the Columbia Basin Project Act of 1943, as amended, and the Reclamation Act of 1939.

In response to the public's concern about the declining aquifer and associated economic and other effects, Congress has funded Reclamation to investigate this problem. The State of Washington has partnered with Reclamation by providing funding and collaborating on various technical studies.

The State, Reclamation, and irrigation districts signed the Columbia River Initiative Memorandum of Understanding (CRI MOU) in December 2004, to promote a cooperative process for implementing activities to improve Columbia River water management and water management within the Columbia Basin Project. The Odessa Subarea Special Study implements Section 15 of the CRI MOU, which states in part that, ''The parties will cooperate to explore opportunities for delivery of water to additional existing agricultural lands within the Odessa Subarea.'' In February 2006, the State legislature passed the Columbia River Water Resource Management Act (HB 2860) that directs Ecology to aggressively pursue development of water benefiting both instream and out-of-stream uses through storage, conservation, and voluntary regional water management agreements. Among the activities identified in the legislation, Ecology is directed to focus on ''development of alternatives to ground water for agricultural users in the Odessa subarea aquifer.'' Ecology is participating in the Odessa Subarea Special Study to provide support for state and local agency permit decisions that will likely be necessary to implement a water delivery project.

Reclamation is developing alternatives to replace the current and increasingly unreliable groundwater supplies used for irrigation with a surface supply as part of continued phased development of the Columbia Basin Project. Reclamation can only deliver water to lands authorized to receive Columbia Basin Project water. An estimated 170,000 acres within the Odessa Subarea are now being irrigated with groundwater with an estimated 140,000 of these acres eligible to receive Project surface water. Reclamation is considering alternatives that would provide a replacement surface water supply for up to 140,000 groundwater-irrigated acres within the Study area. Alternatives include two main components.

- *Water conveyance;* this component consists of infrastructure such as canals, pumping plants and laterals to deliver surface water to groundwater-irrigated lands. These could include building a new East High canal system and reregulating reservoir in Black Rock Coulee north of Interstate 90 and/or expanding the capacity of the existing East Low Canal system and building a 2.3 mile extension.
- *Water supply;* this component consists of storage facilities that could store the replacement surface water supply for later use in the Odessa Subarea. These involve modifying operations at Banks Lake and/or constructing a new reservoir in Rocky Coulee.

Alternatives would involve various combinations and configurations of these water conveyance and water supply components.

Public Involvement

Reclamation will conduct public scoping meetings to solicit comments on the alternatives developed to address the concerns in the Odessa Subarea and to identify potential issues and impacts associated with those alternatives. Reclamation will summarize comments received during the scoping meetings and from letters of comment received during the scoping period, identified under the **DATES** section, into a scoping summary document that will be made available to those who have provided comments. It will also be available to others upon request.

If you wish to comment, you may mail us your comments as indicated under the **ADDRESSES** section. Our practice is to make comments, including names, home addresses, home phone numbers, and e-mail addresses of respondents, available for public review. Individual respondents may request that we withhold their names and/or home addresses, etc., but if you wish us to consider withholding this information you must state this prominently at the beginning of your comments. In addition, you must present a rationale for withholding this information. This rationale must demonstrate that disclosure would constitute a clearly unwarranted invasion of privacy. Unsupported assertions will not meet this burden. In the absence of exceptional, documentable circumstances, this information will be released. We will always make submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, available for public inspection in their entirety.

J. William McDonald,

Regional Director, Pacific Northwest Region.

[FR Doc. E8–19376 Filed 8–20–08; 8:45 am]

BILLING CODE 4310–MN–P

INTERNATIONAL TRADE COMMISSION

[Investigation Nos. 701–TA–457 and 731–TA–1153 (Preliminary)]

Certain Tow-Behind Lawn Groomers and Parts Thereof From China Determinations

On the basis of the record[1] developed in the subject investigations, the United States International Trade Commission (Commission) determines, pursuant to sections 705(b) and 735(b) of the Tariff Act of 1930 (19 U.S.C. 1671d(a) and 1673d(a)) (the Act), that there is a reasonable indication that an industry in the United States is materially injured by reason of imports from China of certain tow-behind lawn groomers and parts thereof (''TBLG''), provided for in statistical reporting numbers 8432.40.0000, 8432.80.0000, 8432.90.0030, 8432.90.0080, 8479.89.9897, 8479.90.9496, and 9603.50.0000 of the Harmonized Tariff Schedule of the United States, that are alleged to be sold in the United States at less than fair value (LTFV) and alleged to be subsidized by the Government of China.

Commencement of Final Phase Investigations

Pursuant to section 207.18 of the Commission's rules, the Commission also gives notice of the commencement of the final phase of its investigations. The Commission will issue a final phase notice of scheduling, which will be published in the **Federal Register** as provided in section 207.21 of the Commission's rules, upon notice from the Department of Commerce (Commerce) of affirmative preliminary determinations in the investigations under sections 703(b) and 733(b) of the Act, or, if the preliminary determinations are negative, upon notice of affirmative final determinations in those investigations under section 705(a) and 735(a) of the Act. Parties that filed entries of appearance in the preliminary phase of the investigations need not enter a separate appearance for the final phase of the investigations. Industrial users, and, if the merchandise under investigation is sold at the retail level, representative consumer organizations have the right to appear as parties in Commission antidumping and countervailing duty investigations. The Secretary will prepare a public service list containing the names and addresses of all persons, or their representatives, who are parties to the investigations.

Background

On June 24, 2008, a petition was filed with the Commission and Commerce by Agri–Fab, Inc., Sullivan, IL, alleging that an industry in the United States is materially injured by reason of subsidized imports of TBLGs from China and LTFV sales of TBLG imports from China. Accordingly, effective June 24, 2008, the Commission instituted countervailing duty investigation No. 701–TA–457 (Preliminary) and antidumping investigation No. 731–TA–1153 (Preliminary).

Notice of the institution of the Commission's investigations and of a public conference to be held in connection therewith was given by posting copies of the notice in the Office of the Secretary, U.S. International Trade Commission, Washington, DC, and by publishing the notice in the **Federal Register** of July 1, 2008 (72 FR 37494). The conference was held in Washington, DC, on July 15, 2008, and all persons who requested the opportunity were permitted to appear in person or by counsel.

The Commission transmitted its determinations in these investigations to the Secretary of Commerce on August 8, 2008. The views of the Commission are contained in USITC Publication 4028 (August 2008), entitled *Certain Tow-Behind Lawn Groomers and Parts Thereof from China Investigation Nos. 701–TA–457 and 731–TA–1153 (Preliminary).*

By order of the Commission.

Issued: August 18, 2008.

William R. Bishop,

Acting Secretary to the Commission.

[FR Doc. E8–19400 Filed 8–20–08; 8:45 am]

BILLING CODE 7020–02–P

[1] The record is defined in sec. 207.2(f) of the Commission's Rules of Practice and Procedure (19 CFR 207.2(f)).

DEPARTMENT OF JUSTICE

Notice of Lodging of Consent Decree Under the Clean Air Act

Notice is hereby given that on August 13, 2008, a proposed Consent Decree (the ''Decree'') in *United States* v. *Allied Waste Services of Massachusetts, LLC,* Civil Action No. 08–11382, was lodged with the United States District Court for the District of New Jersey.

In a complaint, filed simultaneously with the Decree, the United States alleges that Allied Waste Services of Massachusetts, LLC (''Allied Waste'') violated the Clean Air Act, 42 U.S.C. 7401 *et seq.*, at four of its waste-hauling depots in western Massachusetts by allowing some of its diesel waste-hauling trucks to idle in excess of five minutes, as prescribed by 30 CMR 7.11(b), a regulation included in the Massachusetts State Implementation Plan.

Pursuant to the Decree, Allied will implement a number of compliance measures, including: Requiring a supervisor to walk-through the four depots where violations were found (''subject facilities'') twice a day to identify and rectify illegal idling; the implementation of a driver training program that highlights Allied Waste's anti-idling policy; the inclusion of the anti-idling policy as part of the subject facilities' daily debriefing checklist to be reviewed with each driver of a waste-hauling truck at the end of their route; the posting of ''No Idling'' signs at the subject facilities; and the certification by Allied Waste that all trucks equipped with automatic engine shut-offs are working and set to turnoff the engine at the expiration of five minutes of idling. If Allied Waste fails to conduct the aforementioned compliance measures, or is in future violation of 30 CMR 7.11(b), it will be subject to stipulated penalties under the terms of the Decree.

Allied Waste will pay a $195,000 civil monetary penalty to the United States pursuant to the Decree.

The Department of Justice will receive, for a period of thirty (30) days from the date of this publication, comments relating to the Decree. Comments should be addressed to the

Determination of Significance

DETERMINATION OF SIGNIFICANCE AND REQUEST FOR COMMENTS ON SCOPE OF ENVIRONMENTAL IMPACT STATEMENT FOR THE ODESSA SUBAREA SPECIAL STUDY

The Department of Interior, Bureau of Reclamation (Reclamation) and the Washington State Department of Ecology (Ecology) are beginning preparation of an Environmental Impact Statement (EIS) for the Odessa Subarea Special Study. The EIS will be a joint National Environmental Policy Act (NEPA) and State Environmental Policy Act (SEPA) EIS. Reclamation and Ecology are requesting comments regarding the scope of the EIS.

Lead Agency: Reclamation and Ecology are joint lead agencies for the combined NEPA and SEPA process.

EIS Required: Pursuant to section 102(2)(C) of the National Environmental Policy Act of 1969, as amended, Reclamation proposes to prepare an EIS for the Odessa Subarea Special Study. The Ecology has determined that an EIS is required under SEPA (Chapter 43.21C RCW).

Location: Adams, Franklin, Grant, Lincoln and Walla Walla counties, Washington

Description of Proposal:

The purpose of Reclamation's Odessa Subarea Special Study is to evaluate alternatives that would deliver project water from the Columbia Basin Project (CBP) to lands currently using groundwater for irrigation in the Odessa Ground Water Management Subarea.
The Study is needed to fulfill the obligation Reclamation made in a Memorandum of Understanding between the State of Washington (State) and the three CBP irrigation districts in December 2004, which included cooperating on a study to explore opportunities for delivery of CBP water to existing groundwater-irrigated lands within the Odessa Subarea.

Action is needed to avoid significant economic loss, in the near term, to the region's agricultural sector because of resource conditions associated with continued decline of the aquifers in the Odessa Subarea. Groundwater in the Odessa Subarea is currently being depleted to such an extent that water must be pumped from great depths. Pumping depths are 750 feet in some areas, and well depths are as great as 2,100–2,400 feet. Well drilling costs and pumping water from this depth have resulted in expensive power costs and water quality concerns such as high water temperatures and high sodium concentrations.

The ability of farmers to irrigate their crops is at risk. Domestic, commercial, municipal, and industrial uses and water quality are also affected. Those irrigating with wells of lesser depth live with uncertainty about future well production.
Washington State University conducted a regional economic impact study assessing the effects of lost potato production and processing in Adams, Franklin, Grant, and Lincoln counties from continued aquifer decline.

Assuming that all potato production and processing is lost from the region, the analysis estimated the regional economic impact would be a loss of about $630 million dollars annually in regional sales, a loss of 3,600 jobs, and a loss of $211 million in regional income (Bhattacharjee and Holland 2005). Information on this project can also be found at:

http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html

Scoping Comments:

Written comments will be accepted through September 19, 2008, for inclusion in the scoping summary document. Comments should be addressed to Ellen Berggren at the following address:

Bureau of Reclamation, Pacific Northwest Regional Office,
Attention: Ellen Berggren, Activity Manager
1150 North Curtis Rd. Suite 100
Boise ID 83706

Comments may also be submitted electronically to **StudyManager@pn.usbr.gov**

Requests for sign language interpretation for the hearing impaired or other special assistance needs should be submitted to Ellen Berggren at (208) 378- 5090. TTY users in Washington may dial the following numbers to obtain a toll free TTY relay:

(800) 833-6384(V); for the hearing impaired
(800) 833-6388(T); for the deaf

Scoping Meetings:

Scoping meetings will be held on September 10, 2008 and September 11, 2008, from 7:00 to 9:00 p.m., at the following locations:

- Town of Coulee Dam Town Hall, 300 Lincoln Avenue, Coulee Dam, WA 99116 (September 10, 2008)
- The Advanced Technologies Education Center (ATEC), Big Bend Community College, 7611 Bolling Street NE, Moses Lake, WA 98837 (September 11, 2008)

The meeting facilities are physically accessible to people with disabilities.

SIGNATURE: ______________________ **DATE:** 8/21/08
Derek I. Sandison, SEPA Responsible Official

Study Update

ODESSA SUBAREA SPECIAL STUDY

Columbia Basin Project

STUDY UPDATE

August 2008

STUDY BACKGROUND

The Odessa Subarea Special Study is an investigation of continued phased development of the Columbia Basin Project to provide a replacement surface water supply for current groundwater irrigation occurring in the Odessa Ground Water Management Subarea. An estimated 170,000 acres within the Odessa Subarea are now being irrigated with groundwater; an estimated 140,000 of these acres are eligible to receive Columbia Basin Project surface water. The Washington Department of Ecology (Ecology) is participating in the Study to provide support for state and local agency permit decisions that may be necessary to implement a selected alternative. Additional information about the Study is available at Reclamation's website: http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

PUBLIC SCOPING MEETINGS SCHEDULED

Reclamation is preparing an Environmental Impact Statement (EIS) in cooperation with Ecology that will comply with the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA). Reclamation and Ecology are hosting two public meetings to obtain your input about the Study. During these meetings, the current alternatives being considered will be described and staff will be available to answer questions. You will also be given an opportunity to identify issues and concerns associated with the current alternatives and to identify other potential alternatives.

SCOPING MEETING DETAILS

Wednesday, September 10, 2008
Town of Coulee Dam Town Hall
300 Lincoln Avenue
Coulee Dam, Washington

Thursday, September 11, 2008
The Advanced Technologies Education Center (ATEC)
Big Bend Community College
7611 Boling Street
Moses Lake, Washington

Both meetings are from 7 – 9 p.m.

The meeting facilities are physically accessible to people with disabilities. If you need other accommodations or auxiliary aids, please contact Jennifer McConnell at 509-754-0202 before September 5, 2008. TTY users in Washington may dial the following numbers to obtain a toll free TTY relay: 800-833-6384(V) for the hearing impaired; 800-833-6388(T) for the deaf.

Si decea atender la junta y necesita un interprete en Espanol, por favor llame a Casimira Garza al (509) 754-0239.

PURPOSE AND NEED FOR THE STUDY

The purpose of Reclamation's Odessa Subarea Special Study is to evaluate alternatives to replace current groundwater irrigation in the Odessa Subarea. The Study is needed to fulfill the obligation Reclamation made in a Memorandum of Agreement between the State of Washington (State) and the Columbia Basin Project irrigation districts in December 2004, to cooperatively explore opportunities for delivery of Columbia Basin Project water to existing groundwater-irrigated lands within the Odessa Subarea.

Action, if taken, would avoid significant economic loss in the near term to the region's agricultural sector resulting from resource conditions associated with continued decline of the aquifers in the Odessa Subarea. Groundwater is currently being depleted to such an extent that water must be pumped from depths as great as 750 feet in some areas, with well depths as great as 2,100–2,400 feet deep. Well drilling and pumping costs have resulted in expensive power costs and poor water quality due to high water temperatures and high sodium concentrations.

The ability of farmers to irrigate their crops is at risk. In addition, water supply for domestic, commercial, municipal, and industrial uses is also affected. Those irrigating with wells of lesser depth live with uncertainty about future well production. Washington State University conducted a regional economic impact study assessing the effects of lost potato production and processing in Adams, Franklin, Grant, and Lincoln counties from continued aquifer decline. Assuming all potato production and processing is lost from the region, the analysis estimated the regional economic impact would be a loss of about $630 million dollars annually in regional sales, a loss of 3,600 jobs, and a loss of $211 million in regional income (Bhattacharjee and Holland. 2005. Economic Impact of a Possible Irrigation-Water Shortage in Odessa Subarea: Potato Production and Processing. WO2005-4. Washington State University, Pullman, Washington).

PROPOSED ALTERNATIVES

Reclamation is currently investigating the alternatives summarized below. These alternatives involve construction of water delivery infrastructure to convey Columbia Basin Project water to current groundwater-irrigated lands. Proposed construction would include expanding the capacity of existing facilities and constructing new canals, siphons, tunnels, pumping plants, piped laterals, and a re-regulating reservoir. The proposed infrastructure is part of the original development plan for the Columbia Basin Project.

Alternatives	Groundwater Acres Served	Additional Columbia River Diversion *(acre-feet)*	Appraisal-level Estimated Construction Cost Range* *(in million $)*
No Action	0	0	$ 0
Enlarge and extend existing East Low Canal south of Interstate 90 and construct a new East High canal system north of Interstate 90 in phases	127,300	453,200	$ 1,944 – $ 4,391
Enlarge and extend existing East Low Canal south of Interstate 90	61,900	202,300	$ 377 – $ 2,261

*These are appraisal-level cost estimates that are considered preliminary and not suitable for determining actual construction costs or requesting construction fund appropriations from the Congress. Updated feasibility-level cost estimates are currently being prepared.

Additional Columbia River diversions will be required above current diversions for the Columbia Basin Project to provide the replacement surface water supply. Reclamation is examining several options to provide replacement water including modifying operations at Banks Lake through additional draw down or a two-foot operational raise, and construction of a new 127,000 acre-foot reservoir in Rocky Coulee. All water supply options would be configured to work with the proposed alternatives; several water supply options may be necessary to provide a sufficient replacement water supply.

YOUR FEEDBACK REQUESTED

We want to hear your thoughts about the issues and concerns associated with the alternatives proposed for study. Please attend one of the scoping meetings scheduled in September 2008 to provide input. If you cannot attend one of our public scoping meetings, please submit your comments using the enclosed comment form and return it to us no later than **September 19, 2008**.

FOR MORE INFORMATION

For more information about the Study, please contact:

Ellen Berggren, Study Manager
Bureau of Reclamation
1150 North Curtis Road, Suite 100
Boise, Idaho 83706
208-378-5090 (telephone)
208-378-5102 (fax)
StudyManager@pn.usbr.gov

Visit our website at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html, or sign up with Ecology's list serve at http://listserv.wa.gov/archives/cwp.html .

THE NEPA/SEPA PROCESS

What is NEPA?

The National Environmental Policy Act (NEPA) was passed by Congress and signed into law in 1969. It requires Federal agencies to evaluate and consider the environmental factors of proposed actions during decision making and to seek input to these evaluations from state and local agencies, Tribal Governments, organizations, and the public. Agencies must also consider and evaluate a range of alternatives that meet the purpose and need of the proposed action. A Federal agency must prepare an environmental impact statement (EIS) for any major action that may have significant impacts.

What is SEPA?

Washington's State Environmental Policy Act (SEPA), enacted in 1971, provides the framework for State agencies to consider the environmental consequences of a proposal before taking action. Environmental review is required for any proposal which involves a government "action," as defined in the SEPA rules, and gives agencies the ability to condition or deny a proposal due to identified likely significant adverse impacts. The Act is implemented through the SEPA Rules, Chapter 197-11, Washington Administrative Code.

What is the NEPA/SEPA Process for this project?

Reclamation published a Notice of Intent to Prepare an EIS in the Federal Register on August 21, 2008 (Federal Register, Vol. 73 No. 163, 49487), and Ecology published a Determination of Significance on August 21, 2008. The EIS will be prepared jointly by Reclamation and Ecology and will satisfy the requirements of both NEPA and SEPA.

A public scoping period, in which issues and concerns and other potential alternatives are identified, will run through September 19, 2008. Reclamation will develop a scoping summary of the comments received during this scoping period and it will be available to the public.

Following the scoping period, a draft EIS will be developed for public review and comment. It is anticipated that the Draft EIS will be available early in 2010. An EIS is a comprehensive, full-disclosure document that assesses the social, economic, and environmental effects, both positive and negative, of a proposed action and alternatives to it. Impacts of those alternatives are compared to the No Action Alternative. Following a 60-day public review and comment period, a Final EIS will be prepared and made available to the public. The NEPA process is concluded with a Record of Decision (ROD) issued no sooner than 30 days after the Final EIS is completed. The ROD identifies Reclamation's decision and the basis for that decision.

RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

COMMENT FORM

Odessa Subarea Special Study

Name (please print legibly):	
Organization:	
Mailing Address:	
City, State, and Zip Code:	
Telephone:	**E-mail:**

If you received this form in the mail or attended a public scoping meeting you will be placed on our mailing list. Please indicate your preferred method of contact below:

___ I prefer to be contacted about Study progress though (CHECK ONE): ___ Post office ___ E-mail.
___ I want my name removed from this mailing list.

Please note: Our practice is to make comments, including names, home addresses, home phone numbers and email addresses of respondents, available for public review. Individual respondents may request that we withhold their names and/or home addresses, etc., but if you wish us to consider withholding this information you must state this prominently at the beginning of your comments. In addition, you must present a rationale for withholding this information. This rationale must demonstrate that disclosure would constitute a clearly unwarranted invasion of privacy. Unsupported assertions will not meet this burden. In the absence of exceptional, documentable circumstances, this information will be released**.** We will always make submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, available for public disclosure in their entirety.

My comments on the Odessa Subarea Special Study are:

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(Use back of sheet or additional sheets as necessary)

Please mail, fax, or email your comments before SEPTEMBER 19, 2008, to: Ellen Berggren, Study Manager, Bureau of Reclamation, 1150 North Curtis Road, Boise, ID 83706; fax: (208) 378-5102; email: StudyManager@pn.usbr.gov.

Comments (continued)

Please mail, fax, or email your comments before SEPTEMBER 19, 2008, to: Ellen Berggren, Study Manager, Bureau of Reclamation, 1150 North Curtis Road, Boise, ID 83706; fax: (208) 378-5102; email: StudyManager@pn.usbr.gov.

News Releases

From: "Hill, Tim (ECY)" <tihi461@ECY.WA.GOV>
To: CWP@LISTSERV.WA.GOV
Date: Monday - August 25, 2008 6:57 PM
Subject: Scoping Meetings for Odessa Subarea EIS
Odessa_Study_Update_8-08 (2).pdf (46242 bytes) [View] [Save As]
Mime.822 (74477 bytes) [View] [Save As]

The US Bureau of Reclamation is preparing an Environmental Impact Statement (EIS) in cooperation with Ecology . The EIS will look at alternatives for delivering surface water to replace current groundwater irrigation. We want to hear your thoughts about the issues and concerns associated with the alternatives proposed for study. Please attend one of the scoping meetings scheduled in September 2008 to provide input.

Scoping Meeting Details

Wednesday, Sept. 10, 2008
7- 9 p.m.

Town of Coulee Dam
Town Hall
300 Lincoln Avenue
Coulee Dam, WA
(directions)

Thursday, Sept. 11, 2008

7- 9 p.m.
The Advanced Technologies Education Center (ATEC)
Big Bend Community College
7611 Boling Street
Moses Lake, WA
(directions)

The meeting facilities are physically accessible to people with disabilities. If you need other accommodations, or auxiliary aids, please contact Jennifer McConnell at 509-754-0202 before September 5, 2008. TTY users in Washington may dial the following numbers to obtain a toll free TTY relay: 800-833-6384(V) for the hearing impaired; 800-833-6388(T) for the deaf. Si decea atender la junta y necesita un interprete en Espanol, por favor.

If you cannot attend one of our public scoping meetings, please submit your comments to Ellen Berggren no later than September 19, 2008.

Ellen Berggren
Study Manager
Bureau of Reclamation
1150 North Curtis Road, Ste 100
Boise, Idaho 83706
208-378-5090

See the attached Study Update for more information.

Pacific Northwest Region
Boise, Idaho

Media Contact: Diana Cross (208) 378-5020 | Bill Gray (509) 754-0214

Released On: September 02, 2008

Reclamation and Ecology Host Public Meetings for Odessa Subarea Special Study

The Bureau of Reclamation and Washington State Department of Ecology will hold two public scoping meetings for the Odessa Subarea Special Study. Ecology is a joint lead with Reclamation in the preparation of an Environmental Impact Statement that will satisfy the requirements of the National Environmental Policy Act and the Washington State Environmental Policy Act.

The purpose of the study is to evaluate alternatives that would deliver surface water from the Columbia Basin Project to replace current groundwater use for irrigation in the Odessa Ground Water Management Subarea. Continued declines of aquifers in the Odessa Subarea place well production and farmers' ability to irrigate crops at risk and could cause significant economic loss to the region.

The purpose of the scoping meetings is to give the public the opportunity to identify issues and concerns associated with the alternatives proposed for study, and to identify other potential alternatives that could be considered in the EIS.

Scoping meetings will be held:

September 10, 7:00 - 9:00 p.m., Town of Coulee Dam Town Hall, 300 Lincoln Avenue, Coulee Dam WA 99116.

September 11, 7:00 - 9:00 p.m., the Advanced Technologies Education Center (ATEC), Big Bend Community College, 7611 Bolling Street NE, Moses Lake WA 98837.

The study fulfills the obligation Reclamation made in a Memorandum of Agreement between the State of Washington and Columbia Basin Project irrigation districts in December 2004 to cooperatively study opportunities for delivery of Columbia Basin Project water to existing groundwater-irrigated lands within the Odessa Subarea.

A Notice of Intent to Prepare an EIS was published in the Federal Register on August 21, 2008. In addition to comments received at the scoping meetings, written comments will be accepted through September 19, and may be submitted to Bureau of Reclamation, Pacific Northwest Regional Office, Attention: Ellen Berggren, Study Manager, 1150 North Curtis Road, Suite 100, Boise ID 83706. Telephone (208) 378- 5090. Comments may also be submitted electronically to StudyManager@pn.usbr.gov.

The meeting facilities are physically accessible to people with disabilities. Please direct requests for sign language interpretation for the hearing impaired, or other auxiliary aids, to Jennifer McConnell at (509) 754-0202 by September 5.

The Columbia Basin Project, located in central Washington, was authorized for the irrigation of 1,029,000 acres. Currently, the Project serves about 671,000 acres in four eastern Washington counties. The multi-purpose project provides irrigation, power production, flood control, municipal water supply, recreation, and fish and wildlife benefits.

For more information about the study, including past reports and study updates, please go to: http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

# # #

Reclamation is the largest wholesale water supplier and the second largest producer of hydroelectric power in the United States, with operations and facilities in the 17 Western States. Its facilities also provide substantial flood control, recreation, and fish and wildlife benefits. Visit our website at www.usbr.gov.

Relevant Links:

http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html

From: "Hill, Tim (ECY)" <tihi461@ECY.WA.GOV>
To: <CWP@LISTSERV.WA.GOV>
Date: Thu, Sep 4, 2008 9:23:59 AM
Subject: Reminder: Scoping Meetings for Odessa Subarea Special Study.

The Bureau of Reclamation and Washington State Department of Ecology will hold two public scoping meetings for the Odessa Subarea Special Study. Ecology is a joint lead with Reclamation in the preparation of an Environmental Impact Statement that will satisfy the requirements of the National Environmental Policy Act and the Washington State Environmental Policy Act.

The purpose of the study is to evaluate alternatives that would deliver surface water from the Columbia Basin Project to replace current groundwater use for irrigation in the Odessa Ground Water Management Subarea. Continued declines of aquifers in the Odessa Subarea place well production and farmers' ability to irrigate crops at risk and could cause significant economic loss to the region.

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The study fulfills the obligation Reclamation made in a Memorandum of Agreement between the State of Washington and Columbia Basin Project irrigation districts in December 2004 to cooperatively study opportunities for delivery of Columbia Basin Project water to existing groundwater-irrigated lands within the Odessa Subarea.

A Notice of Intent to Prepare an EIS was published in the Federal Register on August 21, 2008.

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# # #

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From: "Hill, Tim (ECY)" <tihi461@ECY.WA.GOV>
To: <YAKIMA-STORAGE-STUDY@LISTSERV.WA.GOV>
Date: Thu, Sep 4, 2008 9:33:42 AM
Subject: Reminder: Scoping Meetings for Odessa Subarea Special Study.

The Bureau of Reclamation and Washington State Department of Ecology will hold two public scoping meetings for the Odessa Subarea Special Study. Ecology is a joint lead with Reclamation in the preparation of an Environmental Impact Statement that will satisfy the requirements of the National Environmental Policy Act and the Washington State Environmental Policy Act.

The purpose of the study is to evaluate alternatives that would deliver surface water from the Columbia Basin Project to replace current groundwater use for irrigation in the Odessa Ground Water Management Subarea. Continued declines of aquifers in the Odessa Subarea place well production and farmers' ability to irrigate crops at risk and could cause significant economic loss to the region.

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The study fulfills the obligation Reclamation made in a Memorandum of Agreement between the State of Washington and Columbia Basin Project irrigation districts in December 2004 to cooperatively study opportunities for delivery of Columbia Basin Project water to existing groundwater-irrigated lands within the Odessa Subarea.

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Meeting Handouts

RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

ODESSA SUBAREA SPECIAL STUDY
Columbia Basin Project

PUBLIC SCOPING MEETING
Coulee Dam, Washington

September 10, 2008

AGENDA

7:00 p.m. **Doors open**

7:15 p.m. **Welcome**
Ellen Berggren, Study Manager, Reclamation

Presentations by Reclamation and Washington Department of Ecology
Bill Gray, Assistant Area Manager, Reclamation
Derek Sandison, Central Regional Director, Washington Department of Ecology
David Kaumheimer, Environmental Programs Manager, Reclamation

Identification of Issues and Concerns
Take this opportunity to provide written comments about any issues or concerns you have about the impacts associated with the alternatives currently proposed or identify other alternatives that address the Study purpose and need. Post-its are provided for you to jot down your comments and then place them on the appropriate comment board.

Comment board categories include:

Banks Lake Operations
Aquifer
Water Supply and Quality
Construction
Hydropower
Historic Properties and Cultural Resources
Recreation
Social / Economic
Fish
Wildlife
Vegetation
Other Issues and Concerns
Alternatives

This is also an opportunity to review maps and other information and have one-on-one discussions with technical team members and managers.

Review and Wrap-Up

9:00 p.m. **Adjourn**
If you have additional comments, please turn in your comment form before you leave.

ODESSA SUBAREA SPECIAL STUDY
Columbia Basin Project

PUBLIC SCOPING MEETING
Moses Lake, Washington

September 11, 2008

AGENDA

7:00 p.m. **Doors open**

7:15 p.m. **Welcome**
Ellen Berggren, Study Manager, Reclamation

Presentations by Reclamation and Washington Department of Ecology
Bill Gray, Assistant Area Manager, Reclamation
Derek Sandison, Central Regional Director, Washington Department of Ecology
David Kaumheimer, Environmental Programs Manager, Reclamation

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This is also an opportunity to review maps and other information and have one-on-one discussions with technical team members and managers.

Review and Wrap-Up

9:00 p.m. **Adjourn**
If you have additional comments, please turn in your comment form before you leave.

RECLAMATION

Managing Water in the West

Odessa Subarea Special Study

Columbia Basin Project

Scoping Meeting

September 10, 2008 - Coulee Dam, WA
September 11, 2008 - Moses Lake, WA

U.S. Department of the Interior
Bureau of Reclamation

Meeting Objectives

- Describe proposed alternatives
- Provide overview of NEPA/SEPA process
- Obtain feedback on issues and concerns about proposed alternatives

RECLAMATION

Study Process Overview

- Organize and Develop Plan of Study
- Pre-appraisal Investigation
- Appraisal Investigation (Pre-plan formulation)
- Feasibility Investigation (Plan formulation)
- Environmental Regulatory Requirements
- Alternative Selected
- Repayment Contract Discussions Begin
- Federal Appropriations
- Final Engineering Design and Specifications
- Award Construction Contract

RECLAMATION

Columbia River Partnership

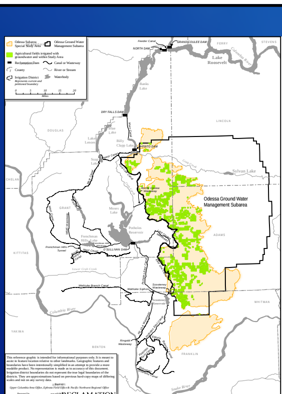
- December 2004 – Columbia River Initiative Memorandum of Understanding
- February 2006 – State's Columbia River Water Resource Management Act

RECLAMATION

Study Purpose and Need

- Fulfill obligation in Columbia River Initiative to cooperatively study delivery of Columbia Basin Project water as a replacement for groundwater pumping
- Evaluate alternatives to replace current groundwater irrigation in Odessa Subarea

RECLAMATION



Study Area

RECLAMATION

Alternatives

Alternatives	Groundwater Acreage Supplied	Additional Columbia River Diversion *(acre-feet)*
No Action	0	0
Enlarge & extend East Low Canal/ Construct new East High canal system	127,300	453,200
Enlarge & extend East Low Canal	61,900	202,300

RECLAMATION

East Low / East High Alternative

- Expand capacity of East Low Canal south of I-90 and extend 2.3 miles
- Construct a new East High Canal system north of I-90

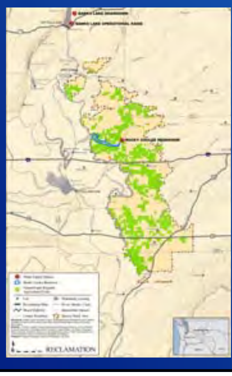
RECLAMATION

East Low Alternative

Expand capacity of East Low Canal south of I-90 and extend 2.3 miles

RECLAMATION

Water Supply Options



- **Banks Lake operations**
  - Additional draw down
  - Two-foot operational raise
- **Reservoir in Rocky Coulee**
  - 126,000 acre-feet

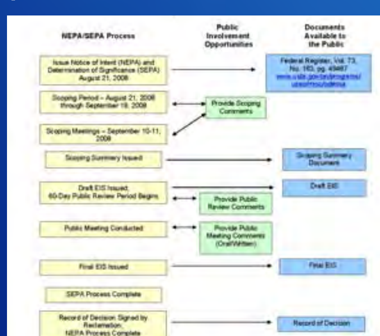
RECLAMATION

Groundwater Acreage Served

Water Supply Options		Storage Available *(acre-feet)*	Groundwater Acreage Supplied
Banks Lake	Draw down	50,000 per 2 ft.	16,700 per 2 ft.
	Two ft raise	50,000	16,700
Rocky Coulee Reservoir		126,000	46,900

RECLAMATION

NEPA/SEPA Process



RECLAMATION

Issues and Concerns
Comment Boards

- Historic Properties / Cultural Resources
- Recreation
- Banks Lake Operations
- Aquifer
- Water Supply and Quality
- Social / Economic
- Fish
- Wildlife
- Vegetation
- Construction
- Hydropower
- Other Issues and Concerns
- Alternatives

RECLAMATION

Contact Information

Scoping comments through September 19, 2008

By mail: Ellen Berggren
Study Manager
Bureau of Reclamation
1150 North Curtis Road
Boise, ID 83706

By email: StudyManager@pn.usbr.gov

Fax: 208-378-5102

RECLAMATION

Questions?

RECLAMATION

RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

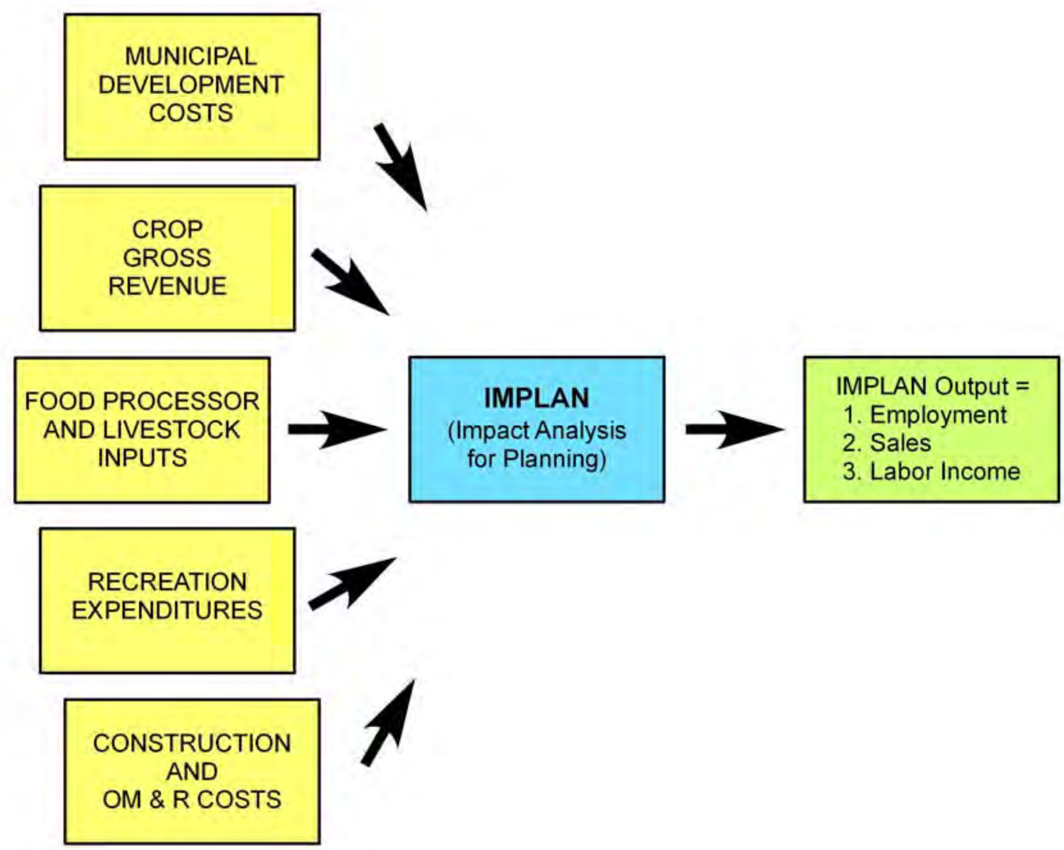
ODESSA SUBAREA SPECIAL STUDY

Columbia Basin Project

REGIONAL ECONOMIC ANALYSIS for the EIS

September 2008

The regional economic analysis for the environmental impact statement (EIS) will describe the current conditions within the study area (Adams, Franklin, Grant, and Lincoln Counties) and evaluate the effects on income and employment within the local economy that could be expected to occur with alternative implementation. The expected regional economic impacts in this study stem from changes in crop production revenues, agricultural inputs to food processing and livestock industries, recreation expenditures, construction and annual operations, maintenance, and replacement (OM&R) costs, and municipal development costs.



For more information about the Study, please contact Ellen Berggren, Study Manager, Bureau of Reclamation, 1150 North Curtis Road, Suite 100, Boise ID 83706; telephone, 208-378-5090; fax, 208-378-5102; email, StudyManager@pn.usbr.gov.

U.S. Department of the Interior
Bureau of Reclamation

Economic and Environmental Principles and Guidelines for Water and Related Resources Implementation Studies (P&Gs)

Reclamation is authorized to continue development of the Columbia Basin Project as long as the development is economically and financially feasible. Reclamation traditionally determines economic feasibility through benefit-cost analysis and financial feasibility through payment capacity analyses. In other words, the benefits must exceed the costs and the beneficiaries must be willing and able to repay reimbursable construction costs and annual operations and maintenance costs. In the Odessa Subarea Special Study, Reclamation will use Principles and Guidelines (P&Gs) established for Federal water resources planning studies to conduct the benefit-cost analysis. The major steps of this process are:

1. Specify problems and opportunities associated with the Federal objective and State and local concerns.

2. Inventory, forecast, and analyze water and land conditions relevant to identified problems and opportunities.

3. Formulate Alternative Plans using criteria of completeness, effectiveness, efficiency, and acceptability.

4. Evaluate effects of Alternative Plans using four "accounts" that attempt to quantify information for comparison purposes.

    - NED (National Economic Development) – compares total benefits to total costs (Federal and non-Federal) by alternative. It is required in Federal analyses and focuses on impacts to the nation and considers changes in the economic value of the national output of goods and services of each alternative.

    - EQ (Environmental Quality) – displays nonmonetary effects on significant natural and cultural resources

    - RED (Regional Economic Development) – estimates both the positive and negative effects on the local economy that result from each alternative plan. Effects are measured as changes in regional economic activity (regional income and employment).

    - OSE (Other Social Effects) – displays effects of each alternative from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

5. Compare Alternative Plans using a "with project" and "without project" analysis.

6. In most cases, the plan selected is to be the alternative with the greatest net national economic benefit, consistent with protecting the environment.

ODESSA SUBAREA SPECIAL STUDY
Columbia Basin Project

ENVIRONMENTAL COMPLIANCE
September 2008

The National Environmental Policy Act

The National Environmental Policy Act (NEPA) was enacted into law on January 1, 1969. It requires Federal agencies to evaluate and consider environmental factors during decisionmaking and to seek input to these evaluations from state and local agencies, Tribal Governments, organizations, and the public. Agencies also must consider and evaluate a range of alternatives that meet the purpose and need of the proposed action.

When a Federal action is determined likely to significantly affect the quality of the human environment, an environmental impact statement (EIS) is prepared. The EIS provides decision-makers with important information on the types of issues and concerns identified by the public, the expected environmental consequences of all alternatives, and potential mitigation measures.

Washington State Environmental Policy Act

SEPA is the acronym for the State Environmental Policy Act. Enacted in 1971, it provides the framework for agencies to consider the environmental consequences of a proposal before taking action. It also gives agencies the ability to condition or deny a proposal due to identified likely significant adverse impacts. The Act is implemented through the SEPA Rules, Chapter 197-11, of the Washington Administrative Code.

Environmental review is required for any proposal which involves a government "action," as defined in the SEPA Rules and is not categorically exempt. Project actions involve an agency decision on a specific project, such as a construction project or timber harvest. Nonproject actions involve decisions on policies, plans, or programs, such as the adoption of a comprehensive plan or development regulations, or a 6-year road plan.

NEPA and SEPA Compliance for This Project

The requirements of NEPA and SEPA are very similar. Both require that a range of reasonable alternatives be considered to meet the purpose and need of the project. The Washington Department of Ecology will be a joint lead with Reclamation on the development of the EIS, which will comply with both NEPA and SEPA regulations.

Terms Commonly Associated with an EIS

- **Federal Action -** This is what triggers the requirement for NEPA compliance. It can be an action that the Federal agency will take, or a decision that must be made, that may significantly impact the human environment.

- **Scoping -** The process by which input from the public, agencies, and organizations is sought to help define the alternatives, issues, and impacts that should be addressed in the EIS.

- **Purpose and Need -** The statement of purpose and need identifies the underlying reasons why an action is needed.

- **Proposed Action -** This is the action initially identified to meet the identified purpose and need for action.

- **Alternatives -** These are reasonable actions that meet the same identified purpose and need as the proposed action.

- **Federal Preferred Alternative -** This is the alternative that the Federal agency proposes to implement. If one has been identified, it will be described in the Draft EIS. A Preferred Alternative must be identified in the Final EIS.

- **No Action Alternative -** This is considered to be the most likely future without implementation of the proposed action or other alternative.

- **Record of Decision -** This document summarizes the alternatives considered in the EIS and identifies the agency's decision along with the basis for that decision. This is a requirement of NEPA, but not SEPA.

FOR MORE INFORMATION

Study Website: http://www.usbr.gov/pn.programs/ucao_misc/odessa/index.html

Study Manager: Ellen Berggren, Study Manager
Bureau of Reclamation
1150 N. Curtis Road
Boise, Idaho 83706

208-378-5090
208-378-5102 FAX
StudyManager@pn.usbr.gov

RECLAMATION
Managing Water in the West

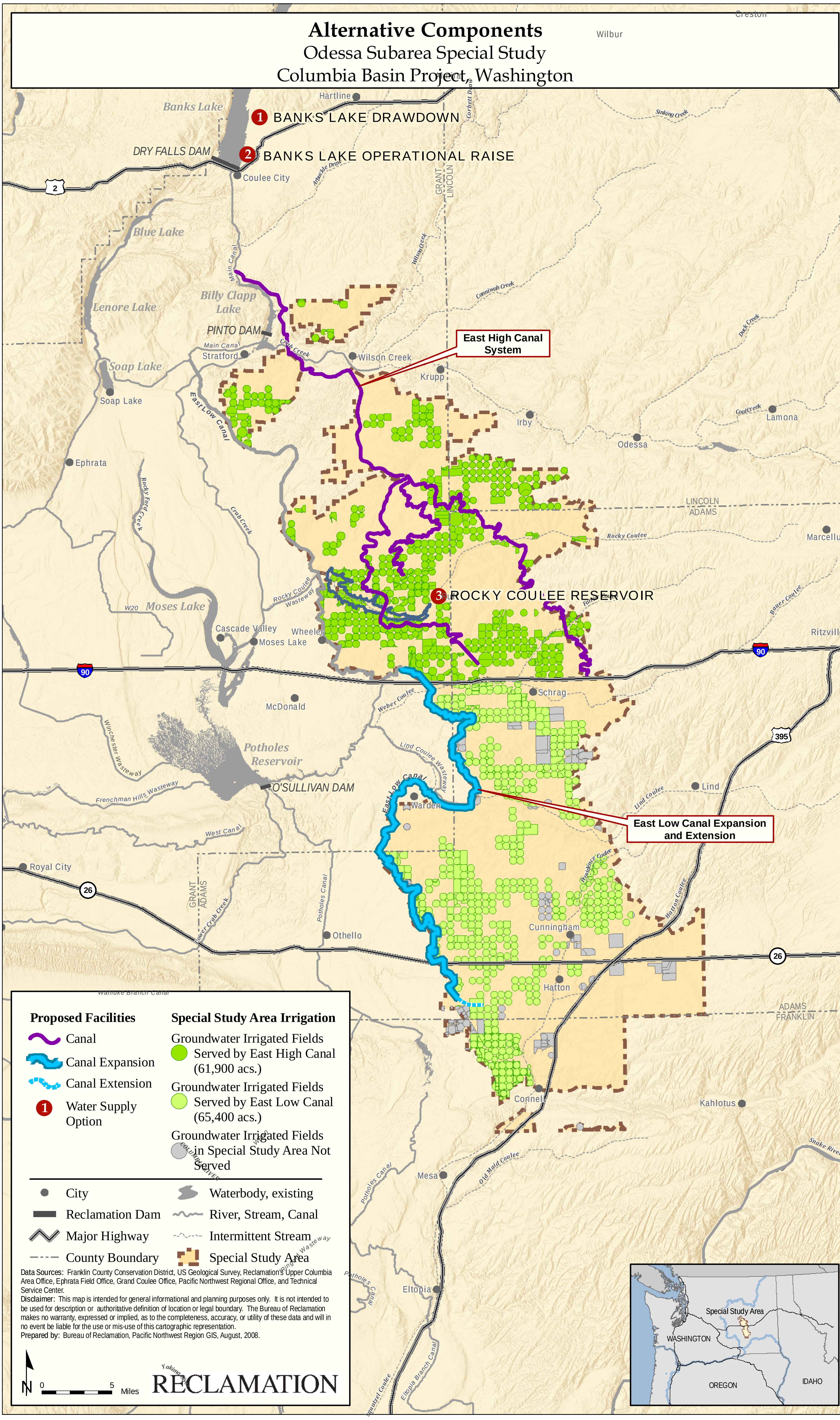
U.S. Department of the Interior
Bureau of Reclamation

ODESSA SUBAREA SPECIAL STUDY
Columbia Basin Project

NEPA/SEPA PROCESS
September 2008

NEPA/SEPA Process	Public Involvement Opportunities	Documents Available to the Public
Issue Notice of Intent (NEPA) and Determination of Significance (SEPA) August 21, 2008 →		Federal Register, Vol. 73, No. 163, pg. 49487 www.usbr.gov/pn/programs/ucao/misc/odessa
Scoping Period – August 21, 2008 through September 19, 2008 ↔	Provide Scoping Comments	
Scoping Meetings – September 10-11, 2008 ↔	Provide Scoping Comments	
Scoping Summary Issued →		Scoping Summary Document
Draft EIS Issued; 60-Day Public Review Period Begins →		Draft EIS
Draft EIS Issued; 60-Day Public Review Period Begins ↔	Provide Public Review Comments	
Public Meeting Conducted ↔	Provide Public Meeting Comments (Oral/Written)	
Final EIS Issued →		Final EIS
SEPA Process Complete		
Record of Decision Signed by Reclamation; NEPA Process Complete →		Record of Decision

Contact: Ellen Berggren, Pacific Northwest Regional Office, Bureau of Reclamation, 208-378-5090



Alternative Components
Odessa Subarea Special Study
Columbia Basin Project, Washington
1 BANKS LAKE DRAWDOWN
2 BANKS LAKE OPERATIONAL RAISE
3 ROCKY COULEE RESERVOIR
East High Canal System
East Low Canal Expansion and Extension
Banks Lake
DRY FALLS DAM
Coulee City
Hartline
Wilbur
Creston
Blue Lake
Lenore Lake
Billy Clapp Lake
PINTO DAM
Stratford
Wilson Creek
Krupp
Soap Lake
Irby
Odessa
Lamona
Ephrata
Marcellus
LINCOLN
ADAMS
Moses Lake
Cascade Valley
Wheeler
Ritzville
McDonald
Schrag
Potholes Reservoir
O'SULLIVAN DAM
Warden
Lind
Royal City
Othello
Cunningham
Hatton
Connell
Kahlotus
Mesa
Eltopia
GRANT
ADAMS
FRANKLIN
Proposed Facilities
Canal
Canal Expansion
Canal Extension
Water Supply Option
Special Study Area Irrigation
Groundwater Irrigated Fields Served by East High Canal (61,900 acs.)
Groundwater Irrigated Fields Served by East Low Canal (65,400 acs.)
Groundwater Irrigated Fields in Special Study Area Not Served
City
Reclamation Dam
Major Highway
County Boundary
Waterbody, existing
River, Stream, Canal
Intermittent Stream
Special Study Area
Data Sources: Franklin County Conservation District, US Geological Survey, Reclamation's Upper Columbia Area Office, Ephrata Field Office, Grand Coulee Office, Pacific Northwest Regional Office, and Technical Service Center.
Disclaimer: This map is intended for general informational and planning purposes only. It is not intended to be used for description or authoritative definition of location or legal boundary. The Bureau of Reclamation makes no warranty, expressed or implied, as to the completeness, accuracy, or utility of these data and will in no event be liable for the use or mis-use of this cartographic representation.
Prepared by: Bureau of Reclamation, Pacific Northwest Region GIS, August, 2008.
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RECLAMATION
Special Study Area
WASHINGTON
OREGON
IDAHO

ODESSA SUBAREA SPECIAL STUDY

Columbia Basin Project

STUDY UPDATE

August 2008

STUDY BACKGROUND

The Odessa Subarea Special Study is an investigation of continued phased development of the Columbia Basin Project to provide a replacement surface water supply for current groundwater irrigation occurring in the Odessa Ground Water Management Subarea. An estimated 170,000 acres within the Odessa Subarea are now being irrigated with groundwater; an estimated 140,000 of these acres are eligible to receive Columbia Basin Project surface water. The Washington Department of Ecology (Ecology) is participating in the Study to provide support for state and local agency permit decisions that may be necessary to implement a selected alternative. Additional information about the Study is available at Reclamation's website: http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

PUBLIC SCOPING MEETINGS SCHEDULED

Reclamation is preparing an Environmental Impact Statement (EIS) in cooperation with Ecology that will comply with the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA). Reclamation and Ecology are hosting two public meetings to obtain your input about the Study. During these meetings, the current alternatives being considered will be described and staff will be available to answer questions. You will also be given an opportunity to identify issues and concerns associated with the current alternatives and to identify other potential alternatives.

SCOPING MEETING DETAILS

Wednesday, September 10, 2008
Town of Coulee Dam Town Hall
300 Lincoln Avenue
Coulee Dam, Washington

Thursday, September 11, 2008
The Advanced Technologies Education Center (ATEC)
Big Bend Community College
7611 Boling Street
Moses Lake, Washington

Both meetings are from 7 – 9 p.m.

The meeting facilities are physically accessible to people with disabilities. If you need other accommodations or auxiliary aids, please contact Jennifer McConnell at 509-754-0202 before September 5, 2008. TTY users in Washington may dial the following numbers to obtain a toll free TTY relay: 800-833-6384(V) for the hearing impaired; 800-833-6388(T) for the deaf.

Si decea atender la junta y necesita un interprete en Espanol, por favor llame a Casimira Garza al (509) 754-0239.

PURPOSE AND NEED FOR THE STUDY

The purpose of Reclamation's Odessa Subarea Special Study is to evaluate alternatives to replace current groundwater irrigation in the Odessa Subarea. The Study is needed to fulfill the obligation Reclamation made in a Memorandum of Agreement between the State of Washington (State) and the Columbia Basin Project irrigation districts in December 2004, to cooperatively explore opportunities for delivery of Columbia Basin Project water to existing groundwater-irrigated lands within the Odessa Subarea.

Action, if taken, would avoid significant economic loss in the near term to the region's agricultural sector resulting from resource conditions associated with continued decline of the aquifers in the Odessa Subarea. Groundwater is currently being depleted to such an extent that water must be pumped from depths as great as 750 feet in some areas, with well depths as great as 2,100–2,400 feet deep. Well drilling and pumping costs have resulted in expensive power costs and poor water quality due to high water temperatures and high sodium concentrations.

The ability of farmers to irrigate their crops is at risk. In addition, water supply for domestic, commercial, municipal, and industrial uses is also affected. Those irrigating with wells of lesser depth live with uncertainty about future well production. Washington State University conducted a regional economic impact study assessing the effects of lost potato production and processing in Adams, Franklin, Grant, and Lincoln counties from continued aquifer decline. Assuming all potato production and processing is lost from the region, the analysis estimated the regional economic impact would be a loss of about $630 million dollars annually in regional sales, a loss of 3,600 jobs, and a loss of $211 million in regional income (Bhattacharjee and Holland. 2005. Economic Impact of a Possible Irrigation-Water Shortage in Odessa Subarea: Potato Production and Processing. WO2005-4. Washington State University, Pullman, Washington).

PROPOSED ALTERNATIVES

Reclamation is currently investigating the alternatives summarized below. These alternatives involve construction of water delivery infrastructure to convey Columbia Basin Project water to current groundwater-irrigated lands. Proposed construction would include expanding the capacity of existing facilities and constructing new canals, siphons, tunnels, pumping plants, piped laterals, and a re-regulating reservoir. The proposed infrastructure is part of the original development plan for the Columbia Basin Project.

Alternatives	**Groundwater Acres Served**	**Additional Columbia River Diversion** *(acre-feet)*	**Appraisal-level Estimated Construction Cost Range*** *(in million $)*
No Action	0	0	$ 0
Enlarge and extend existing East Low Canal south of Interstate 90 and construct a new East High canal system north of Interstate 90 in phases	127,300	453,200	$ 1,944 – $ 4,391
Enlarge and extend existing East Low Canal south of Interstate 90	61,900	202,300	$ 377 – $ 2,261

*These are appraisal-level cost estimates that are considered preliminary and not suitable for determining actual construction costs or requesting construction fund appropriations from the Congress. Updated feasibility-level cost estimates are currently being prepared.

Additional Columbia River diversions will be required above current diversions for the Columbia Basin Project to provide the replacement surface water supply. Reclamation is examining several options to provide replacement water including modifying operations at Banks Lake through additional draw down or a two-foot operational raise, and construction of a new 127,000 acre-foot reservoir in Rocky Coulee. All water supply options would be configured to work with the proposed alternatives; several water supply options may be necessary to provide a sufficient replacement water supply.

YOUR FEEDBACK REQUESTED

We want to hear your thoughts about the issues and concerns associated with the alternatives proposed for study. Please attend one of the scoping meetings scheduled in September 2008 to provide input. If you cannot attend one of our public scoping meetings, please submit your comments using the enclosed comment form and return it to us no later than **September 19, 2008**.

FOR MORE INFORMATION

For more information about the Study, please contact:

Ellen Berggren, Study Manager
Bureau of Reclamation
1150 North Curtis Road, Suite 100
Boise, Idaho 83706
208-378-5090 (telephone)
208-378-5102 (fax)
StudyManager@pn.usbr.gov

Visit our website at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html, or sign up with Ecology's list serve at http://listserv.wa.gov/archives/cwp.html .

THE NEPA/SEPA PROCESS

What is NEPA?

The National Environmental Policy Act (NEPA) was passed by Congress and signed into law in 1969. It requires Federal agencies to evaluate and consider the environmental factors of proposed actions during decision making and to seek input to these evaluations from state and local agencies, Tribal Governments, organizations, and the public. Agencies must also consider and evaluate a range of alternatives that meet the purpose and need of the proposed action. A Federal agency must prepare an environmental impact statement (EIS) for any major action that may have significant impacts.

What is SEPA?

Washington's State Environmental Policy Act (SEPA), enacted in 1971, provides the framework for State agencies to consider the environmental consequences of a proposal before taking action. Environmental review is required for any proposal which involves a government "action," as defined in the SEPA rules, and gives agencies the ability to condition or deny a proposal due to identified likely significant adverse impacts. The Act is implemented through the SEPA Rules, Chapter 197-11, Washington Administrative Code.

What is the NEPA/SEPA Process for this project?

Reclamation published a Notice of Intent to Prepare an EIS in the Federal Register on August 21, 2008 (Federal Register, Vol. 73 No. 163, 49487), and Ecology published a Determination of Significance on August 21, 2008. The EIS will be prepared jointly by Reclamation and Ecology and will satisfy the requirements of both NEPA and SEPA.

A public scoping period, in which issues and concerns and other potential alternatives are identified, will run through September 19, 2008. Reclamation will develop a scoping summary of the comments received during this scoping period and it will be available to the public.

Following the scoping period, a draft EIS will be developed for public review and comment. It is anticipated that the Draft EIS will be available early in 2010. An EIS is a comprehensive, full-disclosure document that assesses the social, economic, and environmental effects, both positive and negative, of a proposed action and alternatives to it. Impacts of those alternatives are compared to the No Action Alternative. Following a 60-day public review and comment period, a Final EIS will be prepared and made available to the public. The NEPA process is concluded with a Record of Decision (ROD) issued no sooner than 30 days after the Final EIS is completed. The ROD identifies Reclamation's decision and the basis for that decision.

RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

COMMENT FORM

Odessa Subarea Special Study

Name (please print legibly):	
Organization:	
Mailing Address:	
City, State, and Zip Code:	
Telephone:	**E-mail:**

If you received this form in the mail or attended a public scoping meeting you will be placed on our mailing list. Please indicate your preferred method of contact below:

___ I prefer to be contacted about Study progress though (CHECK ONE): ___ Post office ___ E-mail.
___ I want my name removed from this mailing list.

Please note: Our practice is to make comments, including names, home addresses, home phone numbers and email addresses of respondents, available for public review. Individual respondents may request that we withhold their names and/or home addresses, etc., but if you wish us to consider withholding this information you must state this prominently at the beginning of your comments. In addition, you must present a rationale for withholding this information. This rationale must demonstrate that disclosure would constitute a clearly unwarranted invasion of privacy. Unsupported assertions will not meet this burden. In the absence of exceptional, documentable circumstances, this information will be released**.** We will always make submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, available for public disclosure in their entirety.

My comments on the Odessa Subarea Special Study are:

(Use back of sheet or additional sheets as necessary)

Please mail, fax, or email your comments before SEPTEMBER 19, 2008, to: Ellen Berggren, Study Manager, Bureau of Reclamation, 1150 North Curtis Road, Boise, ID 83706; fax: (208) 378-5102; email: StudyManager@pn.usbr.gov.

Comments (continued)

Please mail, fax, or email your comments before SEPTEMBER 19, 2008, to: Ellen Berggren, Study Manager, Bureau of Reclamation, 1150 North Curtis Road, Boise, ID 83706; fax: (208) 378-5102; email: StudyManager@pn.usbr.gov.

APPENDIX C

MEMORANDUM OF UNDERSTANDING BETWEEN RECLAMATION, ECOLOGY, AND WDFW – AUGUST 2012

Memorandum of Understanding
No. R12MA13718
between
U.S. Bureau of Reclamation
and
Washington State Department of Ecology
and
Washington State Department of Fish and Wildlife
related to
Implementation and Adaptive Management for the Odessa Program

1 August 2012

This Memorandum of Understanding (MOU) is made and entered into by and among the U.S. Bureau of Reclamation (Reclamation), the Washington State Department of Ecology (Ecology) through the Office of the Columbia River and the Washington State Department of Fish and Wildlife (WDFW) (collectively, the "parties") in order to address any unanticipated effects associated with future environmental and recreational resources from phased implementation of a program to replace groundwater currently used for irrigation in the Odessa Ground Water Management Subarea with Columbia Basin Project surface water.

Reclamation's authority to enter into this MOU is pursuant to the Reclamation Act of June 17, 1902 (32 Stat. 388) and acts amendatory thereof or supplementary thereto, and the Columbia Basin Project Act of March 10, 1943.

Pursuant to the statutory authority and discretion of the United States, Ecology and WDFW, this MOU is made in accordance with the Act of June 17, 1902 (32 Stat. 388), and amendatory acts thereof or supplementary thereto, the Columbia Basin Project Act of March 10, 1943, and other applicable State laws and regulations.

The parties are committed to working together during the design, construction, and implementation phases of the Odessa Subarea Special Study to assure continued protection of the ecological and economic health of the region; therefore the parties have developed this mutually agreed upon MOU.

I. Introduction

The enactment of Engrossed Substitute House Bill 2860 (Chapter 90.90 RCW) in 2006 required Ecology to aggressively pursue new water supplies in the Columbia River Basin. As a result, Reclamation and Ecology are partnering to investigate the continued phased development of the Columbia Basin Reclamation Project (CBP) within the Odessa Subarea as a means to replace groundwater currently used for irrigation in the Odessa Groundwater Management Subarea with surface water delivered through the Columbia Basin Reclamation Project. This project will subsequently be referred in to in this document as the ***Odessa Program***.

II. Purpose and Scope

This MOU outlines the mutual agreement between Reclamation, Ecology, and WDFW to:

- Sustain or create environmental enhancements that complement the delivery of surface water to the Odessa Subarea;
- Provide a framework in which to implement mitigation measures, environmental commitments, and address unexpected effects; and
- Work within an adaptive management context that includes monitoring and evaluation to sustain and/or enhance habitats for fish, wildlife, and recreational opportunities within the Odessa Subarea Special Study.

Reclamation, Ecology and WDFW mutually agree that the intent of this MOU is to retain and continue to enhance environmental and recreational opportunities without compromising Reclamation's obligation to deliver water to irrigators. The parties agree that the protection and maintenance of fish and wildlife and associated habitats, as well as the public benefits they provide, are essential to maintaining the ecological integrity and quality of life within Adams, Franklin, Grant, and Lincoln counties.

III. Odessa Program

The Reclamation/Ecology proposed alternative identified in the final Odessa Subarea Special Study EIS, is a modified partial replacement alternatives which would deliver CBP water to irrigate approximately 70,000 acres of the 102,600 eligible acres in the Study Area. This alternative focuses on acreage both north and south of I-90 that can be served by the existing East Low Canal, although some modification and widening of the system would be required. This alternative would not include construction of new storage reservoirs or extension of the East Low Canal.

The proposed alternative includes an "infill" option to allow some groundwater irrigators in areas distant from the East Low Canal to move their operations to previously disturbed lands closer to the canal. It is anticipated that as much as 15 percent of the lands served under this alternative would involve infill. Relocation would be limited to an acre-per-acre exchange, that is, one acre of currently groundwater-irrigated land would not be irrigated (or converted to dryland agriculture) for each acre of relocated irrigated land served with replacement water. Potential infill lands were not surveyed for wildlife presence when preparing information for the Odessa EIS.

Approximately, a total volume of 164,000 acre-feet of new surface water would be necessary per year. It is understood that water pumped from the Columbia River intended as supply for the Odessa Program will be in accordance with Federal Columbia River Power System's established BiOp water management objectives, as well as other water management obligations.

Precise locations of irrigation facilities and related infrastructure within the Odessa Subarea have not been defined. Because of this, some environmental effects are difficult to anticipate and may need to be further addressed; this may entail additional environmental compliance. Another challenge is anticipating timelines for implementation, which are dependent on the availability of state and federal funding. Complete phased construction of the Odessa Program and full utilization of the additional diversion would take at least 10 years. For these reasons, the parties agree to employ an adaptive management approach to monitor and address the challenges of phased implementation.

IV. Recitals

WHEREAS the State of Washington has set a high priority on the evaluation and implementation of alternatives to replace groundwater currently used for irrigation in the Odessa Groundwater Management Subarea with CBP surface water, and has directed[1] Ecology's Office of Columbia River to prioritize this activity; and

WHEREAS healthy habitats support the fish and wildlife species from which the related recreational value is derived, and fish, wildlife, and habitat-related recreation is a critical component of local economies in and around the CBP; and

WHEREAS Reclamation, Ecology, and WDFW recognize the significance of protecting the social, economic, and conservation values throughout the CBP area;

WHEREAS the Odessa action alternative Reclamation and Ecology have identified as the "proposed-preferred" represents a phased implementation of infrastructure and operational changes that is more pragmatic in the current economic climate; and

WHEREAS phasing development means there are some areas of uncertainty associated with timelines, locations of infrastructure development, etc.; and

WHEREAS, Reclamation and Ecology[2] recognize there may be unanticipated outcomes associated with natural resources as a result of the Odessa Program; and

WHEREAS changes in project operations needed to implement the Odessa Program have potential to change waterfowl usage and production, fish production and assemblages, and fishing opportunities in the CBP; and

WHEREAS on-going water conservation actions that deliver surface water to Odessa Subarea groundwater users is independent of the Odessa Subarea Special Study and will be addressed in a separate agreement; and

WHEREAS the northern leopard frog present in the CBP area are a state endangered species and populations continue to decline; and

WHEREAS new infrastructure necessary to implement the Odessa Program will impact fish and wildlife habitats; and

WHEREAS individual project components may be exempt from State Environmental Policy Act (SEPA) review (RCW 43.21C.030) and local, state, and federal permitting, which could result in overlooking an impact not anticipated during initial review;

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1 RCW 90.90.020, Allocation and Development of Water Supplies

2 Letter from Sandison to Beich dated 01/28/11

NOW THEREFORE THE PARTIES AGREE to make every effort to ensure that water project implementation and natural resource protection/enhancement occur such that the contributions to local and state economies through fish and wildlife related recreation are not compromised from the implementation of Odessa Program.

Acknowledging that state and federal agencies cannot fiscally encumber future legislatures/congresses, Reclamation, Ecology, and WDFW commit to work as partners towards common goals and objectives, and will make good faith efforts to pursue funding to implement the following actions, which support a collaborative and adaptive management approach for the Odessa Program.

V. Interagency Odessa Team

Ecology will convene an Odessa Program interagency implementation team that includes Reclamation, WDFW, USFWS, and others deemed essential by Ecology in order to support implementation of the Program. Team objectives and activities include:

a) Evaluate infill proposals and infrastructure siting to avoid or minimize impacts to wildlife use, habitat function, and habitat connectivity;

b) Evaluate water delivery mechanisms and associated delivery infrastructure to avoid unintended consequences and take advantage of opportunities to enhance environmental benefits as a result of implementing the Odessa Program; and

c) Oversee implementation and adaptive management for the Odessa Program in relation to elements of this MOU.

VI. Adaptive Management Program

A. Fish and wildlife surveys:

The parties agree that new surveys may be needed to collect information for lands/waters that were not identified during EIS development as being impacted by the Odessa Program. Additionally, more detailed surveys might be needed for lands/waters on which limited surveys were conducted for EIS development. Such surveys may be appropriate, for example, on infrastructure and "infill" properties not identified during alternatives development.

B. Waterfowl mitigation program:

Operational changes in Banks Lake will result in adverse, significant impacts to Western Grebe nesting success, thus reducing successful grebe reproduction. As per the environmental commitments, Reclamation and Ecology will consult with WDFW to establish a "Banks Lake Grebe Management" area and provide and maintain floating nesting structures in an effort to avoid significant impacts to grebes.

C. *Fishery monitoring program:*

Ecology and WDFW, in coordination with Reclamation will develop and implement a monitoring program to evaluate species response to operational changes related to the Odessa Program. WDFW will serve as the lead to:

a) Monitor reservoir and lake productivity in water bodies affected by the Odessa Program;

b) Conduct creel surveys to assess any changes in annual angler effort, harvest, and catch;

c) Compare the entrainment of piscivorous warmwater fish into the mid-Columbia River under current operations with operational changes under the Odessa Program. Warmwater fish entrainment should be monitored to determine if there are any affects to Columbia River ESA-listed species such as spring Chinook salmon and steelhead;

d) Every three years report findings and recommendations; and

e) Adapt fishery management actions in response to new conditions, including but not limited to changes in fish stocking strategies, system rehabilitation, and changes to fishing rules.

If WDFW recommends fishery management adaptations, such as changes in fish stocking strategies, system rehabilitation, and/or changes to fishing rules, that are needed in order to maintain the value of the recreational fishery, Ecology will fund under separate agreement and/or pursue partnership funding to help implement those changes if they are beyond WDFW's fiscal capacity.

D. *Northern leopard frog protection*

Current expectations for Odessa Program implementation do not include changes in Potholes Reservoir lake elevation operation. In the event that Program implementation is noted to, or altered to, affect Potholes Reservoir operations or the northern leopard frogs that reside there, the parties will support actions that reduce risks to northern leopard frogs within the reservoir.

E. *Wetlands protection*

Wetlands with the Odessa Subarea are influenced by natural springs, adjacent water bodies, groundwater irrigation systems, and in areas where return flows collect. Given the uncertainty around implementation of the tiered Odessa Program, the parties agree to evaluate changes to wetlands and wetland species, and to support enhancement opportunities and implement protection strategies as needed.

F. *Upland habitat protection and connectivity*

Because upland development will unfold in a phased and unpredictable manner under the NEPA/SEPA tiered-process, ecosystems may respond differently than expected, the parties agree to coordinate on the following actions:

a) The parties will meet prior to initiation of infill proposals to ensure that wildlife, habitat function, and connectivity are not adversely affected by the infill;

b) Where habitat function and connectivity is compromised by infill, Ecology will fund under separate agreement and/or secure partnership funding for WDFW to identify and acquire (or obtain conservation easements for) contiguous upland habitat to maintain or enhance habitat connectivity within the CBP area;

c) The parties will coordinate on revegetation efforts outlined in the environmental commitments section of the EIS over a minimum of 7 years to ensure those revegetation efforts perform as intended; and

d) If harm to valuable upland habitats can't be avoided, the parties will investigate alternative mitigation strategies.

VII. Dealing with unavoidable impacts

Because the Odessa Subarea provides an array of cultural, economic and natural resource values to the residents of Washington State, it is important for the parties to collaborate to ensure that upland, riparian, and fish, wildlife, and aquatic habitats within the Odessa Subarea sustain and enhance those values as the Odessa Program is implemented[3]. WDFW's goal is to achieve no net loss of populations, habitat functions, and values. If unavoidable impacts occur, the parties will adopt mitigation sequencing actions to assure impacts are addressed.

VIII. Effective Date

The period of performance for this MOU shall commence on the date the last signatory signs this agreement. However, starting dates for components of this MOU are directly dependent on a Record of Decision to approve phased development of the Odessa Program, construction timelines, and funding allowances.

IX. Dispute Resolution

If any disputes arise regarding the implementation of this agreement, representatives of the parties will meet and confer in good faith to resolve their differences. The parties may employ a mutually agreed upon mediator or other facilitator if they believe this may help resolve their dispute.

X. Termination, Amendments and Severability

This MOU terminates when it is assured that:

a) Revegetation efforts were successful;

b) Fish, wildlife, and habitat responses to changes in operations have been identified and management adaptations have been accomplished;

c) After all infrastructure has been built and all water is being delivered;

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[3] Reference WDFW Policy 5002: Requiring or Recommending Mitigation

d) When all actions required under the environmental commitments and this MOU are completed; and

e) All activities are projected to be completed within 15 years from final signature.

This MOU may be amended by mutual written agreement of the parties. Such amendments must be made in writing, refer to the section being amended, clearly specify the provision being changed, and signed by authorized representatives of each of the parties.

Early termination can be done through written consent of all parties. If extended beyond 15 years, expectations for responsibilities during the extended period must be clearly specified and done through written consent of all parties.

XI. General Provisions

a) Nothing herein shall or shall be construed to obligate any party to expend funds or involve their respective agencies in any contract or other obligation for the future payment of money in excess of appropriations authorized by law and administratively allocated for the purposes and projects contemplated hereunder.

b) No Member of or delegate to Congress, or resident Commissioner, shall be admitted to any share or part of this MOU or to any benefit that may arise out of it.

c) The parties agree to comply with all Federal statutes relating to nondiscrimination, including but not limited to: Title VII of the Civil Rights Act of 1964, as amended, which prohibits discrimination on the basis of race, color, religion, sex, or national origin; Title IX of the Education amendments of 1972, as amended, which prohibits discrimination on the basis of sex; the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act of 1990, as amended, which prohibit discrimination on the basis of disability; the Age Discrimination in Employment Act of 1967, as amended, which prohibits discrimination based on age against those who are at least 40 years of age; and the Equal Pay Act of 1963.

XII. Agency Contacts

The following staff members are the primary contacts for all communications regarding the performance of this Agreement.

For Reclamation:	For Ecology:	For WDFW:
Field Office Manager, Ephrata Field Office U.S. Bureau of Reclamation Box 815 Ephrata, WA 98823 Phone: (509) 754-0261 Email: SUtter@USBR.gov	Director, Office of the Columbia River (OCR) Department of Ecology 303 S. Mission St -- Suite 200 Wenatchee, WA 98801 Phone: (509) 662-0516 Email: dsan461@ecy.wa.gov	Director Region 2 Department of Fish and Wildlife 600 Capitol Way North Olympia, WA 98501 Phone: (360) 902-2713 Email: teresa.scott@dfw.wa.gov

XI. Signatories

This MOU is executed by the signatory parties below:

U.S. BUREAU OF RECLAMATION
COLUMBIA-CASCADES AREA OFFICE

Jerry Kelso
Area Manager

8/3/12
Date

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

for Ted Sturdevant

Ted Sturdevant
Director

8/3/12
Date

STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE

Phil Anderson
Director

8/9/12
Date

APPENDIX D

RECLAMATION'S RESPONSES TO RECOMMENDATIONS IN THE ODESSA SUBAREA SPECIAL STUDY FINAL FISH AND WILDLIFE COORDINATION ACT REPORT

AND

ODESSA SUBAREA SPECIAL STUDY FINAL FISH AND WILDLIFE COORDINATION ACT REPORT – JULY 2012

Reclamation's Responses to Recommendations in the Odessa Subarea Special Study Final Fish and Wildlife Coordination Act Report

This appendix includes Reclamation's responses to recommendations included in Section 9 of the *Odessa Subarea Special Study Final Fish and Wildlife Coordination Act Report* (CAR), July 18, 2012 and the final report, prepared by the U.S. Fish and Wildlife Service, Central Washington Field Office, Wenatchee, Washington.

The CAR is used as part of the environmental analysis of the project, to identify the effects of proposed alternatives on fish and wildlife resources. Through analysis in this report, the Service has identified the alternative that is best for fish and wildlife resources, having the least negative effects and most positive effects.

Following is Section 9, *Fish and Wildlife Mitigation Recommendations*, from the CAR and Reclamation's response in italics below each recommendation:

9.0 FISH AND WILDLIFE MITIGATION RECOMMENDATIONS

The Service's mitigation policy (FWS Manual, 501 FW 2) was used to formulate recommendations to mitigate for potential negative impacts associated with the Project's alternatives. In accordance with this policy, attempts were made to (a) avoid the impact altogether by not taking a certain action or parts of an action; (b) minimize impacts by limiting the degree or magnitude of the action and its implementation; (c) rectify the impact by repairing, rehabilitating, or restoring the affected environment; (d) reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action; and (e) compensate for the impact by replacing or providing substitute resources or environments (40 CFR Part 1508.20(a-e)), in that order. The Service has considered its responsibilities under the Endangered Species Act, Migratory Bird Treaty Act, Bald Eagle and Golden Eagle Protection Act, and the National Environmental Policy Act (USFWS 1981) in formulation of our recommendations. Service recommendations are also based on the ecological value and relative abundance of the affected habitats.

The Service's Mitigation Policy includes four Resource categories that were used to provide a consistent value rating for wildlife habitats. Based on the HSI values used in our analysis of project effects to fish and wildlife in the Project Area, the Service has designated a Resource Category for each terrestrial habitat in the Project Area.

Resource Category 1

Resource Category 1 habitats are of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion. The mitigation goal for habitat in Resource Category 1 is to experience no loss of existing habitat value. No such areas were designated within the Project Area.

Resource Category 2

Resource Category 2 habitats are of high value for evaluation species and are relatively scarce or becoming scarce on a national basis or in the ecoregion. The mitigation goal for habitat in Resource Category 2 is to experience no net loss of in-kind habitat value. Resource Category 2 habitats within the Project Area are shrub-steppe habitat, native grasslands, jurisdictional wetlands, and native riparian areas. Other Resource Category 2 habitats within the Project Area include the Washington State Priority Habitats previously described, areas containing known sage-grouse leks, and Black Rock Coulee.

Resource Category 3

Resource Category 3 habitats are of high to medium value for evaluation species. The mitigation goal for habitat in Resource Category 3 is to experience no net loss of habitat value. Examples of this resource category include low to medium quality shrub-steppe habitat, native grasslands, and native riparian areas.

Resource Category 4

Resource Category 4 habitats are of medium to low value for evaluation species. The mitigation goal for habitat in Resource Category 4 is to minimize loss of habitat value for wildlife species. Examples of this resource category include active and fallow agricultural lands, actively grazed and ungrazed pasture, and currently or previously disturbed lands.

In formulating these mitigation and minimization recommendations, the Washington State's *Wind Power Guidelines* (WDFW, 2009b, p. 1), *Wetland Mitigation in Washington State – Part 1: Agency Policies and Guidance*, and various species recovery plans, both State and Federal were used. Recovery plans were also used, including those for the pygmy rabbit (USFWS 2007, p. 1), Spalding's catchfly (USFWS 2005b, p.1), Ute ladies'-tresses (USFWS 1995, p. 1) and Washington state Greater sage grouse (Stinson, Hays, and Schroeder 2004).

Several of these mitigation measures were developed in coordination with WDFW. The Project will impact several Washington State Priority Habitats. Although the DEIS (Reclamation 2010, pp. 3-70) lists six Priority habitat Areas, impacts to others may be occur once the location of new facilities are determined..

Mitigation measures recommended below do not negate Reclamation's responsibilities under the ESA, the Migratory Bird Treaty Act (16 U.S.C. § 703–712), Bald and Golden Eagle Protection Act (16 U.S.C. § 668–668d), and the National Environmental Policy Act. The Project possesses the possibility for the take of state or federally listed species. "Take" is defined under the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in any such conduct or any activity significantly impairing essential wildlife behavioral patterns, including breeding, feeding, or sheltering. ESA does not prohibit incidental take of listed plants; however it does prohibit certain deliberate disturbance, removal and possession of Federally listed plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of federally listed plants on non-Federal areas in violation of State law or regulation or in the course of any violation of State criminal trespass law. Under the Migratory Bird Treaty Act, "take" is defined as to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, any migratory bird, any part, nest, or eggs of any such bird, or any product thereof, composed in whole or in part, of any such bird or any part, nest, or egg thereof. The Bald and Golden Eagle Protection Act defines "take" as pursuing, shooting, shooting at, poisoning, wounding, killing, capturing, trapping, collecting, molesting, or disturbing bald or golden eagles, but it does not cover habitat damage.

This report does not complete consultation under section 7 of the ESA; therefore, the Service recommends that Reclamation complete consultation with the Service on this project, if Reclamation moves forward to implement Alternative 4A.

The Service recommends the following measures be implemented with any alternative to avoid or mitigate potential adverse impacts or enhance fish and wildlife resources. If the alternatives are modified in planning or implementation, the mitigation recommendations may need to be modified and the Service should be contacted for assistance.

Mitigation of Effects to Fish and Aquatic Habitats Common to All Alternatives

Reclamation will:

- Ensure Crab Creek flows are compatible with migration, spawning, and rearing of resident and migratory fish that utilize the Crab Creek Watershed, by maintaining, improving and/or monitoring Reclamation's project effects to the flow regime and temperatures.
  Reclamation will continue to work with the Service and the WDFW to monitor Reclamation's Odessa Subarea Special Study effect to flow regime and temperature in Crab Creek as part of the implementation of the Study. At this time Crab Creek operations is outside the scope of the Study.

- In coordination with WDFW, investigate alternative barrier systems at Dry Falls Dam on Banks Lake and Pinto Dam on Billy Clapp Lake to reduce fish escapement out of both reservoirs.

  The Odessa Subarea Special Study will not affect the current fish barrier above Dry Falls Dam, but additional fish barriers are not presently included as part of the project.

- Provide adequate fish structures that meet NOAA and WDFW fish screening compliance standards in all facilities that have the potential to entrain or kill fish, while moving water within Reclamation facilities.

  Reclamation will provide fish structures that meet NOAA and WDFW compliance standards to the extent practicable for facilities within the Odessa Subarea.

- To document fish and invasive species within the water conveyance system, engineer facilities that provide opportunities to identify and collect information pertaining to entrained fish and invasive species, during maintenance and operations. Document and report invasive species and fish species by, size and life stage.

Reclamation will continue to collaborate with the Service on options for documenting use of the conveyance system by fish and invasive species.

- In coordination with the Washington Department of Ecology and WDFW, develop and implement a site-specific and site appropriate plan to monitor water quality within the Odessa Subarea that is compatible with existing Reclamation water quality monitoring efforts; including:

    - Continue to fund water quality monitoring in Banks Lake and Moses Lake, using established protocols for a minimum of 10 years;

    - Initiate annual water quality monitoring in Potholes Reservoir, for a minimum of 10 years, using protocols established for Banks Lake and Moses Lake.

    - Monitor potential transport of contaminants from Lake Roosevelt to downstream areas, in the Columbia River between Lake Roosevelt and Hanford Reach National Monument.

  Reclamation administers a water quality monitoring program developed for the Columbia Basin Project. Current efforts will continue and incorporate additional monitoring requests for areas within the Study area. However, Moses Lake is not a feature of the Columbia Basin Project; and Potholes and the reach between Lake Roosevelt and Hanford National Monument is outside of the Odessa Study Area. Existing and Future facilities constructed as part of the Odessa Study will be included in monitoring efforts.

- Will develop and implement a monitoring program in coordination with WDFW to evaluate fish species' response to operational changes related to the Odessa Subarea. A monitoring and adaptive management plan for the Odessa Subarea fisheries shall include the following components:
    - Monitor reservoir and lake productivity affected by the Odessa Subarea;
    - Conduct creel surveys in recreational fishing areas to assess any changes in annual angler effort, harvest, and catch;
    - Compare the entrainment of piscivorous warm water fish between current operations and operational changes under the selected alternative. Warm water fish entrainment should be monitored to determine if there are any effects to Columbia River ESA-listed species such as bull trout, salmon and steelhead;
    - Annually report findings and recommendations to the Service and WDFW; and
    - Adapt fishery management actions in response to new conditions, including but not limited to changes in fish stocking strategies, system rehabilitation, and changes to fishing rules.

  Reclamation, WDFW and Ecology have entered into a Memorandum of Understanding, July, 2012 to address these recommendations. A copy is provided in Appendix C.

- The Service further recommends that water conservation measures continue to be implemented as a means to conserve water in the Project Area, avoid increased use of Columbia River water for agricultural irrigation, and minimize impacts to wetlands and wetland species.

Water conservation will continue to be implemented as a means to conserve water in the Project Area.

- Reclamation and Ecology, in coordination with WDFW, should evaluate changes to wetland habitat and species within the Odessa Subarea, in association with water use changes.

  Monitoring of certain impacts will continue as discuss in the Memorandum of Understanding between Reclamation, WDFW and Ecology, July, 2012.

Mitigation of the Effects to Vegetation

- Locate construction staging areas, in coordination with WDFW that would avoid or minimize disturbance to wildlife and damage to priority habitats, including aquatic resources. Locate all staging areas in such a manner as to preclude water and soil contamination from solvents, fuels, and lubricants. Also all staging areas should be adequately equipped to deal with hazardous material spills, spill prevention, and clean-up.

  Reclamation, WDFW and Ecology have entered into a Memorandum of Understanding, July, 2012 to address these recommendations. A Copy is provided in Appendix C.

- All contracts awarded should require that workers comply with Best Management Procedures (Reclamation 2008b) to prevent the introduction of non-native plant and animal species in terrestrial and aquatic habitats. Monitor and manage disturbed areas post-construction to prevent the introduction and spread of non-native plants.
  A list of Best Management Practices will be incorporated into contracts as suggested.

- In consideration of Executive Order 13112, dated February 3, 1999, regarding invasive plant species, Reclamation should develop a weed management plan that will include clear goals for the control and eradication of invasive exotic plants, as well as methods and a timeline for meeting those goals in areas affected by the selected action alterative.

  An integrated pest management plan will be developed and implemented as needed.

- In consultation with the Service and WDFW develop and implement a Native Plant Restoration and Conservation Management and Monitoring Plan for documenting performance criteria, establishing clear goals and objectives, a schedule, and annual reports to evaluate the success of Reclamation's efforts to avoid permanent impacts to native vegetation. This plan should address Federal and State listed species, Species of Concern, and should cover all areas impacted by construction activities. We recommend that monitoring occur for 7 years following restoration efforts. The determination of adequate replacement ratios/locations for impacted wetland habitats should occur in consultation with Ecology and WDFW. Mitigation for affected riparian areas should be done according to the ratios for mitigation set forth below. Due to the time frame required to restore shrub-steppe with biotic soil crust and the uncertainty of successful restoration, any disturbance to the biotic crust should be considered long-term and replacement lands should be provided as mitigation for their destruction.

Reclamation, WDFW and Ecology have entered into a Memorandum of Understanding, July, 2012 to address these recommendations. A Copy is provided in Appendix C.

- To compensate for the loss of native habitat due to construction activities, Reclamation should develop, in association with the Service and WDFW, a mitigation plan containing a provision for monitoring restoration efforts for a minimum of 7 years. If, after 7 years, restoration has not been adequately successful (meaning it does not meet the goals of the plan), mitigation lands should be acquired at established mitigation ratios (WDOE 2004, Appendix 8-D, pp. 17-20; WDFW 2009a, p. 20) Wetland mitigation is based on a variety of variables and should be determined in consultation with WDOE and WDFW. The ratios shown below are suggested starting points for further discussion and may change based on final project impacts and further negotiations. Shrub-steppe, grassland, and riparian habitats have established mitigation ratios as shown below (Table 9):

Table 1. Recommended Habitat Mitigation Ratios

Habitat Type	Permanent Disturbance	Temporary Disturbance
Shrub-steppe[1]	2:1	0.5:1
Grassland[1]	1:1	0.1:1
Riparian[2]	20:1	10:1

1. (WDFW 2009a, p. 20)
2. (WDOE 2004, Appendix 8-D, pp.17-20)

Reclamation, WDFW and Ecology have entered into a Memorandum of Understanding, July, 2012 to address these recommendations. A Copy is provided in Appendix C.

- If suitable areas for shrub-steppe mitigation are not present in the immediate Project Area, then another location will need to be selected in the Project Area and evaluated for use as mitigation. If a suitable area for restoration cannot be found in the Project Area, then Reclamation should work with the Service to find mutually agreeable mitigation lands in the mid-Columbia area.

Reclamation will work to find mitigation land within the Columbia Basin Project Area.

- Any mitigation land acquisitions will require maintenance or transfer to a land management agency for management and maintenance of resource goals and must include adequate funding to attain those goals.

Land acquired for any Project purposes will either be managed directly by Reclamation or with another land management agency to the extent possible. However, funding is dependent upon availability of appropriations.

- Work cooperatively with the South Central Washington Shrub Steppe and Rangeland Partnership, as well as WDFW regional wildlife and habitat staff, to identify areas of shrub-steppe habitat that could be protected or restored as mitigation for any shrub-steppe habitat lost during the implementation of the Project. Assist the Service in identifying agricultural lands that will not be farmed or dry-land farming areas suitable for shrub-steppe restoration, particularly areas that may provide sage-grouse habitat connectivity.

  Reclamation, WDFW and Ecology have entered into a Memorandum of Understanding, July, 2012 to address these recommendations. A Copy is provided in Appendix C.

Mitigation for the Effects to Wildlife

- Reclamation should work with the Service and WDFW to identify and protect any existing Federal and state endangered, threatened, candidate, species of concern, and state sensitive plant species and their associated habitats that may occur within the Project Area. Surveys should be conducted at the appropriate time and frequency in areas of permanent or temporary disturbance to detect the presence of any state or federally listed species, candidate species or species of concern.

  Reclamation, WDFW and Ecology have entered into a Memorandum of Understanding, July, 2012 to address these recommendations. A Copy is provided in Appendix C.

- To avoid impacts to any existing pygmy rabbits, survey all suitable pygmy rabbit habitat prior to beginning construction in those areas. Coordinate with the Service if pygmy rabbits are found in the Project area.

  Reclamation will continue to work with Service.

- During construction, minimize or avoid all vegetation removal during the avian nesting season, to minimize the effect of the action on federally protected migratory birds. Typically the nesting season in this part of Washington occurs between March and August annually.

  Reclamation will take precautions to minimize impacts during construction using BMPs.

- To avoid displacement of wildlife from high value habitats to less suitable habitat by human activities, any future recreation facilities should be located away from important wildlife use areas, including wildlife mitigation lands.

  There are no future recreation facilities being proposed.

- Locate any above ground structures in areas that would cause the least disturbance to wildlife and loss or degradation of wildlife habitats. Creation of any barriers to or fragmentation of travel corridors for wildlife should also be avoided. Barriers to wildlife movement would include fences, roads, power lines, pipelines, canals, and large water bodies.

Consideration will be given to the extent possible in determining the location of facilities to be constructed.

- If reservoirs (storage and re-regulation) are created, design them to include wetland and riparian habitats that do not negatively impact existing shrub-steppe habitat and species.

  The preferred Alternative 4A does not involve construction of reservoirs and related facilities.

- Based on the significant loss of wildlife habitat that would occur with the creation of new reservoirs, we recommend that Reclamation consult with WDFW to establish a wildlife management area adjacent to the reservoirs, in areas that would be able to provide suitable wildlife habitat for waterfowl and shorebirds and that a wildlife management plan be developed to guide the management of that area.

  The preferred Alternative 4A does not involve construction of reservoirs and related facilities.

- Reclamation and Ecology should consult with WDFW to establish a "Banks Lake Grebe Management" area and provide and maintain floating nesting structures in an effort to avoid additional significant impacts to grebes.

  Reclamation, WDFW and Ecology have entered into a Memorandum of Understanding, July, 2012 to address these recommendations. A Copy is provided in Appendix C.

- Activities associated with the Black Rock Coulee Flood Storage Area have potential for significant impacts to Washington ground squirrels. In addition, widening the East High Canal will likely disturb Washington ground squirrel colonies. If Washington ground squirrels will be affected by construction, Reclamation and Ecology should coordinate with the Service and WDFW to identify suitable habitat for their potential translocation and facilitate translocation activities, if recommended.
  The preferred Alternative 4A does not involve construction of the East High Canal. In the event that Alternatives 3A or 3B are chosen Reclamation will coordinate with the Service and WDFW to identify suitable habitat for Washington ground squirrel potential translocation and facilitate translocation activities.

- Design and implement measures to maintain the connectivity of wildlife habitats and provide for the movement of wildlife within the Project Area. Mitigation measures should include wildlife crossings and escape mechanisms for canals, roads, pipelines and other structures, to minimize wildlife mortality and to maximize potential gene flow between populations. Bury pipelines underground, when pipelines present a barrier to the movement of wildlife, and restore native vegetation along the pipeline corridor and other construction areas. Reclamation should consult with WDFW for appropriate native plants for this purpose.

Reclamation, WDFW and Ecology have entered into a Memorandum of Understanding, July, 2012 to address these recommendations. A Copy is provided in Appendix C.

- To reduce impacts to northern leopard frogs and other amphibians, Reclamation should work cooperatively with WDFW to assist them in developing and implementing, in consultation with the Service, a Northern Leopard Frog Monitoring and Habitat Enhancement Plan for northern leopard frog habitat within the Project Area. The plan should:

  - Develop the means to investigate whether water level fluctuations within the project's canals and reservoirs are impacting northern leopard frog habitat and reproductive success.

  - Identify areas to enhance northern leopard frog habitat within the Project Area, particularly in and around the Gloyd Seeps, Willow Springs, Potholes Reservoir, Columbia National Wildlife Refuge and middle Crab Creek areas.

  - Develop and implement an inventory and monitoring plan to determine frog occurrence, reproduction, and the extent of suitable habitat within the Project Area. Inventory and monitoring of suitable habitat should occur for a minimum of 7 years after the operational changes for this project take effect and be conducted in areas created or enhanced for northern leopard frog habitat. The plan should monitor project effects on all northern leopard frog populations known to occur in the Project Area. Occurrence, population trends and the presence of other amphibian species (including invasive amphibian species, such as bull frogs) should be documented within existing northern leopard frog habitat in the Project Area. Habitat changes and the effects of operations on northern leopard frogs and their habitat within the Project Area should be documented.

  - Adaptively manage the project so as to increase frog populations, protect occupied and unoccupied habitat and increase suitable habitat within the Project Area.

  Reclamation, WDFW and Ecology have entered into a Memorandum of Understanding, July, 2012 to address these recommendations. A Copy is provided in Appendix C.

- Ensure that treated power distribution and transmission poles are not installed in areas that have potential to leach into irrigation canals, ponds, creeks, wetlands, groundwater or any waters of the state.

  Reclamation will take precautions to minimize impacts during construction using BMPs.

- All transmission lines and guy wires should be constructed to avoid avian species electrocution and collisions. Implement techniques set forth in the Service's *Avian Protection Plan Guidelines* (USFWS 2005a) to protect birds using project facilities.

  Reclamation will take precautions to minimize impacts during construction using BMPs.

- Provide artificial burrowing owl nesting structures in areas where their populations may decline as a result of the Project. Coordinate with WDFW on the placement, design, and installation of the nesting structures. Examine use of the right-of-way (i.e., expansion dirt piles) along the East Low Canal as potential nesting habitat for this species. Protect earthen nesting areas with "Soil Removal Prohibited" signs.

  Reclamation, WDFW and Ecology have entered into a Memorandum of Understanding, July, 2012 to address these recommendations. A Copy is provided in Appendix C.

- If fence is constructed in sage-grouse habitat, install reflective tape or other reflective devices at 4-foot intervals along all wire fencing to reduce bird collisions. Wire fence construction specifications should comply with designs recommended by WDFW for sage-grouse protection.

  Reclamation will take precautions to minimize impacts during construction using BMPs.

- Where applicable, implement Reclamation's best management procedures as set forth in the *Integrated Pest Management Manual for Effective Management on Reclamation Facilities* (2008a); and to protect sage-grouse and its habitat, incorporate the Natural Resources Conservation Service's sage grouse conservation measures set forth in the *Conference Report for the Natural Resources Conservation Service Sage-grouse Initiative* as best management practices for the Project (NRCS 2010).

  Reclamation will take precautions to minimize impacts during construction using BMPs.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
Central Washington Field Office
215 Melody Lane # 103
Wenatchee, WA 98801-8122

IN REPLY REFER TO:
01E00000-2012-CPA-0020
Hydro Unit Code: 17-02-00-15

MEMORANDUM

July 18, 2012

To: Area Manager
Bureau of Reclamation, Columbia-Cascades Area Office
Yakima, Washington

From: Assistant Project Leader
Wenatchee, Washington
Jessica L Gonzales

Subject: **Odessa Subarea Special Study Final Fish and Wildlife Coordination Act Report, Columbia Basin Project, Grant, Adams, Lincoln, and Franklin Counties, Washington.**

Attached is the U.S. Fish and Wildlife Service's (Service) Final Coordination Act Report (CAR) for the Bureau of Reclamation's (Reclamation) Odessa Subarea Special Study, located in Grant, Adams, Lincoln, and Franklin Counties, Washington. The project proposes six action alternatives to replace water used for irrigated agriculture that is currently served by the Odessa Subarea aquifer. Proposed alternate water source options include water from the Columbia River that would be siphoned from Lake Roosevelt and moved directly to users and/or stored in Banks Lake for use. A new reservoir for water storage is also proposed under the full replacement alternatives.

This CAR fulfills the last of the Service's deliverables under interagency agreement (USFWS 1928-1086); Reclamation IA No: R10PG10402) for this project.

This CAR has been closely coordinated with the Washington Department of Fish and Wildlife and includes input from that agency in the main report, as well as internally coordinated with the Mid-Columbia River Fishery Resource Office. A set of WDFW documents containing the agency's recommendations, comments on the draft environmental impact statement, the WDFW/Washington Department of Ecology Shrub-steppe Agreement, and a Washington Department of Ecology letter to WDFW regarding the project are included as appendices to this CAR and are submitted for Reclamation's full consideration in the project decision.

The Service appreciated the opportunity to work with Reclamation to plan for the protection and enhancement of fish and wildlife and their habitat in the Odessa Subarea Special Study. Thank you for commenting on the draft CAR, working with us to address those comments, and assisting in word processing the final document for printing. Questions or issues regarding this CAR should be directed to Jessica Gonzales at the Central Washington Field Office.

Attachment

cc by email:
Mark Miller, USFWS - ES, Washington FWO, Lacey, WA
Jim Craig, USFWS – Fish, MCRFRO, Leavenworth, WA
Wendy Christensen, Columbia-Cascades Area Office, BOR, Yakima, WA
Stephanie Utter, Ephrata Field Office, BOR, Ephrata, WA
Dennis Beich, WDFW Region 2 Office, Ephrata, WA
Charity Davidson, WDFW, Wenatchee, WA

Odessa Subarea Special Study

Final Fish and Wildlife Coordination Act Report

July 18, 2012

Prepared for

Bureau of Reclamation

Columbia-Cascades Area Office

Yakima, Washington

Prepared by

U.S. Fish and Wildlife Service

Central Washington Field Office

Wenatchee, Washington

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TABLES

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EXECUTIVE SUMMARY

The Odessa Subarea Special Study (Project) is a technical investigation of six options to replace ground water used for irrigation with surface water in the Odessa Groundwater Management Subarea (Odessa Subarea), located in Adams, Franklin, Grant, and Lincoln Counties, Washington. The Project is jointly undertaken by the U.S. Bureau of Reclamation (Reclamation) and the Washington Department of Ecology (Ecology). The Project's objective is to replace the use of groundwater wells with surface water by modifying or constructing a variety of conveyance and storage facilities to move water from the Columbia River to agricultural areas located farther south and east within the Columbia Basin Project (CBP) Area.

The Project proposes various combinations of three water delivery options and two water supply options, totaling seven alternatives, including a No Action Alternative and is considered part of the continued phased development of the CBP. The project includes alternatives that would replace approximately 102,600 acres of irrigation ground water with surface water to improve the Odessa Subarea water quality and quantity, thereby avoiding economic loss in the agricultural industry and improving domestic, commercial, municipal, and industrial water uses in the subarea. No increase in agricultural acreage is expected to result from the Project.

Pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C 661-667e) and the 2008 and 2010 Interagency Agreements between the U.S. Fish and Wildlife Service (Service) and the Reclamation, the Service has prepared this Coordination Act Report for the Project. This report will be used as part of the environmental analysis of the Project, to identify the effects of proposed alternatives on fish and wildlife resources. Through analysis in this report, the Service has identified the alternative that is best for fish and wildlife resources, having the least negative effects and most positive effects.

The Service's recommended alternative, 4A, is expected to have the lowest level of negative impacts to aquatic and riparian resources and the lowest level of negative impacts to shrub-steppe and grassland habitats, excluding the no action alternative. In our analyses, alternatives with the least disturbance to shrub-steppe, riparian and grassland habitats were generally best for wildlife and fish resources. In Alternative 4A, approximately 70,000 acres will be provided with Columbia River Water; approximately 25,000 acres north of I-90 and approximately 45,000 acres south of the interstate.

1.0 PURPOSE, SCOPE, AND AUTHORITY

1.1 PURPOSE

The purpose of this report is to identify and evaluate anticipated impacts of implementing each proposed alternative on fish and wildlife resources, and to recommend conservation and mitigation measures for the protection of those resources. Protection and conservation of all fish and wildlife resources were included in this report, not just federal or state listed species.

The purpose of this report is to:

- Describe the current condition of fish and wildlife resources within the Project Area that are likely to be affected by the proposed alternatives. The "Project Area" is the boundary within which Project effects are anticipated to occur. For some effects, such as noise disturbance, the effects can extend beyond the Project Area or actual footprint of the project;

- Describe the effects of the proposed alternatives on fish and wildlife resources in the Project Area and;

- Provide recommendations to avoid, minimize, and, or, compensate for adverse impacts to fish and wildlife resources associated with the proposed alternatives.

1.2 SCOPE

The Project is tiered to ongoing operations, meaning that the project describes anticipated changes in the operation and infrastructure of Reclamation's current water delivery program that are needed to meet current and proposed project objectives. However some aspects of the proposed project, such as specific locations and detailed designs of some of the proposed new or modified infrastructure, are uncertain. The objectives and anticipated effects of implementing any of the proposed alternatives are described in this report and the associated compliance documents for the National Environmental Policy Act (NEPA) (42 U.S.C. § 4321 *et seq.*) and section 7(a)(2) of the Endangered Species Act of 19734 (ESA)(16 U.S.C. § 1531 *et seq.*) for the proposed action.

This report does not negate the need to conduct section 7 consultation under ESA for the proposed action. Any changes in project elements, scope, or scheduling that are not fully described in the Environmental Impact Statement (EIS) *and have effects to listed species* will need to be consulted on under section 7(a)(2) of the ESA, with the Service and in coordination with WDFW, to ensure ESA compliance prior to issuing a record of decision.

1.3 AUTHORITY

This document constitutes the Secretary of the Interior's report for the Odessa Subarea, in accordance with section 2(b) of the Fish and Wildlife Coordination Act, as amended (16 U.S.C 661-667e), and the 2008 and 2010 Interagency Agreements between the U.S. Fish and Wildlife Service and Reclamation.

1.4 COORDINATION WITH WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

WDFW and the Service collaborated in writing this report to identify data needs and gaps, discuss species surveys, and jointly assess potential project impacts to fish, wildlife, and their habitats. WDFW performed wildlife and habitat surveys during 2009 and 2010 and provided the results to the Service for analysis. WDFW has reviewed and provided information to assist with the production of this report; additionally WDFW provided resource protection recommendations in a comment letter that is attached (Attachment 1).

2.0 DESCRIPTION OF THE PROPOSED PROJECT

The Project is jointly undertaken by Reclamation and Ecology under a December 2004 Memorandum of Agreement between the State of Washington and the CBP irrigation districts, to cooperatively explore opportunities for delivery of surface water to existing groundwater-irrigated lands within the Subarea, located in Adams, Franklin, Grant, and Lincoln Counties, Washington. The Project is being planned under the authority of the Columbia Basin Project Act of 1943, as amended, and the Reclamation Act of 1939. The Project is considered part of the continued phased development of the Columbia Basin Project which originally authorized water development to irrigate a total of 1,029,000 acres, of which 671,000 acres are currently irrigated in the CBP area. An estimated 1,029,000 acres are authorized under the CBP and the CBP currently provides water to approximately 671,000 acres in Grant, Douglas, Walla Walla and Adams Counties. An estimated 102, 614 acres are eligible to receive CBP water. The proposed alternatives are tiered process and will create changes to the water delivery program that are designed to meet outlined objectives and are described generally at this stage of planning. The exact locations and fully described designs of new infra-structure are not yet available and will be fully analyzed at the next level of project planning.

The need for the Project is to avoid potential economic loss to agriculture and arrest the decline of water quantity and quality in the Odessa Subarea aquifer. Groundwater in the Odessa Subarea is currently being depleted to such an extent that water must be pumped from depths as great as 2000 feet, in some areas. Domestic, commercial, municipal, and industrial uses are also affected by this decreasing ground water supply. This is a water source replacement project; therefore, no increase in irrigated agricultural acreage is expected as a result of the Project.

The Project's objective is to replace the use of groundwater wells with surface water. Surface water would be delivered through a variety of new and/or modified existing conveyance and storage facilities to move water from the Columbia River to agricultural areas farther south and east within the Project Area. The proposed alternatives consist of various combinations of three water delivery options and two water supply options. A total of seven alternatives, including a No Action Alternative, are proposed (see Table 1 for alternative description). (Alternatives 2C, 2D, 3C, and 3D are no longer under consideration and have been eliminated from further analysis in this report.) The partial replacement options (2A and 2B) would provide surface water to 57,000 acres south of I-90 and east of the East Low Canal. The full replacement or full replacement options of the Project (Alt 3A and 3B) would provide surface water to approximately102, 600 eligible acres in the Project Area. In the modified partial replacement proposal, Alternative 4A, an estimated approximately 70,000 acres will be provided with Columbia River Water; approximately 25,000 acres north of I-90 and approximately 45,000 acres south of the interstate.

Table 1. Water Source and Delivery Provisions of the Odessa Subarea Special Study Alternatives 1-4

Water Delivery Provisions	**Water Source**	
	Banks Lake	**Lake Roosevelt**
No Action Alternative	1	1
Additional Drawdown of Banks Lake	No	No
Additional Drawdowns of Lake Roosevelt	No	No
CBP surface water provided to additional groundwater-irrigated lands in the Study Area	No	No
Additional facility construction required	No	No
Current Columbia River and CBP program, commitments, and operations	Yes	Yes
Partial Replacement	2A	2B
Additional Drawdown of Banks Lake	Yes	Yes
Additional Drawdowns of Lake Roosevelt	No	Yes
Approximately 57,000 acres eligible lands provided with CBP surface water	Yes	Yes
Lands south of I-90 are supplied with CBP surface water replacement	Yes	Yes
Lands north of I-90 are supplied with CBP surface water replacement	No	No
Water delivered by enlargement and extension of the existing East Low Canal and construction of a pressurized pipeline system	Yes	Yes
Current Columbia River and CBP programs, commitments, and operations continue	Yes	Yes
Full Replacement	3A	3B
Additional Drawdown of Banks Lake	Yes	Yes
Additional Drawdowns of Lake Roosevelt	No	Yes
Approximately 102,600 acres of eligible land in the Study Area provided with CBP surface water, north and south of I-90	Yes	Yes
Water delivered south of I-90 by enlargement and extension of the existing East Low Canal and construction of a pressurized pipeline system	Yes	Yes
Water delivered north of I-90 by construction of a new East High Canal system, with an associated pressurized pipeline system	Yes	Yes
Current Columbia River and CBP programs, commitments and operations continue	Yes	Yes

Modified Partial Replacement	4A (Service Preferred)	4B
Additional Drawdown of Banks Lake	Yes	Yes
Additional Drawdowns of Lake Roosevelt	No	Yes
Approximately 70,000 acres of eligible lands provided with CBP surface water	Yes	Yes
Lands south of I-90 are supplied with CBP surface water replacement	Yes	Yes
Lands north of I-90 are supplied with CBP surface water replacement	Yes	Yes
Water delivered by enlargement of the existing East Low Canal and construction of a pressurized pipeline system	Yes	Yes
Current Columbia River and CBP programs, commitments, and operations continue	Yes	Yes

Reclamation's Alternatives 4A and 4B are comprised of supply and delivery elements from both the partial replacement alternatives and the full replacement alternatives. These alternatives will partially replace ground water use in the Project Area and will exchange surface water for ground water to users both north and south of I-90. Water to supply needs in the area south of I-90 will be delivered by widening the existing East Low Canal to increase its capacity. In the area north of I-90, water will be delivered from the East Low Canal and move eastward through lateral pipes and pumps. An estimated 70,000 acres will be provided with Columbia River Water; 25,000 acres north of I-90 and 45,000 acres south of the interstate. Alternative 4A will draw water from Banks Lake only, while Alternative 4B will draw water from Banks Lake as well as Lake Roosevelt. Alternatives 4A and 4B would include an "infill" option to allow some groundwater irrigators in areas farthest from the East Low Canal to move their operations to previously disturbed lands located closer to the canal. Relocation of irrigated agriculture areas would primarily be accomplished through land acquisitions and leases and could apply to as much as 15 percent of the lands served under these alternatives.

3.0 RELEVANT STUDIES, REPORTS AND REQUESTED INFORMATION

Reclamation, WDOE and WDFW have engaged in fish, wildlife, and habitat investigations and analyses that provide information used in this report to help determine the potential effects of the Project on species and habitats. The following studies and investigations conducted by WDFW were used in this report:

- Habitat surveys conducted in 2009 (WDFW 2009a, p.1) and 2010,
- Wildlife surveys conducted in 2009 (WDFW 2009c, p.1) and 2010,
- Habitat Evaluation Procedures (HEP) Analysis for 13 species listed in Table 6 (WDFW 2009c, p.1),
- Banks Lake Productivity and Water Quality Study completed in 2010 and,
- Banks Lake Fish Entrainment Study completed in 2010 (WDFW 2011, p.1).

Project planning documents, used to determine the proposed project's description and to formulate anticipated effects of the project, are general in nature for some aspects of the project. The project information used for this report is from planning documents that have evolved through the planning process and contain various levels of certainty regarding project implementation and design. The Project documents used for this report include:

- *Odessa Subarea Special Study Federal Notice of Intent and Determination of Significance* (73 FR 49487-49489);
- *Odessa Special Study Update* (Reclamation 2006);
- *Appraisal-Level Investigation Summary of Findings, Odessa Subarea Special Study, Columbia Basin Project* (Reclamation 2008); and
- *Draft Environmental Impact Statement Odessa Subarea Special Study, Columbia Basin Project* (Reclamation 2010).

The Service analyzed the Project's terrestrial impacts, including all six remaining action alternatives and the No-Action Alternative, using two different sets of data as described in Section 6.0 of this report. These data were the result of the wildlife surveys conducted by WDFW (WDFW 2009c, p.1) and data provided by Reclamation (2010).

In March, 2010, Reclamation provided the Service with a project description, analysis of impacts, and the environmental consequences of the alternatives in the form of an internal draft of the Environmental Impact Statement for the Odessa Subarea Special Study (EIS). In this document, Reclamation (2010, p. 3-121) determined that no impacts to listed terrestrial species would result from the Project. The Service considered effects that have a low probability of occurrence, could happen infrequently, or may affect resources beyond the footprint of the project. These effects are analyzed in this report.

The Service has produced Fish and Wildlife Coordination Act Reports on the proposed Banks Lake Drawdown (USFWS 2003) and the Potholes Reservoir Supplemental Feed Route (USFWS 2007). These projects move Columbia River water from Lake Roosevelt to irrigated lands west and south of the Project, through existing facilities that are also proposed for use in this Project.

4.0 DESCRIPTION OF THE PROJECT AREA

The Project Area is located in portions of Adams, Grant, Franklin, and Lincoln Counties, is within the CBP boundary, and is generally defined by the area bounded on the west by the Project's East Low Canal, on the east by the City of Lind, on the north to Wilson Creek and south to the Connell area (Reclamation 2006a, p. 4) (Figure 1).

Each of the two remaining partial replacement alternatives (2A and 2B) would provide CBP surface water to approximately 57, 000 acres of lands south of I-90. The partial-replacement alternatives differ only in the combination of reservoirs used to provide a portion of the water supply goal (Figure 2). Modified Partial Replacement Alternative 4A and 4B would provide CBP water to the majority of users south of I-90 and a limited

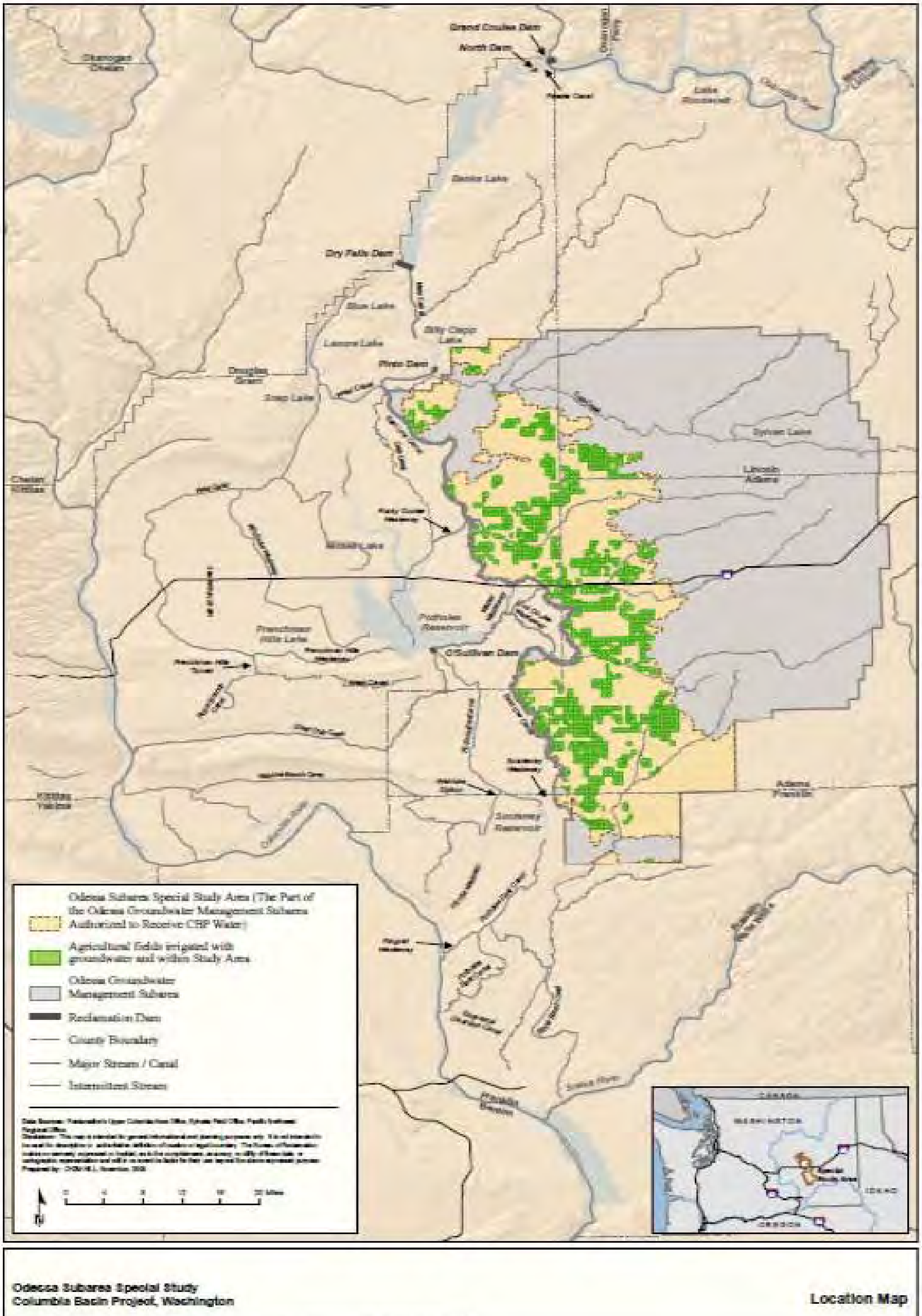

Figure 1. Project Area Map (Reclamation 2012)

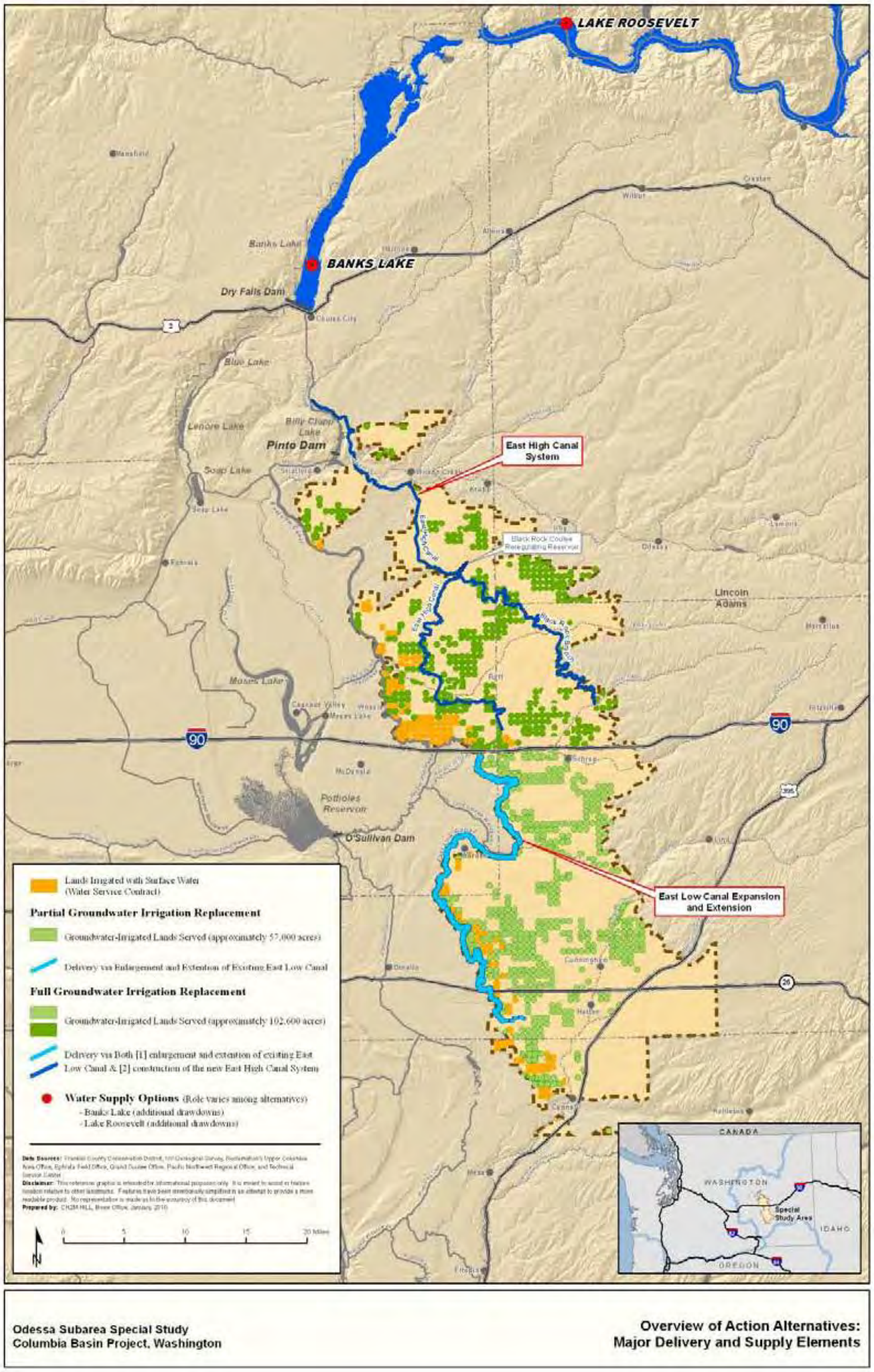

Figure 2. Map of Action Alternatives (Reclamation 2012)

number of users north of I-90. The number of users and acreages, up to 25,000 acres, irrigated north of I-90 will depend upon how many users south of I-90 opt not to participate. Those irrigators that participate in the exchange of ground water for surface water will apply it to the same number of acres that are currently irrigated; therefore, irrigators will not be allowed to continue to use ground water and use additional surface water to irrigate more acres. The irrigated areas north of I-90 may change spatially, as irrigation of fields shifts closer to the canal system providing surface water.

The Full Replacement Alternatives 3A and 3B would provide the full complement of CBP surface water to replace existing groundwater used for irrigation of most eligible lands in the Study Area (102,600 acres), both north and south of I-90. The two full-replacement alternatives differ only in the combination of reservoirs used to provide the necessary surface water supply (Figure 2) from Lake Roosevelt and Banks Lake. Water from both reservoirs originates from the Columbia River.

In spring 2012, Reclamation provided the Service and WDFW with a map and proposed description for two additional alternatives (Alternatives 4A and 4B; see Figure 3). At that time, Reclamation also agreed to incorporate Best Management Procedures (BMPs) to reduce impacts to fish, wildlife and their respective habitats. Alternative 4 is comprised of elements from both the partial and the full replacement alternatives.

Alternative 4A, Reclamation's preferred alternative, would provide CBP water to the majority of users south of I-90 and a limited number of users north of I-90. Alternative 4A differs from the existing Partial Groundwater Replacement Alternatives (2A thru 2D) evaluated in the DEIS in that it:

- Provides replacement water for existing irrigated lands both north and south of I-90,
- Allows implementation of conveyance system improvements to commence immediately after project approval and to proceed in increments over a 10-year period,
- Maximizes use of existing CBP infrastructure by incorporating capacity improvements (canal and siphon expansions) and conservation measures over the life of the project, and
- Incorporates a single water supply source, Banks Lake reservoir, avoiding the impacts associated with further drawdown of Lake Roosevelt.

Alternative 4B would provide CBP water to the majority of users south of I-90 together with a limited number of users north of I-90. Alternative 4B also differs from the existing Partial Groundwater Replacement Alternatives evaluated in the DEIS in that it:

- Provides replacement water for existing irrigated lands both north and south of I-90,

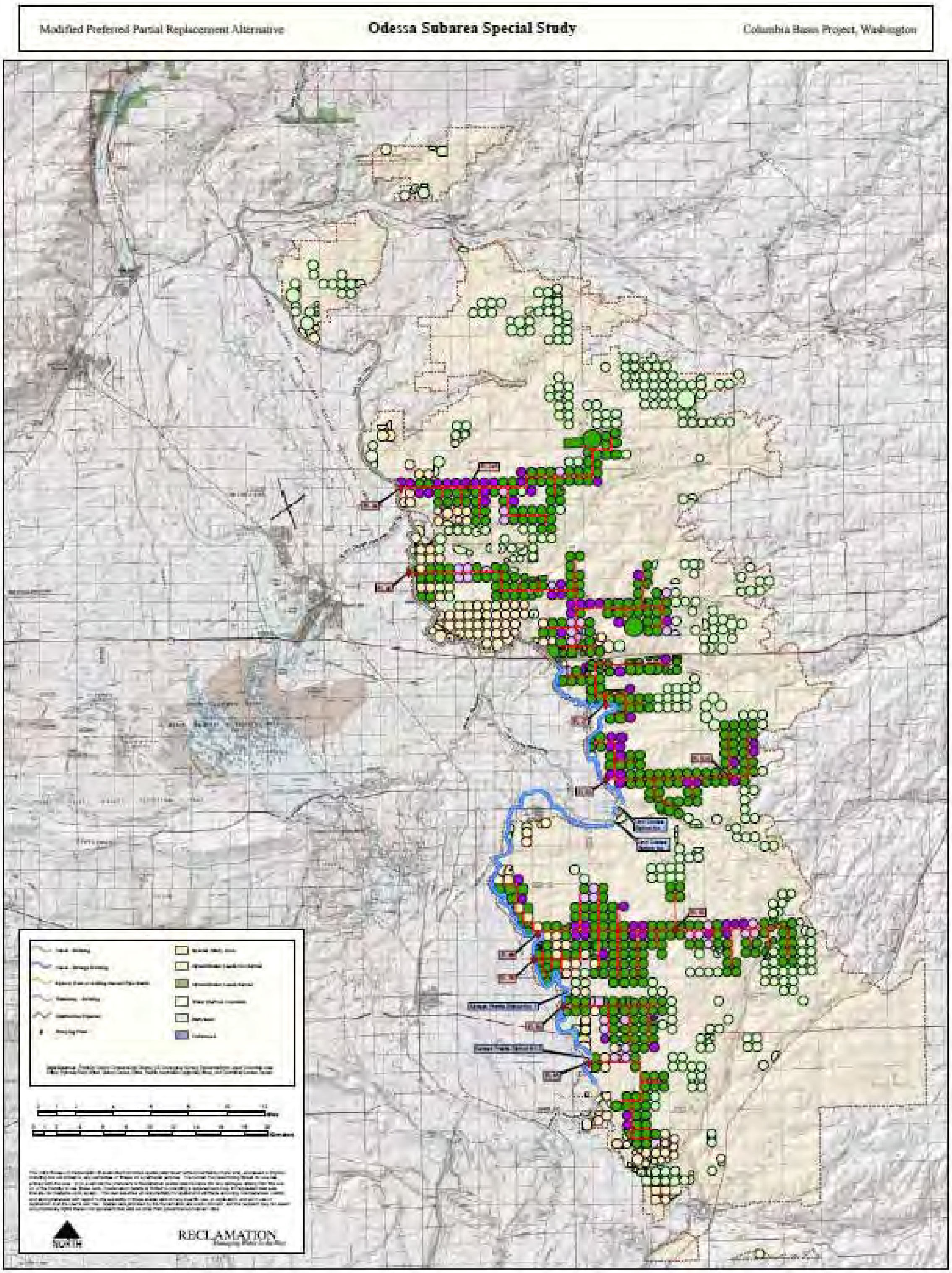

Figure 3. Alternative 4A and 4B (Reclamation 2012)

- Allows implementation of conveyance system improvements to commence immediately after project approval and to proceed in increments over a 10-year period,
- Maximizes use of existing Columbia Basin Project infrastructure by incorporating capacity improvements (canal and siphon expansions) and conservation measures over the life of the project, and
- It incorporates two sources of water, Banks Lake and Lake Roosevelt.

Over the life of the project, Alternatives 4A and 4B will provide replacement water for approximately 70,000 acres of land currently irrigated with groundwater. Approximately 25,000 acres located north of I-90 and 45,000 acres south of I-90 would receive water under this alternative.

Alternatives 2C, 2D, 3C, and 3D were eliminated from further consideration by Reclamation and therefore, will not be analyzed further in this report. For a detailed analysis of the impacts possibly resulting from these alternatives, please see the *draft* Fish and Wildlife Coordination Act Report at (http://www.usbr.gov/pn/programs/eis/odessa/reports/FWCAR.pdf).

4.1 Water Delivery Options

In spring of 2012, Reclamation provided two new water delivery scenarios that involve supplying surface water for all the alternatives by diverting water from the Columbia River using existing CBP water rights and existing storage reservoirs (Lake Roosevelt and Banks Lake). This would allow stored water to be used from Lake Roosevelt to Banks Lake and would be moved from Banks Lake to irrigators, during the irrigation season. Banks Lake would be filled during the fall and winter when river flow is available. Spring diversions, when possible (April through June), are for direct delivery to the Study Area. Stored water for delivery to the Study Area would be provided from Banks Lake by itself or Banks Lake and Lake Roosevelt. Alternatives 2A, 3A and 4A would utilize water stored in Banks Lake, exclusively. Alternatives 2B, 3B, and 4B would utilize water stored in both Banks Lake and Lake Roosevelt.

4.2 Quantity and Timing of Diversions

Two Diversion Scenarios are included in this FEIS for each alternative:

> *Spring Diversion Scenario*: This scenario is similar to that assumed in the DEIS, except that the maximum diversion in October has been increased to 2,700 cfs. Additional diversions up to 350 cfs could occur during November through March to refill Banks Lake and Lake Roosevelt. Diversions in April through June for direct delivery to the Study Area also would be allowed from the Columbia River when flows exceed 135,000 cfs at Priest Rapids Dam and 260,000 cfs at McNary Dam and there is adequate pump capacity to pump water from Lake Roosevelt to Banks Lake. This is consistent with limitations in the previous analyses performed for the DEIS.

Limited Spring Diversion Scenario: During informal ESA consultation with National Marine Fisheries Service (June 2012), it was suggested that Reclamation limit diversions in the spring (April through June) when Columbia River flow at Grand Coulee Dam exceeds 200,000 cfs and there is adequate pump capacity. Diversions in October of up to 2,700 cfs would be allowed and additional diversions of up to 350 cfs could occur November through March to refill Banks Lake and Lake Roosevelt.

5.0 FISH AND WILDLIFE RESOURCES OF CONCERN

The term "wildlife resources" as used herein, includes birds, fish, mammals, and all other types of wild animals and aquatic and land vegetation upon which fish and wildlife are dependent, pursuant to the Fish and Wildlife Coordination Act (16 USC § 666[b]). Shrub-steppe habitat, native grassland, and riparian corridors in the Project Area are of primary importance to the Service and to WDFW because these habitats are generally less plentiful, many species use them, and they support some of the rarest species in the Columbia Basin. However, all fish and wildlife resources were considered in this report.

Wildlife resources within the Project Area are briefly described below. More details about these resources can be found in the FEIS.

5.1 Aquatic Habitats

Major water bodies within the Project Area include Banks Lake, Lake Roosevelt, and Billy Clapp Lake, all of which are part of the existing surface water storage and conveyance systems operated by Reclamation (Figure 1). Many smaller water bodies also exist within the Project Area. The major water bodies, from North to South are described as follows:

- **Lake Roosevelt National Recreation Area** is located in northeastern Washington, in the mainstem of the Columbia River. Grand Coulee Dam created the 154 mile-long Lake Roosevelt, which includes 29 mile-long Spokane Arm. Grand Coulee Dam was completed in 1942 and is operated by Reclamation in Grand Coulee, Washington. At 81,389 acres, it is the sixth largest reservoir in the U.S. and is managed cooperatively with the National Park Service and local Native American tribes. Most of the water in Lake Roosevelt originates from glacial ice, lakes, and snow high in the Canadian Rockies.
- **Banks Lake** is a re-regulation reservoir for the CBP which is located in the upper Grand Coulee in central Washington, south of the Columbia River. Banks Lake receives its water supply from the Columbia River via pumps at Grand Coulee Dam and was developed by Reclamation primarily to receive and store water from the Columbia River. This lake provides the irrigation water supply for the CBP through a system of canals and laterals starting at the southern end of Banks Lake at the Main Canal. Banks Lake holds over one million acre/feet (ac-ft.) of water, but supplies over 2.654 million ac-ft. to the Project Area each year.
- **Billy Clapp Lake** is a 1,000 acre equalizing reservoir located 10.5 miles downstream from Banks Lake. This lake maintains equilibrium in the distribution system between the primary water supply and the consumer. The lake is basically

a wide spot in the main canal with an average inflow/outflow rate of 6500 cfs of water during normal irrigation demand periods. Use of water in this lake results in a rather rapid turnover rate for the reservoir, less retention of nutrients, and a more lotic (running water) environment than Banks Lake. Fish species enter into Billy Clapp Lake through water from Banks Lake.

The Columbia Basin has four major watersheds: Crab, Douglas, and Foster Creeks flow to the Columbia River, and the Palouse River that flows to the Snake River. Only Crab Creek is within the Project Area. Upper Crab Creek begins above the Columbia River canyon in Spokane County and flows southwest to Wilson Creek in Grant County, then to Moses Lake.

Wasteways are channels used to divert surplus flow from the main canal systems into a natural or constructed drainage channel. Wasteway channels have seasonal and daily flood patterns not typical of native streams. Some wasteways are dry during the part of the year outside of the irrigation season and some retain some water all year long. Several coulees that had intermittent streams prior to the CBP now support perennial flow from water supplied by the conveyance system, including Crab Creek, Lind, and Weber.

Crab Creek is over 124 miles (200 km) in length and drains an area of some 5,097 square miles (13,200 square kilometers). The creek was created by the ancient floods of Lake Missoula, and it winds along in rocky channels for most of its length. Crab Creek flows through several lakes starting with Sylvan Lake in south-central Lincoln County, then Brook, Round, Willow, and Moses Lakes, as well as Potholes Reservoir in Grant County. This creek is separated into three major reaches:

- Upper Crab Creek - Runs from its source near Reardon, Washington downstream to Brook Lake (also called Stratford Lake);
- Middle Crab Creek - Runs from Brook Lake to, and including, Potholes Reservoir; and
- Lower Crab Creek - Runs from below Potholes Reservoir to its confluence with the Columbia River.

Flows in lower Crab Creek are not anticipated to change as a result of this proposed project. Additional water put into East Low Canal is anticipated to be removed by users before it reaches lower Crab Creek and flows in the canal system are matched to anticipated needs downstream. The amount and timing of water flow into Columbia National Wildlife Refuge are expected to remain the same as they currently are under this project. The Project does not include operational changes that would affect flows in lower Crab Creek during flood conditions, so wildlife resources in lower Crab Creek could still be negatively impacted when water must be released at Sullivan Dam during flood years.

Declining Aquifer

The Plan of Study (Reclamation 2006a, pg. 9) states that the Columbia Basin Development League has estimated that 170,000 acres are irrigated with groundwater from the Odessa Subarea in an area larger than the Project Area. Withdrawal of water has diminished the amount and quality of water in the aquifer. As the water table is lowered, surface water levels are reduced in some potholes and wetlands, reducing the fish and wildlife habitat contained within them.

Wetlands

Despite the creation of wetlands by the CBP, the number of wetlands in Washington, as a whole, has declined by 30 percent, with the loss of freshwater wetlands statewide estimated at 25 percent from historic levels (USFWS 2003, pp. 5-7). Losses have been attributed to agriculture conversion including grazing; filling for solid waste disposal; road construction and commercial, residential and urban development; construction of dikes, levees and dams for flood control, water supply and irrigation; discharges of materials; hydrologic alteration by canals, drains, spoil banks, roads and other structures; and groundwater withdrawal. Aside from direct losses in the quantity of wetlands, many wetlands have also been reduced in quality as a result of the above factors. It must also be noted that wetland and riparian areas have been created in many new areas as a result of seepage from the infra-structure (canals, wasteways pipes and pumps) of the CBP. For example, Crab Creek has been dissected and larger ponds created along its streambed. Therefore, riparian area loss has been offset to some degree in eastern Washington by the relocation and movement of water within the CBP area.

Wetlands in the Project Area perform an array of functions, such as providing important habitat for fish and wildlife, groundwater recharge, floodwater storage, nutrient uptake, and recreational opportunities. Because the Project Area is situated in a semi-arid environment, wetlands are extremely important to the survival of numerous wildlife species, as they provide some of the best vegetation for food and cover, invertebrate production, and water.

Several species of waterfowl dependent on riparian and wetland habitats may be found in the Project Area. Appendix A lists representative birds and their current trends. Some common wetland plants found in the Project Area include common cattail (*Typha latifolia*), hardstem bulrush (*Scirpus acutus*), spikerush (*Eleocharis* sp.), sedges (*Carex species*), scouring rush (*Equisetum hyemale*), reed canarygrass (*Phalaris arundinacea*), meadow foxtail (*Alopecurus pratensis*), common reed (*Phragmites australis*), as well as black cottonwood (*Populus trichocarpa)*, which is a dominant overstory species. Willows (*Salix* sp.) and Russian olive (*Elaeagnus angustifolia* L.) are typical understory species found in wetlands within the Project Area. Aquatic plants can include pondweeds (*Potamogeton* sp.), coontail (*Ceratophyllum demersum*), Eurasian milfoil (*Myriophyllum spicatum*) (an invasive species) and duckweeds (*Lemna* sp.) (USFWS 2003, pp. 5-7).

5.2 Terrestrial Habitats

Shrub-steppe Habitat

Current shrub-steppe habitat conditions in the Columbia Basin are different from those that existed prior to the 1900s. Wooten (2003, p. 14) estimated that only 46.3 percent of previously existing shrub-steppe habitat remains in the Basin. Ninety-eight percent of this habitat loss (or 52.06 percent of the original acreage) is attributable to farmland development (Wooten (2003, p. 14). By the time of the Reclamation Act of 1902, much of the land in the Columbia Basin had already been converted to agriculture (Dobler *et al* 1996, p.2). Previously, Dobler *et al.* (1996, p. 10) reported that from 62 percent (Lincoln County) to 76 percent (Adams County) of the shrub-steppe habitat within the Project Area has been lost (Table 2). Dobler *et al.* (1996, p.10) reported that almost 60% of the remaining shrub-steppe habitat is privately owned.

Table 2. Remaining shrub-steppe habitat by county (Dobler et al. 1996, p.10).

County	Historic Acres	Current Acres	Percent of Habitat Lost
Adams	1,187,399	279,758	76%
Franklin	753,716	230,778	69%
Grant	1,614,555	571,830	65%
Lincoln	1,260,032	473,674	62%
TOTALS	4,815,702	1,556,040	68%

Undisturbed shrub-steppe habitat is dominated by big sagebrush (*Artemisia tridentata*) as the principal shrub and bluebunch wheatgrass (*Pseudoroegneria spicata*) as the principal grass (Dobler *et al.* 1996, p. 10). Smaller amounts of gray rabbitbrush (*Ericameria nauseosa*) and green rabbitbrush (E. *viscidiflorus*), spiny hopsage (*Grayia spinosa*), three-tip sagebrush (*Artemisia tripartite*) and horsebrush (*Tetradymia canescens*) may occur in the shrub layer. Cheatgrass (*Bromus tectorum*), a nonnative annual grass, has become widespread throughout the region. In some areas it has replaced native grass species along with native shrubs and forbs. In other disturbed areas, shrubs are completely absent and cheatgrass dominates the area (Dobler *et al.* 1996, p. 10).

5.3 Riparian Habitat

In this report, the term "riparian habitat" is defined as the area adjacent to flowing (i.e. streams, rivers) waters that contain elements of both aquatic and terrestrial ecosystems which mutually benefit each other (Crawford 2007, p. 7). They generally occur as relatively narrow linear units along rivers, creeks, lakes and ponds. Riparian areas also include forested and scrub-shrub habitats that are too dry to be classified as wetlands, gravel bars, and other stream related habitats and vegetation. Scrub shrub, mesic shrub, and riparian forest cover types were combined for mapping purposes. Mesic shrub and riparian forest were merged with scrub shrub to form the Scrub Shrub/Mesic Shrub/Riparian Forest cover type. The vegetation found in the riparian forest cover type is hydrophytic in nature, which lent further support to this classification (WDFW 2009d, p. 31). Thus, palustrine, lacustrine, and riverine habitats would be considered a subset of the overall area described as riparian areas in this report.

Dispersed throughout the shrub-steppe habitat are areas of streamside or riparian habitat. Knutsen and Naef (1997, pp. 8-10) estimate between 50 and 90 percent of previously existing riparian areas on the Columbia Plateau have been destroyed or drastically altered by mankind. Since the early 1800s, the annual loss statewide averages 2,034 acres per year (Knutsen and Naef 1997, pp. 8-10). Although, accurate estimates of annual riparian loss are not available for the area within the CBP, riparian habitats are of concern in this project because of their importance to many fish and wildlife species and many of the existing riparian habitats are not assured to be maintained or protected through time.

Although irrigation and agricultural conversion may adversely impact riparian habitats, it is also true that seepage from canals and leaks from irrigation systems created many riparian and wetland areas within the Project Area (Canning & Stevens 1990, p.2; Furnald & Guldan 2004, p. 1-3). This is especially apparent along the East Low Canal. Reclamation reports that waterfowl often use the embayments that were created to control water flow (Dave Kaumheimer, USBR, 2010, *pers. comm*.).

Undisturbed riparian areas in the Project Area typically contain rose (*Rosa* sp.), serviceberry (*Amelanchior alnifolia*), and hawthorn (*Crataegus douglasii*). WDFW (2009d, p. 4) reports that "…. riparian vegetation found in scrub shrub wetlands includes, but is not limited to, willows (*Salix* sp.), rose (*Rosa* sp.), water birch (*Betula occidentalis*), black cottonwood (*Populus trichocarpa*), aspen (*P. tremuloides*), hawthorn (*Crataegus douglasii*), and serviceberry (*Amelanchier alnifolia*). Native and introduced herbaceous wetland species consist of cattail (*Typha latifolia*), common reed (*Phragmites* spp.), reed canary grass (*Phalaris arundinacea*), purple loose-strife (*Lythrum salicaria*), and various sedges (*Carex* sp.) and sedges (*Juncus* sp.)…".

5.4 Fish and Wildlife

Birds

A total of 151 species of birds were observed within the study area during the Service's studies for the Banks Lake Drawdown project; this total number of species is indicative of the total Project Area. A representative list of birds found in the Project Area is shown in Appendix A. A total of 104 species of birds were found within the Project Area during surveys conducted in 2009 (WDFW 2009c, p.7).

Neotropical migratory birds (NTMB) are species which breed in the United States and Canada and then migrate south to Mexico, Central or South America or the Caribbean to spend the winter. They do not include waterfowl, shorebirds, or herons and egrets, even though some species in these groups also winter south of the Mexico-United States border. There is widespread concern about the future of NTMB, since many of these species have experienced large population declines due to habitat destruction on the breeding grounds, wintering areas, and along migration routes (USFWS 2003, pp. 5-7). In addition to riparian and wetland habitats, which are important for two-thirds of the NTMB within that study area, mesic shrub and shrub-steppe habitats are also important to several of these species.

Large amounts of excellent raptor nesting habitat in the basalt cliffs and the diversity of other habitats within the Project area provide nesting and foraging habitat for peregrine falcons, bald eagles, and other raptors.

Waterfowl use primarily occurs during the breeding seasons of March, April, and May, below Dry Falls Dam, Devils Punch Bowl (close to Steamboat Rock), and Osborne Bay. More scattered use occurs in the smaller bays and inlets on Banks Lake and other wetlands throughout the Project. Waterfowl use is heaviest and diversity of species is highest throughout the summer and fall seasons in the various wetlands and ponds below Dry Falls Dam. Nesting colonies of grebes occur within Osborne Bay and Devils Punch Bowl in Banks Lake, and are present in smaller numbers at other sites. Breeding colonies of grebes are of special concern to WDFW, as 54 nesting pairs have been reported using Banks Lake (Rich Finger, 2010, pers. comm.).

Shorebird use of the Banks Lake area is diverse; however, their numbers are low. It is likely that shorebirds are normally found in lower numbers, during migration and breeding seasons, because there is little suitable habitat for nesting and loafing. The area with the highest shorebird use is the area below Dry Falls Dam, although many shorebird species are found throughout the Project Area. Shorebirds may also be found at Lake Billy Clapp, Potholes Reservoir, Gloyd Seeps, lower Crab Creek, Seeps Lake and along the Audubon Trail in Grant County.

Mammals

A minimum of 34 mammal species have been identified in the Project Area (Appendix B). These mammals play an important part in maintaining the diversity of the Project Area by providing multiple layers in the food web and maintaining stable habitat functions. WDFW (2009c, p. 7) reported 15 species of mammals were observed during the 2009 surveys.

Reptiles and Amphibians

At least eleven species of amphibians and seven species of reptiles have been documented within the Project Area. Appendix C provides a checklist for reptiles and amphibians within the Project Area. The Service used this list as representative of species in the Project Area. WDFW (2009c, p. 7) reported 5 species of reptiles and amphibians were observed during the 2009 surveys.

Fish

Both warm and cold water fish species occur within the Project Area. Lake Roosevelt, Banks Lake, Potholes Reservoir, and Billy Clapp Lake contain numerous fish species. These species include peamouth chub (*Mylochelius caurinus*), northern pikeminnow (*Ptychochelius oregonensis*), carp (*Cyprinus carpio*), longnose sucker *(Catostomus catostomus*), largescale sucker (*Catostomus macrocheilus*), bridgelip sucker (*Catostomus columbianus*), brown trout (*Salmo trutta*), mountain whitefish (*Prosopium williamsoni*), lake whitefish (*Coregonus clupeaformis*), brown bullhead (*Ictalurus nebulosis*), walleye (*Stizostedion vitreum*), bluegill sunfish (*Lepomis macrochirus*) and prickly sculpin (*Cottus asper*), yellow bullhead (*Ictalurus natalis*), white catfish (*I. catus*), channel catfish (*I. punctatus*) and smallmouth bass (*Micropterus dolomieui*). The primary species of commercial or recreational importance in the Project Area, including Lake Roosevelt, are lake whitefish, steelhead, rainbow trout, brown trout, Chinook salmon (summer/fall run), kokanee, brown bullhead, walleye, largemouth bass, smallmouth bass, bluegill, black crappie, yellow perch, and burbot (*Lota lota*).

5.5 Threatened and Endangered Species

Bull Trout

The bull trout (*Salvelinus confluentus*) is a wide ranging, salmonid species that formerly inhabited most of the cold lakes, rivers and streams throughout the western states and British Columbia. It exhibits two life forms, a resident and migratory form. The resident form inhabits fresh water streams and lakes and grows to about twelve inches. The migratory form commonly exceeds twenty inches in length and spawns in streams, where juveniles live for some time before migrating to rivers, lakes and the ocean, returning to spawn in streams. Bull trout are piscivorous and require an abundant supply of forage fish for vigorous populations.

The coterminous United States population of the bull trout was listed as threatened on November 1, 1999 (64 FR 58910). Bull trout in the Columbia River Distinct Population Segment were listed as threatened on June 10, 1998 (63 FR 31647). The bull trout occurs in the Klamath River Basin of south-central Oregon and in the Jarbidge River in Nevada, north to various coastal rivers of Washington to the Puget Sound and east throughout major rivers within the Columbia River Basin to the St. Mary-Belly River, east of the Continental Divide in northwestern Montana.

Bull trout require cold water, with 7-8^{o}C appearing optimal for all their seasonal activities and 15^{o}C maximum. Spawning occurs in cooling water below 9^{o} C. Optimal incubating temperature seems to be 2-4^{o}C. Spawning occurs from August through November and eggs hatch in late winter or early spring. Emergence occurs in early April through May, commonly following spring peak flows. Because of extended time in the substrate, bull trout are susceptible to mortality in unstable conditions. Successful reproduction requires channel and substrate stability and adequate winter water flow to prevent the substrate from freezing. Bull trout require complex forms of instream cover. Adults use pools, large woody debris and undercut banks for resting and foraging. Juveniles also use side channels and smaller wood in the water. Freely flowing rivers and streams are necessary for bull trout to move between safe wintering areas and summer foraging areas are also necessary.

During the winter months, temperatures appear to be cool enough for bull trout to use the reach and predate on small steelhead. Reclamation maintains temperature data for the lower Crab Creek. Although bull trout presence has not been confirmed, the instream habitat conditions of Crab Creek appear to be conducive to seasonal use by bull trout. Also, migratory and resident populations of bull trout do occur above and below the project in the Columbia River. Using an upper growth-limit temperature of 15° C and Reclamation temperature data as shown in Appendix D (Gina Hoff 2007, pers. comm.), bull trout are likely to occupy lower Crab Creek, especially during the winter months, for foraging purposes.

Bull trout are not known to occur in Banks Lake; however, they have been documented to be in Lake Roosevelt. This fish species is rarely captured by anglers due to their relatively low numbers present in Lake Roosevelt. These fish are presumably wash downs from the Pend Oreille or Canadian systems.

Steelhead

Steelhead (*Oncorhynchus mykiss*) adults and juveniles, an anadromous form of rainbow trout, inhabit the Columbia River. Steelhead may be able to ascend higher in Crab Creek, but potential passage barriers have not been thoroughly described for most of the reach, which is privately owned. A natural falls south of McManamon Road may pose a barrier about 35 miles (56 km) above the mouth. This fish barrier may be two culverts on Para Tract Road (Gordon Warrick 2011, *pers. comm.*). Documentation exists indicating steelhead were planted in both upper and lower Crab Creek in the past. However, we were unable to find specific planting information regarding dates, specific locations, numbers of fish, or origin. NOAA Fisheries describes the end of the anadromous portion of Crab Creek as the base of O'Sullivan Dam. The lower 35 miles (56 kilometers) of Crab Creek are designated critical habitat for the species (70 FR 52630-52858).

Spawning habitat within Crab Creek appears to be limited due to high silt loads, temperature and water quality. As with Chinook salmon, steelhead use of Crab Creek prior to irrigation development was probably very limited; and the stream would not have produced smolts, given its ephemeral character. Even with the present perennial flows, steelhead smolt production in lower Crab Creek has not yet been documented. Due to the large presence of rainbow trout (stocked and naturally reproducing), it is difficult to determine if steelhead par are migrating to the Columbia River to rear. The presence of resident rainbows in Red Rock suggests that steelhead smolts might be produced in this tributary and finish rearing in the Columbia River.

Steelhead are not known to occur in Lake Roosevelt or Banks Lake.

Chinook Salmon

Chinook salmon (*Oncorhynchus tshawytscha)* are the largest of any salmon, with adults often exceeding 40 pounds (18 kg); individuals over 120 pounds (54 kg) have been reported. Chinook mature at about 36 inches and 30 pounds. Body size, which is related to age, may be an important factor in migration and spawning bed, or redd, construction success. Adults migrate from a marine environment into the freshwater streams and rivers of their birth in order to mate. They spawn only once and then die. They feed on terrestrial and aquatic insects, amphipods, and other crustaceans while young, and primarily on other fishes when older.

There are different seasonal (i.e., spring, summer, fall, or winter) "runs" in the migration of Chinook salmon from the ocean to freshwater, even within a single river system. These runs have been identified on the basis of when adult Chinook salmon enter freshwater to begin their spawning migration. Distinct runs also differ in the degree of maturation at the time of river entry, the temperature and flow characteristics of their spawning site, and their actual time of spawning. Freshwater entry and spawning timing are believed to be related to local temperature and water flow regimes. There is a fall and summer run of Chinook salmon in Roosevelt Lake.

Recent research indicates that the Chinook located in lower Crab Creek and Red Rock Creek (a tributary to lower Crab Creek) are of a unique genetic make-up.

Pygmy Rabbit

The pygmy rabbit (*Brachylagus idahoensis*) is the smallest native rabbit species in North America (68 FR 10388-10409). It is distributed in patches of sagebrush-dominated areas of the Great Basin of Oregon, California, Nevada, Utah, Idaho, Montana, Wyoming, and Washington. Washington populations are isolated from the core of the species' range, apparently having been separated for thousands of years. Today, the known range of the pygmy rabbit in Washington is greatly restricted. Museum specimen records and reliable sight records show that pygmy rabbits formerly occupied sagebrush habitat in five Washington counties: Benton, Adams, Grant, Lincoln, and Douglas. Pygmy rabbit habitat occurs in the Project Area; although at the time of this report, all known pygmy rabbits are currently in captivity, awaiting reintroduction into the southern portion of Douglas County, within WDFW's Sagebrush Flat Wildlife Area. A possible recent sighting of a Columbia Basin pygmy rabbit was reported within the Project Area by a consultant in March, 2010. Attempts were made to confirm the sighting; however, they were unsuccessful. Based on the information gathered, no further investigation of the sighting was recommended (Rich Finger, WDFW 2010, pers. comm.).

The pygmy rabbit is the only rabbit native to North America that digs its own burrows. It is also uniquely dependent upon sagebrush, which comprises up to 99% of its winter diet. Dense sagebrush and relatively deep, loose soil are important characteristics of pygmy rabbit habitat. The primary factor contributing to the decline of the pygmy rabbit in Washington has been loss of habitat due to the conversion of habitat into agricultural areas.

In 1990, the pygmy rabbit was listed as a state threatened species and the status was changed to Endangered in 1993 by the Washington Wildlife Commission. The species was listed federally as Endangered on March 5, 2003(68 FR 10388-10409). In June, 2011, the Service released an amendment to the Draft Recovery Plan for the Columbia Basin Distinct Population Segment of the Pygmy Rabbit (*Brachylagus idahoensis),* which recommended surveying all suitable habitat for possible presence of the pygmy rabbit (USFWS 2011, p.10-11). The draft amendment of the recovery plan was released for public comment on June 29, 2011 (76 FR 38203-38204).

Spalding's Catchfly

Spalding's catchfly (*Silene spaldingii*) is a long-lived perennial in the carnation or pink family. The species is native to portions of Idaho, Montana, Oregon, Washington, and British Columbia, Canada, and is found predominantly in bunchgrass grasslands and sagebrush-steppe habitats, and occasionally in open pine habitats. The plant was listed as a federally threatened species in 2001(66 FR 51598). A final recovery plan for the species was published on October 12, 2007 (72 FR 58111-58112).

Spalding's catchfly blooms from mid-July through August, and occasionally into September, producing small white tubular flowers. It emerges in spring and dies back to below ground level in the fall. It can remain dormant for up to 6 consecutive years. Plants typically range from 8 to 24 inches in height, although occasionally this species can be up to 30 inches tall. There is generally one distinctively yellow-green stem per plant; but it may have multiple stems. Each stem bears four to seven (up to 12 or more) pairs of leaves that are 2 to 3 inches in length, and has swollen nodes where the leaves are attached to the stem. All green portions of the plant are covered in dense sticky hairs that frequently trap dust and insects, hence the common name "catchfly". The plant's long taproot makes transplanting the species difficult.

The species is typical of grasslands ranging from the Palouse Prairie and Northern Great Plains types, found in the Ponderosa biogeographic climatic zone. Exact locations of the species within the Project Area are unknown.

Ute Ladies'-tresses

Ute ladies'-tresses (*Spiranthes diluvialis*) is a perennial, terrestrial orchid with 7 to 32-inch stems arising from tuberous thickened roots. The flowering stalk consists of few too many small white or ivory flowers clustered into a spiraling spike arrangement at the top of the stem. The species is characterized by whitish, stout flowers. It generally blooms from late July through August.

The orchid occurs along stable riparian edges, gravel bars, old oxbows, high flow channels, and moist to wet meadows along perennial streams. It typically occurs in stable wetland and seep areas associated with old landscape features within historical floodplains of major rivers, as well as in wetlands and seeps near freshwater lakes or springs. Ute ladies'-tresses ranges in elevation from 720 to 1,830 feet elevation in Washington to 7,000 feet in northern Utah. Nearly all occupied sites have a high water table (usually within 5 to 18 inches of the surface) that is augmented by seasonal flooding, snowmelt, runoff and irrigation.

The Ute ladies'-tresses is currently listed as a federally threatened species (66 FR 51597-51606). A range-wide status review was conducted in 2005 and the Federal status was unchanged at that time. A second status review is being conducted this year (2011) and was not completed by the end of the year.

This orchid is known to occur in Colorado, Idaho, Montana, Nebraska, Nevada, Utah, Washington, and Wyoming. In Washington, it is known to occur in Okanogan and Chelan Counties along the west bank of the Columbia River. Suitable habitat for this plant exists in riparian areas within the Project Area, particularly along the Columbia River. Occurrences of the Utes' ladies' tresses are reported near the Project in Chelan

County, within the Chief Joseph watershed (USFWS 2005c, p. 20). However, this species is not known to occur in the Project Area.

5.6 Candidate Species

Greater Sage-grouse

Sage-grouse in Washington belong to the western subspecies of greater sage-grouse (*Centrocercus urophasianus*). The greater sage-grouse is a large, rounded-winged, ground-dwelling bird, up to 30 inches long and two feet tall, weighing from two to seven pounds. It has a long, pointed tail with legs feathered to the base of the toes. Females are a mottled brown, black, and white. Males are larger and have a large white ruff around their neck and bright yellow air sacks on their breasts, which they inflate during their mating display. Sage-grouse feed on soft plants and insects. They are also highly dependent on sage brush for food and cover.

The distribution of greater sage-grouse has contracted, most notably along the northern and northwestern periphery and in the center of the historic range. Currently, greater sage-grouse are found in Washington, Oregon, Idaho, Montana, North Dakota, eastern California, Nevada, Utah, western Colorado, South Dakota and Wyoming and the Canadian provinces of Alberta and Saskatchewan and occupy approximately 56 percent of their historical range. Sage steppe habitat loss, fragmentation and degradation have resulted in population declines throughout its range (Connelly et al, 2004, p. 1-1).

In 2010, the Service determined that listing the greater sage-grouse was warranted but precluded by higher priority listing actions; which resulted in the species, including those in Washington, becoming a federal candidate species (75 FR 13909). Greater sage-grouse in Washington were federally listed as a candidate species within the Columbia Basin Distinct Population Segment on May 7, 2001(66 FR 22984), largely because they are isolated from remaining greater sage-grouse populations. Greater sage-grouse are state listed as threatened. Currently there are between 100,000 and 500,000 greater sage-grouse, with an estimated 1,292 Columbia Basin sage-grouse occurring in Washington as of spring 2010, located primarily on private land (Sage-Grouse Working Group 2010). Recovery efforts are focused on reducing mortality due to structural barriers (i.e. fences, roads, etc.) and predators, reducing habitat loss and degradation, and improving habitat connectivity between populations. Wildfire, agricultural land development, and livestock grazing have degraded or destroyed habitat in Washington and within the Project Area.

There are two Columbia Basin sage-grouse populations remaining in Washington, one in Douglas and Grant counties and one in Yakima County. Sage-grouse likely migrate from Moses Coulee to surrounding sage steppe habitats in the east. Suitable habitat within the Project Area, particularly north of I-90, is very important for recovery of the sage-grouse. Lands within the Conservation Reserve Program and conservation easements near sage-steppe in Douglas, Grant, and Lincoln Counties provide foraging, sheltering, and nesting habitat for sage-grouse (Schroeder 2006, p. 1).

A translocated sage-grouse population does occur in the Crab Creek Sage-grouse Management Unit. Several attempts have been made to re-establish new populations in Lincoln and Kittitas Counties; however, sage-grouse released in those areas are not yet considered fully established and viable populations. Greater sage-grouse have been released in the Swanson Lake Wildlife Management Area, since 2004. This translocated population is beginning breeding and producing young.

WDFW personnel conducted aerial surveys for sage-grouse in 2008 and 2009 and conducted ground surveys in 2010. Surveys were limited to searching for lek sites. Aerial surveys were within a 2 mile buffer of the East High Canal (EHC). Ground surveys were made of potential habitat during March, 2010. No grouse were found (WDFW 2010, pp. 14-15).

The Project Area is located within two of the five Sage-Grouse Management Units (Crab Creek and Dry Falls), which were designated in the *Washington State Recovery Plan for the Greater Sage-Grouse* (Stinson and Schroeder 2004, pp. 28.29) (Figure 4).

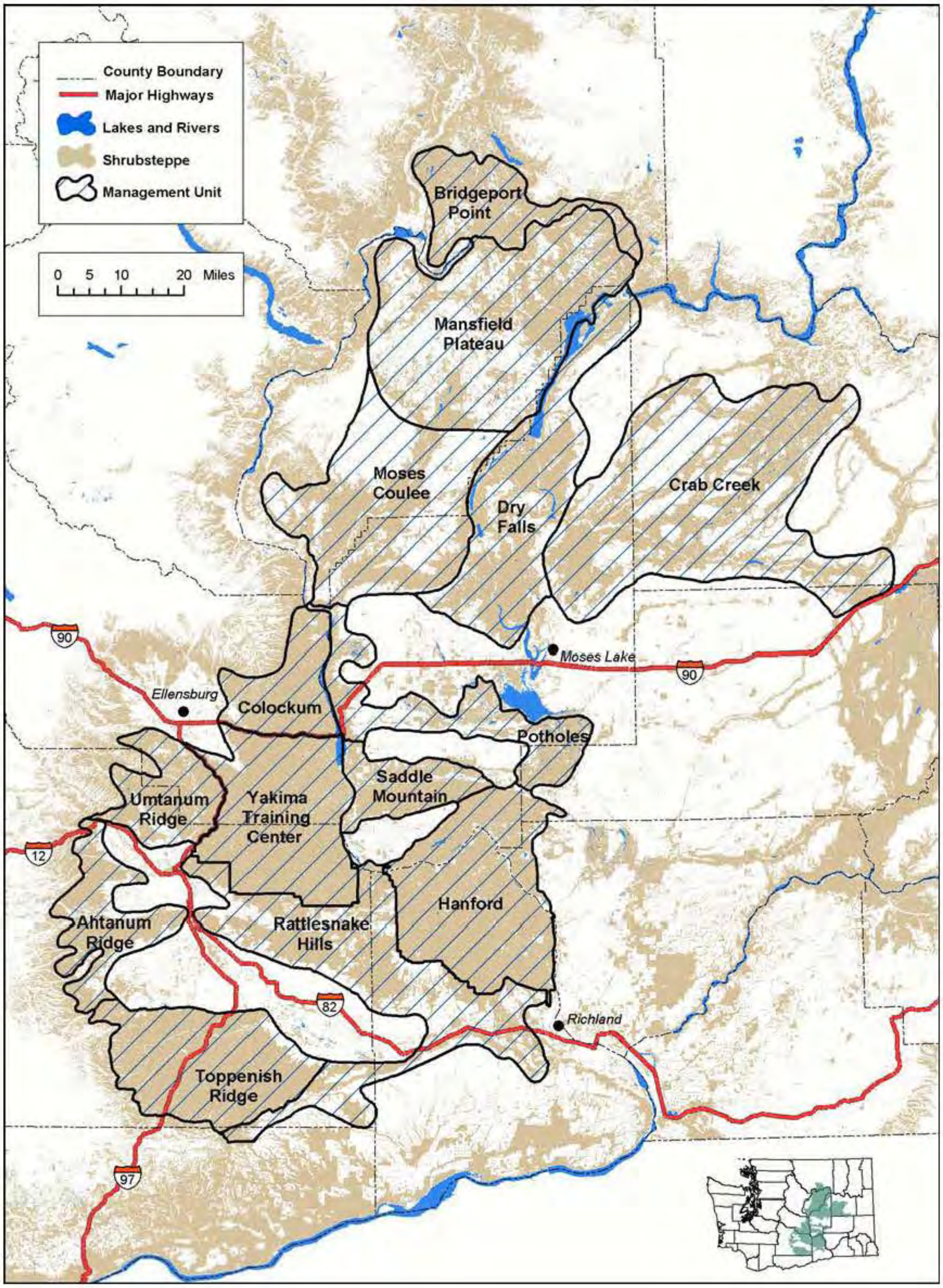

Figure 4. Sage-grouse Management Units (Stinson 2004, p. 30)

Washington Ground Squirrel

The Washington ground squirrel (*Spermophilus Washingtoni)* is a small ground dwelling rodent that spends much of its time underground. They hibernate/estivate 7-8 months of the year. Adults emerge from hibernation between January and early March to mate and gain weight in preparation for hibernation/estivation in late spring to early summer. Males emerge before females. Juveniles emerge from the burrow in March and disperse into new areas.

Although the species is associated with sagebrush-grasslands of the Columbia Plateau, recent studies indicate that silty soils in the Warden Soil series, are particularly favored by this squirrel for burrow locations. These deep, high silt content soils are an important habitat feature; they allow these squirrels to construct and maintain deep burrows. Warden Soils typically occur east and south of the Columbia River. Washington ground squirrels occur in scattered locations throughout the Project Area; the largest known colony lies within Black Rock Coulee (WDFW 2010, p. 18).

Conversion of shrub-steppe habitat to agricultural areas is the primary cause of the decline of the Washington ground squirrel. Tilling and other mechanisms involved in conversion of shrub-steppe habitats destroy the species' food plants and burrows. Intensive grazing of their shrub steppe habitat reduces cover and forage. Since they are often viewed as pests, these squirrels are also subject to illegal recreational shooting and poisoning.

The Washington ground squirrel became a federal candidate species in October 1999 (64 FR 58982-59028) and a state candidate species in the early 1990's (Finger *et al* 2007, p.3). An annual review of the status of the species was last conducted in November 2009 (74 FR 57803-57878).

Northern Wormwood

Northern wormwood (*Artemisia campestris ssp. borealis var. wormskioldii* [Bess. ex Hook.] Cronq.) is a low growing, tap rooted, biennial or perennial shrub in the Asteraceae (composite) plant family. Northern wormwood is 20 to 60 inches tall with greenish to red stems covered by stiff hairs. Leaves occur in crowded rosettes, are 1 to 4 inches long, divided into linear divisions, and are covered by dense silky hairs. Plants typically begin to flower in April, but individual plants occasionally flower throughout the growing season. The inflorescence is narrow and spike-like to diffuse and panicle-like. Flowers are pale yellow to yellow.

Northern wormwood generally grows in arid shrub steppe vegetation within the flood plain of the Columbia River and populations are occasionally flooded. Plants are generally sparsely distributed covering less than 1% of the suitable habitat at known sites.

Northern wormwood is a narrow endemic species that has only two populations, which occur in Grant and Klickitat Counties. In Washington, northern wormwood is found along the east bank of Columbia River in Grant County.

In addition to direct loss of habitat as a result of dam construction, the unnatural manipulation of water flows by hydroelectric dams is a major threat to this plant. The severity of spring floods has been reduced or eliminated in most years; thereby affected the distribution of this species. Altered water flows, as well as recreational uses and grazing, have allowed nonnative plants to invade both sites. The loss of genetic variability is a threat to the two small populations, as it can affect disease resistance, response to climatic change, and reproductively compatible gene combinations (genotypes) (64 FR 57534–57547).

This wormwood is a Federal Candidate species (50 FR 39526- 39584) and is a State endangered species. Federal annual reviews have been conducted and the most recent of record was November 10, 2010 (75 FR 69222- 69294).

5.7 Species of Concern

A "*species of concern*" is a species in need of concentrated conservation actions in order to keep them from becoming threatened by extinction. Such conservation actions vary depending on the health of the populations and degree and types of threats the species is subject to. "Species of concern" receive no legal protection under the federal Endangered Species Act or state law. They are mentioned in this report should Reclamation want to consider them in their environmental analysis in case they are listed prior to the Project's implementation and to facilitate proactive conservation actions for these species, since they are rare. Species of concern that may be found in the Project Area are shown in Appendix D, whereas species of concern actually found are shown in Table 3.

WDFW conducted a series of surveys to detect the presence of Federal and State terrestrial species of concern, during 2009 (WDFWc 2009, p .5). Over 514 miles of transects were surveyed for a variety of species. Table 3 shows the species found in these surveys. Surveys were conducted within a ½ mile corridor (1/4 mile on each side) along the proposed alignment of the proposed East High Canal, the existing East Low Canal (proposed expansion and extension areas), and all proposed reservoir sites. Each area was surveyed twice, once between March 6 to May 11 and another survey between May 12 to July 27, 2009. Survey times were adjusted for daily variation in sunrise. Some species (e.g. northern leopard frog) required specialized survey techniques and survey methodology was adapted as needed (e.g. call chorus surveys). Any indication of presence (sight, sound, or artifact) was recorded as an observation.

Table 3. Federal and state species of concern found during surveys (WDFW 2009c, p 8-12).

Species	Scientific Name	Federal Status	State Status
Bald Eagle	*Haliaeetus leucocephalus*	species of concern	sensitive
Loggerhead Shrike	*Lanius ludovicianus*	species of concern	candidate
Peregrine Falcon	*Falco peregrinus*	species of concern	sensitive
American White Pelican	*Pelecanus erythrorhynchos*	none	endangered
Badger	*Taxidea taxus*	none	monitored

Table 3. Federal and state species of concern found during surveys (WDFW 2009c, p 8-12).

Species	Scientific Name	Federal Status	State Status
Black-crowned Night-Heron	*Nycticorax nycticorax*	none	monitored
Black-necked Stilt	*Himantopus mexicanus*	none	monitored
Burrowing Owl	*Athene cunicularia*	none	candidate
Great Blue Heron	*A. herodias*	none	monitored
Long-billed Curlew	*Numenius americanus*	none	monitored
Osprey	*Pandion haliaetus*	none	monitored
Prairie Falcon	*Falco mexicanus*	none	monitored
Pygmy Short-horned Lizard	*Phrynosoma douglasii*	none	monitored
Sage Sparrow	*Amphispiza belli*	none	candidate
Sage Thrasher	*Oreoscoptes montanus*	none	candidate
Sandhill Crane	*Grus canadensis*	none	endangered
Swainson's Hawk	*Buteo swainsoni*	none	monitored
Turkey Vulture	*Cathartes aura*	none	monitored

6.0 EVALUATION METHODS

The alternatives benefits and negative impacts to wildlife habitat were analyzed and described using a general descriptive method. Potential habitat impacts were analyzed using several sets of information.

Aquatic impacts were analyzed by using the *Pathways and Indicators Matrix* (Matrix) (USFWS, 1998), developed by the Service to analyze impacts to bull trout habitat. This provided a framework for analyzing impacts to different components of aquatic habitat for each alternative. Each impact was rated high (H), medium (M) or low (L) and alternatives compared in several ways (total score, magnitude of impacts, etc.)

Data from wildlife surveys conducted by WDFW were used to determine the species and habitat types present in the Project Area. Habitat Evaluation Procedures (HEP) was the method chosen to determine relative terrestrial habitat effects of each alternative on key species. As a part of the HEP analysis, models called Habitat Suitability Indices for key species were used to determine habitat effects of each alternative. The types of facilities and activities that Reclamation planned and their general location were used to determine broad-scale habitat loss and degradation, as seen when plotted against the DEIS maps. Also, the estimated number of acres impacted within each habitat type was compared between alternatives. Using these data, predicted impacts to five selected terrestrial habitats were analyzed.

Impacts to the five key habitat types were analyzed for each alternative. These habitats were selected because they occur within the planning area, are important to many wildlife species or to rare wildlife species, and/or are relatively limited in the planning area. Key habitats and those analyzed in the Planning Area included riparian and riparian/ mixed habitat, shrub-steppe habitat, grasslands, emergent wetlands, and agricultural lands.

Whether the Project would impact federal and state listed species, candidate species, and any species of concern was also taken into consideration, but not weighted differently when considering effects in the HEP analyses. However, the conservation measures suggested in this report could be incorporated into the Project and would reduce negative impacts to these species. Listed and sensitive species were given special consideration in determining priority habitats of concern, in identifying mitigation measures, and in selection of the Service's recommended alternative.

Two impact analyses were conducted to determine the effects of each alternative on terrestrial habitats and species. Method one used the acreages from the WDFW surveys; and the second method used the acreages provided by Reclamation and set forth in the DEIS. The impacts were compared to determine the alternative estimated to have the least impact and greatest benefit to each habitat type. The second impact analysis method to determine the magnitudes of the impacts of each alternative used the amount of habitat impacted by each alternative that was provided by Reclamation. The rankings from both methods were then compared to determine which alternative would have the least adverse impacts and greatest benefits to fish, wildlife, and their habitats.

Also subsequent to the draft CAR, Reclamation provided descriptions of Alternatives 4A and 4B. These two alternatives were analyzed using factors and figures assigned to the already analyzed alternatives, where applicable (see further discussion below).

6.1 Assumptions in the Effects Evaluation Methods

For the purpose of our analysis, we assume that certain changes to habitats due to future natural changes in the environment will occur equally under all of the alternatives. Natural processes, such as climate change will change conditions in the Project Area, as will responses to those changes, such as proposed water conservation measures. Natural processes, such as climate change, will occur and proceed independently of which alternative is implemented. Although changes to the natural environment and water supply are being considered in the proposed alternatives, these changes do not significantly affect the outcome of our analyses used to rank the alternatives. Possible water conservation measures and methods to achieve them were not specifically included as part of any of the proposed alternatives at the time of this report.

Due to the lack of specific information regarding the exact location of proposed facilities, existing habitat mapping, and construction methods for proposed facilities, the Service made some reasonable assumptions for the analysis. These assumptions were consistently applied, within each analysis, to evaluate project effects on wildlife resources:

- The proportions habitat types within the Project Area, as obtained by the WDFW surveys, were correct.
- The length of time required to restore shrub-steppe habitat is longer than 10 or 15 years and full restoration is uncertain to occur, based on numerous studies and authorities (Stinson 2004, pp. 41-43; Mike Gregg, USFWS, May 3, 2010, *pers. comm.)*.
- A permanent increase in depredation by avian predators will result from construction of new transmission lines and fences. The area of predation will extend up to 4.3 miles (6.9 kilometers) on each side of the transmission lines (Connelly *et al* 2004, p. 13-21).
- An unspecified amount of seepage will occur and may result in new or expanded wetlands and/or riparian areas along canals, pipes and pumps. Wetland and riparian habitat will be created equally within each alternative. The number, location, quality, and permanence of these new habitats cannot be determined at this time. It is expected that some level of benefit to wetland and riparian habitats will result with the action alternatives. Although these riparian areas are used by wildlife and add to the environment overall, there is no protection or management to protect or maintain these habitats and they are considered not to be permanent.
- Certain impacts would occur due to the effects of change in climate.

To assess Project impacts on aquatic habitats and aquatic species, we evaluated different life-stage parameters and habitat elements necessary for aquatic vertebrate, invertebrate, and plant species. We evaluated changes to water quality, habitat access, channel conditions and dynamics, habitat elements, flow and hydrology, and watershed condition parameters (USFWS 1999).

6.2 Assumptions Regarding Bull Trout, Steelhead and Chinook Salmon

Although, bull trout presence has not been confirmed in Crab Creek, migratory and resident populations of bull trout do occur above and below the project in the Columbia River. During the winter months, temperatures are cool enough for bull trout to use the reach and predate on small steelhead. Reclamation maintains temperature data for the lower Crab Creek. Although bull trout presence has not been confirmed, the instream habitat conditions of Crab Creek are conducive to seasonal use by bull trout. Also, migratory and resident populations of bull trout do occur above and below the project in the Columbia River. Using an upper growth-limit temperature of 15° C and Reclamation temperature data as shown in Appendix E (Gina Hoff 2007, *pers. comm*.), we assume bull trout move from the Columbia River mainstem, enter into, and forage (possibly on steelhead) in lower Crab Creek during the winter months.

The existing flow regime in Lower Crab Creek will not be affected by the Project during normal operations. Flow augmentation from groundwater seepage will be negligible. The water taken from the Columbia River as a result of this project is expected to be used and delivered to water users before it reaches Crab Creek, so the flow into Crab Creek from the wasteway and canals is not expected to change (Chuck Carnahan, Reclamation, 7/27/2011, *pers comm.)* FCRPS mandated flows will not be affected significantly by this Project; therefore, connectivity between Lower Crab Creek and the Columbia River will not be affected (Chuck Carnahan, Reclamation, 7/27/2011, *pers comm.).* In summary, the Service has determined that impacts to bull trout in lower Crab Creek are likely to be insignificant; therefore, effects to bull trout in the lower Crab Creek are not discussed further.

Numerous runs of adult salmon and steelhead migrate upstream through the lower and mid-Columbia River. We anticipate the greatest reduction in flows as a result of the proposed alternatives would occur in September and October. Similarly, spawning success of fall Chinook in the free-flowing Hanford Reach of the Columbia River, and for chum salmon that spawn below Bonneville Dam would likely experience a low level of impact from the proposed alternatives.

During the salmonid smolt downstream migration season from mid-April through August, flows as a result of the proposed alternatives would either not change or the changes would be small that no or non-measurable minimal impacts would be expected

6.3 The Effects of Climate Change

In order for the Service to analyze future climate impacts, we must first determine how far into the foreseeable future we feel we can make projections, with a reasonable degree of certainty. The climate in eastern Washington is arid, with an average of 7.4 inches of precipitation and 17.4 inches of annual snowfall at Ephrata, and 10.9 inches of precipitation and 16.3 inches of snowfall at Odessa (Washington State Climatologist, 2009). Figure 4 shows the predicted increase in mean global temperature for three diverse and equally likely scenarios. This predicted increase is a composite of numerous scenarios. These scenarios are labeled the A2 (high emissions), A1B (moderate emissions), and B1 (low emissions) models. The A2 scenario predicts a 3.4 ^{o}C increase in ambient temperature (with a projected range: 2.0 to 5.4 ^{o}C), the A1B predicts 2.8 ^{o}C increase (with a projected range of 1.7 to 4.4 ^{o}C) and the B1 predicts 1.8 ^{o}C increase (with a projected range of 1.1 to 2.9 ^{o}C) (IPCC 2007, p.13). In Figure 4, at about year 2050, these three projections quickly begin to diverge. Since economic and political impacts and responses are linked to climate change, become harder to predict, and confidence in the prediction decreases the further into the future they are made, the more divergent the scenarios become into the future (Hall and Behl 2006, p. 443). We believe the limits of our "foreseeable future" condition will occur between 2040 and 2060. We used year 2050 as an end point of our analysis and predict that, under the three climate change scenarios, no substantial difference in habitat, resource management, laws, and land-use will occur before year 2050. Therefore, using these projections, we feel that our effects analysis should remain valid until at least the year 2050. Also, the proposed action is likely to be implemented before this time, so climate conditions should not change dramatically.

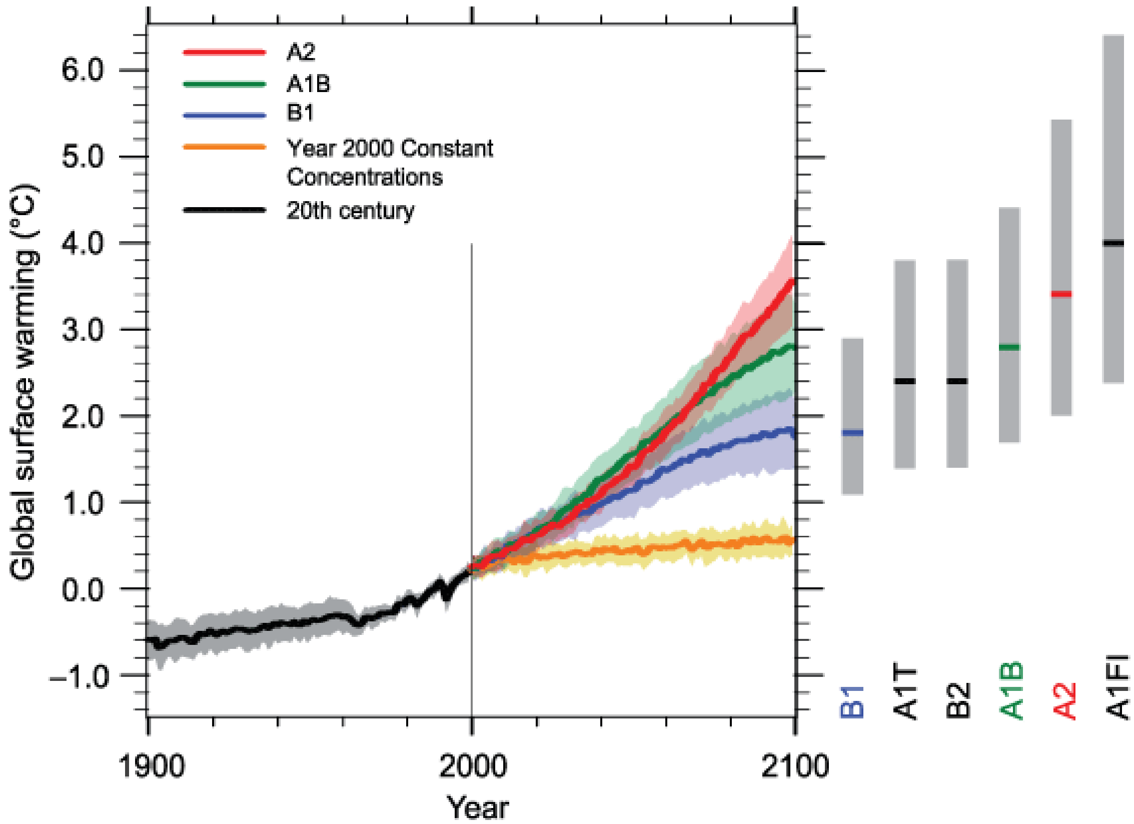

Figure 5. Predicted increases in mean global temperature under A2, A1B, and B1 scenarios (IPCC 2007, p. 12).

Based on climate trend projections by the Intergovernmental Panel on Climate Change (IPCC) (IPCC 2007, p.12) and the Climates Impact Group of the University of Washington (CICG) (CICG 2009, p. 198), in general, habitats and species will tend to migrate further north or higher in elevation in response to global climate change (Shafer *et al* 2001, p. 18; Chambers and Pellant 2008, p.30). However, migration may not result from heat stress, *per se* but will more likely occur through such mechanisms as competition between species with similar requirements or limitations resulting from unsuitable habitat (Shafer *et al* 2001, p. 18; Chambers and Pellant 2008, p.30). The concept that species will "migrate" through competitive exclusion over time is further borne out by the surveys conducted by WDFW which indicate no North-South variations in habitat suitability for the 14 species chosen to represent the assemblages of wildlife found in the Project Area (WDFW 2009a, Chapter 5, p.3).

For the Pacific Northwest, the amount and timing of rainfall is expected to increase, temperatures to increase, and droughts will be more frequent. Precipitation is projected to come more in the form of rain rather than snow which will result in decreased groundwater recharge and less spring moisture, due to more run off (CICG 2009, p.198). Projections for Lind show that, although annual rainfall will increase by 10 to 14 per cent by 2080, seasonal rainfall (spring and summer) will only increase by 10 to 12 percent while non-seasonal (fall and winter) rainfall will increase by 12 to 16 percent (CICG

2009, p. 198). Groundwater recharge is not expected to change in the Odessa Subaquifer. Forest and grass land cover is predicted to increase (Wooten 2003, p. 9) in the Columbia Basin in general; although few changes are expected to occur within the Project Area. A net decrease of shrub steppe habitat in the Project Area will likely result, as the boundaries of shrub steppe habitat shift northward (Shafer *et al* 2001, p. 18; Chambers and Pellant 2008, p.30), but these changes are not expected to occur within the next 40 years.

The changes described above present a broad picture of predicted effects of climate change. Their magnitude will also be dependent on actions taken in political, private, and economic arenas. These general predictions are expected to occur regardless of which alternative is implemented and are based on recent climate change predictions.

6.4 Assumptions Regarding the Impacts of Noise on Wildlife

Temporary impacts from noise will result from Project construction. Although noise levels may be the same for each alternative, impacts from noise will vary seasonally depending on the species and its seasonal life history needs. Avoidance has less impact on a species than noise during nesting, which would be likely to occur during the breeding season. Seasonal operating restrictions could be put in place to protect animals during critical life history events, such as nesting and breeding.

Noise will result from operation and maintenance of the Project, as well. These impacts can interfere with vital behavior (i.e. breeding) in mammals and birds. Some species will adjust their behavior to constant noise and others will be effectively excluded from an area due to noise in it. Negative effects from noise are less likely to occur in invertebrates, reptiles, and amphibians, but may still result in damage through altering vital behavior (Federal Highway Administration 2004, p. 8).

Noise has been proven to have a disruptive effect on many types of animal life (Federal Highway Administration 2004, p. 10). Effects vary from creating higher levels of stress, to permanent hearing damage and loss, to increased predation, and reduced vigor and fitness (Federal Highway Administration 2004, p. 10). As strength of the sound increases, so does the level of hearing damage (New York 2000, p. 15). Hearing damage can occur instantaneously with very load sounds and load sounds elicit changes in animal behavior (i.e. movement away from the sound, bolting for cover, etc.). In general, adverse effects to wildlife can be expected if Project noise is greater than 10 to 15 decibels Base A [dB(A)] above background noise. (EPA 1978, p. 17) Ambient, or background, noise in farmland is usually somewhere near 45 dB(A), whereas ambient wilderness noise can be expected to be about 35 dB(A). Windier areas, such as the Wyoming shrub-steppe, have a base level of approximately 39 dB(A) (K.C. Harvey 2009, p.1). Sage-grouse are very sensitive to noise. Specifically, noise levels of 10 dB(A) above ambient have been shown to negatively affect sage-grouse by altering vital behavior in Wyoming (K.C. Harvey 2009, p.1). Indeed, the 10 dB(A) over ambient noise level threshold is widely used to determine disturbance and non-disturbance to sage-grouse (Freudenthal 2008 pg. 1).

Sound levels attenuate, or diminish, at a set rate. In general, sound attenuates at a rate of 6 dB(A) for every doubling of the distance after the first 50 feet (~15 meters) (New York 2000, p. 8). Table 4 shows noise levels for some common machinery used in construction and Table 5 shows the expected level of noise generated by common construction machinery at various distances. Therefore, it is prudent to assume that adverse impacts will occur at a distance of 800 feet or less from the center-line of the right-of-way, which creates a 1600-foot wide buffer. The buffer width needed to protect sage-grouse from noise disturbance is significantly greater than the 600-foot wide buffer areas used in the Project description.

Table 4. Noise levels of common construction machinery (New York 2000, p. 15)

Situation	Noise Level
Farmland (Ambient)	45 dB(A)
Wilderness (Ambient)	35 dB(A)
Backhoe	83-86 dB(A)
Bulldozer	80 dB(A)
Grader	85 dB(A)
Rock drill	98 dB(A)

Table 5. Noise attenuation over distance for common construction equipment (New York 2000, p. 15)

dB(A) at Different Distances From The Source								
Source	0 ft	100 ft	200 ft	400 ft	800 ft	1600 ft	3200 ft	6400 ft
Backhoe	86	80	74	68	62	56	50	44
Bulldozer	80	74	68	62	56	50	44	38
Grader	85	79	73	67	61	55	49	43
Rock drill	98	93	87	81	75	69	63	57

Since most construction work will take place within the 600-foot easement that exists along the canal right-of-ways, temporary noise impacts will occur over an additional 500 feet or more. Due to the uncertainties present in the Project description, actual acreages of impact areas will need to be reassessed by actual construction location and method, as well as the habitat types present during construction, to further evaluate environmental compliance needs and amelioration.

Using the above assumptions, a series of calculations were done to estimate the area affected by sound within the Project footprint. These acreages, together with temporary impacts from construction, and temporary impacts from construction noise were identified as negative impacts for each alternative. The amount of area affected by noise was used to evaluate potential habitat impacts resulting from implementing each alternative; estimates of noise impacts are likely conservative. Requirements to reduce effects to wildlife from noise will need to be revised, when exact locations of Project infrastructure are known. Timing restrictions and BMPs can reduce the impacts likely to result from construction and operations activities but some level of avoidance behavior can be expected to result.

6.5 Analytical Method One: HEP Impact Analysis Using Acres Derived From WDFW Surveys

Our analytical design used Habitat Suitability Indices (HSI) for selected species to calculate a numerical value that represented the relative benefit or impact of implementing each alternative on that species and its habitat within the Project Area. Index variables include, but are not limited to, foraging areas, migration areas, amount of escape cover, nesting cover, and others. These variables were assessed to develop a ranking factor for each, ranging from 0.0 to 1.0, with 1.0 being of highest benefit to the species. Action alternatives that yielded the most habitat variables with a value of 1 meant that action alternative is best for providing or maintaining that habitat variable.

The species used in the HEP (Habitat Evaluation Process) analysis were decided by a team of biologists from WDFW and the Service (Table 6).

Table 6. Species with HSIs Used in the FY2008 HEP Analysis

Species	Habitat
Red-winged blackbird (*Agelaius phoeniceus)*	Wetland >0.25 ac (0.10 ha)
Muskrat (*Ondatra zibethicus)*	Wetland
Brewer's sparrow (*Spizella breweri)*	Shrub-steppe > 0.5 ac (0.20) ha
Ferruginous Hawk (*Buteo regalis)*	Shrub-steppe, grassland
California Quail (*Callipepla californica*)	Multiple
Mule deer (*Odocoileus hemionus*)	Shrub-steppe
Meadowlark (*Sturnella neglecta)*	Multiple
Black-capped chickadee (*Poecile atricapillus*)	Riparian
Pheasant (*Phasianus colchicus*)	Agriculture
Song sparrow (*Melospiza melodia)*	Mixed shrub
Columbia spotted frog (*Rana luteiventris*)	Wetland
Yellow Warbler (*Dendroica petechia)*	Riparian > 0.37 ac (0.15 ha)
Gray partridge (*Perdix perdix)*	Grassland > 1.0 ac (4.0 ha)

The HEP Analysis consisted of using established Habitat Suitability Indices (HSI) for selected species that represent general groups of species that utilize habitats found in the Project Area and they have the same or similar requirements. The HSI is a model for determining the value of existing habitat by comparing it with an idealized habitat and contains a suite of environmental parameters needed by each species to successfully live and reproduce. For example, the parameters for a species might include foraging areas, migration areas, amount of escape cover, and amount of nesting cover. Values, such as acres or percent cover, for these environmental parameters are assessed for each species to determine a ranking factor for each area that indicates the relative impact each action has on the species. The HSI values range from 0.0 (no value) to 1.0 (most benefit to the species). WDFW, in the survey report, categorized habitat as poor, marginal, fair, good, or optimum (WDFW 2009a, pp. 31-32). For example, the HSI for the Brewer's sparrow is based on the equation $[(V_1 \text{ x } V_2) (V_3 \text{ x } V_5 \text{ x } V_6)^{1/3} \text{ x } V_4]^{1/2}$, where V_1 is the size of the habitat block, V_2 is the terrain characteristics of the habitat block, V_3 is the composition of the substrate, V_4 are the species of shrubs present, V_5 is present cover, and V_6 is the average height of the shrub cover. Instructions for quantifying variables are contained in the model designed by the Service (Short 1984, pp. 9-12). Habitat variables and equations are not the same for each species. For example, the equation for computing the HSI for the yellow warbler is $(V_1 \text{ x } V_2 \text{ x } V_3)^{1/2}$, where V1 is percent cover, V_2 is average height, and V_3 is percent cover of hydrophytic species (Shroeder 1982, p. 6).

6.6 Analytical Method Two: Areal Analysis using Reclamation's Habitat Figures

A second method of analyzing the project's effects to habitat was done, using preliminary acreages of habitat types provided by Reclamation. However, Reclamation's estimates do not include habitat impacts that extend beyond project component boundaries or have potentially long or short term effects. In order to correctly assess and compare habitat impacts, we considered the following:

- Shrub-steppe and attendant grasslands are priority habitats for both the Service and WDFW. The U.S. Forest Service and Bureau of Land Management also determined that shrub-steppe was of the highest priority for preservation and necessary for preservation of Neotropical migrant birds (Saab and Rich, 1997 p. 16).
- The predicted acreages do not include "…those from substations, transmission lines and pump stations because their location is not known at this time." (Reclamation 2010, p 4-60) The Service and WDFW expect an increase of impacts in the Project Area.
- Destruction of the soil (biotic or cryptogrammic) crust in undisturbed shrub steppe areas will result in long-term degradation of shrub steppe habitat, and may equate to long term destruction of the unique combination of soil and vegetation characteristics of the site (Stinson 2004, pp. 41-43). Therefore long term (greater than 20 year) impacts to soil and vegetation components can occur, if construction activities occur in undisturbed shrub steppe areas.
- Short term impacts may be considered a long term or permanent impact if shrub steppe restoration efforts fail, due to "issues related to weeds, the (in) ability to restore high quality shrub-steppe communities, and the long times required to mitigate the losses" (Reclamation 2010, p. 4-60), McClendon and Rodente (1990, pp. 298-299) and Samuel and Hart (1994, pp. 183 & 190) report on the potentially long length of time required to achieve full restoration. Samuel and Hart (1994, p. 190) found that after 61 years, full restoration and complete ecological function

had not been accomplished. Reclamation (2010, p.4-60) states that it is likely that complete restoration of shrub-steppe habitat may not be accomplished. However, enhancement of current conditions may be done.

- Construction noise will likely interfere with vital behavior (i.e. breeding) in mammals and birds. These impacts will extend beyond the Project footprint by several hundred yards (see previous analysis). We expect this will substantially increase the impacted area. Noise resulting from operations and maintenance will continue after construction is completed.
- Predation by raptors may occur up to 4.3 miles (6.9 km) from power and fence lines planned for the Project. Access roads will facilitate predation by terrestrial predators.

Based on the above assumptions, the Service has determined that the area of impacts will be greater than that reported by Reclamation in the EIS. WDFW (2009a, Tables 2-8 and 2-9) reports that the Project Area footprint contains 6,260 acres of shrub-steppe habitat (in Alternatives 3A& 3B); of which 200 acres are contained within the area covered by the Project footprint of the partial replacement alternatives (2A& 2B). Grassland covers approximately 4,940 acres (in Alternatives 3A& 3B) and the partial replacement alternatives Project footprint (2A& 2B) contains 1450 acres. Agricultural land totals 4,523 acres (in Alternatives 3A&3B) with 390 acres being contained within the area planned for the partial replacement alternatives (Alternatives 2A& 2B). Additional areas of impact may occur in Black Rock Coulee and possibly the Black Rock flood easement. The above figures are not absolute but will likely change when Project infrastructure and locations are determined for Reclamation's Alternatives 4A and 4B. When temporary and off-site impacts (i.e. increased avian predation) are considered, the actual area of disturbance will be significantly larger than reported, but will still be a small percentage of the total amount of habitat that remains. Also, many of the impacts described by Reclamation as temporary are considered by the Service to be long term in nature (i.e. restoration of construction areas created while building a new reservoir or canal), because these impacts will be of such duration (>10 years) as to consider them long-term.

6.7 Summary of Impact Analyses and Comparison of Impacts of the Alternatives

The two methods of impact analysis yielded two sets of results for comparing impacts from the Project: one used acreages of habitat impacts as reported by WDFW resulting from their HEP surveys and the second used Reclamation's acreage descriptions of the Project impacts. Using these two analyses to assess impacts of the proposed alternatives on terrestrial habitats, the Service estimated impact of each alternative using Reclamations' habitat acreage estimates. Total effects of the proposed alternatives were assessed by combining the terrestrial habitat impacts analysis (considering both methods) and the analysis of impacts to aquatic habitats components.

7.0 THE ALTERNATIVES' EFFECTS ON FISH AND WILDLIFE RESOURCES

In this section, we examine the impacts that will occur if the No Action Alternative is implemented, followed by the impacts of the two Partial Replacement Alternatives (2A and 2B), the Full Replacement Alternatives (3A and 3B) and, finally, the two Modified Partial Replacement Alternatives (4A and 4B).

7.1 EFFECTS OF THE NO ACTION ALTERNATIVE

Effects of the No Action Alterative on fish and wildlife resources of concern are discussed in this section. The No-Action Alternative includes implementation of water conservation measures and water acquisitions authorized under Section 1203 of Title XII of the Act of October 31, 1994 that may occur in the future. However, future impacts of water conservation measures implemented by Reclamation cannot be estimated at this time and, therefore, are not factored into our analysis.

Aquatic Resources

The following are the expected impacts and changes if the no action alternative is implemented:

Effects to Water Quality and Quantity

Changes in water temperature and turbidity, as well as their associated effects to biotic and abiotic components of the lakes are anticipated to continue in a negative manner in Billy Clapp Lake and Banks Lake as part of the No Action Alternative. WDFW's study of Banks Lake primary productivity, fish bioenergetics, and fish entrainment revealed that water temperatures in this lake can be stressful for fish; however, turbidity data demonstrated limited dynamic variability

Current manipulation of water quantity in the CBP is likely to result in impacts to local fish communities in the bodies of water within the Project. Fisheries within Banks and Billy Clapp Lakes will likely continue to decline at a rate similar to that of recent years. The current hydrograph and water operations of these water bodies limit the establishment of a stable fishery. Water elevations at water bodies such as Banks Lake fluctuate quickly with the onset and termination of irrigation flows. Typical water operations on Banks Lake include a 5-foot drawdown in August with refill occurring usually by late September. These fluctuations in water levels can have negative effects on aquatic communities by reducing habitat availability, stranding benthic organisms, decreasing water retention times which increase entrainment, and congregate predators with their prey (Ploskey, 1986). It is our understanding that water quality data, along with primary and secondary bio-production data, do not exist for Billy Clapp Lake. However, high volumes of water entering the lake from Banks Lake most likely transport nutrients and plankton that are susceptible to water flow. Billy Clap Lake is operated as an equalizing reservoir whose primary purpose is water storage related, not fisheries related. The low relative abundance of walleye in Billy Clapp Lake is most likely indicative of low natural production and high water clarity, which are sub-optimal for walleye forage success. Water originating from Billy Clapp Lake through Pinto Dam likely experiences less negative effects from total dissolved gas due to the installation of an energy dissipater within the stilling basin of this dam, which reduces the level of dissolved gases.

Effects to Fish Habitat Access

In general, it is reasonable to assume that water supplies will decline due to predicted effects of climate change and an increase in seasonal water demand due to longer summer droughts; therefore, resulting in a slight reduction of both aquatic habitat and habitat access due to reservoir draw-downs under this alternative. Entrainment rates such as those discussed in scientific studies will likely continue with the No Action Alternative (Polacek 2011). Tributary access by fish species for spawning and rearing purposes will also continue to be influenced in a negative manner by fluctuating water levels under the No Action Alternative.

Effects to Habitat Structural Elements

The No Action Alternative would continue to impact habitat in a negative manner for resident fish from hydrographic variation and the impoundment of water by the CBP. Currently, the CBP offers minimal aquatic habitat diversity for fish resources through the use of irrigation canals and associated structures. Although existing fish resources in existing impoundments such as Banks Lake provide recreational benefits, these same resources are influenced in a negative manner by current water practices which focus on meeting irrigation needs rather than the stability of aquatic habitats. The overall effect of the No Action Alternative on resident fish and bull trout habitat will continue and effort should be made to maintain and improve degraded habitat elements in the CBP, such as fragmented riparian zones, intermittent off-channel habitat, and thermal refugia for fish resources where applicable.

Effects to Channel Condition and Dynamics

Effects to the channel condition and dynamics of Crab Creek are likely to continue with the implementation of the No Action Alternative. The overall effect of the alternative is likely to maintain degraded channel conditions and dynamics in Crab Creek.

Effects to Flow/Hydrology

*E*ffects to the flow/hydrology habitat indicator will continue to be most pronounced in the Crab Creek drainage through the implementation of the No Action Alternative. Hydrographic variation has resulted in a moderation of the amplitude of hydrographic change. Further dependence on sub-surface water would also reduce both surface and sub-surface flows and further alter hydrologic regimes.

Effects to Watershed Conditions

Although it is anticipated that overall watershed conditions will not change dramatically in Banks Lake, Billy Clapp Lake, Potholes Reservoir, and Crab Creek, watershed conditions will likely continue to deteriorate slowly with respect to water quality in the near-shore riparian zones associated with these larger water bodies. We therefore conclude that the implementation of the No Action Alternative will continue to result in negative impacts to this indicator.

Terrestrial Resources

In general, habitat conditions can be expected to continue to deteriorate further accelerated by climate change, population growth and increases in farmed area as farmers increase area to compensate for diminishing farm returns. The following conditions are expected to result if no action alternative is implemented:

Effects to Riparian and Riparian-mixed Habitat

It is likely that the agricultural use of lands in the Project Area will increase and the presence of mesic shrub habitats along riparian areas will likely diminish, based on land use trends for the basin (USDA 2003, Table 1; Rural Policy Research Institute 2006, p. 2, 10, & 12)

Effects to Shrub-steppe Habitat

Climate change, without implementation of any alternative described herein will continue to negatively impact shrub-steppe habitats in the Project Area. This will happen through two general mechanisms: changes in plant communities and changes in the soil communities. Agricultural land use increase is most likely to continue to occur in the form of dry-land farming and will likely include a shift in the composition and timing of crops as water becomes more or less available. Regardless, a negative impact to wildlife will result.

Effects to Grassland Habitat

It is likely that the agricultural use of lands in the Project Area will continue to increase and the presence of grasslands will diminish, as some of these areas are converted to agricultural areas or transition into shrub lands. Grassland habitat is expected to increase as shrub-steppe habitat decreases due to climate change. This increase will be facilitated by an increase in invasive species such as cheat grass, which are better adapted to predicted drier conditions (Chambers and Pellant 2008, pp. 30-31). Increase in urban area will also cause a decrease in total grassland area as northwestern populations continue to increase.

Effects to Wetland Habitat

In light of changes predicted to occur from global climate change, the agricultural use of lands in the Project Area will increase and the presence of emergent wetland will likely diminish. Longer droughts in the summer months and less snowpack will impact the Odessa area by providing less water reserves in the rivers and streams and in the aquifer. If the Project is not implemented, the existing Odessa wetlands habitat will receive less water runoff.

Effects to Federally Listed Species and Species of Concern

As noted above, operations and flow regimes in the Odessa Subarea would be maintained without the implementation of any of the alternatives, so bull trout habitat will not be significantly affected by not implementing the Project. Conditions will continue to degrade in parts of the Odessa Subarea for sage grouse and other shrub-steppe obligate species. Further loss or degradation of important habitats, such as shrub steppe, will continue to impact sensitive species. Diminished groundwater will negatively impact aquatic and amphibian species, as surface water dries up in low-lying areas. Summer drought conditions, along with increased runoff will further exasperate these conditions. Concrete-like conditions resulting from runoff and drought will reduce burrowing opportunities such for species such as Washington ground squirrel and the pygmy rabbit. These effects will be felt at all trophic levels, as prey bases diminish, culminating in impacts to raptors and top predators. Longer summer drought may not affect the more xeric plant species, especially as disease and insect predators will likely decrease, while, conversely, more mesic species will be unduly impacted.

7.2 EFFECTS OF THE ACTION ALTERNATIVES ON FISH AND WILDLIFE

Without more specific information regarding infrastructure location, timing of construction and other variables, the type and magnitude of action alternative's impacts on fish, wildlife and their habitats cannot be fully assessed at this time. However, we have concluded that aquatic impacts will largely be the same between the alternatives but the magnitude of effects vary, depending on the water source. Terrestrial impacts will be larger and more severe under the full groundwater replacement alternative, since the project footprint is larger, more pristine habitats are impacted, and more construction with temporary habitat disturbances are necessary.

Effects of the Partial Replacement Alternatives (Alternatives 2A & 2B)

Under these alternatives, water from Lake Roosevelt and the Banks Lake Reservoir will be utilized to convey water through the existing East Low Canal and its proposed extension for the purpose of providing surface water to the Project Area south of I-90. The Lake Roosevelt Drawdown proposes diverting more water from behind the Grand Coulee Dam for agricultural, municipal, industrial, and instream uses. All water supplied by these projects will come from Columbia River water stored behind Grand Coulee Dam. Further drawdown of water from Lake Roosevelt is contemplated in some of the proposed actions.

Impacts to resident fish resulting from water releases at Lake Roosevelt and Banks Lake are discussed below in the Aquatic Habitats section. None of the partial replacement alternatives will produce significant impacts to mainstem Columbia River flows (Olson *et al*. 2010). The same habitat parameters were used as in the analysis of the No Action Alternative, including water quality and quantity, habitat access, habitat elements, channel condition and dynamics, flow/hydrology, and watershed conditions, to assess these alternatives:

> 2A: Partial replacement of ground water use with water from Banks Lake. Water delivery options include an expanded East Low Canal (ELC) with a 2.5-mile extension together with an additional drawdown of Banks Lake (up to 9.8 feet);
>
> 2B: Partial replacement of ground water use with water from Banks Lake and Lake Roosevelt. Water delivery options include an expanded ELC with a 2.5-mile extension together with an additional drawdown of Banks Lake and use of additional water from Lake Roosevelt;

Aquatic Habitats

Effects to Water Quality and Quantity

Lake Roosevelt is contaminated with trace elements that were discharged as a result of mining, smelting, pulp mill effluents and other industrial processes occurring upstream within the watershed. Numerous studies conducted over several decades have documented contamination in Lake Roosevelt sediments, surface water and biota (Serdar, *et al.* 1993, p.1; Majewski, *et al.* 2003, p. 1; WDOH, 2010, p. 9). A potential effect of the action alternatives on water quality is an increase in contaminated water released from Lake Roosevelt into Banks Lake, and Billy Clapp Lake. These contaminants may be suspended in the water or lie in sediments within Lake Roosevelt that are flushed back into the system when water is released. Data related to trace metals and organic contaminants in the water column, either in dissolved or suspended particulate form, are limited; therefore, it is uncertain to what degree contaminants would be distributed to downstream areas. However, conveyance of contaminated water to downstream areas is considered a resulting effect of the action alternatives, unless it can be demonstrated that contaminant concentrations are below levels of ecological concern. One could argue that the water being pumped into Banks Lake from the Columbia River at Lake Roosevelt does not contain a high level of contaminants since the intakes at Lake Roosevelt are located at a significant height in the water column which would prevent mobilization of existing contaminants in this body of water. The Service is unaware of substantial information to support this conclusion. Therefore, the Service concludes that conveyance of contaminants in the CBP may be a resource issue concern related to the implementation of the partial replacement alternatives. An assessment of water quality, bottom sediment, and biota explains how the CBP, in general, does not have an adverse effect on biota; however, irrigation drainage from the CBP does contribute to elevated levels of harmful trace elements which may affect aquatic vegetation and associated wildlife species that feed upon this aquatic vegetation (Embrey and Blok 1995, pp. 70-73). Conveyance of other contaminants such as pesticides has also been demonstrated to occur throughout the CBP (Wagner *et al.* 2006, p. 1). We would expect an increase in the conveyance of contaminants through the implementation of the alternatives.

Other water quality effects will include temperature increases beyond existing levels due to the continued impoundment of water in reservoirs and water velocity increased; increased sediment suspension in the water due to fluctuating river levels and bank erosion (which is also related to higher temperatures); and the increased occurrence of gas supersaturation due to spillway operations at the associated reservoirs. Water quality effects associated with temperature will also include those described under water quality and quantity for the No Action Alternative, in addition to any minor effects resulting from global climate change. The overall effect of the proposed actions is likely to maintain or further degrade water quality in water bodies associated with the CBP.

Contaminants appear to have an association with detrimental direct and indirect effects on bull trout (Cuffney *et al.* 1997, p.1). Lethal impacts may occur from accidental spills of contaminants during construction and facility maintenance activities associated with the action alternatives; whereas sub lethal impacts may occur from agriculture, residential/urban, and grazing. Reductions in aquatic invertebrate numbers and aquatic community structure were documented in the upper as well as the lower Columbia Basin ecoregion due to water quality issues related to contaminants (Cuffney *et al*. 1997, p.1). Specifically, both the presence of stoneflies, mayflies and caddis flies and total species richness were lower in the mainstem Yakima River, below the storage dams, largely as the result of water contamination, especially heavy metals (Cuffney *et al.* 1997, p.1).

Water temperature in Middle Crab Creek, is expected to improve with the implementation of this alternative as the operation of the CBP results in return flow to this reach of the creek. Currently, the operation of the CBP does not result in return flow to the CBP below the areas south of Moses Lake, specifically Lower Crab Creek.

Based on the Project description for partial replacement, alternative 2B would impact water quality the greatest by increasing the distribution of contaminants within the Columbia Basin. Even though the fluctuations of water levels within existing reservoirs and the Columbia River would likely result in increased erosion in some instances, water temperature in the Columbia River is likely to be sustained in its current condition based upon these proposed alternatives. It is also our understanding that Banks Lake would experience changes in the frequency and magnitude of elevation changes through the implementation of all six action alternatives as compared to Lake Roosevelt. At this time, based on the proposed project description it is not clear how the proposed Black Rock Coulee Reservoir (a totally new reservoir) would serve to re-regulate additional flows for these alternatives. The depth in which water is drafted from these bodies of water may affect water quality and quantity in outflow streams. For example, water from Banks Lake is drafted within the top 20 feet of the reservoir whereas Billy Clapp Lake water is drafted solely from the bottom section of this reservoir resulting in different water temperature regimes downstream. Water in Billy Clapp Lake has a low residence time and water drafted from Billy Clapp Lake will likely be cooler than water drafted from Banks Lake. Therefore, when these effects to resident fish are considered collectively, it is likely that current degraded water temperature conditions in the CBP will continue with any of the partial replacement action alternatives. A comparison of the impacts is shown in section 9.1.6 and Table 7, therein.

Effects to Fish Habitat Access

Habitat access is the ability for fish to freely move between areas of suitable habitat, whether it is for foraging, migration, spawning, rearing, or other necessary life-functions. Dry Falls and Pinto Dams currently have outlet works that cause fish to be entrained downstream. We understand that these dams and associated outlet works have general trash racks intended to capture debris that allow entrainment of resident fish. For example, the Banks Lake outlet structure is comprised of a 4-inch bar screen and barrier net, and the associated hydropower bypass valve has no screening mechanism. We anticipate that fish will continue to be entrained in water moving from Lake Roosevelt, Banks Lake, and Billy Clapp Lake, to its destined use. Currently, fish entrainment at Lake Roosevelt has affected the harvest of kokanee and rainbow trout in the reservoir (Olson *et al*. 2010, p. 19). Entrainment of fish at Banks Lake (Dry Falls Dam) has been shown to be a significant resource concern (Olson *et al.* 2010, p. 35; Polacek 2010,

p. 28). Entrainment rates at Banks Lake will likely continue at a higher level with the action alternatives; since, significant water withdrawals from Lake Roosevelt (i.e., action alternative 2B) will result in more water distributed through Banks Lake and surrounding water conveyance structures. Entrained fish do not necessarily represent a complete loss of those individuals due to mortality; however, these respective fish would not be able to migrate back upstream to desired instream habitats and may experience injury/mortality by passing through the structures and devices associated with downstream passage or entrainment through hydroelectric projects. As such, we anticipate that entrainment levels will continue to occur at moderate levels through the proposed implementation of the remaining alternatives. Primary effects to resident fish that are entrained will likely include effects associated with changes in pressure differentials within the water column and injury/mortality when fish come in contact with structures associated with hydropower facilities (i.e., Banks Lake). The Service is also aware that factors such as density, life stage, species composition and age, and swimming ability of fish species present contribute to the discussion of injury/mortality resulting from entrainment.

Entrainment effects may not be limited solely to resident fish, but may include fish forage resources as well. For example, entrainment of zooplankton from Banks Lake into the system may affect the survivability of the fish populations in this lake, since the forage base for fish in Banks Lake is being continually reduced while canals are being fed water (Polacek 2010, p. 1). Daphnia and copepods are the primary food source for kokanee and other planktivores in Banks Lake. Alternative 2B would have the highest risk to these forage resources.

Access to spawning and rearing habitats within close proximity to the shorelines of these bodies of water will also decrease significantly due changes in the frequency and duration of water fluctuations. Effects to spawning and rearing habitats are explained in more detail in the habitat elements discussion below.

In addition, existing smaller-scaled water control structures and natural barriers to fish movement located in the Project Area have not been subjected to altered flow regimes as anticipated by the action alternatives. Subjecting these artificial and natural barriers to altered flow regimes may contribute to the immigration and emigration of fish species into undesirable habitats thereby affecting fish community structure. The scope and nature of these proposed flow modifications amongst water bodies in the CBP are not well understood at this time. The scope and nature of these proposed flow modifications are not well understood at this time, since Reclamation has not established designated flow regimes for each of the alternatives. However, significant drawdowns such as those proposed at Lake Roosevelt and/or Banks Lake will likely translate into effects to the local resident fish community within the Project. These impacts include access to tributaries by fish species for spawning and rearing purposes.

Effects on the habitat access indicator may not be limited solely to the aforementioned bodies of water. One could surmise that the further withdrawal of water from the mid-Columbia River would detract from the safe, timely, and effective upstream and downstream passage of fish species inherent to this aquatic ecosystem (USFWS 2002).

An analysis of fisheries and aquatic resources potentially affected by the alternatives concludes that this type of further water withdrawal from the mid-Columbia River to the Banks Lake Reservoir would have minimal effect on these resources; however, these effects should not be discounted. The alternatives would result in a small reduction of discharge in the Columbia River on an annual basis and would slightly alter the seasonal flow regime as well (Olson *et al.* 2010, p. 1). This analysis further concludes that the alternatives would have no adverse effects on the downstream survival of spring-migrant salmonid smolts in addition to the upstream migration of salmon and steelhead (Olson *et al*. 2010, p. 59). A comparison of the impacts is shown in section 9.1.6 and Table 7, therein.

Effects to Habitat Structural Elements

Implementation of the partial replacement action alternatives is likely to increase the effects to structural elements of streams, rivers and reservoirs associated with current reservoir operations. Water level fluctuations currently experienced at reservoirs, such as Banks Lake, likely affects spawning and rearing conditions for fish species in these reservoirs. The additive loss of littoral habitats in Banks Lake due to the implementation of the alternatives will likely reduce the low abundance of fish species in Banks Lake. Significant lake drawdowns such as those proposed in the alternatives can alter the structure and dynamics of aquatic macrophyte communities through several avenues, including changes in distribution, density, and species composition of these communities due to desiccation from water level reductions, wave damage, and alteration of substrate conditions.

These habitat elements were evaluated and are currently negatively impacted by hydrographic variation and impoundment of water bodies associated throughout the CBP, including:

- Increased levels of sediment from fluctuating water levels and bank erosion have increased substrate embeddedness from historical levels in rivers (i.e., Middle Crab Creek) and reservoirs affected by the Project;
- Pool frequency and quality in riparian areas created by the CBP, especially primary pools that have been flooded by the CBP, experience variation from the normal and historic flow regimes and are maintained by hydrologic variation caused by CBP operations;
- Off-channel habitat in riparian areas created by the CBP, has reduced in quality from historical levels and fish have less access to off-channel habitat due to fluctuating river levels and overall channel simplification; and,
- Refugia within riparian areas created by the CBP and associated reservoirs have likely been eliminated in most cases; although, the Columbia River and Crab Creek may have thermal refugia created from cold water sources (e.g., very deep pools, upwelling, large groundwater influences).

Alternative 2B is anticipated to have the most significant impacts on spawning and rearing habitats for resident fish in Lake Roosevelt because it results in the most significant changes in water elevation. Although the habitat access effects will be smaller in scope and magnitude, all of the action alternatives will affect spawning and rearing habitats for resident fish within Banks Lake. The overall effect of all the partial replacement action alternatives is to likely continue to and may increase degraded aquatic habitat elements within the CBP. A comparison of these impacts is shown in section 9.1.6 and Table 7.

Effects to Channel Condition and Dynamics

Currently, hydrographic variation has resulted in an overall change in wetted width/maximum depth ratio, increasing this ratio and overall water depth (i.e., Crab Creek). While increased water depth is generally beneficial to the bull trout and other resident fish, in this case it is also accompanied with slower water, warmer temperatures, simplified habitat conditions, and other habitat degradation. However, return water from the CBP that seeps into Crab Creek would likely minimize some of these effects. Stream bank condition and near-shore reservoir habitats would also be impacted, primarily by the fluctuations in pool/river levels for bodies of water associated with the Project. Effects can stem from direct bank erosion to indirect impacts to the condition and extent of riparian vegetation, which if degraded, can lead to additional stream bank and near-shore instability. The Service is cognizant that the partial alternatives may provide some level of benefit to bull trout and resident fish species by providing additional flows and improving certain aspects of instream ecology; however, floodplain connectivity is also impacted by hydrographic variation, reducing hydrologic connectivity between off-channel habitat, wetlands, and riparian areas. In addition, the extent of wetlands has likely been reduced and riparian vegetation and succession have been altered significantly. The overall effect of any of the partial replacement alternatives is not likely to improve degraded channel conditions and dynamics in a significant manner in water bodies associated with the CBP such as Middle Crab Creek.

Alternative 2B will likely demonstrate the highest level of channel condition and water level impacts in aquatic areas created by the CBP as this alternative entails the most significant water withdrawals from Lake Roosevelt. Water withdrawals from Lake Roosevelt under these alternatives would be distributed to Banks Lake for further distribution in the CBP. It is anticipated that alternative 2A, will have moderate (M) to high (H) impacts on the channel condition and habitat dynamics; since, water withdrawals from Lake Roosevelt and Banks Lake are lower in magnitude under that alternative. A comparison of the impacts is shown in section 9.1.6 and Table 7, therein.

Effects to Flow/Hydrology

Under existing CBP operations, hydrographic variation results in lower proportional change in peak flows and higher base flows from water impoundment in existing reservoirs. As a result of any of the partial replacement alternatives, a highly modified hydrograph with altered peak and base flows, and fluctuating reservoir levels will result in moderate impacts in Lake Roosevelt, Banks Lake, and Billy Clapp. These flow alterations are in addition to those anticipated as a result of the No Action Alternative and the anticipated effects of global climate change. Flow alterations will impair a number of natural ecosystem processes, including accumulation and deposition of sediment and large woody debris. Since details of flow alterations resulting from reservoir operations and instream flow releases is not yet well-defined under the proposed alternatives, it is our assumption that the effects discussed above will continue in the near future or increase.

Alternative 2B entails the most significant water withdrawals from Lake Roosevelt. The effects of this alternative will have the highest level of negative impact on the hydrology of aquatic areas created by the CBP. Water withdrawn from Lake Roosevelt under these alternatives would then be pumped to Banks Lake for further distribution. The effects to the hydrology of Lake Roosevelt are not as significant as the effects of the drawdown of Banks Lake, which occurs in all eight action alternatives. A moderate (M) to high (H) level of hydrologic impact to Banks Lake is expected to result. A comparison of the impacts is shown in section 9.1.6 and Table 7, therein.

Effects to Watershed Conditions

Even though the CBP has created many aquatic ecosystem features for some species of resident fish, the resulting hydrographic variation has resulted in substantial effects to the watershed conditions within the CBP. The overall effect of the partial replacement action alternatives is likely to further degrade watershed conditions in the CBP. The action area has been altered by substantial changes to the hydrograph due to irrigation demands and hydropower generation, degraded riparian areas, and agricultural development. This lead to the impairment of a number of ecosystem processes that support fish habitats. In addition, the natural disturbance regime for floods and fires has departed substantially from its historic properly functioning interval and effects. Therefore, the overall watershed condition is currently characterized as being of poor quality, with little resiliency, and limited (L) ability to provide habitat for salmon and trout in the long term.

Implementation of any partial replacement action alternative is likely to contribute towards currently degraded watershed conditions in the CBP. Significant drawdowns at Lake Roosevelt, such as those contemplated in action alternative 2B will likely produce a high level (3) of negative impact on the ecological function of the watershed within the Project Area.

Terrestrial Resources

The majority of the impacts to terrestrial habitats from the various partial replacement scenarios are anticipated to be very similar. In general, the Conservation Measures and Best Management Practices will reduce the adverse effects of the partial replacement alternatives to a minimum. The primary differences in effects of the partial replacement alternatives will largely depend on the water supply option chosen, which will heavily influence the magnitude and type of aquatic impacts that will result. Generally, terrestrial impacts of the partial replacement alternatives are described in this section.

Effects to Riparian and Riparian-Mix Habitat

The WDFW HEP analysis (WDFW 2009a, p. 28) indicates that a habitat loss equivalent to 21 acres of optimal riparian habitat will be lost under all of the partial replacement alternatives. Riparian-mixed habitat is heterogeneous in nature and contains some of the features and qualities of riparian habitat as well as the features and qualities of other habitat types.

An unknown amount of riparian habitat will likely be created by seepage and spillage resulting from operation of the Project when completed. It is possible that some of the existing riparian habitat could, through proper management, be useful as seasonal habitat for such species as geese and other migratory waterfowl.

Effects to Shrub-steppe Habitat

According to the WDFW 2009 HEP analysis (WDFW 2009a, p. 28), a direct loss of the equivalent of over 4,000 acres of *prime* shrub-steppe habitat will occur under any of the partial replacement alternatives (2A & 2B).

Effects to Grassland Habitat

The WDFW HEP analysis (WDFW 2009a, p. 28) indicated that a loss of a maximum of 3,183 acres of optimal grassland habitat will be lost under any of the partial replacement alternatives. Temporary disturbance, or short-term loss, could result from construction noise or maintenance activities of short duration (i.e. one day to one month).

Effects to Federally Listed Species and Species of Concern

Columbia Basin Pygmy Rabbit

The further loss of shrub-steppe habitat, as a result of Alternatives 2A or 2B, will impact recovery of the pygmy rabbit by reducing the amount of its available habitat. Since many areas of potential habitat have never been surveyed, there is a small possibility of disturbing, injuring or killing undiscovered individuals or small undiscovered populations. Loss of suitable habitat and further fragmenting remaining pygmy rabbit habitat could hamper long term recovery of the species.

Bull Trout

As discussed in section 6.2 above, the Service has determined there will be no measurable impacts to the bull trout which may use Crab Creek. However, Alternatives 2A and 2B entail the manipulation of water from the Columbia River within the confines of Lake Roosevelt and Banks Lake. Bull trout are somewhat numerous in certain segments of the Columbia River during specific times of the year, but their likelihood of exposure to mortality or injury at Reclamation facilities or infrastructure as a result of these alternatives is anticipated to be low. The bull trout's overall ability to migrate upstream and downstream through the hydroelectric system of the Columbia River will likely not be impaired in a significant manner, but it will continue to be exposed to effects associated with entrainment, albeit rare, at Lake Roosevelt and Banks Lake.

Spalding's Silene

The further loss of grassland habitat especially at elevations of 1900-3050 feet will have a detrimental effect on Spalding's silene. In the partial replacement alternatives, the potential also exists for the removal or disturbance of individuals of the species. There are 49 populations known in Washington, many within or around the Project Area

(USFWS 2005, pp. 5-6). Any remaining populations that exist could be isolated further by the Project.

Ute's Ladies'-tresses

It is unknown if the species occurs within the Project Area; however, the further loss of emergent wetland habitat will have a detrimental effect on the Ute's ladies' tresses. The potential to removal or disturb of individuals plants exists, if they are not surveyed for prior to construction near riparian habitats. Occurrences of the ladies' tresses are reported near to the Project in Chelan County, within the Chief Joseph watershed (USFWS 2005c, p. 20).

Greater Sage-grouse

Because much of the sage-grouse habitat within the Project Area is likely unoccupied, direct effects to individuals are not likely to occur. However, recent and historical records of sage-grouse occurrence in areas within the Project Area do exist and much of the remaining sage-steppe habitat is suitable for use by sage-grouse (Stinson 2004, pp. 28-29).

It is anticipated that surveys will be done prior to construction in any suitable sage-grouse habitat to locate any nesting sage-grouse and work windows will be adjusted to avoid disturbance to nesting sage-grouse, should they be found in or immediately adjacent (within 200 m) to the construction areas.

Alternatives 2A and 2B are expected to have little impact to sage grouse habitat. It is also anticipated that undisturbed sage-grouse habitat (habitat that has not been previously farmed or grazed) will be protected by avoiding it in the placement of permanently constructed lateral water pipe or canal facilities. The area within the ellipse, in Figure 6, is the approximate area where effects could occur due to construction impacts and loss of habitat. Few additional impacts are anticipated from the partial replacement alternatives because construction will occur outside of sage-grouse management units and construction will largely be confined to expansion of an existing canal system that largely lies in disturbed area within existing agricultural areas. With seasonal restrictions on construction activity, if sage-grouse are found in the area, and no modification or destruction of sage-grouse habitat, the partial replacement alternatives should have little to no effect on sage-grouse.

Washington Ground Squirrel

Removal of Rocky Coulee from consideration as a potential site for a new reservoir will eliminate impacts to the largest colony of Washington ground squirrels within the Project area. Any remaining populations of Washington ground squirrel that exist could be physically isolated by the Project (WDFW 2009b, pp. 13-15). It is expected that pre-construction surveys and BMPs will reduce possible impacts to the extent possible.

Northern Wormwood

Any remaining populations of Northern wormwood that exist would likely be physically isolated by the Project (WDFW 2009b, pp. 13-15). However, it is not believed that

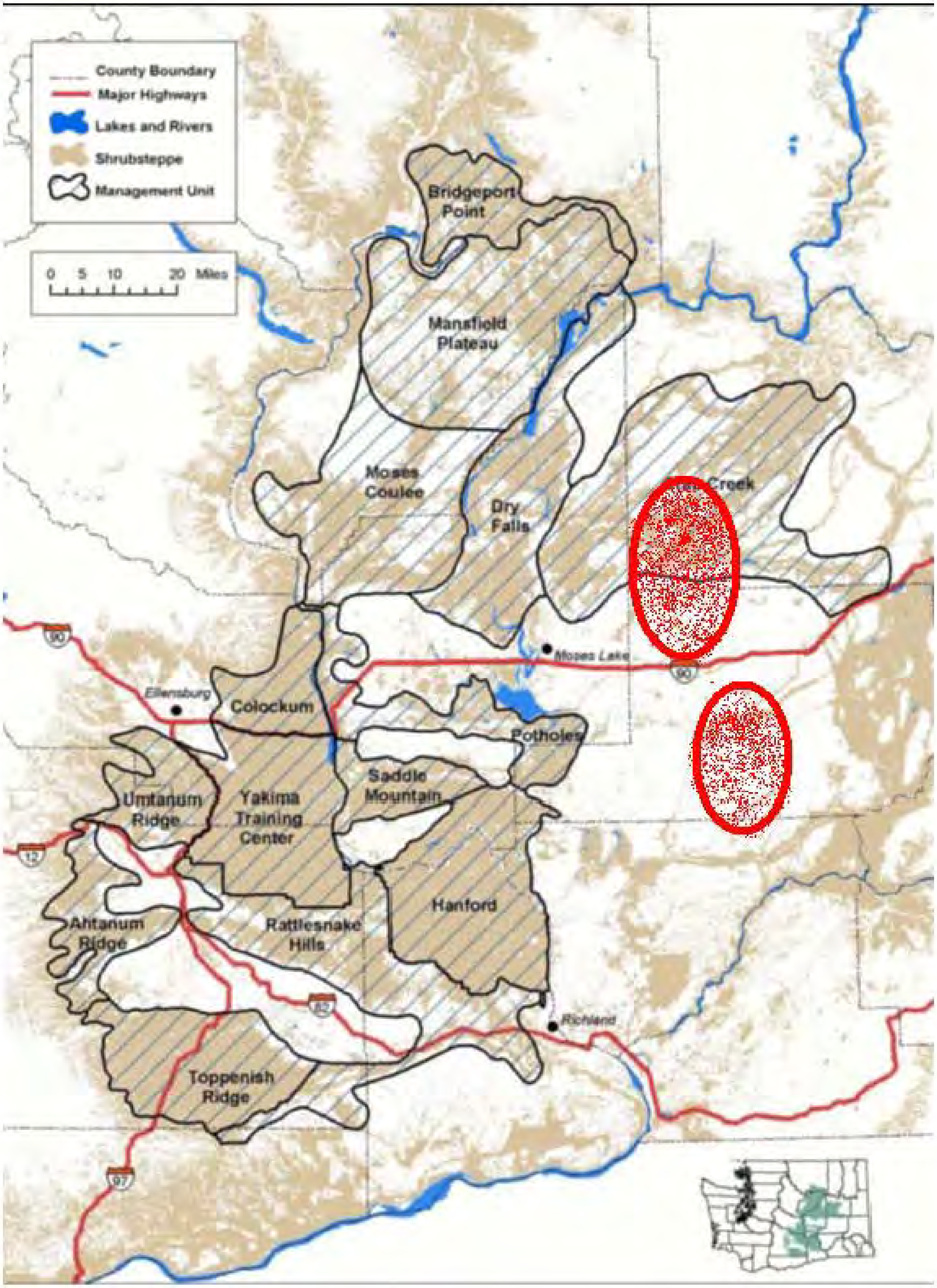

Figure 6. Sage-grouse Management Units (Stinson 2004, p. 30)

northern wormwood is to be found within the Project Area. It is expected that pre-construction surveys and BMPs will reduce possible impacts to the extent possible.

Yellow-billed Cuckoo

No impacts to yellow-billed cuckoo habitat are expected to occur, since riparian habitat is not expected to be impacted by construction activities.

Effects to Species of Concern

Species of Concern that may be present are also expected to possibly be adversely affected by all of the partial replacement alternatives.

Loss of shrub-steppe and grassland habitat will negatively impact bald eagle *(Haliaeetus leucocephalus),* burrowing owl (*Athene cunicularia)*, Columbian sharp-tailed grouse *(Tympanuchus phasianellus columbianus),* ferruginous hawk (*Buteo regalis*), loggerhead shrike (*Lanius ludovicianus*), long-eared myotis (*Myotis evotis*), northern goshawk *(Accipiter gentilis),* olive-sided flycatcher *(Contopus cooperi),* possibly northern leopard frog (*Rana pipiens),* pallid Townsend's big-eared bat (*Corynorhinus townsendii pallescens*), and sagebrush lizard (*Sceloporus graciosus*). The bald eagle will lose some foraging areas, suffer a reduced prey base, possibly increased competition for resources, and lose perching sites. The burrowing owl will likely gain burrow sights, if in less than optimum habitat but will also suffer a reduced prey base as rodents such as the Washington ground squirrel are reduced in number. The sharp-tailed grouse will suffer from loss of habitat and interference with vital behaviors such as lek displays as noise increases. The ferruginous hawk will lose nesting sites as areas are inundated and will suffer from prey base depression, as will the loggerhead shrike and goshawk, Insect populations, in general, will likely increase. While increased pesticide use will result in increased impacts, animals such as the flycatcher and the bats will find an increased prey base available. There should be little or no impact with regard to nesting and roosting sites and hibernacula. If farms are abandoned, bat roosting sites and hibernacula may increase.

Effects of the Full Replacement Alternatives (Alternatives 3A & 3B)

Aquatic Habitats

Under the full replacement alternatives, water from Lake Roosevelt and the Banks Lake Reservoir will be utilized to supplement water in Reclamation's East Low Canal for purpose of providing additional instream flows in the CBP. Reclamation has also identified the Weber Siphon expansion as part of the project that will expand the water delivery capacity of the CBP into the East Low Canal. This would entail the construction of a new East High Canal system north of Interstate 90 in phases, to deliver water northeastward.

The alternatives discussed in this section are described below:

> 3A: Full replacement of ground water use with water from Banks Lake. Water delivery options include an expanded East Low Canal with a 2.5-mile

extension together with construction of the East High Canal from above Billy Clapp Lake to a point about 15 miles east of Moses Lake, construction of the Black Rock reregulation reservoir, and construction of the Black Rock Branch Canal from the proposed Black Rock reregulating reservoir to about 21 miles east of Moses Lake, Washington. Water supply options include an additional drawdown of Banks Lake (up to 18 feet at the time of this report);

3B: Full replacement with water from Banks Lake and Lake Roosevelt. This alternative includes full replacement of ground water use with water from Banks Lake. Water delivery options include an expanded East Low Canal with a 2.5-mile extension together with construction of the East High Canal from above Billy Clapp Lake to a point about 15 miles east of Moses Lake, construction of the Black Rock reregulation reservoir, and construction of the Black Rock Branch Canal from the proposed Black Rock reregulating reservoir to about 21 miles east of Moses Lake, Washington. Water supply options include an additional drawdown of Banks Lake and use of additional water from Lake Roosevelt;

Effects to Water Quality and Quantity

As with the partial replacement alternatives, the primary effect of the full replacement action alternatives on water quality and quantity is related to increasing the distribution of contaminants from Lake Roosevelt through water releases to Banks Lake Reservoir, Billy Clapp Lake, Potholes Reservoir, and Crab Creek. The overall effect of the action is likely to maintain or further degrade water quality in water bodies associated with the CBP. This effect is estimated to be of a moderate to high level of impact.

Full replacement will produce similar impacts to those resulting from the partial replacement alternatives; but effects will occur over a greater area due to the increase in the water distribution area and the increased amount of contaminated water and sediment anticipated moving through the CBP. At this time, it is unclear whether or not full replacement will improve water quantity in a meaningful manner.

Effects to Fish Habitat Access

The action alternatives do not include the construction of upstream fish passage facilities at Chief Joseph, Dry Falls, O'Sullivan, or Pinto dams. These structures currently have outlet works that cause fish to be entrained downstream. We expect that fish will continue to be entrained at Lake Roosevelt, Banks Lake, and Billy Clapp Lake based upon current operational regimes at these locations. Information regarding the rates of entrainment for these bodies of water is limited, but most likely determines the success of annual recreational fisheries. The Service analyzed entrainment data collected from WDFW at Dry Fall Dam (Banks Lake). Entrainment of fish from Banks Lake appears to be at its highest level during the daytime period of this study. Sculpin, smallmouth bass, and largemouth bass were the highest proportion of fish species sampled during entrainment studies at Banks Lake. Entrainment rates at Banks Lake will likely increase with all the action alternatives, since significant water withdrawals from Lake Roosevelt (i.e., action alternative 3B) will result in more water available for distribution through Banks Lake and surrounding water conveyance structures. Since bull trout have been documented to reside in Lake Roosevelt, we are not able to discount the potential effect of bull trout entrainment at this facility. Due to the infrequent nature of documented bull trout occurrences in Lake Roosevelt at this time, it is likely that bull trout entrainment would be rare. We also anticipate that entrainment levels will continue to occur at moderate levels through the proposed implementation of the remaining alternatives, specifically 3A.

Full replacement will produce impacts similar to those resulting from the partial replacement alternatives; but the effects will occur over a greater area due to the increase in project size. This effect would be considered a moderate level of impact.

Effects to Habitat Elements

Implementation of the Full replacement Alternatives is likely to increase the effects associated with the current reservoir operations of the CBP.

For example, alternative 3B is anticipated to have the most significant impacts on spawning and rearing habitats for resident fish in Lake Roosevelt. Depending on the water amount available and the time of year, this alternative will result in the most significant changes in water elevation. This elevational change would be approximately 2.2 feet under Alternative 3B. Although the habitat access effects will be larger in scope and magnitudes, all of the action alternatives will affect spawning and rearing habitats for resident fish within Banks Lake. The overall effect of the action alternatives is likely to continue to degrade aquatic habitat elements within the CBP.

Full replacement will produce impacts similar to those resulting from the partial replacement alternatives; but again the effects will occur over a greater area due to the increase in project size. This effect would be of a moderate level of impact.

Effects to Channel Condition and Dynamics

Implementation of any of the full replacement alternatives will likely have more pronounced effects to the channel conditions within the Middle Crab Creek drainage of the CBP. The overall effect of any of the full replacement alternatives is likely to maintain degraded channel conditions and dynamics in water bodies associated with the Columbia River Basin Irrigation Project. Channels throughout the CBP have suffered from truncated flow regimes, altered water levels, channelization and resulting impacts to other dynamics as described in this report.

Alternative 3B will likely demonstrate the highest level of impacts as this alternative entails the most significant water withdrawals from Lake Roosevelt. Water withdrawals from Lake Roosevelt under the full replacement alternatives would be distributed to Banks Lake for further distribution in the CBP. It is anticipated that alternatives 3A and 3C, will have moderate impacts on the channel condition and dynamics habitat indicator since water withdrawals from Lake Roosevelt and Banks Lake are lower in magnitude under these alternatives.

Full replacement will produce impacts of the same nature as the partial replacement alternatives but will produce these effects over a greater area due to project size. This effect is estimated be of moderate level of impact.

Effects to Flow/Hydrology

The full replacement alternatives require extensive construction, which would include expanding the capacity of existing facilities and constructing new canals, siphons, tunnels, pumping plants, piped laterals, and new re-regulating reservoirs. We anticipate that these types of activities will alter the flow/hydrology of the affected water bodies. For example, the new proposed re-regulating reservoir at Black Rock Coulee would offer a higher level of active storage capacity for disseminating flows in the CBP. However, at this time, it is unclear how this water would be allocated and released to other infrastructure within the CBP once it leaves Banks Lake. The exact timing, number and seasonal incremental flows released from Lake Roosevelt down the Columbia River are also not known at this time.

Hydrographic variation has resulted in lower proportional change in peak flows, higher base flows have resulted from water impoundment in bodies of water such as Lake Roosevelt, Banks Lake, and Billy Clapp Lake. A natural hydrograph would have the ability to support possible bull trout occurrences in Crab Creek by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation. However, Crab C reek is not comprised of the necessary instream habitat components needed to sustain all life history stages of bull trout. As a result of the proposed action, a highly modified hydrograph with altered peak and base flows, and reservoir levels will be continued in Lake Roosevelt, Banks Lake, Billy Clapp Lake, and Crab Creek (i.e., Middle Crab Creek).

Specifically, action alternative 3B entails the most significant water withdrawals from Lake Roosevelt. The effects of these alternatives would appear to have the highest level of negative impact on the flow/hydrology indicator. Water withdrawn from Lake Roosevelt under these alternatives would then be pumped and transported via canal to Banks Lake for further distribution in the CBP. The effects to the flow/hydrology indicator are not as significant to the drawdown of Banks Lake for all action alternatives. The overall effect of any of the full replacement alternatives is likely to increase degraded flow and hydrology conditions in water bodies associated with the CBP. These effects are estimated to be of moderate level of impact.

Effects to Watershed Conditions

Full replacement will produce the same types of impacts as the partial replacement alternatives but will produce a much greater range and magnitude of effects due to increased project size and habitat differences. A greater proportion of the Project Area under the full replacement alternatives is currently composed of suitable and good quality habitats. Hydrographic variation has resulted in substantial effects to the watershed conditions within the CBP. The overall effect of the full replacement action alternatives is likely to further degrade watershed conditions in general in the CBP. The disturbance history in the project area has been altered by substantial changes to the hydrograph in the CBP irrigation canals and associated aquatic zones due to water withdrawal for irrigation, operational needs for hydropower generation, degraded riparian areas, and nearly a century of fire suppression. This has led to the impairment of a number of ecosystem processes that support habitats used by fish. Analysis of the riparian conservation area indictor in particular suggests a condition that is fragmented, poorly connected, and provides limited protection to aquatic species within the Project Area. In addition, the natural disturbance regime, in terms of floods and fires, has departed substantially from its historic properly functioning condition and frequency. This will likely translate to overall watershed conditions of poor quality habitats, little resiliency, and limited ability to provide habitat for the fish in the long term.

Implementation of any of the alternatives is likely to contribute to degraded watershed conditions in the CBP. Significant drawdowns at Lake Roosevelt, such as those contemplated in alternative 3B will likely produce a high level of negative impact on the ecological function of the watershed within the Project Area. Table 7 summarizes these impacts to aquatic habitats. Low impacts could be detected but would be unlikely to trigger adverse reactions in aquatic life. Moderate (M) impacts would likely trigger avoidance behavior or would cause modification of, but not preclude, vital functions in aquatic life, and high impacts would cause significant damage up to and including mortality or interference with vital life functions or life stages.

Summary of Effects

Based on predicted impacts described above for each of the six aquatic habitat indicators, Table 7 summarizes estimated impacts to aquatic habitat indicators, using a high, medium, or low rating category. Assigned level of impact was derived by assessing the amount, frequency, and duration of water releases from Lake Roosevelt and/or Banks Lake in accordance with the proposed alternatives.)

Table 7. Evaluation and Benefit Ratings of Aquatic Habitat Indicators for Aquatic Species by Alternative

	Aquatic Habitat Indicators					
Project Alternative	Water Quality & Quantity	Habitat Access	Habitat Elements	Channel Condition and Dynamics	Flow/ Hydrology	Watershed Conditions
1 (No Action)	2	2	2	2	2	2
Action 2A	2	2	2	2	2	2
Action 2B	3	3	3	3	3	3
Action 3A	2	2	2	2	2	2
Action 3B	3	3	3	3	3	3
Action 4A	2	2	1	1	2	1
Action 4B	3	2	1	1	2	1
3 = High Impact, 2 = Moderate Impact, 1 = Low Impact						

Terrestrial Habitats

The difference in the impacts to terrestrial habitats resulting from each alternative is largely a matter of magnitude. We have the same concerns under full replacement as we do under partial replacement but, with a larger footprint for the construction of the EHC, the larger the degree of uncertainty becomes without a detailed description of the Project. We are aware that native habitat North of I-90 is more contiguous than habitat South of I-90 and contain a greater proportion of native habitat within the Project Area. Therefore, impacts of the full replacement alternatives (3A& 3B) will be significantly greater.

Riparian and Riparian-mixed Habitat

Alternatives are the -most destructive to these habitats. Habitat loss will occur primarily through construction of the East High Canal, and the reservoir in Black Rock Coulee, along with attendant structures such as pumping plants. Exact locations and designs for many of these structures have not been determined at this preliminary stage of the project; therefore, our assessment is qualitative in nature. Under Alternatives 3A and 3B, significant and irreplaceable impacts are expected to occur to unique upland and riparian habitats located within the Black Rock Coulee flood easement area. These effects are predicted to be of moderate (M) to high (H) levels of impacts.

As with the partial replacement alternatives, an unknown amount of riparian habitat is expected to be created through seepage of the new infrastructure. We expect that the habitat benefits derived will be minimal unless pre-project planning and design for the creation of habitat is incorporated.

Shrub-steppe habitat

We have numerous concerns about the impacts we expect to result from any of the full replacement alternatives (3A or 3B).

According to the WDFW HEP analysis (WDFW 2009a, p. 28) a direct loss of the equivalent of over 4,000 acres of shrub-steppe habitat will occur. This is out of an estimated 6,260 acres of available habitat within the Project footprint (WDFW 2009d, p.4). However, up to a total of 19,448 acres of shrub-steppe habitat may be loss due to temporary impacts and noise disturbances, if conservation measures are not incorporated. This habitat loss likely may extend beyond the perimeters of the Project footprint. This figure is based on our assumptions concerning noise and the Project description provided by Reclamation. Impact area may change when construction surveys are completed and project infrastructure is determined; most likely a reduction in impacted area will result. Impacts could be further reduced by incorporation of the proposed Conservation Measures into the Project design.

Grassland Habitat

The WDFW HEP analysis (WDFW 2009a, p. 28) shows that a loss of an undetermined amount of grassland habitat will occur. This is out of an estimated 4,938 acres of available habitat within the Project footprint (WDFW 2009d, p. 4). However, up to a total of 5,500 acres of additional grassland habitat may be lost when temporary and noise disturbances are included. This habitat loss may extend beyond the perimeters of the Project footprint. This figure is based on our assumptions concerning noise and the Project description provided by Reclamation. Impact area may change when construction surveys are completed and project infrastructure is determined. If the Conservation Measures are incorporated and preconstruction surveys conducted, the total area impacted will likely be smaller.

Agricultural Habitat

Regardless of which alternative is chosen, agricultural lands are expected to increase in area. The extent of this increase will be influenced by socio-economic influences and from political influences. It is expected that an increase in agricultural habitat will occur and will benefit some wildlife, such as pheasant and possibly sage-grouse, depending on the agricultural practices, crop, and their proximity to native habitats. Conversely, those species that rely on native habitat, such as Washington ground squirrel and mule deer, will likely decrease in numbers. If conservation measures are incorporated and preconstruction surveys conducted, the total area impacted will likely be smaller.

Effects to Federally listed Threatened and Endangered Species under the Full Replacement Alternatives

Bull Trout

As discussed in section 6.2 above, the Service has determined there will be insignificant impacts that are likely to rarely occur to the bull trout which have the potential to use Crab Creek. However, Alternatives 3A and 3B entail the manipulation of water from the Columbia River within the confines of Lake Roosevelt and Banks Lake. Bull trout are somewhat numerous in certain segments of the Columbia River during specific times of the year, but their likelihood of exposure to mortality or injury at Reclamation facilities or infrastructure as a result of these alternatives is anticipated to be low. The primary impacts are entrainment through siphons at Lake Roosevelt that could move bull trout into Banks Lake, which is not quality habitat for bull trout, and the habitat effects described for fish habitat in Lake Roosevelt and the mainstem Columbia River.
The bull trout's overall ability to migrate upstream and downstream through the hydroelectric system of the Columbia River will likely not be impaired in a significant manner, but it will continue to be exposed to effects associated with entrainment, albeit rare, at Lake Roosevelt and Banks Lake.

Columbia Basin Pygmy Rabbit

The further loss of shrub-steppe habitat will possibly have a detrimental effect on recovery of the pygmy rabbit by reducing the habitat available for reintroduction. Since many areas of potential habitat have never been surveyed, the potential also exists for disturbing, injuring or killing undiscovered individuals or small surviving populations. Any remaining populations that may exist could be isolated, genetically and physically by the Project (WDFW 2009b, p p.13-15). Loss of suitable habitat and habitat connectivity could also hamper long term recovery of the species. A possible recent sighting of a Columbia Basin pygmy rabbit was reported within the Project Area by a consultant in March, 2010. Attempts were made to confirm the sighting; however, they were unsuccessful. Based on the information gathered, no further investigation of the sighting was recommended (Rich Finger, WDFW 2010, *pers. comm*.). The majority of possible pygmy rabbit habitat lies within the footprint or near to the full replacement alternatives.

Spalding's Silene

The further loss of grassland habitat especially at elevations of 1900-3050 feet will have a detrimental effect on Spalding's silene. The potential also exists for the removal or disturbance of individuals of the species. There are 49 populations known in Washington, many within or around the Project Area (USFWS 2005, pp. 5-6). Any remaining populations that exist could be genetically isolated further by the Project. Due to the potentially larger area covered by the impacts from the full replacement alternatives; especially those creating a new reservoir, the effects of isolation and lack of connectivity could be significant. Pre-construction surveys should preclude the take of individual plants.

Ute's ladies' tresses

The further loss of emergent wetland habitat, especially streamside habitats that are periodically grazed, will have a detrimental effect on the Ute's ladies' tresses. The potential also will be present for the removal or disturbance of individuals of the species. Occurrences of the ladies' tresses are reported near to the Project in Chelan County, within the Chief Joseph watershed (USFWS 2005c, p. 20). It is unknown if the species occurs within the Project Area. Any remaining populations that may exist could be genetically isolated by the Project (WDFW 2009b, pp.13-15). Again, because of the potentially larger area covered by the impacts from the full replacement alternatives, especially those creating a new reservoir, the effects of isolation and lack of connectivity could be significant. Pre-construction surveys should preclude the take of individual plants.

Greater Sage-grouse

Because much of the sage-grouse habitat within the Project Area is likely unoccupied, direct effects to individuals are not likely to occur. However, recent and historical records of sage-grouse occurrence in areas within the Project Area do exist and much of the remaining sage-steppe habitat is suitable (Stinson 2004, pp. 28-29). It is anticipated that surveys will be done prior to construction in any suitable sage-grouse habitat to locate any nesting sage-grouse and work windows will be adjusted to avoid disturbance to nesting sage-grouse, should they be found in or immediately adjacent to the construction areas.

Alternatives 3A and 3B are expected to have little impact to sage grouse habitat now that the Project excludes the possibility of a new reservoir in Rocky Coulee. It is also anticipated that undisturbed sage-grouse habitat (habitat that has not been previously farmed or grazed) will be protected by avoiding it in the placement of permanently constructed lateral water pipe or canal facilities. The area within the ellipse, in Figure 6, is the approximate area of impact for the alternatives. Few additional impacts should be anticipated from the partial replacement alternatives because construction will occur outside of sage-grouse management units and construction will largely be confined to expansion of an existing canal system that largely lies within existing agricultural areas. With seasonal restrictions on construction activity and avoidance of disturbance or destruction of sage-grouse habitat, the partial replacement alternatives should have little to no effect on sage-grouse. Any remaining populations of greater sage-grouse that exist could be physically isolated by the Project (WDFW 2009b, pp. 13-15).

The three units in the Project Area south of I-90 are occupied but do not support functional populations of sage-grouse. Sage-grouse likely migrate from Moss Coulee east to surrounding sage steppe habitats within Dry Falls Sage-grouse Management Unit; therefore, the suitable habitat within the Project Area, particularly north of I-90, is very important for recovery of the sage-grouse.

Washington Ground Squirrel

Removal of Rocky Coulee from consideration as a potential site for a new reservoir will eliminate impacts to the largest colony of Washington ground squirrels within the Project area. Any remaining populations of Washington ground squirrel that exist could be physically isolated by the Project (WDFW 2009b, pp. 13-15). It is expected that pre-construction surveys and BMPs will reduce possible impacts to the extent possible.

Northern Wormwood

Any remaining populations of Northern wormwood that exist would likely be physically isolated by the Project (WDFW 2009b, pp. 13-15). However, it is not believed that northern wormwood is to be found within the Project Area. It is expected that pre-construction surveys and BMPs will reduce possible impacts to the extent possible.

Yellow-billed Cuckoo

Any remaining yellow-billed cuckoo habitat that currently exists would likely be physically isolated and diminished in riparian areas by the Project (WDFW 2009b, pp. 13-15). This could preclude any efforts to re-establish cuckoo populations in eastern Washington

Effects to Species of Concern

Species of Concern that may be present are also expected to possibly be adversely affected by all of the partial replacement alternatives.

Species of Concern that may be present are also likely to be adversely affected. Loss of shrub-steppe and grassland habitat will negatively impact bald eagle *(Haliaeetus leucocephalus),* burrowing owl (*Athene cunicularia)*, Columbian sharp-tailed grouse *(Tympanuchus phasianellus columbianus),* ferruginous hawk (*Buteo regalis*), loggerhead shrike (*Lanius ludovicianus*), long-eared myotis (*Myotis evotis*), northern goshawk *(Accipiter gentilis),* olive-sided flycatcher *(Contopus cooperi),* possibly northern leopard frog (*Rana pipiens),* pallid Townsend's big-eared bat (*Corynorhinus townsendii pallescens*), and sagebrush lizard (*Sceloporus graciosus*). Depending on location, habitat present, season, and species present, these impacts may include loss of nesting and rearing habitat, loss of roosting and perching disturbance at hibernation sites, avoidance of foraging habitat, and direct mortality through stress and increased predation. Effects may occur directly or through disturbance of vital behavior patterns or through avoidance behavior. Populations may be separated from food sources. Any remaining populations that are isolated by project infrastructure could potentially suffer from lack of gene flow, inbreeding depression, and genetic drift, rendering these isolated populations more susceptible to stochastic events. Conversely, food sources such as small mammals are likely to increase and new canals will provide habitat for burrowing species such as burrowing owls.

Plant species such as gray cryptantha (*Cryptantha leucophaea*), Hoover's desert-parsley (*Lomatium tuberosum*), prairie lupine (*Lupinus cusickii*), Washington polemonium (*Polemonium pectinatum*), basalt daisy (*Erigeron basalticus*), and Wanapum crazyweed (*Oxytropis campestris* var. *wanapum*) will be susceptible to ground disturbance impacts. Pollutants leaking from construction equipment or treated construction materials (i.e., treated wooden poles) may impact plant species, especially those near construction staging areas or near pole lines and fences. Construction activities can introduce invasive species into new areas, resulting in increased competition for resources. BMPs proposed by Reclamation should eliminate these hazards.

Effects of the Modified Partial replacement Alternatives (Alternatives 4A & 4B)

Alternative 4 is comprised of elements of the partial alternatives (2A and 2B) and the full replacement alternatives (3A and 3B). As described previously, Alternatives 4A and 4B differ only in the source of Project water. Over the life of the project, Alternative 4 will provide replacement water for approximately 70,000 acres of currently groundwater irrigated lands. Of that total, 60,000 acres could be served with planned expansions of East Low Canal. Conveyance conservation measures that have been incorporated into Alternative 4 will allow an additional 10,000 acres of land to be served with replacement water over time. The conveyance conservation measures will be implemented concurrent with canal capacity improvements (canal and siphon expansions). Approximately 25,000 acres of the 70,000 acres would be located north of I-90, while the remaining 45,000 acres would be south of I-90. The 25,000 acres of land north of I-90 that would be served under Alternative 4 are a portion of the groundwater irrigated lands that would have been supplied with CBP water under the Full Groundwater Replacement Alternatives described in Section 2.5 of the DEIS. No water would be delivered to lower Crab Creek. Additional features such as pumping plants, staging areas and, utility lines will be located in existing rights-of-way or other disturbed areas to the extent possible.

Aquatic Habitats

Water Quality and Quantity

An assessment of water quality, bottom sediment, and biota explains how the CBP, in general, does not have an adverse effect on biota, however, irrigation drainage from the CBP does contribute to elevated levels of trace elements which may affect aquatic vegetation and associated wildlife species that feed upon this aquatic vegetation (Embrey and Blok 1995, pp. 70-73).

Conveyance of other contaminants such as pesticides has also been demonstrated to occur throughout the CBP (Wagner *et al.* 2006, p. 1). We would expect continued conveyance of contaminants through the implementation of the Alternative 4. Water temperature in Middle Crab Creek, is expected to improve with the implementation of this alternative. Water from Banks Lake is drafted within the top 20 feet of the reservoir whereas Billy Clapp Lake water is drafted solely from the bottom section of this reservoir resulting in different water temperature regimes downstream. Water in Billy Clapp Lake has a low residence time and water drafted from Billy Clapp Lake will likely be cooler than water drafted from Banks Lake. Therefore, when these effects to resident fish are considered collectively, it is likely that current degraded water temperature conditions in the CBP will continue with this alternative.

Effects to Habitat Access

We anticipate that fish will continue to be entrained in water moving from Lake Roosevelt, Banks Lake, and Billy Clapp Lake, to its destined use. Entrainment of fish at Banks Lake (Dry Falls Dam) has been shown to be a significant resource concern (Olson *et al.* 2010, p. 35; Polacek 2010, p. 28). Entrainment rates at Banks Lake will likely continue at a higher level with this alternative. Primary effects to resident fish that are entrained will likely include effects associated with changes in pressure differentials within the water column and injury/mortality when fish come in contact with structures associated with hydropower facilities (i.e., Banks Lake). Entrainment effects may not be limited solely to resident fish, but may include fish forage resources as well. For example, entrainment of zooplankton from Banks Lake into the system may affect the survivability of the fish populations in this lake, since the forage base for fish in Banks Lake is being continually reduced while canals are being fed water (Polacek 2010, p. 1). Access to spawning and rearing habitats within close proximity to the shorelines of these bodies of water will also decrease significantly due to the higher frequency and duration of water fluctuations.

In addition, existing smaller-scaled water control structures and natural barriers to fish movement located in the Project Area have not been subjected to altered flow regimes as anticipated by this alternative. The scope and nature of these proposed flow modifications are not well understood at this time, since Reclamation has not established designated flow regimes for each of the alternatives. However, significant drawdowns such as those proposed at Banks Lake will likely translate into effects to the local resident fish community within the Project. These impacts include access to tributaries by fish species for spawning and rearing purposes.

Habitat Structural Elements

A number of habitat elements were evaluated and are currently negatively impacted by hydrographic variation and impoundment of water bodies associated throughout the CBP, including:

Increased levels of sediment from fluctuating water levels and bank erosion have increased substrate embeddedness in rivers (i.e., Middle Crab Creek) and reservoirs affected by the Project;

Pool frequency and quality, especially primary pools that have been flooded by the CBP, experience variation from the normal and historic flow regimes and are maintained by hydrologic variation caused by CBP operations.

Off-channel habitat has been reduced in quality and fish have less access to off-channel habitat due to fluctuating river levels and overall channel simplification; and,

Refugia within the river and lakes have likely been eliminated in most cases; although, the Columbia River and Crab Creek may have thermal refugia created from cold water sources (e.g., very deep pools, upwelling, large groundwater influences).

Channel Condition and Dynamics

These parameters have been altered significantly. The overall effect of the Alternative 4 is likely to continue degraded channel conditions and dynamics in water bodies associated with the CBP such as Middle Crab Creek.

Habitat Conditions and Other Habitat Degradation

Effects can stem from direct bank erosion to indirect impacts to the condition and extent of riparian vegetation, which if degraded, can lead to additional stream bank and near-shore instability. Floodplain connectivity is also impacted by hydrographic variation, reducing hydrologic connectivity between off-channel habitat, wetlands, and riparian areas. In addition, the extent of wetlands has likely been reduced and riparian vegetation and succession have been altered significantly. The overall effect of any of the partial replacement alternatives is likely to continue degraded channel conditions and dynamics in water bodies associated with the CBP such as Middle Crab Creek.

Flow/Hydrology

Flow alterations will impair a number of natural ecosystem processes, including accumulation and deposition of sediment. Since details of flow alterations resulting from reservoir operations and instream flow releases is not yet well-defined under the proposed alternatives, it is our assumption that the effects discussed above will continue in the near future or increase.

Watershed Conditions

Hydrographic variation has resulted in substantial effects to the watershed conditions within the CBP. The overall effect of the preferred is likely to further degrade watershed conditions in the CBP. The action area has been altered by substantial changes to the hydrograph due to irrigation demands and hydropower generation, degraded riparian areas, and agricultural development. This has led to the impairment of a number of ecosystem processes that support fish habitats. In addition, the natural disturbance regime for floods and fires has departed substantially from its historic properly functioning interval and effects. Therefore, the overall watershed condition is currently characterized as being of poor quality, with little resiliency, and limited ability to provide habitat for salmon and trout in the long term.

Terrestrial Habitats

The majority of the terrestrial impacts from the various partial replacement scenarios (2A& 2B) will be very similar. In general, the Conservation Measures and proposed BMPs will reduce the adverse effects to the minimum. The primary differences in the final magnitude of impact will largely depend on the water supply option chosen, which will heavily influence the level and type of aquatic impacts that will result. Generally, terrestrial impacts will consist of the following, independent of the alternative under consideration:

Riparian and Riparian-Mix Habitat

The WDFW HEP analysis (WDFW 2009a) did not address the Alternative 4 directly; however, impacts will likely be similar to those for Alternative 2A. Additional acreage north of I-90 currently consists primarily of agricultural land.

An unknown amount of riparian habitat may be created by seepage and spillage resulting from operations of the Project when completed. Some of the existing riparian habitat, as well as the newly created habitat, will be managed to create useful riparian habitat for migratory waterfowl and neotropical migratory birds.

Shrub-steppe Habitat

Shrub-steppe is a priority habitat for both the Service and WDFW. Therefore, the Service is concerned about the impacts expected to result from expansion of the East Low Canal. However, any shrub-steppe habitat impacted will be replaced and restored by Reclamation. If restoration is not accomplished within 5 years, alternative mitigation lands will be acquired at a 2:1 ration. Also, if any lands are exchanged (acre-per-acre) for lands not currently irrigated, those lands will presumably revert and provide a limited amount of wildlife habitat.

Grassland Habitat

The Alternative 4 should not impact the number of acres currently grassland habitat. Irrigated lands will remain irrigated lands, although an unknown number of acres may be converted from one crop to another.

Agricultural Lands

We expect that minimal impacts to agricultural land will result from implementation of the Alternative 4. Wildlife often uses the borders of agricultural land for foraging and agricultural land itself may provide sheltering and nesting areas. Conservation Reserve Program lands and lands with conservation easements on them may provide foraging, sheltering, and nesting habitat for sage-grouse (Schroeder 2006, p. 1). Ungulates may use agricultural land extensively during the growing season but females with young of the year (YOY) will strenuously avoid cultivated land during those months (Bjorneraas *et al,* 2011, p. 50-51*).* Fall mowing of herbaceous buffers in CREP lands reduced bird abundance, species richness, and conservation value among overwintering birds (Blank *et al* 2011, p. 61-62). Human activities may also deeply disturb circadian activities in ungulates (Duo Pan *et al* 2011, p.66*).* Overall, although the location of agricultural lands may shift, no increase in either acreage or level of disturbance is likely to result. As with all the other proposed alternatives, no increase in acreage of irrigated lands will be allowed to occur.

Effects to Federally listed Threatened and Endangered Species

Bull Trout

As discussed in section 6.2 above, the Service has determined there will be insignificant impacts that are unlikely to rarely occur to the bull trout which have the potential to use Crab Creek. However, Alternatives 4A and 4B entail the manipulation of water from the Columbia River within the confines of Lake Roosevelt and Banks Lake. Bull trout are somewhat numerous in certain segments of the Columbia River during specific times of the year, but their likelihood of exposure to mortality or injury at Reclamation facilities or infrastructure as a result of these alternatives is anticipated to be low. The primary impacts are entrainment through siphons at Lake Roosevelt that could move bull trout into Banks Lake, which is not quality habitat for bull trout, and the habitat effects described for fish habitat in Lake Roosevelt and the mainstem Columbia River.The bull trout's overall ability to migrate upstream and downstream through the hydroelectric system of the Columbia River will likely not be impaired in a significant manner, but it will continue to be exposed to effects associated with entrainment, albeit rare, at Lake Roosevelt and Banks Lake.

Columbia Basin Pygmy Rabbit

The further loss of shrub-steppe habitat will possibly have a detrimental effect on recovery of the pygmy rabbit by reducing the habitat available for reintroduction. Since many areas of potential habitat have never been surveyed, the potential also exists for disturbing, injuring or killing undiscovered individuals or small surviving populations. Any remaining populations that may exist could be isolated, genetically and physically by the Project (WDFW 2009b, pp .13-15). Loss of suitable habitat and habitat connectivity could also hamper long term recovery of the species. A possible recent sighting of a Columbia Basin pygmy rabbit was reported within the Project Area by a consultant in March, 2010. Attempts were made to confirm the sighting; however, they were unsuccessful. Based on the information gathered, no further investigation of the sighting was recommended (Rich Finger, WDFW 2010, *pers. comm*.). However, with the footprint, only extremely small patches of appropriate habitat remain, although many have not been surveyed. BMPs will require proper surveys be conducted prior to groundbreaking.

Spalding's Silene

The further loss of grassland habitat especially at elevations of 1900-3050 feet will have a detrimental effect on Spalding's silene. The potential also exists for the removal or disturbance of individuals of the species. There are 49 populations known in Washington, many within or around the Project Area (USFWS 2005, pp. 5-6). Appropriate habitat is not believed to exist within the footprint and pre-construction surveys will confirm this.

Ute's ladies' tresses

The further loss of emergent wetland habitat, especially streamside habitats that are periodically grazed, will have a detrimental effect on the Ute's ladies' tresses. The potential also will be present for the removal or disturbance of individuals of the species. Occurrences of the ladies' tresses are reported near to the Project in Chelan County, within the Chief Joseph watershed (USFWS 2005c, p. 20). It is unknown if the species occurs within the Project Area. Appropriate habitat is not believed to exist within the footprint and pre-construction surveys will confirm this.

Effects to Candidate Species

Greater sage-grouse, Washington ground squirrel, Northern wormwood, yellow-billed cuckoo, and Suksdorf's monkey-flower will be adversely affected by further loss of shrub-steppe and riparian habitat, as well as possible direct or indirect mortality. Any remaining populations of greater sage-grouse, Washington ground squirrel, Northern wormwood, yellow-billed cuckoo, and Suksdorf's monkey-flower that exist would likely be genetically and physically isolated by the Project (WDFW 2009b, pp. 13-15).

Much of the sage-grouse habitat within the Project Area is likely unoccupied. There are, however, recent and historical records of sage-grouse occurrence in all the management units and much of the nearby habitat north of I-90 is suitable (Stinson 2004, pp. 28-29). A translocated sage-grouse population does occur in the Crab Creek Sage-grouse Management Unit. The suitable habitat within the Project Area, particularly north of I-90, is very important for recovery of the sage-grouse. However, within the footprint, shrub-steppe habitat is patchy and habitat impacts should be minimal.

Effects to Species of Concern

Species of Concern that may be present are also expected to be adversely affected. Loss of shrub-steppe and grassland habitat will negatively impact bald eagle *(Haliaeetus leucocephalus),* burrowing owl (*Athene cunicularia)*, Columbian sharp-tailed grouse *(Tympanuchus phasianellus columbianus),* ferruginous hawk (*Buteo regalis*), loggerhead shrike (*Lanius ludovicianus*), long-eared myotis (*Myotis evotis*), northern goshawk *(Accipiter gentilis),* olive-sided flycatcher *(Contopus cooperi),* possibly northern leopard frog (*Rana pipiens),* pallid Townsend's big-eared bat (*Corynorhinus townsendii pallescens*), and sagebrush lizard (*Sceloporus graciosus*). Depending on location, habitat present, season, and species present, these impacts may include loss of nesting and rearing habitat, loss of roosting and perching disturbance at hibernation sites, avoidance of foraging habitat, and direct mortality through stress and increased predation. Effects may occur directly or through disturbance of vital behavior patterns or through avoidance behavior. Populations may be separated from food sources. Any remaining populations that are isolated by project infrastructure could potentially suffer from lack of gene flow, inbreeding depression, and genetic drift, rendering these isolated populations more susceptible to stochastic events. Conversely, food sources such as small mammals are likely to increase and new canals will provide habitat for burrowing species, such as burrowing owls.

Plant species such as gray cryptantha (*Cryptantha leucophaea*), Hoover's desert-parsley (*Lomatium tuberosum*), prairie lupine (*Lupinus cusickii*), Washington polemonium (*Polemonium pectinatum*), basalt daisy (*Erigeron basalticus*), and Wanapum crazyweed (*Oxytropis campestris* var. *wanapum*) will be susceptible to ground disturbance impacts. Pollutants leaking from construction equipment or treated construction materials (i.e., treated wooden poles) could potentially impact plant species, especially those near construction staging areas or near pole lines and fences. Construction activities can introduce invasive species into new areas, resulting in increased competition for resources. BMPs proposed by Reclamation should minimize these hazards.

8.0 EVALUATION AND COMPARISON OF ALTERNATIVES

In review, we examined the No-Action Alternative, partial replacement Alternatives 2A, 2B; the full replacement Alternatives 3A, 3B, 3C, and 3D; and Alternatives 4A and 4B. Potential effects on aquatic habitats and fish were qualitatively examined. Effects on terrestrial resources, including wildlife, were examined using two methods: WDFW's HEP analysis using estimated acreages for canals and reservoirs and HEP analysis using Reclamation's preliminary acreage estimates of the Projects' features and facilities. Ultimately, final effects and their magnitude cannot be fully determined without final designs, on-site surveys, and a completely detailed Project description. Ultimate analysis may require re-examination as the Project evolves.

Due to time constraints, these new alternatives were not quantitatively examined. However, we did have enough information to compare the new alternatives and water diversion scenarios with what we had already examined to draw a conclusion on the effects of the new alternatives.

Our evaluation and analyses indicate that none of the action alternatives will benefit fish, wildlife, or their habitats, to the degree that negative effects will be outweighed by positive effects, without the added benefits of mitigation and wildlife habitat improvements. A summary of our analyses for the seven alternatives:

8.1. Alternative One: The No Action Alternative

The Service has determined that the No Action Alternative provides no new benefits to fish, wildlife, or their habitats; but has no additional negative impacts beyond what is already occurring. No opportunities to create habitats or do habitat improvements will be created through no action.

8.2 Alternative Two: Partial Replacement Alternative(s)

The Service has made the following determinations regarding the sub-alternatives 2A and 2B.

Alternative 2A

The Service had determined that this alternative's effects would be similar to the aquatic species and habitats effects of Alternative 4A and 4B, but is less preferred than Alternative 4A. The large drawdowns of Banks Lake would negatively impact aquatic species and habitats in the lake. Terrestrial species and habitat effects will be minimal through the implementation of conservation measures and BMPs during construction activities.

Alternative 2B

The Service has determined that alternative 2B would negatively impact aquatic species and their habitats resulting from the drawdown of Banks Lake and is less preferred than Alternative 4A. Terrestrial species and habitat effects will be minimal through the implementation of conservation measures and BMPs during construction activities.

8.3 Alternative Three: Full Replacement Alternative(s)

The Service has made the following determinations regarding the sub-alternatives 3A, 3B, 3C, and 3D. These alternatives are not preferred because the magnitude of all the impacts will be greater than the partial replacement alternatives. A greater drawdown from Banks Lake will be required, a greater amount of terrestrial habitat (shrub-steppe) disturbance will occur through construction activities, and a greater amount of habitat will be destroyed through construction of a new canal system. Although mitigation will be performed, the temporary disturbance and chance of direct take will be much greater from more extensive construction activities.

Alternative 3A

The Service has determined that Alternative 3A is less preferred than Alternative 4A because it will require the greatest drawdown and will cause the greatest negative impacts to aquatic life and aquatic habitats. Construction of the EHC will block mule deer migration routes, disrupt habitat connectivity, and possibly negatively affect small populations of terrestrial species, such as sage grouse. Alternative 3A also has the potential to significantly impact high priority shrub-steppe wildlife habitats, through flooding of Black Rock Coulee.

Alternative 3B

The Service has determined that Alternative 3B is less preferred than Alternative 4A because it will require sizeable drawdowns of Banks Lake and also has the potential to significantly impact high priority shrub-steppe habitats, through flooding of Black Rock Coulee. Construction of the EHC will block mule deer migration routes, disrupt habitat connectivity, and possibly negatively affect small populations of terrestrial species, such as sage grouse

8.4 Alternative 4: Modified Partial Replacement Alternative(s)

The Service has made the following determinations regarding the sub-alternatives 4A and B: ***Alternative 4A is the Service's preferred alternative*** because it will disturb the least habitat, particularly high priority shrub-steppe and riparian habitats, and the magnitude of disturbance from construction and maintenance activities will be less. A greater drawdown from Banks Lake will be required, but a lesser amount of habitat disturbance will occur overall, and a lesser amount of habitat will be destroyed by constructed features. Through mitigation and BMPs, temporary disturbance from construction activities will be reduced and the chance of direct take will be minimized.

Alternative 4A

Alternative 4A is the Service's preferred alternative. The Service has determined that impacts to aquatic habitats under Alternative 4A would be similar to 2A and 3A that do not require additional draw down of Lake Roosevelt; however, additional draw down of Banks Lake would still occur annually. The impacts to terrestrial habitats would be similar to Alternatives 2A and 2B, as they only require widening the existing East Low Canal. Construction activities would occur in already disturbed areas, outside of high priority habitats. Overall, this alternative will be the best for fish and wildlife due to creating only minor adverse impacts to aquatic and terrestrial habitats of listed and sensitive species and opportunity for creating improvements in the existing water delivery system (i.e. wildlife crossings and habitat improvements). Through mitigation and BMPs the temporary disturbance will be reduced and the chance of direct take will be minimized.

Alternative 4B

The Service has determined that impacts to aquatic habitats under Alternative 4B would be less Alternative 3B, but greater than Alternative 4A. Impacts to terrestrial habitats would be similar to Alternative 4A and concentrated around modification of the East Low Canal.

Summary of Alternative Effects

By ranking impacts as "high", "medium" or "low" and comparing the level of impacts, our analysis has determined that alternative 4A will have the least negative effects to wildlife resources.

Aquatic resources will be affected negatively by the drawdown of Banks Lake and to a lesser extent from water withdrawal from Lake Roosevelt. Since pumping scenarios are to be applied to any of the alternatives chosen, their effects were applied to all alternatives. The pumping scenarios are fully described in the FEIS.

The summary impact level was derived by assigning a numeric value to each estimated impact level (Low = 1, Medium = 2, High = 3) to determine a mean score for each alternative, as seen in Table 8. A low average score for an alternative means the negative impacts to fish and wildlife resources for that alternative are low. We have also determined that the most limited and imperiled habitat type in the Project Area is shrub-steppe. Some proposed alternatives would significantly and adversely impact shrub-steppe habitat.

Table 8. Comparison of Impacts from Project Alternatives Using Evaluation Factors

Alternative	Habitat Types or Evaluation Factors				Mean Evaluation Score
	Aquatic	Shrub-steppe	Grassland	Riparian	
1 (No Action)	2	1	1	1	1.25
2A	2	1	1	2	1.50
2B	3	1	1	2	1.75
3A	2	2	2	1	1.75
3B	3	2	2	1	2.0
4A	2	1	1	1	1.25
4B	3	1	1	1	1.50
3 = High Impact, 2 = Moderate Impact, 1 = Low Impact					

Based on our review and evaluation of the information acquired during preparation of this report, particularly the significant loss and/or fragmentation of shrub-steppe habitat, we recommend that Reclamation implement Alternative 4A, if action must be taken.

Some negative effects of implementing Alternative 4A can be reduced or eliminated, if proper amelioration and mitigation measures are implemented as part of the project. The following mitigation measures will be necessary to prevent adverse impacts to the natural resources within the Project Area.

9.0 FISH AND WILDLIFE MITIGATION RECOMMENDATIONS

The Service's mitigation policy (FWS Manual, 501 FW 2) was used to formulate recommendations to mitigate for potential negative impacts associated with the Project's alternatives. In accordance with this policy, attempts were made to (a) avoid the impact altogether by not taking a certain action or parts of an action; (b) minimize impacts by limiting the degree or magnitude of the action and its implementation; (c) rectify the impact by repairing, rehabilitating, or restoring the affected environment; (d) reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action; and (e) compensate for the impact by replacing or providing substitute resources or environments (40 CFR Part 1508.20(a-e)), in that order. The Service has considered its responsibilities under the Endangered Species Act, Migratory Bird Treaty Act, Bald Eagle and Golden Eagle Protection Act, and the National Environmental Policy Act (USFWS 1981) in formulation of our recommendations. Service recommendations are also based on the ecological value and relative abundance of the affected habitats.

The Service's Mitigation Policy includes four Resource categories that were used to provide a consistent value rating for wildlife habitats. Based on the HSI values used in our analysis of project effects to fish and wildlife in the Project Area, the Service has designated a Resource Category for each terrestrial habitat in the Project Area.

Resource Category 1

Resource Category 1 habitats are of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion. The mitigation goal for habitat in Resource Category 1 is to experience no loss of existing habitat value. No such areas were designated within the Project Area.

Resource Category 2

Resource Category 2 habitats are of high value for evaluation species and are relatively scarce or becoming scarce on a national basis or in the ecoregion. The mitigation goal for habitat in Resource Category 2 is to experience no net loss of in-kind habitat value. Resource Category 2 habitats within the Project Area are shrub-steppe habitat, native grasslands, jurisdictional wetlands, and native riparian areas. Other Resource Category 2 habitats within the Project Area include the Washington State Priority Habitats previously described, areas containing known sage-grouse leks, and Black Rock Coulee.

Resource Category 3

Resource Category 3 habitats are of high to medium value for evaluation species. The mitigation goal for habitat in Resource Category 3 is to experience no net loss of habitat value. Examples of this resource category include low to medium quality shrub-steppe habitat, native grasslands, and native riparian areas.

Resource Category 4

Resource Category 4 habitats are of medium to low value for evaluation species. The mitigation goal for habitat in Resource Category 4 is to minimize loss of habitat value for wildlife species. Examples of this resource category include active and fallow agricultural lands, actively grazed and ungrazed pasture, and currently or previously disturbed lands.

In formulating these mitigation and minimization recommendations, the Washington State's *Wind Power Guidelines* (WDFW, 2009b, p. 1), *Wetland Mitigation in Washington State – Part 1: Agency Policies and Guidance*, and various species recovery plans, both State and Federal were used. Recovery plans were also used, including those for the pygmy rabbit (USFWS 2007, p. 1), Spalding's catchfly (USFWS 2005b, p.1), Ute ladies'-tresses (USFWS 1995, p. 1) and Washington state Greater sage-grouse (Stinson, Hays and Schroeder 2004).

Several of these mitigation measures were developed in coordination with WDFW. The Project will impact several Washington State Priority Habitats. Although the DEIS (Reclamation 2010, pp. 3-70) lists six Priority habitat Areas, impacts to others may be occur once the location of new facilities are determined..

Mitigation measures recommended below do not negate Reclamation's responsibilities under the ESA, the Migratory Bird Treaty Act (16 U.S.C. § 703–712), Bald and Golden Eagle Protection Act (16 U.S.C. § 668–668d), and the National Environmental Policy Act. The Project possesses the possibility for the take of state or federally listed species. "Take" is defined under the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in any such conduct or any activity significantly impairing essential wildlife behavioral patterns, including breeding, feeding, or sheltering. ESA does not prohibit incidental take of listed plants; however it does prohibit certain deliberate disturbance, removal and possession of Federally listed plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of federally listed plants on non-Federal areas in violation of State law or regulation or in the course of any violation of State criminal trespass law. Under the Migratory Bird Treaty Act, "take" is defined as to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, any migratory bird, any part, nest, or eggs of any such bird, or any product thereof, composed in whole or in part, of any such bird or any part, nest, or egg thereof. The Bald and Golden Eagle Protection Act defines "take" as pursuing, shooting, shooting at, poisoning, wounding, killing, capturing, trapping, collecting, molesting, or disturbing bald or golden eagles, but it does not cover habitat damage.

This report does not complete consultation under section 7 of the ESA; therefore, the Service recommends that Reclamation complete consultation with the Service on this project, if Reclamation moves forward to implement Alternative 4A.

The Service recommends the following measures be implemented with any alternative to avoid or mitigate potential adverse impacts or enhance fish and wildlife resources. If the alternatives are modified in planning or implementation, the mitigation recommendations may need to be modified and the Service should be contacted for assistance.

Mitigation of Effects to Fish and Aquatic Habitats Common to All Alternatives

Reclamation will:

- Ensure Crab Creek flows are compatible with migration, spawning, and rearing of resident and migratory fish that utilize the Crab Creek Watershed, by maintaining, improving and/or monitoring Reclamation's project effects to the flow regime and temperatures.
- In coordination with WDFW, investigate alternative barrier systems at Dry Falls Dam on Banks Lake and Pinto Dam on Billy Clapp Lake to reduce fish escapement out of both reservoirs.
- Provide adequate fish structures that meet NOAA and WDFW fish screening compliance standards in all facilities that have the potential to entrain or kill fish, while moving water within Reclamation facilities.
- To document fish and invasive species within the water conveyance system, engineer facilities that provide opportunities to identify and collect information pertaining to entrained fish and invasive species, during maintenance and

operations. Document and report invasive species and fish species by, size and life stage.

- In coordination with the Washington Department of Ecology and WDFW, develop and implement a site-specific and site appropriate plan to monitor water quality within the Odessa Subarea that is compatible with existing Reclamation water quality monitoring efforts; including:

    a. Continue to fund water quality monitoring in Banks Lake and Moses Lake, using established protocols for a minimum of 10 years;
    b. Initiate annual water quality monitoring in Potholes Reservoir, for a minimum of 10 years, using protocols established for Banks Lake and Moses Lake.
    c. Monitor potential transport of contaminants from Lake Roosevelt to downstream areas, in the Columbia River between Lake Roosevelt and Hanford Reach National Monument.

- Will develop and implement a monitoring program in coordination with WDFW to evaluate fish species' response to operational changes related to the Odessa Subarea. A monitoring and adaptive management plan for the Odessa Subarea fisheries shall include the following components:

    a. Monitor reservoir and lake productivity affected by the Odessa Subarea;
    b. Conduct creel surveys in recreational fishing areas to assess any changes in annual angler effort, harvest, and catch;
    c. Compare the entrainment of piscivorous warm water fish between current operations and operational changes under the selected alternative. Warm water fish entrainment should be monitored to determine if there are any effects to Columbia River ESA-listed species such as bull trout, salmon and steelhead;
    d. Annually report findings and recommendations to the Service and WDFW; and
    e. Adapt fishery management actions in response to new conditions, including but not limited to changes in fish stocking strategies, system rehabilitation, and changes to fishing rules.

- The Service further recommends that water conservation measures continue to be implemented as a means to conserve water in the Project Area, avoid increased use of Columbia River water for agricultural irrigation, and minimize impacts to wetlands and wetland species.
- Reclamation and Ecology, in coordination with WDFW, should evaluate changes to wetland habitat and species within the Odessa Subarea, in association with water use changes.

Mitigation of the Effects to Vegetation

- Locate construction staging areas, in coordination with WDFW that would avoid or minimize disturbance to wildlife and damage to priority habitats, including aquatic resources. Locate all staging areas in such a manner as to preclude water and soil contamination from solvents, fuels, and lubricants. Also all staging areas should be adequately equipped to deal with hazardous material spills, spill prevention, and clean-up.
- All contracts awarded should require that workers comply with Best Management Procedures (Reclamation 2008b) to prevent the introduction of non-native plant and animal species in terrestrial and aquatic habitats. Monitor and manage disturbed areas post-construction to prevent the introduction and spread of non-native plants.
- In consideration of Executive Order 13112, dated February 3, 1999, regarding invasive plant species, Reclamation should develop a weed management plan that will include clear goals for the control and eradication of invasive exotic plants, as well as methods and a timeline for meeting those goals in areas affected by the selected action alterative.
- In consultation with the Service and WDFW develop and implement a Native Plant Restoration and Conservation Management and Monitoring Plan for documenting performance criteria, establishing clear goals and objectives, a schedule, and annual reports to evaluate the success of Reclamation's efforts to avoid permanent impacts to native vegetation. This plan should address Federal and State listed species, Species of Concern, and should cover all areas impacted by construction activities. We recommend that monitoring occur for 7 years following restoration efforts. The determination of adequate replacement ratios/locations for impacted wetland habitats should occur in consultation with Ecology and WDFW. Mitigation for affected riparian areas should be done according to the ratios for mitigation set forth below. Due to the time frame required to restore shrub-steppe with biotic soil crust and the uncertainty of successful restoration, any disturbance to the biotic crust should be considered long-term and replacement lands should be provided as mitigation for their destruction.
- To compensate for the loss of native habitat due to construction activities, Reclamation should develop, in association with the Service and WDFW, a mitigation plan containing a provision for monitoring restoration efforts for a minimum of 7 years. If, after 7 years, restoration has not been adequately successful (meaning it does not meet the goals of the plan), mitigation lands should be acquired at established mitigation ratios (WDOE 2004, Appendix 8-D, pp. 17-20; WDFW 2009a, p. 20) Wetland mitigation is based on a variety of variables and should be determined in consultation with WDOE and WDFW. The ratios shown below are suggested starting points for further discussion and may change based on final project impacts and further negotiations. Shrub-steppe, grassland, and riparian habitats have established mitigation ratios as shown below (Table 9):

Table 9. Recommended Habitat Mitigation Ratios

Habitat Type	Permanent Disturbance	Temporary Disturbance
Shrub-steppe[1]	2:1	0.5:1
Grassland[1]	1:1	0.1:1
Riparian[2]	20:1	10:1

1. (WDFW 2009a, p. 20)
2. (WDOE 2004, Appendix 8-D, pp.17-20)

- If suitable areas for shrub-steppe mitigation are not present in the immediate Project Area, then another location will need to be selected in the Project Area and evaluated for use as mitigation. If a suitable area for restoration cannot be found in the Project Area, then Reclamation should work with the Service to find mutually agreeable mitigation lands in the mid-Columbia area.
- Any mitigation land acquisitions will require maintenance or transfer to a land management agency for management and maintenance of resource goals and must include adequate funding to attain those goals.
- Work cooperatively with the South Central Washington Shrub Steppe and Rangeland Partnership, as well as WDFW regional wildlife and habitat staff, to identify areas of shrub-steppe habitat that could be protected or restored as mitigation for any shrub-steppe habitat lost during the implementation of the Project. Assist the Service in identifying agricultural lands that will not be farmed or dry-land farming areas suitable for shrub-steppe restoration, particularly areas that may provide sage-grouse habitat connectivity.

Mitigation for the Effects to Wildlife

- Reclamation should work with the Service and WDFW to identify and protect any existing Federal and state endangered, threatened, candidate, species of concern, and state sensitive plant species and their associated habitats that may occur within the Project Area. Surveys should be conducted at the appropriate time and frequency in areas of permanent or temporary disturbance to detect the presence of any state or federally listed species, candidate species or species of concern.
- To avoid impacts to any existing pygmy rabbits, survey all suitable pygmy rabbit habitat prior to beginning construction in those areas. Coordinate with the Service if pygmy rabbits are found in the Project area.
- During construction, minimize or avoid all vegetation removal during the avian nesting season, to minimize the effect of the action on federally protected migratory birds. Typically the nesting season in this part of Washington occurs between March and August annually.

- To avoid displacement of wildlife from high value habitats to less suitable habitat by human activities, any future recreation facilities should be located away from important wildlife use areas, including wildlife mitigation lands.
- Locate any above ground structures in areas that would cause the least disturbance to wildlife and loss or degradation of wildlife habitats. Creation of any barriers to or fragmentation of travel corridors for wildlife should also be avoided. Barriers to wildlife movement would include fences, roads, power lines, pipelines, canals, and large water bodies.
- If reservoirs (storage and re-regulation) are created, design them to include wetland and riparian habitats that do not negatively impact existing shrub-steppe habitat and species.
- Based on the significant loss of wildlife habitat that would occur with the creation of new reservoirs, we recommend that Reclamation consult with WDFW to establish a wildlife management area adjacent to the reservoirs, in areas that would be able to provide suitable wildlife habitat for waterfowl and shorebirds and that a wildlife management plan be developed to guide the management of that area.
- Reclamation and Ecology should consult with WDFW to establish a "Banks Lake Grebe Management" area and provide and maintain floating nesting structures in an effort to avoid additional significant impacts to grebes.
- Activities associated with the Black Rock Coulee Flood Storage Area have potential for significant impacts to Washington ground squirrels. In addition, widening the East High Canal will likely disturb Washington ground squirrel colonies. If Washington ground squirrels will be affected by construction, Reclamation and Ecology should coordinate with the Service and WDFW to identify suitable habitat for their potential translocation and facilitate translocation activities, if recommended.
- Design and implement measures to maintain the connectivity of wildlife habitats and provide for the movement of wildlife within the Project Area. Mitigation measures should include wildlife crossings and escape mechanisms for canals, roads, pipelines and other structures, to minimize wildlife mortality and to maximize potential gene flow between populations. Bury pipelines underground, when pipelines present a barrier to the movement of wildlife, and restore native vegetation along the pipeline corridor and other construction areas. Reclamation should consult with WDFW for appropriate native plants for this purpose.
- To reduce impacts to northern leopard frogs and other amphibians, Reclamation should work cooperatively with WDFW to assist them in developing and implementing, in consultation with the Service, a Northern Leopard Frog Monitoring and Habitat Enhancement Plan for northern leopard frog habitat within the Project Area. The plan should:

- o Develop the means to investigate whether water level fluctuations within the project's canals and reservoirs are impacting northern leopard frog habitat and reproductive success.
- o Identify areas to enhance northern leopard frog habitat within the Project Area, particularly in and around the Gloyd Seeps, Willow Springs, Potholes Reservoir, Columbia National Wildlife Refuge and middle Crab Creek areas.
- o Develop and implement an inventory and monitoring plan to determine frog occurrence, reproduction, and the extent of suitable habitat within the Project Area. Inventory and monitoring of suitable habitat should occur for a minimum of 7 years after the operational changes for this project take effect and be conducted in areas created or enhanced for northern leopard frog habitat. The plan should monitor project effects on all northern leopard frog populations known to occur in the Project Area. Occurrence, population trends and the presence of other amphibian species (including invasive amphibian species, such as bull frogs) should be documented within existing northern leopard frog habitat in the Project Area. Habitat changes and the effects of operations on northern leopard frogs and their habitat within the Project Area should be documented.
- o Adaptively manage the project so as to increase frog populations, protect occupied and unoccupied habitat and increase suitable habitat within the Project Area.

- Ensure that treated power distribution and transmission poles are not installed in areas that have potential to leach into irrigation canals, ponds, creeks, wetlands, groundwater or any waters of the state.
- All transmission lines and guy wires should be constructed to avoid avian species electrocution and collisions. Implement techniques set forth in the Service's *Avian Protection Plan Guidelines* (USFWS 2005a) to protect birds using project facilities.
- Provide artificial burrowing owl nesting structures in areas where their populations may decline as a result of the Project. Coordinate with WDFW on the placement, design, and installation of the nesting structures. Examine use of the right-of-way (i.e., expansion dirt piles) along the East Low Canal as potential nesting habitat for this species. Protect earthen nesting areas with "Soil Removal Prohibited" signs.
- If fence is constructed in sage-grouse habitat, install reflective tape or other reflective devices at 4-foot intervals along all wire fencing to reduce bird collisions. Wire fence construction specifications should comply with designs recommended by WDFW for sage-grouse protection.
- Where applicable, implement Reclamation's best management procedures as set forth in the *Integrated Pest Management Manual for Effective Management on Reclamation Facilities* (2008a); and to protect sage-grouse and its habitat, incorporate the Natural Resources Conservation Service's sage grouse

conservation measures set forth in the *Conference Report for the Natural Resources Conservation Service Sage-grouse Initiative* as best management practices for the Project (NRCS 2010).

10.0 SUMMARY AND CONCLUSION

Under authority of the Columbia Basin Project Act of 1943, as amended, and the Reclamation Act of 1939, the Bureau of Reclamation has proposed substituting Columbia River water for groundwater currently used for agriculture. This proposal contains seven possible action alternatives in addition to the no-action alternative. Four alternatives (2A, 2B, 4A, and 4B) would primarily use the existing infrastructure to supply water to areas South of I-90, whereas the other two alternatives (3A and 3B) would use existing infrastructure to supply those areas South of I-90 and construct new infrastructure to supply areas North of I-90. Water would be supplied via Banks Lake, Lake Roosevelt, or a combination of these water supply sources.

The Service and WDFW have collaborated to examine possible impacts resulting from the Project and to coordinate mitigation and recommendations for the project. WDFW's comments and recommendations are attached as an appendix to this report.

Pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C 661-667e) and the 2008 and 2010 Interagency Agreements between the U.S. Fish and Wildlife Service (Service) and the Reclamation, the Service has prepared a coordination act report (CAR) examining the impacts of six proposed alternatives, as well as a No Action Alternative. Based upon information contained in the draft Environmental Impact Statement, surveys conducted by Washington Department of Fish and Wildlife (WDFW) as reported in the Odessa Subarea Special Study Habitat Evaluation Procedures Project and the Odessa Subarea Special Study 2009 Wildlife Surveys Annual Report, other information in this office, and various previous studies and reports on record, the Service has determined that Alternative 4A is the best alternative for fish, wildlife, and their habitats.

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ATTACHMENT 1
COORDINATION ACT REPORT

WDFW Recommendations for the Odessa Subarea Special Study, Coordination Act Report

ATTACHMENT 1

State of Washington
Department of Fish and Wildlife
Mailing Address: 600 Capitol Way N. • Olympia, WA 98501-1091 • (360) 902-2200, TDD (360) 902-2207
Main Office Location: Natural Resources Building • 1111 Washington St. SE • Olympia, WA
Region 2 Office - 1550 Alder Street - Ephrata, WA 98823

July 16, 2012

Jessica L. Gonzales
U. S. Fish and Wildlife Service, Central Washington Field Office
215 Melody Lane, Suite 119
Wenatchee, WA 98801

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RE: WDFW Recommendations for the Odessa Subarea Special Study, Coordination Act Report

Dear Ms. Gonzales,

The Washington Department of Fish and Wildlife (WDFW) appreciate the opportunity to have worked closely with the U.S. Fish and Wildlife Service (Service) throughout the Odessa Subarea Special Study Environmental Review. WDFW continues to be concerned with: protection of northern leopard frogs if operations at the Potholes Reservoir changes, impacts to Washington ground squirrels, the impacts to nesting grebes in Banks Lake, potential changes to waterfowl usage and production, fish production and assemblages, fishing opportunities as a result of changing project operations, and continued incremental losses to shrub steppe and wetland habitats. In addition, individual project components exempt from additional State Environmental Policy Act (SEPA) review (RCW 43.21C.030) and local, state, and federal permitting could result in overlooking an impact not anticipated during initial review.

WDFW values the Service's commitment to the development of the Coordination Act Report (CAR); the CAR highlights many of the same concerns and solutions expressed by WDFW throughout the review process. WDFW is dedicated to the protection and enhancement of fish and wildlife resources within the Odessa Subarea and the conservation measures developed by the Service are indicative of the fisheries and terrestrial resource needs within it.

WDFW recognizes that continued, close working relationships with the Service are vital as the project progresses towards implementation to assure conservation measures and resource recommendations are pursued and adaptive management strategies deployed are favorable to fish, wildlife, and their habitats. WDFW further recognizes the necessity to make every effort to ensure project implementation and natural resource protection/enhancement occur such that the contributions to local and state economies through fish and wildlife related recreation are not compromised from the implementation of the Odessa Program. Thank you for the opportunity to work collaboratively on the development of the CAR! Please feel free to contact me with questions or concerns.

Sincerely,

Dennis Beich
Region 2 Director

Appendix B
Washington Department of Fish and Wildlife Odessa Subarea Coordination Act Report Recommendations

July 16, 2012

Recommendations provided have been developed by WDFW in coordination with the U.S. Fish and Wildlife Service (Service). Recommendations provided here serve as an appendix to the final CAR. Recommendations were developed based on information provided within the Odessa Subarea Special Study Draft Environmental Impact Statement (EIS) dated October 26th, 2010 and the distribution of the draft modified, Proposed Alternative (May 2012; June 2012).

Introduction

WDFW recognizes that Engrossed Second Substitute House Bill (ESSHB) 2860 directs the Washington State Department of Ecology (Ecology) to aggressively pursue development of water supplies to benefit both in-stream and out-of-stream uses through storage, conservation and voluntary regional water management agreements. Currently, Ecology is working within their regulatory framework to achieve objectives of ESSB 2860 and has identified that utilizing Columbia River surface water to replace current groundwater irrigation located in Adams, Franklin, Grant, Lincoln, and Walla Walla Counties, Washington may be a viable option.

Ecology is partnering with the United States Bureau of Reclamation (Reclamation) to study how farms currently served by the declining Odessa aquifer can be supplied with surface water from the Columbia River. Reclamation prepared an EIS in cooperation with Ecology to comply with the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA). The Odessa Subarea Special Study DEIS is part of the original development plan for the Columbia Basin Project (CBP), which focuses on replacing groundwater currently used for irrigation in the Odessa Ground Water Management Subarea with surface water.

Reclamation and Ecology have identified a combination of full and partial groundwater replacement alternatives. However, due to the anticipated complexity of the project, Reclamation and Ecology will use a "tiered" review process.

Tiered Approach

Reclamation and Ecology will use a tiered approach to implement any of the action alternatives, which may require additional environmental compliance to evaluate resource impacts. Reclamation and Ecology have identified the current Draft EIS as the initial environmental review within the tiered review process. This means that project or actions advanced out of this first-tier EIS will undergo subsequent second-tier, project-level environmental review under NEPA and SEPA before being advanced for implementation. The tiered approach is a step-by-step process that will require additional environmental compliance, mitigation, and local, state, and federal permitting.

As paraphrased from 40 C.F.R § 1508.28 - Tiering is appropriate when the sequence of decision-making or analyses is (a) From a program, plan, or policy EIS to a program, plan, or policy analysis of lesser scope, or to a site specific statement or analysis; or (b) From an EIS on an action at an early stage to a supplemental EIS or subsequent analysis at a later state.

WDFW should be consulted prior to construction of water conveyance systems, pump stations, substations, electrical distribution and transmission, and the acquisition of infill properties to avoid impacts to fish, wildlife, and their habitat if not initially contemplated.

Project Description

Alternatives

Beyond the No Action Alternative, the DEIS proposed several reservoir operational combinations of FDR and Banks Lake to store and convey water for irrigation. Alternative 2A & 2B (partial replacement) would provide CBP surface water to approximately 57,000 acres currently using groundwater south of I-90, Alternative 3A & 3B (full replacement) would provide CBP surface water to approximately 102,000 acres to most groundwater-irrigated lands, and Alternatives 4A & 4B (modified partial) would provide CBP surface water to approximately 70,000 groundwater-irrigated acres within the Odessa Subarea. In addition, there are two water diversion scenarios that apply to each alternative that includes a spring and a limited spring diversion scenario (Table 1).

Table 1. Odessa Diversion Scenario Summary, Odessa Subarea Special Study.

Odessa Diversion Scenario Summary Table			
Diversion Scenario	**Spring (April-June)**	**October**	**November-March**
Spring	Diversion from Columbia River allowed when flows exceed 260,000 cfs at McNary Dam	Up to 2,700 cfs	Up to 350 cfs
Limited Spring	Diversions from Columbia River allowed when flows exceed 200,000 cfs at Grand Coulee Dam	Up to 2,700 cfs	Up to 350 cfs

In coordination with the Service, WDFW identified the following potential impacts based on the information provided in the DEIS and studies conducted by WDFW under contract with Ecology:

WDFW notes that environmental impacts are very high for the Full Replacement alternatives 3A and 3B. Impacts to native shrub-steppe communities and wildlife migration corridors due to the development of the East High Canal, pumping plants, substations, transmission lines, and other supporting infrastructure would be significant. In particular, inundation of the Black Rock Coulee as a result of the re-regulation reservoir would significantly impact the largest known contiguous aggregation of Washington Ground Squirrels; a candidate for listing under both federal and state endangered species statutes. The Black Rock Coulee area also includes near-perennial wetlands that are rare on the Columbia Plateau. Instead of being inundated to form the Black Rock Coulee re-regulation reservoir; WDFW will continue to advocate that is area be protected as it is a unique attribute within the Columbia Basin.

Even under partial replacement alternatives, a great deal of uncertainty remains regarding water management regimes and ecological responses. However, it is clear that impacts to wildlife and wildlife habitats are far less significant for the partial replacement alternatives than for full replacement alternatives.

As a result of the comments received during the DEIS comment period, Reclamation and Ecology notified WDFW that Alternative 4A (modified partial replacement) will move forward in the FEIS as the proposed, preferred alternative.

Resource Impacts

WDFW comments to the DEIS provided a detailed discussion of the potential impacts of implementing each of the alternatives, as well as a list of recommendations to avoid or reduce resource impact (Appendix C). However, Alternatives 4A and 4B were not directly evaluated. It is anticipated that the environmental commitments, mitigation measures, and best management practices within the FEIS will resolve resource impacts associated with the proposed alternative. Below represents a generalized list of likely and potential impacts and resource concerns associated with the action alternatives presented in the DEIS.

- Operational changes in Banks Lake will result in adverse, significant impacts to Western Grebe nesting success, thus reducing successful grebe reproduction success.
- Construction of the East High Canal would have significant, adverse impacts to wildlife by fragmenting habitats and impeding wildlife access by bisecting lands habitats.
- The Black Rock Coulee Flood Storage Area has potential for significant, adverse impacts to Washington ground squirrels from inundation. In addition, excavation work to construct the East High Canal alignment will likely disturb Washington ground squirrel colonies.
- Additional fragmentation of shrub-steppe within the Odessa Subarea would result in significant impacts to obligate shrub steppe species; fragmentation could further reduce the amount of sage grouse critical habitat available.
- If operational changes occur to the Potholes Reservoir, this could threaten the survival of the only known remaining Northern leopard frog population in Washington.
- Intensification of irrigation associated with "infill" irrigated lands may create barriers to wildlife movement and/or exacerbate wildlife habitat

fragmentation. "Infill" may shift irrigation water to fields that are currently "dry-land" farmed and/or enrolled in CRP; intensification of agriculture may reduce habitat value to wildlife.

- Altered Banks Lake operations will reduce recreational fishing opportunities in ways that are difficult to predict. Changes in fishery characteristics (e.g., catch-per-unit-effort or species composition of the creel) could reduce the numbers of anglers participating in the Banks Lake fishery, which could result in a significant, adverse impact to the economic vitality of the region.
- On-going water conservation actions that deliver surface water to Odessa Subarea groundwater users (No Action Alternative) could reduce wetland habitats.
- Impacts on mainstem Columbia River salmonids as a result of warmwater fish escaping out of the project area are unknown.

WDFW Recommendations

The recommendations developed for the Final CAR address the resource impacts addressed above. The recommendations are a product of several WDFW reports submitted to Ecology for the purpose of identifying and evaluating potential impacts to fisheries and terrestrial resources within the Odessa Subarea, as a result of the action alternatives. Recommendations set forth in this document do not specifically respond to the Proposed, Preferred Alternative in the event that the "Preferred Alternative" is not the alternative supported by a Record of Decision (ROD).

Following is a list of protection and conservation recommendations, most of which correspond with the mitigation measures provided by the USFWS in this report and the WDFW comments sent in response to the October 26th, 2010 DEIS. The scientific basis that led to these recommendations can be found in more detail in the reports provided by WDFW and subcontractors in 2009-2011 and WDFW's DEIS comment letter submitted to Reclamation and Ecology on January 31, 2011 (Appendix C).

Reports used in the development of the recommendations listed below include:

Gabriel, A. and Cordner, D. 2009. Shoreline Habitat Characterization and Analysis for the Banks Lake Fishery Evaluation Project (Phase 2), Central Washington University. Prepared for the Washington State Department of Fish and Wildlife, Submitted to the Washington State Department of Ecology.

Miller, P. and Ashely, P. December 2009. Odessa Subarea Special Study Habitat Evaluation Procedures Project, Washington State Department of Fish and Wildlife.

Polacek, M., Stotz, G., and Didricksen, D. July 2011. Banks Lake Primary Productivity, Fish Bioenergetics, and Fish Entrainment Evaluations - Final Report Washington State Department of Fish and Wildlife.

Sullivan, C., McFadden, B., and Nealson, P. 2010. Final Report: Hydroacoustic Estimation of Fish and Entrainment at Dry Falls Dam in 2009 and 2010. Prepared for the Washington State Department of Fish and Wildlife, Submitted to the Washington State Department of Ecology.

Wisniewski, J., Hoenes, B., and Finger, R. 2009. Annual Report for the Odessa Subarea Special Study Wildlife Survey Final Report, Washington State Department of Fish and Wildlife, Region 2, Ephrata, Washington.

Wisniewski, J., Hoenes, B., and Finger, R. 2010. Final Report for the Odessa Subarea Special Study Wildlife Survey Final Report, Washington State Department of Fish and Wildlife, Region 2, Ephrata, Washington.

AQUATIC RESOURCES

Reclamation and Ecology should work cooperatively with WDFW to:

1. Monitor reservoir and lake primary and secondary productivity (zooplankton) to evaluate fishery effects in Banks Lake for 5 consecutive years following operational changes and every 3 years for the life of the project;
2. Conduct creel surveys for 5 consecutive years following operational changes to assess any changes in annual angler effort, harvest, and catch and every 3 years for the life of the project;
3. Monitor warmwater fish entrainment out of the irrigation delivery systems within the Odessa Subarea into the mid-Columbia River for 2 consecutive years to ensure protection of ESA listed spring Chinook salmon and threatened steelhead salmon;
4. Adapt fishery management actions in response to new conditions, including but not limited to changes in fish stocking strategies, system rehabilitation, and changes to fishing rules for the life of the project and;
5. Evaluate, and if feasible, implement a strategy to "boost" the kokanee fishery in Banks Lake;
6. Monitor changing reservoir conditions with the Odessa Subarea, including temperature and flow to evaluate changes to fish assemblages, spawning habitat, and entrainment rates; and
7. Report findings and recommendations for 5 consecutive years and every 3 years for the life of the projects.

WILDLIFE

WESTERN GREBES

Reclamation and Ecology should work with WDFW to:

1. Establish a "Banks Lake Grebe Management" area and provide and maintain floating nesting structures within Banks Lake to mitigate impacts associated with additional Banks Lake elevation reductions; and

2. Develop monitoring protocols to report success of management measures (floating nest structures) to adapt the number and location of floating nesting structures as needed.

NORTHERN LEOPARD FROGS

In the event that changes to Potholes Reservoir beyond current operations needs to occur to implement the Odessa Project, Reclamation and Ecology should work with WDFW to:

1. Monitor water elevations in Potholes Reservoir by a subsample of ponds within areas identified as habitat for Northern Leopard Frogs for 2 years pre-project and 2 years post-project if operations at Potholes Reservoir are expected to change;

2. Monitor Northern leopard frog populations for 7 years within the Potholes Reservoir if changes to current reservoir operations change; 2 years pre-project and 5 years post-project; and

3. In coordination with the Service, work on developing a Northern leopard frog supplementation program within the Potholes Reservoir to maintain, sustain, and increase populations to avoid federal listing under the Endangered Species Act.

WASHINGTON GROUND SQUIRRELS

Reclamation and Ecology should work with WDFW to:

1. Conduct research to test and perfect translocation methods;
2. Identify suitable WGS habitat as target locations for WGS translocation; and
3. Acquire land within the Black Rock Coulee area to protect the large WGS colony located there.

BURROWING OWLS

Reclamation and Ecology should work with WDFW to:

1. Install and cluster artificial burrowing owl nesting in the banks of the East High

Canal (south of Black Rock Coulee) and in the East Low Canal expansion and extension sections.

Habitat Connectivity

Connectivity

Reclamation and Ecology should work with WDFW to:

1. Provide wildlife crossings and escape ramps within canals per WDFW design and placement recommendations WDFW (DEIS, 2010);
2. Design new bridges constructed over canals within the Odessa Subarea with inter-beam spaces (i.e. crevices) such as parallel box beam, cast in place, or those made of pre-stressed concrete girder spans to provide bat habitat when feasible; and
3. Identify and evaluate habitat use patterns and general population dynamics of mule deer herds within the Odessa Subarea to develop management strategies.

Vegetation

Shrub-Steppe and Grasslands

Reclamation and Ecology should work with WDFW to:

1. Implement the WDFW/Ecology Shrub-Steppe Mitigation Agreement relative to permanent losses of shrub steppe related to this project (Appendix D). Losses of other native grassland habitats should be mitigated per the WDFW Wind Power Guidelines (Table 2).

Table 2. Minimum, accepted mitigation ratios as used by WDFW Wind Power Guidelines (2009) and recommended by USFWS (Odessa Subarea Special Study Draft CAR, 2011).

Habitat Type	Permanent Disturbance*	Temporary Disturbance
Shrub-steppe	2:1	0.5:1
Grassland	1:1	0.1:1

**These ratios only include mitigation ratios for impacts to habitat and are subject to increases in areas utilized by a state species of concern, a state threatened species, or a state candidate species.*

2. Develop and implement an Upland Native Plant Restoration and Conservation Management Plan, in coordination with the USFWS, to implement mitigation ratios (Table 2) and monitor success for a minimum of 7 years. The plan should include:
    a. Clear goals, objectives, performance criteria, and an implementation

schedule;

b. Provisions for annually reporting and evaluating the success of native plant restoration and conservation; and

c. Identification of areas within and outside the Odessa Subarea that could serve to mitigate shrub-steppe and grassland loss if replacement cannot occur within the impacted area.

3. If, after 7 years, restoration has not been adequately successful, explore acquiring mitigation lands at established mitigation ratios and in consultation with WDFW and the Service.

RIPARIAN AND WETLANDS

Reclamation and Ecology should work with WDFW to:

1. Stabilize banks with riparian/wetland vegetation to promote habitat use and avoid increased sedimentation from bank erosion caused by reservoir fluctuations;

2. Establish long-term mechanisms to protect project water that sustains priority and productive riparian and wetland areas;

3. Deliver water from the East Low Canal to Artesian and Black Lakes throughout the irrigation season to provide additional open-water and riparian habitat for waterfowl, migratory birds, and other wildlife;

4. Investigate wetland hydrology activities such that Artesian and Black Lakes function as alkali, vernal pools, as they did historically; and

5. Re-vegetate and maintain new and enhanced wetland lands to reduce invasive species establishment and provide wildlife benefits.

IRRIGATED AGRICULTURAL LANDS

Reclamation and Ecology should work with WDFW to:

1. Develop a set of habitat criteria to assure lands are not inadvertently converted from a naturalized habitat to irrigated agricultural lands via the "infill" program;

2. Ground truth aerial analyses used to choose the infill lands to evaluate potential impacts to wildlife and their habitat (e.g. important migration corridor for mule deer or Washington Ground Squirrel habitat);

3. Identify any additional opportunities for wildlife benefits on agricultural lands; and

4. Determine if any of the potential "infill" lands are currently located within designated CRP.

RECREATION

FISHERIES

Reclamation and Ecology should work with WDFW to:

1. Develop a Monitoring and Evaluation Plan to identify and implement management strategies to sustain fishing opportunities within the Odessa Subarea; activities should include:
    a. Fish stock assessment activities;
    b. Investigating changes to fishing regulations;
    c. Altering fish stocking species mix, numbers, timing, or sizes;
    d. Providing facilities or resources that increase fish stocks' self-sustainability; and
    e. Enhancing fishers access to the fishery;

2. Conduct creel surveys in reservoirs within the Odessa Subarea every 3 years to evaluate potential adverse impacts to the recreational fishery.

ACCESS

Reclamation and Ecology should work with WDFW to:

1. Continue to allow and increase public access to Reclamation lands for hunting, wildlife viewing, hiking, biking, and fishing opportunities;

2. Promote new recreational opportunities within the Odessa Subarea, including but not limited to joint signage, radio advertisements, new releases, and web media;

3. Upgrade and potentially construct new boat launches impacted by changes in the operations of Banks Lake; and

4. Continue dedication of fishing and hunting easements on lands deeded from Reclamation consistent with the original intent of the CBP for wildlife-related recreation.

HYDROLOGY

COLUMBIA RIVER AND FLOWS

Reclamation and Ecology should work with WDFW to:

1. Water supply to serve the Odessa comes from Lake Roosevelt, thus reducing flows in the mainstem Columbia River. Reclamation and Ecology should ensure that diversions from Lake Roosevelt for this project occur during times when flows exceed minimum instream flow rules and flow targets provided in the FCRPS BiOp [Odessa DEIS section 4.2]; and
2. Reclamation should continue to obtain flowage easements in natural coulees and low-lying topographical areas to accommodate future climate change scenarios, waste water collection, and for flood protection

GENERAL PROVISIONS

Reclamation and Ecology should work with WDFW to:

1. Identify funding mechanisms to provide additional operation and maintenance funds to control weeds and protect fish, wildlife, and their habitat on lands within the Odessa Subarea - managed by WDFW for Reclamation;

2. Given the uncertainty around implementation of the tiered Odessa Program, opportunities for enhancement to wetlands and wetland species should be investigated as needed;

3. Ensure that non-treated distribution and transmission poles are installed in areas that have potential to leech into irrigation canals, ponds, creeks, wetlands, groundwater or any waters of the state; and

4. WDFW's goal is to achieve no net loss of populations, habitat functions, and values. If unavoidable impacts occur or in circumstances that will require additional environmental compliance (e.g. new transmission lines), Reclamation and Ecology should consult with the Service and WDFW to adopt mitigation sequencing actions to assure impacts are addressed.

Works Cited

U. S. Bureau of Reclamation & Washington State Department of Ecology, October, 2010. Odessa Subarea Special Study Draft Environmental Impact Statement.

U.S. Bureau of Reclamation, May 2012, Draft Proposed, Preferred Alternatives, personal communication.

U.S. Bureau of Reclamation, June 2012, Draft Proposed, Preferred Alternatives, Update, personal communication.

Appendix C
Washington Department of Fish and Wildlife
WDFW Comments – Odessa FEIS

January 31, 2011

State of Washington
Department of Fish and Wildlife
Mailing Address: 600 Capitol Way N. • Olympia, WA 98501-1091 • (360) 902-2200, TDD (360) 902-2207
Main Office Location: Natural Resources Building • 1111 Washington St. SE • Olympia, WA
Region 2 Office - 1550 Alder Street - Ephrata, WA 98823

January 31, 2011

Mr. Charles A. Carnohan
Columbia-Cascades Area Office
U. S. Bureau of Reclamation
1917 Marsh Road
Yakima, WA 98901-2058

Mr. Derek I. Sandison
Director, Office of Columbia River
Washington State Department of Ecology
15 West Yakima Avenue, Suite 200
Yakima, WA 98902-3401

RE: WDFW Comments on the Odessa Subarea Special Study, Draft Environmental Impact Statement

Dear Mr. Carnohan and Mr. Sandison,

The Washington Department of Fish and Wildlife (WDFW) appreciates the opportunity to provide comments to the October 24th, 2010 Draft Environmental Impact Statement (DEIS) issued for the Odessa Subarea Special Study in accordance with the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA). The enclosed comments provided by WDFW have been formulated with the understanding that it is a priority for the State of Washington to replace groundwater currently used for irrigation in the Odessa Ground Water Management Subarea with surface water from the Columbia Basin Project. Cooperation among WDFW, the Washington Department of Ecology (Ecology), and the U. S. Bureau of Reclamation (Reclamation) has been steady throughout the development of this project, and WDFW looks forward to this continuing as Ecology and Reclamation move toward implementation of a preferred alternative.

WDFW is mandated to

> *"... preserve, protect, perpetuate, and manage the wildlife and food fish, game fish, and shellfish in state waters and offshore waters ... in a manner that does not impair the resource. ... consistent with this goal, the department shall seek to maintain the economic well-being and stability of the fishing industry in the state. The department*

> ***shall promote orderly fisheries and shall enhance and improve recreational and commercial fishing in this state."1***

Consistent with this charge, WDFW has been working with Reclamation and Ecology throughout project development to address general and site-specific environmental concerns to reduce or avoid environmental impacts, identify potential resource enhancements, and recommend mitigation. To a certain extent this has been successful, and several project enhancements have been included within the project alternatives that benefit impacted species. However, many uncertainties remain regarding potential Odessa-project-related impacts to WDFW-managed resources.

WDFW and Ecology are committed to narrowing those uncertainties and ensuring that actions are taken throughout project implementation to avoid or mitigate significant project impacts on fish, wildlife, habitats, and the public benefits they provide. Further, WDFW and Ecology will develop a monitoring, evaluation, and adaptive management approach to project implementation that will allow us to collect data on key indicators and adapt the project – or design mitigation – to protect fish and wildlife values.

Setting aside project uncertainties, the EIS overall tends to minimize potential significant environmental impacts, and WDFW must respond to this. WDFW would specifically like to see additional assessment of the potential for significant impacts to northern leopard frogs due to altered Potholes Reservoir operations, impacts to Washington ground squirrels throughout the project area, lake-drawdown impacts to nesting grebes, and incremental losses to shrub steppe habitats, as follows:

- There is potential for impacts to Northern leopard frogs from reservoir operational changes in Potholes Reservoir. These impacts threaten the survival of the only known remaining northern leopard frog population in Washington. Although these frogs are not yet listed under the federal Endangered Species Act, WDFW's management priority is to protect and improve their status in Washington. WDFW requests that potential impacts to northern leopard frogs be evaluated in the FEIS.
- Impacts on Washington ground squirrels living along the pathway of the proposed East High Canal (EHC) are not thoroughly evaluated. Washington ground squirrels are listed as candidate species under federal and state ESA statutes, and EHC development clearly represents a major impact to the Washington ground squirrel population. In addition, a densely populated ground squirrel colony is located within the Black Rock Coulee Flood Storage Area, which extends throughout the majority of the Black Rock Coulee reregulating reservoir and flood zone footprint; this colony is probably the largest contiguous Washington ground squirrel colony currently known. Measures need to be taken to avoid impacting large aggregations of these squirrels. WDFW will work with Reclamation and Ecology to identify for the FEIS additional avoidance, protection, and mitigation measures related to Washington ground squirrels and shrub steppe habitat along the EHC alignment and within Black Rock Coulee. An adaptive management program should identify long-term mitigation alternatives to be employed if short-term mitigation measures do not meet expectations.

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1 Title 77.04.12 Mandate of the department and commission.

- Altered Banks Lake operations under any of the Banks alternatives would impact nesting grebes by disturbing their nests during breeding season. The DEIS identifies this, but suggests no mitigation for this impact. Fortunately, the prospect for mitigation is good, since measures are well-established for this type of impact. WDFW looks forward to working with Reclamation and Ecology to identify specific mitigation measures to be included in the FEIS.
- Incremental losses of native shrub steppe habitat in areas within and adjacent to the Columbia Basin Project present challenges for survival for shrub-steppe-obligate species. To the extent that further development of the Columbia Basin Project causes additional shrub steppe conversion, those conversions must be mitigated. In 2010, WDFW and Ecology penned an agreement for mitigation of shrub steppe habitats lost due to Ecology OCR projects,[2] and this MOA should be incorporated into the FEIS.

WDFW also suggests the following improvements be incorporated into the FEIS:

- Many of the Chapter 4 significance criteria are subjective and/or vague. Please provide clear numeric criteria/thresholds that define significance for the purposes of impacts determinations in Chapter 4. Where significance criteria are difficult to quantify, please identify a program that includes monitoring for project effects, evaluation for significance, and mechanisms for project adaptation or mitigation.
- The DEIS concludes for several environmental topics that none of the action alternatives causes enough impact to require mitigation, even in circumstances where significant impacts have been identified for specific elements. Please ensure that determinations of significance that are identified throughout the FEIS are linked to mitigation for those impacts.
- Text presented on page 4-131 regarding the relationship between mainstem Columbia River stream flow and fish survival contains many inaccuracies and does not represent a shared perspective among project partners. Please replace or omit this text. A proposed replacement is provided in appendix B.
- DEIS assessments of ecological responses of terrestrial and aquatic wildlife and habitats to changes in water operations are incomplete. Changes in hydrological regimes within the project footprint, and altered reservoir operations, could result in major impacts to aquatic species and fisheries. The detailed analysis of reservoir elevations provided in the DEIS is very helpful for the assessment of changes to lake productivity, but other project conditions such as inflow/outflow are equally important, yet are not specifically addressed in the DEIS. Data on predicted changes to the existing water "flow" regime through the reservoir would be helpful in predicting impacts from entrainment of fishes and zooplankton. Please provide more information and evaluation for inflow/outflow in the FEIS.

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2 Memorandum of Agreement between Washington Department of Fish and Wildlife and Department of Ecology Office of Columbia River related to the Mitigation of Impacts of Office of Columbia River Projects to Shrub Steppe Habitats. July 9, 2010.

- The FEIS must identify funding mechanisms to support mitigation activities, along with a process through which the success of those measures can be assured.

Fisheries Effects

The Banks Lake fishery is a primary economic driver for central Washington, and this fishery must be supported if it is to continue to play an important role in local economic sustainability. Fisheries in Billy Clapp Lake, Moses Lake, and Potholes and Skooteney Reservoirs are also important economic contributors. WDFW believes that the Odessa project alternatives could alter lake conditions enough to significantly change fishing success, fishing effort, and therefore local economic contributions from these fisheries. WDFW asks that potential for fishery changes be considered in choosing a preferred alternative.

The current economic analysis (Appendix A to the DEIS) provides detail on the economic impacts of low lake levels on boat launches, yet does not link this analysis with the reason most people launch boats – which is primarily to fish. Please include in the FEIS an economic analysis that evaluates impacts to the fishery-based economic activity in the project area under foreseeable fishery impact scenarios.

WDFW acknowledges that it is difficult to predict the manner and severity of fishery impacts before Odessa Project operational changes have been implemented. WDFW and Ecology will work to develop an adaptive management program for project area fisheries for inclusion in the FEIS. The plan will identify activities for ongoing monitoring of Odessa project effects in area fisheries and provide mechanisms for development and implementation of response measures.

Comments on the Alternatives

Full-Replacement:

WDFW notes that environmental impacts are very high for the Full Replacement alternatives - 3A, 3B, 3C, and 3D. Impacts to native shrub steppe communities and wildlife migration corridors due to the development of the East High Canal, pumping plants, substations, transmission lines and other supporting infrastructure are significant. In particular, Black Rock Coulee is a unique and sensitive area comprising perhaps the largest known contiguous aggregation of Washington Ground Squirrels, which are candidates for listing under both federal and state endangered species statutes. The area also includes near-perennial wetlands that are rare on the Columbia Plateau. Instead of being inundated from the Black Rock Coulee re-regulation reservoir, this area should be protected as a unique feature within the Columbia Basin. Please include a rigorous set of mitigation measures for all of the full-replacement alternatives.

Partial Replacement:

Even under partial replacement alternatives, a lot of uncertainties remain regarding water management regimes and ecological responses. However, it is clear that impacts to wildlife and wildlife habitats are far less dramatic for the partial-replacement alternatives than for full-replacement alternatives. WDFW is looking forward to working with Ecology, Reclamation, other federal, tribal, and state resource agencies, and other partners to identify specific necessary mitigation elements and develop a fish and wildlife monitoring, evaluation, and adaptive management program for the partial-replacement alternatives. This collaborative approach facilitates implementation of the Odessa Project while assuring that the effects of project-related environmental changes on our managed resources are detected and mitigated. Once a preferred alternative is being implemented, existing Reclamation Resource Management Plans for Banks Lake and Potholes Reservoir, as well as WDFW Wildlife Area Management Plans and other resource management documents, should be cooperatively updated to reflect changing project conditions and incorporate this adaptive management approach.

Enhancement Opportunities

As you know, the Columbia Basin Project presents unique opportunities to enhance habitats for waterfowl, migrating birds, shorebirds, and amphibians, in addition to the larger observed species (such as mule deer), thereby enhancing fish- and wildlife-related recreational activities. There are several opportunities for enhancement of conditions for fish and wildlife that would increase the overall value of the project. Those enhancements include:

- Provide and maintain artificial spawning facilities, and enhance natural spawning habitat, for kokanee or other fish species in Banks Lake. This type of enhancement could be built into the project, or implemented later should monitoring and adaptive management indicate such action is needed and would be successful.
- One important environmental opportunity is already incorporated into project design: wildlife crossings and other wildlife protections along the ELC alignment. Crossings help maintain habitat/species connectivity and movements within the project. Canal escape ramps reduce the number of deer and other wildlife that are caught and drowned in canals. WDFW thanks Reclamation for cooperating in the initial design and placement of these structures, and lauds the foresight that led to this outcome. WDFW encourages Reclamation to design the crossings using recommendations provided by WDFW to avoid potential retrofitting in the future.
- Under any implementation alternative, acquire properties within and adjacent to Black Rock Coulee in order to protect this unique habitat area in perpetuity.
- Project facilities should be designed to enhance wetland habitats in areas identified by WDFW as exhibiting potential. Minor hydrological alterations could be incorporated that improve wetland function. For example, input from East Low Canal would restore year-round wetland function at Artesian and Black Lakes, thus providing environmental benefits for waterfowl and other migratory birds as well as other wetland species.
- Use Rocky Coulee Reservoir to maximize to the extent practicable resting and staging habitat for migrating waterfowl, as well as offer public hunting and wildlife viewing opportunities.
- Continue dedication of fishing and hunting easements on lands deeded from Reclamation consistent with the original intent of the Columbia Basin Project for wildlife-related recreation.

Additional Comments

The federal Fish and Wildlife Coordination Act states that "wildlife conservation must receive equal consideration and [be] coordinated with other features of water-resources development programs."[3] WDFW requests that the FEIS incorporate the mitigation measures and recommendations provided by the USFWS in their Coordination Act Report.

WDFW appreciates the inclusion of a Native Plant Restoration and Conservation Management and Monitoring Plan in the Environmental Commitment section as an element of the project. This plan provides a mechanism to restore and protect upland habitat in the project area. WDFW looks forward to working with Reclamation and Ecology to develop and implement this long-term effort.

The current Odessa Project description provided by Ecology and Reclamation indicates that implementation is intended to serve only currently-irrigated lands, and states that new land conversion would not be eligible for this project water. Should land conversions impacting native shrub steppe occur as a result of this project, it is assumed that mitigation for those conversions will occur pursuant to WDFW's agreement with Ecology concerning shrub steppe, and undergo environmental review to the extent NEPA and/or SEPA are applicable.

WDFW Odessa Subarea DEIS action recommendations are enclosed as Appendix A. Proposed new language relating to fish survival/flow relationships appears in Appendix B. The WDFW/Ecology Shrub Steppe Memorandum appears in Appendix C. A letter from Ecology to WDFW regarding further collaboration on the Odessa Project is enclosed as Appendix D. WDFW comments on the DEIS detailed by paragraph are enclosed as Appendix E.

In the event that the FEIS is significantly different than the DEIS or an alternative is proposed that was not evaluated during the review period, WDFW may request an amendment to the FEIS with the appropriate 60 day comment period.

WDFW encourages Ecology and Reclamation to work diligently with resource agencies to assure that the FEIS embodies a balance of public interests between the needs of groundwater pumpers and the needs of fish and wildlife and the local economic activity they generate. WDFW looks forward to continued coordination and consultation as the project progresses forward through environmental review and into permitting and project implementation. Thank you for the opportunity to comment.

Sincerely,

Dennis Beich
Region 2 Director

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[3] Fish and Wildlife Coordination Act - 16 U.S.C. 661 et seq

Appendix D

Washington Department of Fish and Wildlife WDFW/Ecology Shrub-Steppe Agreement

July 9, 2010

MEMORANDUM OF AGREEMENT
BETWEEN
STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE
AND
DEPARTMENT OF ECOLOGY
OFFICE OF COLUMBIA RIVER
RELATED TO THE
MITIGATION OF IMPACTS OF OFFICE OF COLUMBIA RIVER PROJECTS
TO SHRUB STEPPE HABITATS

THIS MEMORANDUM OF AGREEMENT (MOA) is made and entered into by and between the DEPARTMENT OF FISH AND WILDLIFE (WDFW) and the DEPARTMENT OF ECOLOGY (Ecology).

WHEREAS resolving longstanding conflicts over water supply in the Columbia River Basin is important to the State of Washington, and

WHEREAS public monies are being used by the Ecology Office of Columbia River (OCR) to implement projects to develop water supplies, and

WHEREAS the use of public monies should minimize environmental impacts of those projects, and

WHEREAS OCR-funded projects may disturb or eliminate shrub steppe habitats through conversion to other land uses, and

WHEREAS Habitat loss, fragmentation, and degradation are the major threats to the persistence of Washington's fish and wildlife[1], and

WHEREAS Ecology provides funding through interagency agreement for WDFW technical fish and wildlife biological services related to the implementation of Chapter 90.90 RCW - Columbia Basin Water Supply, and

WHEREAS WDFW and Ecology OCR agree that protecting at-risk priority habitats such as shrub steppe habitat is important to the State of Washington;

THEREFORE, IT IS MUTUALLY AGREED THAT:

Ecology and WDFW will cooperate to protect priority habitats such as shrub steppe that are put at risk through water supply projects funded by the OCR.

PURPOSE AND SCOPE

The purpose of this MOA is to define roles and actions between WDFW and OCR for mitigating impacts to shrub steppe habitats resulting from OCR-funded projects.

AUTHORITY AND AGENCY ROLES

With respect to this MOA:

1 Washington Comprehensive Wildlife Conservation Strategy (WDFW 2005)

WDFW responsibilities are to preserve, protect, perpetuate, and manage fish and wildlife resources under the authority of 77.04.012 RCW.

Ecology responsibilities are to manage water resources pursuant to 90.54 RCW, among others.

Further, OCR responsibilities are to aggressively pursue the development of water supplies to benefit both instream and out-of-stream uses under 90.90 RCW.

GENERAL PROVISIONS

This MOA establishes standards and procedures through which impacts to shrub steppe habitat will be addressed. WDFW Wind Power Guidelines[2] will serve as a foundation for implementing components of this MOA. In general, WDFW and OCR will use tools such as impact avoidance and mitigation, along with case-specific project reviews, to implement this MOA.

PROCEDURES

1. The first step toward protecting at-risk priority habitats is identifying potential impacts. WDFW and Ecology agree to work together to ensure that impacts are identified well in advance of project imlementation.
2. WDFW and WDOE agree to use environmental review documents and/or employ rapid, course-scale assessment tools[3] to assess impacts unless the two agencies agree that a higher-level assessment is required;
3. Should it be agreed that a review of existing environmental review documents or a course scale assessment is insufficient to determine an appropriate avoidance or mitigation strategy, sufficient resources and time will be provided by Ecology to perform higher-level assessments and develop analyses to determine habitat value, and identify potential impacts;
4. Once impacts are assessed they will either be avoided or mitigated;
5. Site-specific mitigation agreements will be developed for each project that address mitigation requirements for each impacted site.

DETERMINING MITIGATION

1) For impacts identified in the assessment phase, mitigation will be consistent with the WDFW 2009 Wind Power Guidelines. Customized mitigation options may be relevant in situations such as the following:
    a) Depending on risk of development for the impacted habitat, a replacement factor may be appropriate to increase the mitigation required.
    b) As part of a customized mitigation package for an OCR-funded project, the environmental benefits of the project may be considered when determining the mitigation required.

[2] April 2009, available at http://wdfw.wa.gov/hab/engineer/windpower/index.htm
[3] See WDFW 2009 Wind Power Guidelines section 8.3, *Coarse Scale Assessment*.

2) For shrub steppe mitigation, concentration of mitigation investments in the highest priority areas will be encouraged.

3) If shrub steppe was converted within five years prior to the OCR water supply development, those lands will be treated as though they were shrub steppe at the time of conversion, and assessed and mitigated accordingly.

AGENCY RESPONSIBILITIES RELATED TO THIS MOA, PURSUANT TO ECOLOGY/WDFW INTERAGENCY AGREEMENT

Ecology will (to the extent resources allow):

1. Designate an interagency coordination liaison. The liaison will coordinate on any emerging OCR issues affecting shrub steppe habitat and facilitate discussion, resolution, and documentation of a mutually-agreeable mitigation scenario. This includes providing cross-program and cross-region/headquarters coordination within Ecology. The liaison will also coordinate joint procedures and outreach.
2. Notify the WDFW liaison if a project being proposed through the OCR has potential to impact shrub steppe habitat.
3. Provide adequate and timely information for WDFW biologists to determine the impact of a project, including funding higher-level assessments as agreed by the parties.
4. Work with WDFW to identify alternatives for mitigation of project impacts.
5. Coordinate funding to implement the agreed mitigation package.

WDFW will (to the extent resources allow):

1. Designate an interagency coordination liaison. The liaison will coordinate on any emerging OCR issues affecting shrub steppe habitat and facilitate discussion, resolution, and documentation of a mutually-agreeable mitigation scenario. This includes providing cross-program and cross-region / headquarters coordination within WDFW. The liaison will coordinate joint procedures and outreach.
2. Provide coarse-level assessments unless the two agencies agree that a higher-level assessment is required.
3. Identify the impacts of a proposed project on shrub steppe.
4. Identify and prioritize mitigation sites in areas where OCR investments are planned.
5. Convene a work group, comprising individuals with expertise on shrub steppe habitat issues and representing a broad cross-section of shrub steppe interests within Washington State, to ensure that project assessments and mitigation proposals have been adequately vetted.
6. Work with Ecology OCR to identify alternatives for mitigation of those impacts.
7. Assist documentation and implementation of the agreed mitigation package.

GENERAL COORDINATION AND APPLICABILITY

Ecology and WDFW will develop or modify agency guidance documents in order to facilitate implementation of this MOA. Agency staff will treat this MOA, along with applicable policies and guidance documents, as operating procedures.

LIAISONS:

Department of Fish and Wildlife
Teresa Scott

600 Capitol Way North
Olympia, WA 98501

Phone: 360-902-2713

Email: teresa.scott@dfw.wa.gov

Department of Ecology
Daniel Haller

Office of Columbia River
15 West Yakima Ave. Suite 200
Yakima, WA 98902-3452
Phone: 509-454-4255

Email: dhal461@ecy.wa.gov

MOA MANAGEMENT

This MOA shall take effect and be fully implemented by both agencies when signed by both parties. OCR-funded projects with environmental review completed before implementation of this contract are not affected by this MOA. This MOA may be amended or terminated at any time by written approval by Ecology's OCR Director and WDFW's Director. Termination is assumed if Ecology's OCR is eliminated.

The interagency coordination liaisons for Ecology and WDFW will be responsible for, and will be the contact persons for, all communications regarding the performance of this MOA. Either Ecology or WDFW may change its liaison by giving written notice to the other party.

ALL WRITINGS CONTAINED HEREIN

This MOA contains all the terms and conditions agreed upon by WDFW and Ecology. No other understandings, oral or otherwise, regarding the subject matter of this MOA shall be deemed to exist or to bind any of the parties hereto.

IN WITNESS WHEREOF, THE PARTIES HAVE EXECUTED THIS MOA:

Department of Fish and Wildlife	Department of Ecology
[signature]	[signature]
Phil Anderson, Director	Ted Sturdevant, Director
Date: 7/6/10	Date: 7/9/10

Appendix E
Washington Department of Fish and Wildlife
Ecology Letter to WDFW

January 28, 2011

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
303 S Mission St, Ste 200 • Wenatchee, WA 98801-6142 • (509) 662-0500

January 28, 2011

Mr Dennis Beich
Region 2 Director
Washington State Department of Fish and Wildlife
11550 Alder Street
Ephrata WA 98823

Dear Mr. Beich:

The Washington State Department of Ecology's Office of Columbia River (OCR) looks forward to continued collaboration with Washington State Department of Fish and Wildlife (WDFW) as we identify alternative sources of water supply for groundwater irrigators in the Odessa Special Study Area. As we pursue that objective, we are cognizant of the importance of protecting and maintaining fish and wildlife and associated habitats as well as the public benefits they provide.

Ecology recognizes there are some areas of uncertainty regarding potential impacts to WDFW-managed resources as a result of the project alternatives proposed in the Odessa Subarea Special Study Draft Environmental Impact Statement (DEIS). I want to assure you that Ecology will continue to work with WDFW through the EIS and subsequent state permitting process to narrow those uncertainties and ensure that actions are taken to enhance the project, or avoid or mitigate probable significant adverse project impacts.

WDFW fish management staff has expressed concerns that that each water supply option within the DEIS has the potential to affect lake/reservoir productivity and would have the potential to impact recreational fisheries to varying degrees. However, the specific nature of those effects are not likely to be fully understood until after operational changes to the Columbia Basin Project have been implemented. Ecology agrees that it is appropriate for WDFW and Ecology to engage in an adaptive management program for the recreational fisheries to allow monitoring of the effects of those operational changes and to identify and employ response measures as appropriate. Ecology will work with WDFW to help ensure that adequate staff and funding resources are made available to support an ongoing adaptive management program.

Ecology intent to engage in an adaptive management program for lake/reservoir recreational fisheries will be captured in a Memorandum of Understanding (MOU) with WDFW. The MOU will also serve as a vehicle to address other issues related to the project including actions to:

- Protect and enhance habitat for Northern Leopard frogs,
- Protect Washington ground squirrels,
- Ensure wildlife viewing impacts are minimized,
- Create a mechanism to make some of the conserved water funded by OCR available to WDFW for "environmental uses," and
- Identify potential project enhancements that could provide wildlife and wildlife-based recreational benefits within the Columbia Basin Project.

The MOU will be included as a component of the Final EIS for the Odessa Special Study.

I look forward to meeting in the near future to discuss development of the MOU. If you have any questions or need any additional information, please do not hesitate to call me a 509-457-7120.

Sincerely,

Derek Sandison, Director
Office of Columbia River

DS:HCC (110159)

APPENDICES
COORDINATION ACT REPORT

Appendix A – Bird Species Potentially Found in the Project Area and their Population Trends

Appendix B – Mammals Found in the Columbia Basin

Appendix C – Reptiles and Amphibians Potentially in the Project Area

Appendix D – Species of Concern

Appendix E – Mean Water Temperatures in Lower Crab Creek

APPENDIX A
Bird Species Potentially Found in the Project Area and Their Population Trends

Common Name	Scientific Name	Population Trend[1]	Habitat Association[2]			
			SS	GR	RP	JM
Turkey vulture	*Cathartes aura*	3	X	X	X	X
Osprey	*Pandion haliaetus*	3			X	
Bald eagle	*Haliaeetus leucocephalus*	3			X	
Sharp-shinned hawk	*Accipiter stratus*	2				X
Cooper's hawk	*A. cooperii*	3			X	
Northern harrier	*Circus cyaneus*	2	X	X		
Swainson's hawk	*Buteo swainsoni*	3	X	X		
Red-tailed hawk	*B. jamaicensis*	5	X	X	X	X
Ferruginous hawk	*B. regalis*	4	X	X		
Golden eagle	*Aquila chrysaetos*	4	X	X	X	X
American kestrel	*Falco sparverius*	5	X	X	X	X
Prairie falcon	*F. mexicanus*	3	X	X		X
Peregrine falcon	*F. perigrinus*	3	X	X	X	X
Barn owl	*Tyta alba*	3	X	X	X	
Western screech owl	*Otis kennicotti*	2	X	X		
Great-horned owl	*Bubo virginianus*	3	X	X	X	X
Northern pygmy owl	*Glaucinium gnoma*	3			X	X
Northern saw-whet owl	*Aegolius arcadicus*	3				X
Burrowing owl	*Athene cunicularia*	1	X	X		
Long-eared owl	*Asio otis*	3	X	X	X	X
Short-eared owl	*A. flammeus*	3	X	X		
Great-blue heron	*Ardea herodias*	2			X	
Sage-grouse	*Centrocercus urophasianus*	3	X	X		
Sharp-tailed grouse	*Tympanuchus phasianellus*	3	X	X	X	
California quail	*Callipepla californica*	2	X	X	X	X
Sandhill crane	*Grus canadensis*	3		X	X	
Killdeer	*Charadrius vociferus*	3	X	X	X	
Long-billed curlew	*Numenius americanus*	1	X	X		
Rock dove	*Columba livia*	1	X			
Mourning dove	*Zenaida macroura*	5	X	X	X	X
Common poorwill	*Phalaenoptilus nuttalli*	3	X	X		X
Common nighthawk	*Chordelles minor*	2	X	X	X	X

Common Name	Scientific Name	Population Trend[1]	Habitat Association[2]			
			SS	GR	RP	JM
Black swift	*Cypseloides niger*	3			X	
White-throated swift	*Aeronautes saxatalis*	3			X	
Black-chinned hummingbird	*Archilochus alexanri*	3	X		X	
Calliope hummingbird	*Stellula calliope*	3			X	
Rufous hummingbird	*S. rufus*	3			X	
Belted kingfisher	*Ceryle alcyo*	3			X	
Lewis' woodpecker	*Melanerpes lewisi*	3			X	
Red-naped sapsucker	*Sphyrapicus nuchalis*	3			X	
Downy woodpecker	*Picoides pubescens*	3			X	
Hairy woodpecker	*P. villosus*	3			X	
Northern flicker	*Colaptes auratus*	2			X	X
Western wood-pewee	*Contupus sordidulus*	1			X	
Willow flycatcher	*Epidonax traillii Epidonax traillii*	3			X	
Least flycatcher	*E. minimus*	unknown			X	
Dusky flycatcher	*E. oberholseri*	3			X	X
Gray flycatcher	*E. wrightii*	2	X			X
Say's phoebe	*Sayornis saya*	2	X	X	X	X
Western kingbird	*Tyrannus verticallis*	2	X	X	X	X
Eastern kingbird	*T. tyrannus*	3	X	X	X	
Horned lark	*Eremophila alpestris*	5	X	X		
Tree swallow	*Tachycineta bicolor*	2			X	
Violet-green swallow	*T. thalassina*	3			X	X
Northern rough-winged swallow	*Stelgidopterix serripennis*	3	X	X	X	X
Bank swallow	*Riparia Riparia*	2	X	X	X	X
American robin	*Turdus migratorius*	3	X	X	X	X
Cliff swallow	*Petrochilodon pyrrhonota*	1	X	X	X	X
Loggerhead shrike	*Lanius ludovicianus*	5	X	X		X
Cedar waxwing	*Bombycilla cedrorum*	3			X	X
American dipper	*Cinclus mexicanus*	3			X	

Common Name	Scientific Name	Population Trend[1]	Habitat Association[2]			
			SS	GR	RP	JM
Rock wren	*Salpinctus obsoletus*	3	X	X		X
Canyon wren	*Catherpes mexicanus*	3			X	X
House wren	*Troglodytes aedon*	1			X	
Sage thrasher	*Oreoscoptes montanus*	2	X			
Gray catbird	*Dumetella carolinensis*	Unknown			X	
Townsend's solitaire	*Myadestes townsendi*	3				X
Western bluebird	*Sialia mexicana*	3	X	X	X	X
Veery	*Catharus fuscescens*	3			X	
Black-capped chickadee	*Poecile atricapilla*	3			X	
White-breasted nuthatch	*Sitta carolinensis*	3			X	
Brown creeper	*Certhia americana*	3			X	
Song sparrow	*Melospizo melodia*	3			X	
White-crowned sparrow	*Zonotrichia leucophrys*	3			X	
Savannah sparrow	*Passerculus sandwichensis*	3	X	X	X	X
Grasshopper sparrow	*Ammodramus savannarum*	2	X	X		
Brewers sparrow	*Spizella breweri*	5	X	X		X
Vesper sparrow	*Pooecetes gramineus*	2	X	X		X
Lark sparrow	*Chondestes grammacus*	5		X		X
Black-throated sparrow	*Amphispiza bileata*	4	X			
Sage sparrow	*A. belli*	3	X			
Chipping sparrow	*Spizelia passerina*	5			X	X
Dark-eyed junco	*Junco hyemalis*	2			X	X
Spotted towhee	*Pipilo maculatus*	2			X	X
Black-headed grosbeak	*Pheucticus melanocephalus*	1			X	
Lazuli bunting	*Passerina amoena*	1	X		X	X
Western tanager	*Piranga ludoviciana*	3			X	
Orange-crowned warbler	*Vermivora celata*	3			X	X
Nashville warbler	*V. ruficapilla*	3			X	X
Yellow warbler	*Dendroica petechia*	3			X	
Common yellowthroat	*Geothlypis trichas*	2			X	
MacGillivary's warbler	*Oporornis tolmieri*	3			X	
Wilson's warbler	*Wilsonia pusilla*	3			X	

Common Name	Scientific Name	Population Trend[1]	Habitat Association[2]			
			SS	GR	RP	JM
Yellow-breasted chat	*Icteria virens*	2			X	
Cassin's vireo	*Vireo cassenni*	3			X	
Red-eyed vireo	*V. olivaceous*	3			X	
Warbling vireo	*V. gilvus*	3			X	
Bullock's oriole	*Icterus bullocki*	2			X	
Western meadowlark	*Sturnella neglecta*	2	X	X		
Red-winged blackbird	*Aeelaius phoeniceus*	4	X	X	X	X
Brewer's blackbird	*Euphagus cyanocephalus*	5	X	X	X	X
Brown-headed cowbird	*Molothrus ater*	2	X	X	X	X
American goldfinch	*Carduelis tristis*	2			X	
Cassin's finch	*Carpodacus cassinni*	2			X	X
House finch	*C. mexicanus*	2			X	X
Black-billed magpie	*Pica hudsonia*	2	X	X	X	X
American crow	*Corvus brachyrhynchos*	1	X	X	X	X
Common raven	*Corvus corax*	4	X	X	X	X

[1]**Population Trends** shown are generally form breeding bird survey data. Population trends show the magnitude and direction of growth that the population is experiencing.

1 = significant increase in the population
2 = population is stable, has no trend, or is possibly increasing
3 = no data, insufficient data, or trend unknown
4 = possible decrease in the population
5 = significant decrease in the population

[2]**Habitat Associations**

SS = shrub-steppe
GR = grasslands
RP = riparian
JM = juniper/mountain mahogany
X = species is closely associated with this habitat and reaches its greatest abundance in this habitat.

APPENDIX B
Mammals Found in the Columbia Basin

Mammal Species	Source of Information			
	ASM (2006)	Banks Lake Study (2002-3)	Shrub-Steppe Project (Dobler, 2006*)*	Crab Creek Summary (2001*)*
Merriam's shrew *(Sorex trowbridgii)*	X			X
Water shrew (*Sorex palustris)*	X			
Wandering shrew (*S. vagrans*)	X			
Northern grasshopper mouse (*Onychomys leucogaster*)	X			X
Sagebrush vole (*Lagurus curtatus*)	X		X	X
Montane vole (*Microtus montanus)*	X			
Columbian ground squirrel (*Citellus columbianus*)	X			X
Deer mouse *(Peromyscus maniculatus*)	X		X	
Forest deer mouse (*P. keenii*)	X			
Western jumping mouse (*Zapus princesp*)	X			
Porcupine (*Erethizon dorsatum*)	X		X	
Western harvest mouse (*Reithrodontomys megalotis*)	X		X	
Least chipmunk (*Eutamias minimus*)	X			
Yellow-bellied marmot (*Marmota flaviventris*)	X	X	X	
Yellow-pine chipmunk (*Tamias amoenus*)	X		X	
Ord's kangaroo rat (*Dipodomys ordii*)	X		X	
Northern pocket gopher (*Thomomys talpoides*)	X		X	X
Beaver (*Castor canadensis)*	X			X
Bushy-tail woodrat (*Neotomys cinerea*)			X	
Muskrat (*Onadontra zibethica*)	X			X
Washington ground squirrel (*Spermophilus washingtoni*)	X	X		X
Townsend's ground squirrel (*S. townsendii*)	X			
California ground squirrel (*S. beecheyii*)	X			
Columbia Basin pygmy rabbit (*Brachylagus idahoensis*)	X	X		X
White-tailed jackrabbit (*Lepus townsendii*)	X			X
Black tailed jackrabbit (*L. californicus)*	X		X	X
Nuttall's cottontail (*Sylvilagus nuttalli*)	X		X	X
Badger (*Taxidea taxus*)			X	X
Mink (*Mustela vison*)				X
River otter (*lutra canadensis)*				X

Mammal Species	Source of Information			
Long-tailed weasel (*Mustela frenata*)	**X**			
Short-tailed weasel (*M. erminea*)	**X**			
Bobcat *(Lyns rufus*)	**X**			**X**
Cougar (*Felis concolor*)				**X**
Raccoon (*Procyon lotor*)	**X**			**X**
Black bear (*Ursus americanus*)	**X**			**X**
Gray wolf				**X**
Coyote (*Canis latrans*)	**X**		**X**	
Muledeer (*Odocoileus hemionus*)	**X**		**X**	**X**
Elk (*Cervus elaphe*)			**X**	**X**
Yuma myotis (*Myotis yumanensis*)	**X**		**X**	**X**
Small-footed myotis (*M. ciliolabrum*)		**X**		**X**
Pale Townsend's big-eared bat (*Plecotus townsendii pallescens*)	**X**	**X**		
Long-eared myotis (*M. evotis*)	**X**	**X**		**X**
Fringed myotis (*M. thysanodes*)	**X**	**X**		**X**
Little brown bat (*M. lucifigis*)	**X**			**X**
Keen's myotis *(M. keenii*)	**X**			**X**
Long-legged myotis (*M. volans*)				**X**
California myotis (*M. californicus*)	**X**			**X**
Silver-haired bat (*Lasionycterus noctivagans*)	**X**			**X**
Western pipistrelle (*Pipistrellus hesperus*)	**X**			**X**
Big brown bat (*Eptesicus fuscus*)	**X**			**X**
Pallid bat (*Antrozous pallidus*)	**X**			**X**
Hoary bat (*lasiurus cineurus*)				**X**
Townsend's big-eared bat (*Corynorhinus townsendii*)				**X**
Spotted bat (*Euderma maculata*)	**X**			**X**
Western small-footed myotis (*Myotis coopabari*)	**X**			

APPENDIX C
Reptiles and Amphibians Potentially in the Project Area

Species	Source of Information			
	Banks Lake Study (2002-03)	***Shrub-Steppe Project (Dobler, 2006)***	***Crab Creek Summary (2001)***	***UPS Slater Museum List (2006)***
Reptiles				
Common garter snake (*Thamnophis sirtalis*)		**X**		**X**
Sagebrush lizard *(Sceloporus graciosus)*			**X**	**X**
Short-horned lizard (*Phrynosoma douglassi*)		**X**	**X**	**X**
Side-blotched lizard (*Uta stansburiana*)				**X**
Western skink (*Eumeces skiltonianus*)				**X**
Racer (*Coluber constrictor)*				**X**
Rubber boa (*Charina bottae*)				**X(?)**
Striped whipsnake (*Masticophis taeniatus*)			**X**	**X**
Ringneck snake (*Diadophus punctatus*)			**X**	**X**
Sharptail snake (*Contia tenius*)				**X**
Gopher snake (*Pituophis catenifer*)				**X**
Western rattlesnake (*Crotalus viridis*)			**X**	**X**
Night snake *(Hypsiglena torquata)*			**X**	**X**
Amphibians				
Long-toed salamander (*Ambystoma macrodactylum)*				**X**
Tiger salamander (*A. tiginum*)				**X**
Pacific treefrog (*Pseudacris regilla*)				**X**
Western toad (*Bufo boreas*)			**X**	**X**
Woodhouse's toad (*B. woodhousei*)				**X**
Bullfrog (*Rana catesbiana*)				**X**
Northern leopard frog (*R. pipiens*)			**X**	**X**
Columbia spotted frog (*R. luteiventris*)	**X**		**X**	**X**

APPENDIX D
Species of Concern

These species of concern potentially occur in the Project Area, based on their known occurrence in habitats similar to those found in the Project Area. This list contains federally designated species of concern. Species of concern are species whose conservation standing is of concern to the Service, but for which status information is still needed.

ANIMALS:
Burrowing owl (*Athene cunicularia)*
California floater (*Anodonta californiensis*) (mussel)
Columbia clubtail (*Gomphus lynnae*) (dragonfly)
Ferruginous hawk (*Buteo regalis*)
Giant Columbia spire snail (*Fluminicola Columbiana*)
Loggerhead shrike (*Lanius ludovicianus*)
Long-eared myotis (*Myotis evotis*)
Margined sculpin (*Cottus marginatus*)
Pacific lamprey (*Lampetra tridentate*)
River lamprey (*L. ayresi*)
Western brook lamprey (*L. richardsoni*)
Pallid Townsend's big-eared bat (*Corynorhinus townsendii pallescens*)
Sagebrush lizard (*Sceloporus graciosus*)
Townsend's ground squirrel (*Spermophilus townsendii*)
Black swift (*Cypseloides niger*)
Larch mountain salamander (*Plethodon larselli*)
Northern goshawk (*Accipiter gentilis*)
Olive-sided flycatcher (*Contopus cooperi*)
Peregrine falcon (*Falco peregrinus*)
Sharptail snake (*Contia tenius*)
Western gray squirrel (*Sciurus griseus griseus*)
Wolverine (*Gulo gulo*)
Redband trout (*Oncorhynchus mykiss*)
Westslope cutthroat trout (*O. clarki lewisii*)
Pygmy whitefish (*Prosopium coulteri*)

PLANTS:
Columbia milk-vetch (*Astragalus columbianus*)
Suksdorf's monkey-flower (*Mimulus suksdorfii*)
Liverwort monkey-flower (*M.us jungermannioides*)
Gray cryptantha (*Cryptantha leucophaea*)
Palouse goldenweed (*Haplopappus liatriformis*)
Hoover's desert-parsley (*Lomatium tuberosum*)
Persistent sepal yellowcress (*Rorippa columbiae*)
Clustered lady's slipper (*Cypripedium fasciculatum*)
Wenatchee larkspur (*Delphinium viridescens*)
Least phacelia (*Phacelia minutissima*)
whitebark pine (*Pinus albicaulis*)

Seely’s silene (*Silene seelyi*)
Hoover’s tauschia (*Tauschia hooveri*)
Long-bearded sego lily (*Calochortus longebarbatus* var. *longebarbatus*)
Obscure Indian-paintbrush (*Castilleja cryptantha*)
Pale blue-eyed grass (*Sisyrinchium sarmentosum*)

APPENDIX E
Mean Water Temperatures in Lower Crab Creek

Site	n=	Mean Temperature (Centigrade)			
		Winter	Spring	Summer	Fall
Crab Creek Lateral	**42**	6.8	13.4	19.9	12.4
Red Rock Confluence	**42**	4.7	17.0	22.5	11.5
Crab Creek Road	**41**	4.5	17.0	21.1	11.5
McMannon Road	**39**	4.5	17.0	23.6	13.0
Red Rock Coulee Road	**39**	5.1	16.6	21.8	12.4
RBC Wasteway	**40**	4.6	14.8	22.5	15.5

(Gina Hoff, *pers. comm*. USBR, 2007)

APPENDIX E

TRIBAL CORRESPONDENCE

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P. O. Box 815
Ephrata, Washington 98823

IN REPLY REFER TO:
PN-6308
WTR-4.00

MAR 20 2007

Mr. Michael E. Marchand, Chairman
Colville Tribal Business Council
P.O. Box 150
Nespelem, WA 99155

Subject: Odessa Subarea Special Study, Columbia Basin Project (Project), Washington

Dear Chairman Marchand:

The Bureau of Reclamation is currently investigating the possibility of providing Columbia Basin Project water to replace groundwater use in the Odessa Ground Water Management Sub-area (Odessa Subarea). Reclamation's study effort is known as the Odessa Subarea Special Study (Study). Background information about the Study can be found at www.usbr.gov/pn/programs/ucao_misc/odessa/. The State of Washington (State) through the Department of Ecology, is partnering with Reclamation in this effort by providing technical assistance and funding.

We are in the very early stages of alternative identification. Enclosed is a report documenting this effort entitled *Initial Alternative Development and Evaluation*. This report recommended further study of four water delivery alternatives and several water supply options for study at an appraisal-level.

Water delivery alternatives describe proposed infrastructure to carry Project surface water to land currently irrigated with groundwater in the Study area; about 121,000 groundwater irrigated acres occur in the Study area. These preliminary alternatives would provide a replacement surface water supply to 40 to 100 percent of the current groundwater irrigated acres in the study area. This would be done by construction of a new East High Canal system (part of the original plan for the Columbia Basin Project), expansion and partial extension of the existing East Low Canal, or modifying Project operations to use the existing East Low Canal without expansion. Pages 17 through 25 in the enclosed report provide descriptions of these water delivery alternatives.

Additional diversions from the Columbia River at Grand Coulee Dam would be required to provide a replacement surface water supply. Reclamation has identified a number of water supply options that could provide replacement water in a manner that would avoid or minimize effects to salmon and steelhead listed under the Endangered Species Act (ESA). These water supply options include adjusting current Project operations to utilize storage in existing reservoirs such as Banks Lake and Potholes Reservoir and proposals to construct new storage reservoirs within the Project. Pages 27 through 35 of the enclosed report describe these proposed water supply options.

We understand that the Colville Tribes and the State have entered into an Inter-governmental Agreement in Principle (AIP) regarding the Lake Roosevelt component of the Columbia River Water Management Program. This AIP proposes an additional drawdown of Lake Roosevelt to supply instream and out-of-stream uses, including provision of 30,000 acre-feet as a replacement for groundwater use in the Odessa Subarea. Reclamation's Odessa Subarea Special Study is a separate activity that also looks at providing a replacement water supply for groundwater irrigation in the Odessa Subarea. Although the enclosed report discusses additional drawdown of Lake Roosevelt, Reclamation has decided not to pursue this as a Study option at this time.

Reclamation is currently conducting additional analyses of these recommendations at an appraisal-level. We anticipate this analysis will be completed by the end of 2007. The purpose of the appraisal analysis is to collect additional information to verify engineering viability of the proposed alternatives as well as begin to identify environmental and other issues associated with each. Reclamation will use these study findings to make adjustments to alternatives and determine which merit further investigation during a feasibility study. A feasibility study is scheduled to begin sometime next year and would entail detailed engineering design and cost estimates and comprehensive analyses of environmental, cultural, social, and other effects, to comply with the National Environmental Policy Act, the Endangered Species Act, Section 106 of the National Historic Preservation Act, and other requirements.

We invite the participation and value the input of the Colville Confederated Tribes to assist us in future planning activities and analyses that will be conducted for this Study. To ensure successful collaboration and coordination, we are requesting designation of a lead Tribal contact.

Reclamation is available to meet with you about the Odessa Subarea Special Study. Please contact Mr. Craig Sprankle, Native Affairs Coordinator, at 509-633-9503, or Ms. Ellen Berggren, Study Manager, at 208-378-5090, for questions or to arrange a meeting. We look forward to future discussions with you.

Sincerely,

/s/ WILLIAM D. GRAY

William D. Gray
Deputy Area Manager

Enclosure

Ms. Myra Clark (w encl)
Colville Confederated Tribes
P.O. Box 150
Nespelem, WA 99155

Mr. Gary Passmore (w encl)
Colville Confederated Tribes
P.O. Box 150
Nespelem, WA 99155

bc: PN-6308, PN-6514
UCA 1000, UCA-1100, UCA-1613
GCP-1000, GCP-1400
EPH-2000, EPH-2600, EPH-2800, EPH-2704-4 (all w/o encl)

WBR:EBerggren:cnicolai:3/19/07:208-378-5090
EBerggrenColvilleTribesLrt3/19/07.doc

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United States Department of the Interior

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P. O. Box 815
Ephrata, Washington 98823

MAR 20 2007

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CONTROL #: 0701795

IN REPLY REFER TO:
PN-6308
WTR-4.00

Richard L. Sherwood, Chairman
Spokane Tribal Council
Spokane Tribe of Indians
P.O. Box 100
Wellpinit, WA 99040

Subject: Odessa Subarea Special Study, Columbia Basin Project (Project), Washington

Dear Chairman Sherwood:

The Bureau of Reclamation is currently investigating the possibility of providing Columbia Basin Project water to replace groundwater use in the Odessa Ground Water Management Sub-area (Odessa Subarea). Reclamation's study effort is known as the Odessa Subarea Special Study (Study). Background information about the Study can be found at www.usbr.gov/pn/programs/ucao_misc/odessa/. The State of Washington (State) through the Department of Ecology, is partnering with Reclamation in this effort by providing technical assistance and funding.

We are in the very early stages of alternative identification. Enclosed is a report documenting this effort entitled *Initial Alternative Development and Evaluation*. This report recommended further study of four water delivery alternatives and several water supply options for study at an appraisal-level.

Water delivery alternatives describe proposed infrastructure to carry Project surface water to land currently irrigated with groundwater in the Study area; about 121,000 groundwater irrigated acres occur in the Study area. These preliminary alternatives would provide a replacement surface water supply to 40 to 100 percent of the current groundwater irrigated acres in the study area. This would be done by construction of a new East High Canal system (part of the original plan for the Columbia Basin Project), expansion and partial extension of the existing East Low Canal, or modifying Project operations to use the existing East Low Canal without expansion. Pages 17 through 25 in the enclosed report provide descriptions of these water delivery alternatives.

Additional diversions from the Columbia River at Grand Coulee Dam would be required to provide a replacement surface water supply. Reclamation has identified a number of water supply options that could provide replacement water in a manner that would avoid or minimize effects to salmon and steelhead listed under the Endangered Species Act (ESA). These water supply options include adjusting current Project operations to utilize storage in existing reservoirs such as Banks Lake and Potholes Reservoir and proposals to construct new storage reservoirs within the Project. Pages 27 through 35 of the enclosed report describe these proposed water supply options.

The State is currently negotiating an additional drawdown of Lake Roosevelt to supply instream and out-of-stream uses, including provision of 30,000 acre-feet as a replacement for groundwater use in the Odessa Subarea. Reclamation's Odessa Subarea Special Study is a separate activity that also looks at providing a replacement water supply for groundwater irrigation in the Odessa Subarea. Although the enclosed report discusses additional drawdown of Lake Roosevelt, Reclamation has decided not to pursue this as a Study option at this time.

Reclamation is currently conducting additional analyses of these recommendations at an appraisal-level. We anticipate this analysis will be completed by the end of 2007. The purpose of the appraisal analysis is to collect additional information to verify engineering viability of the proposed alternatives as well as begin to identify environmental and other issues associated with each. Reclamation will use these study findings to make adjustments to alternatives and determine which merit further investigation during a feasibility study. A feasibility study is scheduled to begin sometime next year and would entail detailed engineering design and cost estimates and comprehensive analyses of environmental, cultural, social, and other effects, to comply with the National Environmental Policy Act, the Endangered Species Act, Section 106 of the National Historic Preservation Act, and other requirements.

We invite the participation and value the input of the Spokane Tribe of Indians to assist us in future planning activities and analyses that will be conducted for this Study. To ensure successful collaboration and coordination, we are requesting designation of a lead Tribal contact.

Reclamation is available to meet with you about the Odessa Subarea Special Study. Please contact Mr. Craig Sprankle, Native Affairs Coordinator, at 509-633-9503 or Ms. Ellen Berggren, Study Manager, at 208-378-5090 for questions or to arrange a meeting. We look forward to future discussions with you.

Sincerely,

/s/ WILLIAM D. GRAY

William D. Gray
Deputy Area Manager

Enclosure

cc: Mr. Rudy Peone (w encl)
Spokane Tribe of Indians
P.O. Box 100
Wellpinit, WA 99040

bc: PN-6308, PN-6514
UCA 1000, UCA-1100, UCA-1613
GCP-1000, GCP-1400
EPH-2000, EPH-2600, EPH-2800, EPH-2704-4 (all w/o encl)

WBR:EBerggren:cnicolai:3/19/07:208-378-5090
E BerggrenSpokaneTribesLtr3/19/07.doc

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Yakima, Washington

United States Department of the Interior

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1150 North Curtis Road, Suite 100
Boise, Idaho 83706-1234

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CERTIFIED – RETURN RECEIPT REQUESTED

Honorable Doug Seymour, Chairman
Natural Resources Committee
Business Council
Colville Confederated Tribes
P.O. Box 150
Nespelem, WA 99155

Subject: December 4, 2007, Meeting to Discuss Columbia River Basin Activities

Dear Chairman Seymour:

Thank you for the invitation to meet with you in Nespelem on December 4, 2007. Deputy Regional Director Karl Wirkus and I appreciated the opportunity to discuss various studies occurring in the Columbia River basin. The Bureau of Reclamation is partnering with the State of Washington through its Department of Ecology on these efforts.

Mr. Bill Gray, Assistant Area Manager, began the presentation with information about the Columbia Basin Project history and background. He also provided background on the Columbia River Initiative Memorandum of Understanding (MOU) between the State, Columbia Basin Irrigation Districts and Reclamation, and the State's Columbia River Resource Management Act (HB 2860). The MOU and the State's legislation initiated the Columbia River basin activities.

The presentation included discussion of specific activities and studies contained in the MOU and State Legislation. Mr. Gray began by describing Early Action items that include withdrawals from Lake Roosevelt for mainstem drought relief, municipal and industrial uses, instream uses, and for irrigation in the Odessa Subarea to replace current groundwater pumping to 10,000 acres. Finally, Mr. Gray briefly discussed the Potholes Supplemental Feed Route Study. This Study looked at alternative routes for the current feed operation which conveys water to Potholes Reservoir for use by the South Columbia Basin Irrigation District.

Ms. Ellen Berggren, Study Manager, presented study background, engineering appraisal investigation results, and an overview of the study process for the Odessa Subarea Special Study. This study involves authorized phased development of the Columbia Basin Project, investigating delivery of surface water by Project facilities as a replacement for groundwater irrigation in the Odessa Subarea. Alternatives examined in the appraisal investigation look to provide replacement surface water from the Columbia River for up to 140,000 acres of currently groundwater irrigated land. We have provided Mr. Gary Passmore a set of wall-sized maps used in the Power Point presentation to provide additional detail about the alternatives. At the request of Mr. Dan Brudevold, the Tribes' land and property manager, we have provided two reports prepared by Washington State University that discuss the potential impacts to the agricultural economic sector associated with continued declines of the Odessa Subarea aquifers.

Mr. Norbert Ries, Planning Program Manager, made a presentation on the Columbia River Mainstem Off-Channel Storage Study. He briefly described the pre-appraisal and appraisal investigations. The pre-appraisal investigation identified 21 potential sites. The most recent study investigated four sites, with Crab Creek determined to be technically superior. Reclamation requires authorization from Congress before additional study of any selected sites. The Goose Lake and Ninemile Flat sites, located on the Colville Confederated Tribes' Reservation, were identified during the pre-appraisal investigation and eliminated early in the study at the request of the Colville Tribes. During the meeting, the Committee advised us that they would like these two sites assessed for potential mainstem off-channel storage.

We look forward to future meetings to continue to discuss these activities and study status. If you require additional information, please contact Mr. Bill Gray, Assistant Area Manager, at 509-754-0214 or wgray@pn.usbr.gov.

Sincerely,

/s/ J. William McDonald

J. William McDonald
Regional Director

cc: Mr. Gary Passmore
Environmental Trust
Colville Confederated Tribes
P. O. Box 150
Nespelem, WA 99155
w/8 maps

Mr. Dan Brudevold
Administration
Colville Confederated Tribes
P.O. Box 150
Nespelem, WA 99155
w/2 reports

bc: PN-3828 (Berggren); UCA-1000 (Kelso); UCA-1100 (Ries); EPH-2000 (Gray)

WRB:EBerggren:ALane:12-19-07:208-378-5090
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Received in Mailroom PRJ-28.00
NOV 06 2008

The Confederated Tribes of the Colville Reservation
P.O. Box 150, Nespelem, WA 99155 (509) 634-2200
FAX: (509) 634-4116

Monday, November 03, 2008

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J. William McDonald, Regional Director
United States Bureau of Reclamation
1150 North Curtis Road, Suite 100
Boise, ID 83706-1234

RE: Odessa Subarea Special Study

Dear Mr. McDonald

On October 7, 2008 a discussion titled Columbia River Basin Activities: Confederated Tribes of the Colville Reservation occurred in Nespelem Washington. As a result, the Colville Business Council (CBC), governing body of the Confederated Tribes of the Colville Reservation (Colville Confederated Tribes [CCT]), is requesting a second follow-up technical level meeting regarding the Columbia River Initiative (CRI) planned deep drawdown of Banks Lake. The technical meeting is requested to develop an understanding of the project. The CCT History/Archaeology Program further requests information on when the consultation process will be initiated.

Currently, there are several outstanding past cultural resources projects along Banks Lake. To address the outstanding projects and prepare for the CRI drawdown and Odessa Sub Area Section 106 and 110 agency responsibilities, the CCT History/Archaeology Program recommends developing a Cultural Resources Working Group. If implemented early in the project developmental stages, the Cultural Resources Working Group could provide oversight and collective input on cultural resources management issues and responsibilities for both the upcoming and outstanding projects.

The outstanding Banks Lake projects are as follows: finalization of the 2000 Banks Lake archaeological survey, finalization of the 2002 analysis from 45GR13, finalization of Traditional Cultural Properties (TCP) report from 1997, Access for tribal members to conduct traditional practices at Banks Lake and Steamboat Rock State Park, site stabilization at 45GR1008, Archaeological Resources Protection Act (ARPA) investigation at Coulee City vicinity sites, Coyote Story signs at Steamboat Rock State Park, ARPA signs indicating it is unlawful to excavate or remove artifacts and finally, setting aside a piece of land for reburials that have become disturbed from their original resting place on Reclamation lands within the Grand Coulee.

The outstanding projects were brought to the attention of Reclamation staff: Mark DeLeon, David Kaumheimer and Bill Gray during a field visit to Banks Lake on September 13, 2006. The CBC received a response to a few of the stated outstanding projects in your letter of September 26, 2008. Although three of the projects were prioritized in the letter (report on the 45GR13 analysis, data recovery at 45GR1008 [which was proposed by Reclamation instead of the CCT recommended stabilization] and a research summary of the 2000 Banks Lake archaeological survey), additional information for implementation and planning has not been provided. Establishment of a Cultural Resources Workgroup will instigate communication on the outstanding projects, provide methods for resolution while simultaneously creating a platform to plan for the upcoming CRI project.

To arrange the technical meeting, please contact CCT History/Archaeology Program Manager, Camille Pleasants at (509) 634-2654 or email Camille.pleasants@colvilletribes.com. The CCT looks forward to discussing the project and issues pertaining to cultural resources.

Sincerely,

Jeanne Jerred, CBC Chairman

CC:

William Gray
Ephrata Field Office
Box 815
Ephrata, WA 98823

David Murillo
Grand Coulee Dam Power Office
PO Box 620
Grand Coulee, WA 99133

Dawn Wiedmeier
Yakima Field Office
1917 March Road
Yakima, WA 98901-2058

Spokane Tribe of Indians

P.O. Box 100 • Wellpinit, WA 99040 • (509) 458-6500 • Fax (509) 458-6575

November 29, 2010

Karl Wirkus
Regional Director
Bureau of Reclamation
Pacific Northwest Regional Office
1150 North Curtis Road, Suite 100
Boise, ID 83706-1234

Ted Sturdevant
Director
Department of Ecology
PO Box 47600
Olympia, WA 98504-7600

RE: Spokane Tribe's Request to Extend Comment Period on the Draft EIS for the Odessa Subarea Special Study

Dear Director Wirkus and Director Sturdevant:

Through this letter, the Spokane Tribe of Indians ("Tribe") respectfully requests that the comment period on the Draft EIS for the Odessa Subarea Special Study ("DEIS") be extended to at least February 28, 2011. In the alternative, the Tribe suggests that the Bureau of Reclamation and the Department of Ecology withdraw the current DEIS and supplement the document with additional and timely data and cumulative effects prior to releasing it to the public for comment.

As you are aware, the Tribe's Reservation includes portions of the Spokane and Columbia Rivers – now Lake Roosevelt. The Odessa Project ("Project") has long-term and substantial implications for Tribe's rights and economic interests in Lake Roosevelt and the Columbia River. The Tribe has unquantified reserved water rights and reserved fishing rights in the Columbia River. Additionally, the Tribe operates several enterprises, including a marina and a houseboat rental operation that will likely be affected by this Project.

The Tribe has several reasons for this request. First, BOR failed to engage the Tribe in government-to-government consultation regarding this project. The Department of Ecology also failed to engage in meaningful consultation. As the DEIS indicates, BOR and Ecology held meetings with Colville Tribal representatives at least three (3) times for consultation on this project between February 22, 2006 through June 16, 2010. (DEIS, Table 5-1). Unfortunately, the Spokane Tribe had no in-person formal consultations with it during this time regarding this Project. BOR's failure to have direct and meaningful government-to-government consultation between the Spokane Tribe and the federal government is not in keeping with the current Administration's directive. As President Obama outlined in a November 5, 2009 White House Memorandum:

> History has shown that failure to include the voices of tribal officials in formulating policy affecting their communities has all too often led to undesirable and, at times, devastating and tragic results. By contrast, meaningful dialogue between Federal officials and tribal officials has greatly improved Federal policy toward Indian tribes. Consultation is a critical ingredient of a sound and productive Federal-tribal relationship.
>
> My Administration is committed to regular and meaningful consultation and collaboration with tribal officials in policy decisions that have tribal implications including, as an initial step, through complete and consistent implementation of Executive Order 13175.

The Tribe urges BOR to heed this directive by allowing the Tribe and all interested parties additional time to evaluate and meaningfully comment on this DEIS.

Additionally, the Department of Ecology failed to follow the spirit of the Centennial Accord, Millennium Agreement and the specific language of the Water Resource Management Agreement for Lake Roosevelt between the Spokane Tribe of Indians and the State of Washington ("Agreement") dated February 4, 2008. Both of these documents require meaningful consultation with the Tribe prior to pursuing projects that may negatively affect the Tribe's resources. (Agreement, P.6, § 4(b)). In this situation, the Tribe was not directly consulted with and had little warning that the DEIS would be released at this time.

Second, the release of this DEIS prior to the holiday season combined with a brief 60-day comment period make it very difficult for the Tribe to meaningfully review and comment on the lengthy documents and supplemental reports. For example, the Department of Ecology's recent release of Draft NPDES permits for Spokane River dischargers allowed for a 45-day comment period and the documents involved in that case were at least 1/6 less material. In short, it is more than reasonable to allow for a 120-day comment period for this DEIS given its scope and complexity.

Third and finally, the Tribe currently is faced with several large projects that have implications on its resources that require attention of the same limited staff as this DEIS. A myriad of issues and impacts all must be reviewed by the same limited Tribal staff. For example, all of the following have occurred or are on-going: the recent release of the Draft NPDES permits on the Spokane River; tracking and following the studies and discussions surrounding the Columbia River Treaty review; the Department of Ecology's Draft Water Quality Framework review; the Columbia River Biological Opinion litigation; water rights adjudication of the Spokane River in Idaho; and the Lincoln County Passive Rehydration Project. Simply put, in order for the Tribe to comment meaningfully on this DEIS it needs more time. This is especially true in this situation where there was no substantial consultation between the Agencies and the Tribe prior to the release of the DEIS.

In the alternative to granting an extension on the comment period for this DEIS, the Tribe recommends to the Agencies that they withdraw the DEIS from public comment, and supplement the document with additional and timely data and cumulative effects prior to rereleasing it. In its cursory initial review, the Tribe found multiple and substantial issues with the DEIS. For example there is no evaluation of any potential environmental effects of irrigating with water from Banks Lake within the document. Banks Lake is a water body on Washington State's 303d list for PCBs. The DEIS fails to adequately address how this project will be affected by global warming. Additionally, it does not analyze how the Columbia River Treaty changes and potential scenarios surrounding on-call flood control operations will affect the project. It fails to mention the Lincoln County Passive Rehydration Project as a cumulative action along with the Treaty changes. Finally, it fails to address the changes that have occurred due to the 2010 Supplemental FCRPS Biological Opinion. This list of concerns is by no means complete, but it indicates the need for the Agencies to evaluate fully the multiple actions within the Columbia River watershed while analyzing a project of this scale.

In conclusion, the Tribe urges the Agencies to withdraw this DEIS and supplement the document with timely information and rerelease the document with, at a minimum, a 120-day comment period. If the Agencies fail to do withdraw the DEIS, the Tribe respectfully requests that the comment period be extended to at least February 28, 2011.

Sincerely,

Gregory Abrahamson
Chairman
Spokane Tribe of Indians

Cc: Charles Carnohan, Bureau of Reclamation
William D. Gray, Bureau of Reclamation
Derek I. Sandison, Department of Ecology

The Confederated Tribes of the Colville Reservation
P.O. Box 150, Nespelem, WA 99155 (509) 634-2200
FAX: (509) 634-4116

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November 30, 2010

Karl Wirkus
Pacific Northwest Regional Director
U.S. Bureau of Reclamation
1150 North Curtis Road, Suite 100
Boise, Idaho 83706-1234

Ted Sturdevant
Director
Washington Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Re: Request for Extension of Comment Period for Odessa Subarea Special Study Draft EIS

Dear Mr. Wirkus and Mr. Sturdevant,

The Confederated Tribes of the Colville Reservation write to request a 60-day extension of the comment period for the draft EIS, which is currently set to close on December 31. The draft EIS is a substantial document, over 700 pages in length, and a thorough review requires more time than the currently allowed 60-day comment period.

We have already found that the overlap of the Thanksgiving and Christmas/New Years holidays with the comment period is making it very difficult to obtain necessary information to evaluate the impacts to the Tribes from the numerous alternatives of this proposed project. For example, we have been unable to get certain power generation information from BPA that will be necessary to evaluate the impacts of Lake Roosevelt drawdown on the Tribes.

As you are aware, the Colville Tribes will be significantly affected if any of the project alternatives are developed because the proposed alternatives involve drawdown of Lake Roosevelt, which forms the boundary of a substantial portion of the Colville Reservation. The December 17th 2007 Water Resources Management Agreement for Lake Roosevelt between the State and Tribes contains provisions for coordinated planning regarding operation and storage in Lake Roosevelt. We believe that the Tribes should have a sufficient amount of time to properly review, analyze and comment on the draft EIS and to have discussions with the State on the proposal in the context of our agreement. Since 2004 when approached by former governor

Locke, the Tribes has engaged in Columbia River planning in a spirit of cooperation with state and federal entities. We make our request for an extension of time in that spirit.

Sincerely yours,

Michael O. Finley
Chairman, Colville Business Council

Cc:

Charles A. Carnohan
Bureau of Reclamation
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, Washington 98901-2058

Confederated Tribes and Bands
of the Yakama Nation

Established by the
Treaty of June 9, 1855

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Yakima, Washington

12/8/2010

Charles Carnohan
Bureau of Reclamation
Pacific Northwest Region
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, WA 98901-2058

Dear Mr. Carnohan,

My staff is reviewing the Odessa EIS. As you know the comment period established by Reclamation includes both the Thanksgiving and Christmas holiday seasons. These are times when many staff are choosing to spend additional time with their families. That, combined with the fact that expanding the Columbia Basin Project is a complex and controversial issue that has been simmering for decades, justifies an expanded comment period. We request that Reclamation extend the comment period for a minimum of 30 days to allow more adequate time to fully review the document and the impacts of the proposal. Please reply as soon as possible so that I can assign staff time accordingly.

Sincerely,

Andrea J. Spencer

Phil Rigdon, Deputy Director
Yakama Nation Department of Natural Resources

United States Department of the Interior
BUREAU OF RECLAMATION
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, Washington 98901-2058

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CCA-1100
PRJ-1.10

DEC 17 2010

Mr. Phil Rigdon, Deputy Director
Yakama Nation Department of Natural Resources
Confederated Tribes and Bands of the Yakama Nation
PO Box 151
Toppenish WA 98948

Subject: Request for Extension of Odessa Subarea Special Study Draft Environmental Impact Statement Comment Period (Your letter dated 12/8/10)

Dear Mr. Rigdon:

Thank you for your interest in the Columbia Basin Project and the Odessa Subarea Special Study. Your request for additional time to review the document has been carefully considered. This letter is to notify you that the comment period for the Odessa Subarea Special Study Draft Environmental Impact Statement has been extended to January 31, 2011.

The Bureau of Reclamation and the State of Washington, through the Department of Ecology's Office of Columbia River, are co-leads in developing the *Draft Environmental Impact Statement* (DEIS) for the Odessa Subarea Special Study. The DEIS was released to the public October 26, 2010, with a 60-day comment period ending on December 31, 2010. Reclamation and Ecology have opted to extend the comment period to 90 days in an effort to allow interested parties additional time to review the information and provide meaningful comment.

You may provide comments on the DEIS by sending them to Mr. Chuck Carnohan, Study Manager, at the Bureau of Reclamation, 1917 Marsh Road, Yakima, Washington, 98901-2058. You may also provide your comments by fax to 509-454-5650; email, odessa@usbr.gov; or phone, 509-575-5848, extension 603. For further information regarding the Odessa Subarea Special Study DEIS, you may visit the website at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

We appreciate your involvement and look forward to the receipt of your comments on or before January 31, 2011. Should you have any questions or require additional information, please do not hesitate to contact Mr. Carnohan of my staff at 509-575-5848, extension 370, or by email at ccarnohan@usbr.gov

Sincerely,

/s/ Gwendolyn W. Christensen

Gwendolyn W. Christensen
Technical Projects Program Manager

cc: Mr. Derek Sandison
Director
Washington Department of Ecology
Office of the Columbia River
303 S. Mission Street, Suite 200
Wenatchee, WA 98801

bc: CCA-1000, CCA-1002, CCA-1100, CCA-1120, CCA-1123, CCA-1614, CCA-1704
EPH-2000, EPH-2003

WBR:WChristensen:dvanmeter:121610:509-575-5848
W:u:dvm:ms:corres:christensen:OdessaDEIS CommentPeriodExt.YakamaNationResponse

DEC 2 0 2010

The Honorable Michael O. Finley,
Colville Business Council
The Confederated Tribes of the Colville Reservation
PO Box 150
Nespelem, WA 99155

Subject: Request for Extension of Comment Period for Odessa Subarea Special Study Draft EIS (Your letter dated 11/30/10)

Dear Chairman Finley:

This letter responds to your request for additional time to review the Odessa Subarea Special Study.

Reclamation and Ecology have jointly decided to extend the comment period to **January 31, 2011** (90 days) to allow interested parties additional time to review the information and provide comment.

You may provide comments on the DEIS by sending them to Chuck Carnohan, Study Manager, at the Bureau of Reclamation, 1917 Marsh Road, Yakima, Washington, 98901-2058. You may also provide your comments by fax to (509) 454-5650; email, odessa@usbr.gov; or phone (509) 575-5848, extension 603. For further information regarding the Odessa Subarea Special Study DEIS, you may visit the website at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

We appreciate your interest and input during this public comment phase, and we look forward to receiving your comments on or before January 31, 2011.

Sincerely,

Acting for

Karl E. Wirkus
Regional Director
Bureau of Reclamation
1150 N. Curtis Road
Boise, ID 83706

Ted Sturdevant
Director
Washington State Department of Ecology
PO Box 47600
Olympia, WA 98504-7600

cc: Chuck Carnohan, Study Manager, Bureau of Reclamation, Columbia-Cascades Area Office
William Gray, Area Manager, Bureau of Reclamation, Columbia-Cascades Area Office
Derek Sandison, Director, Ecology, Office of Columbia River

DEPARTMENT OF ECOLOGY
State of Washington

DEC 2 0 2010

The Honorable Gregory Abrahamson, Chairman
Spokane Tribe of Indians
PO Box 100
Wellpinit, WA 99040

Subject: Spokane Tribe's Request to Extend Comment Period on the Draft EIS for the Odessa Subarea Special Study (Your letter dated 11/29/10)

Dear Chairman Abrahamson:

Thank you for your interest in the Columbia Basin Project and the Odessa Subarea Special Study. Your request for additional time to review the document has been carefully considered. This letter is to notify you that the comment period for the Odessa Subarea Special Study Draft Environmental Impact Statement has been extended to **January 31, 2011**.

The Bureau of Reclamation and the state of Washington, through the Department of Ecology's Office of Columbia River, are co-leads in developing the *Draft Environmental Impact Statement* (DEIS) for the Odessa Subarea Special Study. The DEIS was released to the public on October 26, 2010, with a 60-day comment period, ending on December 31, 2010. Reclamation and Ecology have opted to extend the comment period to 90 days in an effort to allow interested parties additional time to review the information and provide meaningful comment.

In response to your request for formal consultation, Reclamation's Columbia-Cascades Area Office staff have recently been in contact with the Spokane Tribe of Indians Legal Counsel, Theodore C. Knight to schedule a meeting with the Spokane Tribe, Reclamation and Ecology to formally consult with the Tribe on this study.

As we are currently in the public comment period for the DEIS under the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA), specific responses to requests, inquiries, and comments on the DEIS will not be fulfilled on an individual basis at this time, but will be provided in the final Environmental Impact Statement.

You may provide comments on the DEIS by sending them to Chuck Carnohan, Study Manager, at the Bureau of Reclamation, 1917 Marsh Road, Yakima, Washington, 98901-2058. You may also provide your comments by fax to (509) 454-5650; email, odessa@usbr.gov; or phone (509) 575-5848, extension 603. For further information regarding the Odessa Subarea Special Study DEIS, you may visit the website at
http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

We appreciate your interest and input during this public comment phase, and we look forward to receiving your comments on or before January 31, 2011.

Sincerely,

Acting For

Karl E. Wirkus
Regional Director
Bureau of Reclamation
1150 N. Curtis Road
Boise, ID 83706

Ted Sturdevant
Director
Washington State Department of Ecology
PO Box 47600
Olympia, WA 98504-7600

cc: Chuck Carnohan, Study Manager, Bureau of Reclamation, Columbia-Cascades Area Office
William Gray, Area Manager, Bureau of Reclamation, Columbia-Cascades Area Office
Derek Sandison, Director, Ecology, Office of Columbia River

Spokane Tribe of Indians

OFFICE OF THE SPOKANE TRIBAL ATTORNEY

P.O. BOX 360 Wellpinit, WA 99040
(509) 458-6519; FAX (509) 458-6553

January 25, 2011

Corey Carmack
Native American Affairs Coordinator
Columbia-Cascades Area Office
Yakima, WA 98901

Subject: Meeting with the Spokane Tribe of Indians

Dear Mr. Carmack:

This letter responds to the Bureau of Reclamation's ("BOR") request to meet with representatives of the Spokane Tribe of Indians ("Tribe") regarding the Draft EIS for the Odessa Subarea Special Study ("DEIS"). On December 20, 2010, the Tribe received a joint letter from BOR and the Department of Ecology ("DOE") regarding the Tribe's request for an extension to the comment period on the DEIS. The Tribe was disappointed that only a 30-day period was granted rather than the 60-day period that was requested by the Tribe. Furthermore, the letter offended the Tribe by describing a meeting to be held with Tribal technical staff and requested at this point in the process as formal consultation.

Formal consultation as the Tribe views it, requires initial meetings between high-level officials regarding the project, and then follow up meetings with designated Tribal technical staff. Additionally, these meeting should take place very early in the process on projects that will affect Tribal interests. Early meetings provide federal agencies with the opportunity to hear the Tribe's concerns and make decisions with those concerns in mind. Respect of the government-to-government relationship is shown by early high-level consultation and President Obama's November 5, 2009 Memorandum requires no less. At this juncture, the DEIS is complete and the agencies have laid out a path making meaningful consultation difficult, if not impossible.

However, the Spokane Tribal Business Council is more than willing to meet with Regional Director Wirkus and Director Sturdevant in the future to discuss Columbia River water and the future of this project as well as other issues that impact the Tribe. If the Agencies desire such a meeting, our Office is the designated point of contact for arranging it. If you have any questions, feel free to contact me at 509-474-1265.

Sincerely,

Bruce Didesch

CC: Gregory Abrahamson, Spokane Tribe of Indians, Chairman
Karl Wirkus, Regional Director, Bureau of Reclamation
Ted Sturdevant, Director, Department of Ecology
Charles Carnohan, Bureau of Reclamation
Derek Sandison, Department of Ecology

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Control No.		
Folder I.D.		

United States Department of the Interior

BUREAU OF RECLAMATION
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, Washington 98901-2058

IN REPLY REFER TO:
CCA-1120
PRJ-3.00

NOV 14 2011

Confederated Tribes of the Umatilla
Indian Reservation
Board of Trustees
46411 Timine Way
Pendleton OR 97801

Subject: Request for Government-to-Government Consultation – Odessa Subarea Special Study

Dear Board of Trustees:

With respect to the above-referenced Special Study and Final Environmental Impact Statement for the Odessa Subarea (Study), the Department of the Interior, Bureau of Reclamation, Columbia-Cascades Area Office, would like to engage the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) in formal consultation.

The Grand Coulee Dam Project was authorized for construction by the Act of August 30, 1935, and reauthorized and renamed the Columbia Basin Project (CBP) in the Columbia Basin Project Act of March 10, 1943. Congress authorized the CBP to irrigate a total of 1,029,000 acres; about 671,000 acres are currently irrigated. The Odessa Subarea is within the authorized portion of the CBP, but currently not served.

In December 2004, Reclamation, Washington State, and the CBP irrigation districts signed a Memorandum of Understanding to explore options for delivering surface water to existing groundwater-irrigated lands in that portion of the Odessa Subarea located within CBP boundaries. In February 2006, the State Legislature passed the Columbia River Water Resource Management Act, directing the Washington State Department of Ecology (Ecology) to aggressively pursue development of water supplies benefiting both instream and out-of-stream uses through storage, conservation, and voluntary regional water management agreements. Reclamation's Odessa Subarea Special Study is one of several activities identified in that legislation.

Reclamation and Ecology are joint leads in this Study which is analyzing the potential replacement of groundwater irrigation on an acre-by-acre basis with CBP surface water. The proposed action is to replace currently groundwater-irrigated lands with CBP surface water as a solution to declining groundwater levels within the Odessa Subarea. This surface water would be provided as part of the continued phased development of the CBP. The surface water would come from existing water rights in the Columbia River system. For more detailed information, please go online to: http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

Reclamation and Ecology appreciate the opportunity to have discussed the Study with CTUIR on September 22, 2011, at the Nixyaawii Governance Center, and anticipate additional productive communication toward policy-level decisionmaking between the CTUIR and the United States Federal Government, represented by Reclamation.

Thank you for your consideration of this request for consultation. Please contact Mr. Corey Carmack, Tribal Liaison, at 509-575-5848, extension 210, or ccarmack@usbr.gov if you have any questions.

Sincerely,

/s/ William D. Gray

William D. Gray
Area Manager

bc: CCA-1000, CCA-1002, CCA-1006, CCA-1100, CCA-1120, CCA-1123, CCA-1704

WBR:WChristensen:dvanmeter:11/09/11:509-575-5848
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APPENDIX F

AGENCY AND OTHER CORRESPONDENCE

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United States Department of the Interior

BUREAU OF RECLAMATION
Upper Columbia Area Office
1917 Marsh Road
Yakima, Washington 98901-2058

IN REPLY REFER TO: UCA-1614
PRJ-3.00

FEB 3 2009

Mr. Ron Kreizenbek
Regional Director
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, WA 98101-1128

Subject: Request for Cooperating Agencies for the Odessa Subarea Special Study Environmental Impact Statement

Dear Mr. Kreizenbek:

The Bureau of Reclamation and the Washington Department of Ecology (Ecology) are jointly preparing an Environmental Impact Statement (EIS) for the Odessa Subarea Special Study (OSS) to satisfy the requirements of the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA). The EIS will describe the alternatives considered and assess the social, economic, and environmental effects of the action alternatives compared to a no action alternative.

The OSS is an investigation of continued phased development of the Columbia Basin Project to provide surface water to replace current groundwater irrigation occurring in the Odessa Ground Water Management Subarea. Alternatives currently proposed include construction of water delivery infrastructure to convey Columbia Basin Project water to the groundwater-irrigated lands. Proposed construction would include expansion of the capacity of existing facilities and construction of new canals, siphons, tunnels, pumping plants, piped laterals, and a re-regulating reservoir. The study also considers modifying operations at Banks Lake through an additional drawdown or a 2-foot operational raise, and constructing a new 127,000 acre-foot reservoir in Rocky Coulee.

Preparation of an EIS was initiated with publication of a Notice of Intent to Prepare an EIS in the Federal Register by Reclamation and a Determination of Significance by Ecology on August 21, 2008. A 4-week public scoping period, in which issues, concerns, and other potential alternatives were identified, ran from August 21 through September 19, 2008. During this time, Reclamation and Ecology requested written comments and hosted two public meetings in September 2008.

In accordance with Council of Environmental Quality regulations 40 CFR 1501.6, we are requesting your participation as a cooperating agency in the NEPA/SEPA process for the OSS. As a cooperating agency, you may assist in identifying issues and alternatives, analyzing impacts, and review the draft and final EIS before they are distributed to the public. If you wish to be a cooperating agency, or to discuss specifically what this would involve, please contact Mr. Dave Kaumheimer, Environmental Program Manager, at 509-575-5848, extension 232, or by email at StudyManager@pn.usbr.gov. You may also visit our website at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

Sincerely

David J. Kaumheimer
Environmental Program Manager

Identical Letter Sent To:

Mr. Rick Donaldson
Manager, Habitat Conservation Branch
U.S. Fish and Wildlife Service
11103 East Montgomery Drive
Spokane, WA 99206

Mr. Barry Thom
Acting Regional Administrator
National Marine Fisheries Service
7600 Sand Point Way N.E.
Seattle, WA 98115-0700

Mr. David Byrnes
KEWL-4
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97232

Mr. Rick Pendergrass
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97232

Mr. Ron Kreizenbek
Regional Director
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, WA 98101-1128

bc: UCA-1000, UCA-1100, UCA-1120, UCA-1600, UCA-1614, UCA-1703

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W:u:dvm:corres:kelso:OSSCoopAgencyMainLtrEPA

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United States Department of the Interior

BUREAU OF RECLAMATION
Upper Columbia Area Office
1917 Marsh Road
Yakima, Washington 98901-2058

IN REPLY REFER TO: UCA-1614
PRJ-3.00

FEB 3 2009

Mr. John Easterbrooks
Region 3 Fish Program Manager
Washington State Department of Fish & Wildlife
1701 S. 24th Avenue
Yakima, WA 98902

Subject: Request for Cooperating Agencies for the Odessa Subarea Special Study Environmental Impact Statement

Dear Mr. Easterbrooks:

The Bureau of Reclamation and the Washington Department of Ecology (Ecology) are jointly preparing an Environmental Impact Statement (EIS) for the Odessa Subarea Special Study (OSS) to satisfy the requirements of the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA). The EIS will describe the alternatives considered and assess the social, economic, and environmental effects of the action alternatives compared to a no action alternative.

The OSS is an investigation of continued phased development of the Columbia Basin Project to provide surface water to replace current groundwater irrigation occurring in the Odessa Ground Water Management Subarea. Alternatives currently proposed include construction of water delivery infrastructure to convey Columbia Basin Project water to the groundwater-irrigated lands. Proposed construction would include expansion of the capacity of existing facilities and construction of new canals, siphons, tunnels, pumping plants, piped laterals, and a re-regulating reservoir. The study also considers modifying operations at Banks Lake through an additional drawdown or a 2-foot operational raise, and constructing a new 127,000 acre-foot reservoir in Rocky Coulee.

Preparation of an EIS was initiated with publication of a Notice of Intent to Prepare an EIS in the Federal Register by Reclamation and a Determination of Significance by Ecology on August 21, 2008. A 4-week public scoping period, in which issues, concerns, and other potential alternatives were identified, ran from August 21 through September 19, 2008. During this time, Reclamation and Ecology requested written comments and hosted two public meetings in September 2008.

If you feel you have expertise that would contribute to the NEPA process for the OSS and desire to become a cooperating agency, or would like to discuss specifically what that might involve, please contact Mr. Dave Kaumheimer, Environmental Program Manager, at 509-575-5848, extension 232, or by email at StudyManager@pn.usbr.gov. You may also visit our website at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

Sincerely,

David J. Kaumheimer
Environmental Program Manager

Identical Letter Sent To:

Mr. John Easterbrooks
Region 3 Fish Program Manager
Washington State Department of Fish & Wildlife
1701 S. 24th Avenue
Yakima, WA 98902

Mr. Rex Derr
Washington State Parks and Recreation Commission
P.O. Box 47000
Olympia, WA 98504-2650

Washington State Department of Natural Resources
Lands & Real Estate Section
P.O. Box 47000
Olympia, WA 98054-7000

Mr. Ian Eccles
East Columbia Basin Irrigation District
P.O. Box E
Othello, WA 99344

Mr. Leroy Allison
Grant County Board of Commissioners
P.O. Box 37
Ephrata, WA 98823

Mr. Rudy Plager
Adams County Commissioner
P.O. Box 423
Ritzville, WA 99169

Mr. Dennis Bly
Lincoln County Commissioner
P.O. Box 28
Davenport, WA 99122

Mr. Brad Peck
Franklin County Commissioner – District 1
200 N. Road 34
Pasco, WA 99301

Mr. Robert Koch
Franklin County Commissioner – District 2
90 Access Road
Connell, WA 99326

Mr. Rick Miller
Franklin County Commissioner – District 3
4704 Mesquite Drive
Pasco, WA 99301

bc: UCA-1000, UCA-1100, UCA-1120, UCA-1600, UCA-1614, UCA-1704

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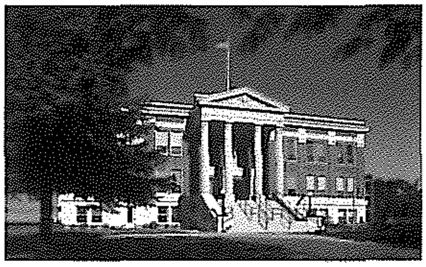
W:u:dvm:corres:kelso:OSSCoopAgencySecondaryLtrWSParksRecreationDerr

ENV-6.00

Received in Mailroom
FEB 26 2009
Yakima, Washington



Grant County
Office of The
Board of County Commissioners
P O Box 37
Ephrata WA 98823
(509) 754-2011

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File # 09012577
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February 17, 2009

Mr. David J. Kaumheimer
United States Department of the Interior
Bureau of Reclamation
1917 Marsh Road
Yakima, WA 98901-2058

RE: Your request for Cooperating Agencies for the Odessa Subarea Special Study Environmental Impact Statement

Dear Mr. Kaumheimer:

The Grant County Board of County Commissioners is in receipt of your letter dated February 3, 2009 wherein you extend a request for cooperating agencies to become involved in the Odessa Special Study Environmental Impact Statement.

Grant County recognizes the importance of this project and the potential for impacts to the culture, customs, economic stability, and private property rights of the citizens of the County. As the Bureau of Reclamation is aware, Grant County has taken the necessary steps to establish itself as a Coordinating Agency and we respectfully request that Grant County be included in this project as a coordinating agency.

Please contact Grant County via the Department of Community Development Director, Mr. David A. Nelson, at (509) 754-2011, extension 344 to discuss our involvement as a coordinating agency.

Sincerely,

BOARD OF COUNTY COMMISSIONERS

Cindy Carter, Chair   Richard Stevens   Carolann Swartz

:bjv

Cc: David A. Nelson, Director, Department of Community Development

ENV- 6.00
Received in Mailroom

MAR 12 2009

Yakima, Washington

Department of Energy

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

POWER SERVICES

BUREAU OF RECLAMATION
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March 10, 2009

In reply refer to: PGP-5

Mr. David J. Kaumheimer
Environmental Program Manager
U.S. Department of the Interior
Bureau of Reclamation
Upper Columbia Area Office
1917 Marsh Road
Yakima, Washington 98901-2058

Dear Mr. Kaumheimer:

In response to your letter of February 3, 2009, Bonneville Power Administration (BPA) agrees to participate as a cooperating agency in the NEPA/SEPA process for the Odessa Subarea Special Study. I will serve as the point of contact for this study. My contact information is:

Mailing Address: P.O. Box 3621, Portland, OR, 97208; Physical Address: 905 NE 11th Avenue, Portland, OR 97232
Phone: 503-230-7666; FAX: 503-230-3939
Email: rpendergrass@bpa.gov

As a cooperating agency I would expect to assist in identifying issues and alternatives, analyzing power impacts to the Federal Columbia River Power System, and review the draft and final EIS before they are distributed to the public.

I look forward to working with you and the other cooperating agencies.

Sincerely,

Richard M. Pendergrass

Richard M. Pendergrass, P.E.
Manager, Power and Operations Planning

cc:
Patrick McGrane, Bureau of Reclamation, Boise, Idaho

ENV-6.00

Received in Mailroom

APR 13 2009

Yakima, Washington

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
Central Washington Field Office
215 Melody Lane, Suite 119
Wenatchee, WA 98801

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Ctrl # 09022428

In Reply Refer To:
USFWS Reference: 13260-2009-FA-0036
Hydrologic Unit Code: 17-02-00-15

April 9, 2009

MEMORANDUM

To: Environmental Programs Manager, United States Bureau of Reclamation
Yakima, Washington

From: Assistant Project Leader, Central Washington Field Office
Wenatchee, Washington

Subject: Request for Cooperating Agencies for the Odessa Subarea Special Study Environmental Impact Statement

This is in response to your letter of February 3, 2009, received in this office on February 9, 2009, wherein the United States Bureau of Reclamation (Reclamation) invited the United States Fish and Wildlife Service (Service) to participate in preparation of an Environmental Impact Statement for the Odessa Subarea Special Study (OSS) to satisfy the requirements of the National Environmental Policy Act (NEPA) and the Washington State Environmental Policy Act (SEPA). Reclamation requested the Service's participation as a cooperating agency under the Council of Environmental Quality regulations (40 **CFR** §1501.6).

The OSS is an investigation of continued phase development of the Columbia Basin Project to replace reliance on groundwater with Columbia River water. Proposed alternatives include expansion of existing facilities, new canals, siphons, tunnels, pumping plants, piped laterals, and a re-regulating reservoir.

Due to limited resources, we must decline the opportunity to participate as a cooperating agency, particularly as we are currently participating under the auspices of the Fish and Wildlife Coordination Act.

Thank you for the invitation to participate in the NEPA/SEPA process and your efforts to protect the environment. For further assistance, please contact Greg Van Stralen at (509) 665-3508, ext. 20, or by e-mail at greg_van_stralen@fws.gov.

cc:
Mark Miller, Eastern Washington Field Office, USFWS, Spokane, WA
Mark Snyder, Northern Idaho Fish and Wildlife Office, USFWS, Spokane, WA

TAKE PRIDE® IN AMERICA

ENV-6.00
Received in Mailroom

APR 21 2009

Yakima, Washington

Department of Energy

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

ENVIRONMENT, FISH AND WILDLIFE

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April 15, 2009

In reply refer to: KE

Mr. David J. Kaumheimer
Environmental Program Manager
U.S. Department of the Interior
Bureau of Reclamation
Upper Columbia Area Office-1600
1917 Marsh Road
Yakima, Washington 98901-2058

Dear Mr. Kaumheimer:

This correspondence is in response to your letter of February 3, 2009, requesting the participation of Bonneville Power Administration (BPA) as a cooperating agency in the NEPA/SEPA process for the Odessa Subarea Special Study (OSS). BPA agrees to participate as a cooperating agency in the NEPA/SEPA process for the OSS Environmental Impact Statement (EIS).

As a cooperating agency BPA would expect to assist in identifying issues and alternatives, analyzing power impacts to the Federal Columbia River Power System, and reviewing the draft and final EISs before they are distributed to the public.

Serving as the technical point of contact for the study will be:

Richard M. Pendergrass, P.E.
Manager, Power and Operations Planning
Phone: 503-230-7666; FAX: 503-230-3939
Email: rpendergrass@bpa.gov
Mailing address: P.O. Box 3621, Portland, OR, 97208
Physical address: 905 NE 11th Ave, Portland, OR 97232

Serving as the NEPA point of contact for the EIS will be:

Sandra J. Ackley
Senior Policy Analyst
Phone: 503-230-3824; FAX: 503-230-5699
Email: sjackley@bpa.gov
Mailing address: P.O. Box 3621, Portland, OR, 97208
Physical address: 905 NE 11th Ave, Portland, OR 97232

We look forward to working with you and the other cooperating agencies.

Sincerely,

Gregory K. Delwiche
Vice President, Environment, Fish and Wildlife

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6/19	McCartney	1120
6/19	[illegible]	1600
Classification		
Project		
Control No.		
Folder I.D.		

United States Department of the Interior

BUREAU OF RECLAMATION
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, Washington 98901-2058

IN REPLY REFER TO:
UCA-1600
PRJ-3.00

JUN 19 2009

Ms. Sandra Ackley
Bonneville Power Administration
P.O Box 3621- KEC-4
Portland, OR 97208-3621

Subject: Cooperating Agency Status for Odessa Subarea Special Study Environmental Impact Statement

Dear Mrs. Ackley:

This responds to your letter of March 10, 2009 concerning the Bonneville Power Administration's (BPA) involvement in the Odessa Subarea Special Study as a cooperating agency. The Odessa Subarea Special Study is an investigation of continued phased development of the Columbia Basin Project to provide surface water to replace current groundwater irrigation occurring in the Odessa Ground Water Management Subarea. It is being conducted jointly with the State of Washington through the Department of Ecology. You indicated in your letter that your agency would be willing to assist in identifying issues and alternatives, analyzing the power impacts to the Federal Columbia River Power System, and reviewing the draft and final Environmental Impact Statement (EIS) before public distribution. We agree to your request and welcome your involvement.

The impacts to the power system includes withdrawing additional water from Lake Roosevelt for delivery to irrigated lands, conveying more water through the Columbia Basin Project power plants, and utilizing additional pumping plants to deliver surface water to irrigators currently using groundwater on the eastern side of the Columbia Basin Project area. We would appreciate your assistance in analyzing impacts of the withdrawal of additional water from Lake Roosevelt and the Columbia River on power generation and revenues at FCRPS facilities and of public utility district facilities below Chief Joseph Dam.

As we discussed with BPA staff on April 29, 2009, our draft EIS is scheduled for release in April 2010. In order to incorporate the materials to be provided by BPA as a cooperating agency into the draft EIS we need to receive that information no later than the end of July 2009. Based on our discussions, we understand that BPA will be able to provide us a quantitative analysis of the impacts to the FCRPS and to the public utility district power generation and revenues from the withdrawal of additional water from Lake Roosevelt and the Columbia River on that schedule.

If you have any questions about the feasibility study, please contact Ms. Wendy Christensen at 509-575-5848, extension 203. For questions pertaining to NEPA please contact Mr. Corey Carmack at 509-575-5848, extension 210. We look forward to working with you on the draft EIS.

Sincerely,

David J. Kaumheimer
Environmental Program Manager

cc: Richard M Pendergrass
Manager, Power and Operations Planning
PO Box 3621
Portland, OR 97208-3621

Mr. Derek Sandison
Washington State Department of Ecology
303 S. Mission Street, Suite 200
Wenatchee, WA 98801

bc: PN-6200 (McGrane), PN-6204 (Mellema). PN-6519 (Abshire)
CCA-1000, CCA-1100, CCA-1120, CCA-1600, CCA-1614, CCA-1704,
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United States Department of the Interior
BUREAU OF RECLAMATION
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, Washington 98901-2058

IN REPLY REFER TO:
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Mr. Mike Schwisow
Director of Government Relations
Columbia Basin Development League
PO Box 1235
Royal City WA 99357

Subject: Odessa Subarea Special Study Draft Environmental Impact Statement Comment Period Extension (Your email dated 12/10/10)

Dear Mr. Schwisow:

Thank you for your interest in the Columbia Basin Project and the Odessa Subarea Special Study. Your request for additional time to review the document has been carefully considered. This letter is to notify you that the comment period for the Odessa Subarea Special Study Draft Environmental Impact Statement has been extended to January 31, 2011.

The Bureau of Reclamation and the State of Washington, through the Department of Ecology's Office of Columbia River, are co-leads in developing the *Draft Environmental Impact Statement* (DEIS) for the Odessa Subarea Special Study. The DEIS was released to the public October 26, 2010, with a 60-day comment period ending on December 31, 2010. Reclamation and Ecology have opted to extend the comment period to 90 days in an effort to allow interested parties additional time to review the information and provide meaningful comment.

You may provide comments on the DEIS by sending them to Mr. Chuck Carnohan, Study Manager, at the Bureau of Reclamation, 1917 Marsh Road, Yakima, Washington, 98901-2058. You may also provide your comments by fax to 509-454-5650; email, odessa@usbr.gov; or phone, 509-575-5848, extension 603. For further information regarding the Odessa Subarea Special Study DEIS, you may visit the website at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

Again, we appreciate your interest and input during this public comment phase, and we look forward to receiving your comments on or before January 31, 2011. Should you have any questions or require additional information, please do not hesitate to contact Mr. Carnohan of my staff at 509-575-5848, extension 370, or by email at ccarnohan@usbr.gov.

Sincerely,

/s/ Gwendolyn W. Christensen

Gwendolyn W. Christensen
Technical Projects Program Manager

cc: Mr. Derek Sandison
Director
Washington Department of Ecology
Office of the Columbia River
303 S. Mission Street, Suite 200
Wenatchee, WA 98801

bc: CCA-1000, CCA-1002, CCA-1100, CCA-1120, CCA-1123, CCA-1614, CCA-1704
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United States Department of the Interior

BUREAU OF RECLAMATION
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, Washington 98901-2058

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Ms. Rachael Paschal Osborn
Executive Director
Center for Environmental Law and Policy
25 West Main, Suite 234
Spokane WA 99201

Subject: Request for Extension of Comment Deadline for Odessa Subarea Draft Environmental Impact Statement (Your letter dated 12/10/10)

Dear Ms. Osborn:

Thank you for your interest in the Columbia Basin Project and the Odessa Subarea Special Study. Your request for additional time to review the document has been carefully considered. This letter is to notify you that the comment period for the Odessa Subarea Special Study Draft Environmental Impact Statement has been extended to January 31, 2011.

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Sincerely,

/s/ Gwendolyn W. Christensen

Gwendolyn W. Christensen
Technical Projects Program Manager

cc: Mr. Derek Sandison
Director
Washington Department of Ecology
Office of the Columbia River
303 S. Mission Street, Suite 200
Wenatchee, WA 98801

bc: CCA-1000, CCA-1002, CCA-1100, CCA-1120, CCA-1123, CCA-1704
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